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Carolyn Dean MD ND

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MAGNESIUM

The Missing Link to Total Health

(Revised)

- Responsible for 80% of known metabolic body functions.
- Magnesium deficiency is a public health crisis.
- Picometer magnesium solves the laxative effect of other magnesium formulas.

What if you could ask an internationally recognized medical doctor, "What am I missing that will increase my wellness right now?" ***Magnesium: The Missing Link to Total Health*** provides the answer. Discover:

- The top thirteen reasons supplementing magnesium supports increasing overall wellness and longevity
- How many traditional diagnoses could very well be magnesium deficiency in disguise
- The importance of magnesium as a partner/co-factor with other essential vitamins and minerals
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Medical Doctor, Naturopath, and Dedicated Researcher

Carolyn Dean MD ND is the author of over 50 books including best seller ***The Magnesium Miracle***® and other noted publications including ***IBS for Dummies, Hormone Balance, Death by Modern Medicine***, and 110+ Kindle books to date. Dr. Dean is committed to helping anyone understand more about nutrients, their requirements in the body, and ways to promote health and vitality in a proactive manner.

In 2015, Carolyn Dean MD ND launched the RnA ReSet® brand based on nutrient protocols she built through 40+ years of experience in private healthcare practice. Dr. Dean's career as a medical doctor and naturopath resulted in a collection of unique, proprietary formulations that support precise applications while remaining safe for everyday use.

Dr. Dean continues to provide her leadership and vision for enabling people to take control of their own health. This includes her 45+ years of educational resources including guidebooks, presentations, and a history of other audio, video, and written assets for anyone wanting to learn more about nutrients and their health.

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Magnesium: The Missing Link to Total Health (Revised)

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BlueStone EDU LLC

During my journey to becoming an expert on magnesium and mineral deficiencies and supplementation, I learned from observing my patients and my own body what is required for optimal health. Like many practitioners who choose natural medicine, I found that "necessity is the mother of invention." I'll tell you my story of how it became necessary for my own health to become an expert in magnesium, and I dedicate this book to the patients and customers who helped me along the way.

Disclaimer

The contents of this book are included for educational purposes and to provide helpful information on the subjects discussed. This book is not intended to be used, and should not be used, to diagnose or treat any medical condition. For diagnosis or treatment of any medical condition, consult your healthcare provider. You are responsible for your own choices, actions, and results regarding any health concerns that may require medical supervision. The author and publisher are not liable for any damages or negative consequences from any action, application, treatment, or preparation to any person reading or individually pursuing the information in this book.

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Introduction

Dietary supplements make up a big part of what we practitioners offer our patients. Allopathic doctors have their drugs, we have our supplements. But I caution new practitioners away from using the recipe approach with their patients where you match a supplement to a symptom like allopaths match a drug to a disease.

When I studied Naturopathic Medicine, I realized how closely I resonated with its principles:

First, to do no harm.
To co-operate with the healing powers of nature.
To address the fundamental causes of disease.
To heal the whole person through individualized treatment.
To teach the principles of healthy living and preventative medicine.

I've been studying and practicing medicine from the inception of the present $160 billion, global dietary supplement industry. I've often noted that when I first began studying medicine in Halifax, Nova Scotia, there were no health food stores. I watched as companies jockeyed for shares of the market that was dominated by the Amway MLM (multi-level marketing) company, Nutralite.

In the late 1990's and early 2000's, I attended Expo East and Expo West, the Natural Products Industry biannual trade shows "where the natural products industry meets to discover, learn and push the industry forward." After a few years I stopped going because of the heavy infiltration of Big Pharma and Hospital executives deciding they wanted to be part of this growing industry. Unfortunately, these interlopers brought their questionable marketing skills into the supplement industry. The adage, "Create the disease and offer the cure," comes to mind. I watched as my favorite supplement companies were bought out by Nestle, Clorox, and subsidiaries of Big Pharma, and most supplements were synthesized in a lab.

I also was an observer at Codex Alimentarius meetings in Europe 2004 and 2005. Codex is a WHO (World Health Organization) and WTO (World Trade Organization) construct created in the early 1960's to standardize food and dietary supplements worldwide. Their stated goal is to only allow and promote the sale of low potency synthetic supplements that will not interfere with prescribed medications. They did not believe that nutrients could prevent or treat disease and wanted supplements to be prescribed by medical doctors.

Many of us saw the threat of a purely drug-based system, and our "health freedom" group met with politicians in Washington and Ottawa to gain support for natural medicine having a say in health care. We

were sadly informed that Big Pharma and allopathic medicine had a stranglehold on government policy (through extensive lobbying and political funding) that would never give natural medicine a seat at the table.

The anti-natural medicine policy among allopaths is long-standing and even today keeps allopathic doctors from recommending that their patients go to naturopaths, chiropractors, or nutritionists when they have nothing to offer people for mild to moderate illnesses including influenza.

I wrote about this competition in my book *Death by Modern Medicine (2005).* Here is a short piece from Chapter One:

> *From the book, Rockefeller Medicine Men, I learned that in 1908, a non-medical, educational reformer, Abraham Flexner, was commissioned by the Carnegie Foundation and later the Rockefeller Foundation to make a survey of North American medical schools and write recommendations. Carnegie and Rockefeller became involved because they wanted to make sure that the burgeoning field of medicine was guided by capitalism. Flexner advised the adoption of German, scientific-based, laboratory medicine, a sharp decrease in the number of medical schools and a reduction in the number of physicians in order to elevate the medical profession to a more elite status. You can access Flexner's report online and read how the allopaths worked alongside the wealthy foundations. You'll read how they limited the number of medical schools; seven black medical schools were reduced to two, the three women's medical schools were completely purged, and 31 homeopathic and eclectic schools were unable to meet the required 'scientific' standards designated by the Flexner Report necessary to receive 'philanthropic' funding. If you did not graduate from an 'approved' allopathic medical school, you would not be permitted to take a licensing exam.*

> *It took a long time but finally in the early 1980's a group of chiropractors sued the AMA for conspiring to destroy and eliminate the chiropractic profession. The AMA fought the case in a long, drawn-out battle that lasted 15 years and cost the AMA $20 million. In the end, the AMA was found guilty of intentionally conspiring to destroy their competition, and the U.S. Supreme Court upheld the verdict.*

> *The AMA revealed, in the nearly one million pages of documentation that entered the public record, its true intent regarding all forms of natural medicine. Clearly stated in internal memos and files was a deliberate and systematic conspiracy to "destroy not only chiropractic but midwifery, homeopathy, naturopathy, and herbalism." "Clearly, the AMA, whose motto is 'Physicians*

dedicated to the healing of America,' was deliberately undermining what it saw as its competition for the medical dollar."

And here we are in 2023, still suffering the effects of this monopoly and acting as if it's normal.

I was quite excited in 1995, when I heard that the NIH (National Institute of Health) was opening an Office of Dietary Supplements. I thought that at last we would have the guidance to research dietary supplements and their effects on preventing and treating disease. I even attended a meeting at the NIH and asked that question. I was quickly told that their prime directive was to simply standardize the RDA (Recommended Daily Allowance) of supplements to prevent vitamin deficiencies – like scurvy (vitamin C), beriberi (vitamin B1), pellagra (vitamin B3) and anemia (iron).

It's possible that you are attracted to Naturopathy because you are aware of the above shortcomings of modern medicine. I think it's safe to say that medicine has fallen short of its intended goal to help people, and Naturopathy can provide people with many more choices than drugs and surgery.

While all this intrigue with Codex was going on, Random House asked me to write a full-length book on magnesium. I had been studying medicine and alternative medicine since the early 70's, and it was only in the early 2000's that I realized I had been dealing with magnesium deficiency my whole life. My charley horse leg cramps, insomnia, neck pain, and heart palpitations were all related to magnesium deficiency. When I tried to supplement with more magnesium than was in my multiple vitamin, I immediately suffered "the laxative effect" and had to cut back. When *The Magnesium Miracle* was published in 2003, I canvassed all the mineral companies and begged them to make a non-laxative magnesium, to no avail. Finally in 2012, I worked with a chemist to create my own picometer sized, stabilized, magnesium ion formula.

In 2017 Random House asked me if there was enough material to write an update. In fact, the page count almost doubled. With *The Magnesium Miracle* being a best-seller and many magnesium companies using my book in their sales pitches, many people know about magnesium. Because of this outreach, it has become one of the fastest selling supplements. I sounded the alarm about magnesium deficiency, and people have been listening.

Mission accomplished? Not really. It turns out that most people are not taking enough magnesium because the brands on the market aren't properly absorbed at the cellular level, which causes the laxative effect. Thus, many, if not most, magnesium consumers remain magnesium-deficient.

By this time, I was also able to share what I'd learned about picometer magnesium and the flood of new information. *The Magnesium Miracle* (2017) is already 600 pages long, and I highly doubt I'll write another edition. So, I've decided to write an up-to-date summary and include the advances in clinical magnesium research and therapy from the past 5 years.

Overview

In this update, I'll cover the Who, What, Where, When, and Whys about magnesium not getting the proper attention it deserves and then tell you how you can contribute to solving that problem. In order to accomplish this goal, let me start by outlining the importance of magnesium.

There are likely hundreds of magnesium facts, but I've decided to focus on the most important ones. I will begin my Top Thirteen Facts about Magnesium, with the first being what many consider to be a bombshell. This fact is so crucial to understanding the importance of magnesium that I will announce it here, say it again below in the Facts, and also make it into a whole section to emphasize, solidify, and promote its importance:

> *Magnesium is responsible and necessary for the body to be able to perform 80% of its known metabolic functions!*[2]

That means, the only responsibility you, as an individual and practitioner, have is to make sure you and your patients get enough magnesium to properly feed all those metabolic processes. Magnesium is as basic as food and water; it should be in your food, but since it isn't, taking a magnesium supplement is crucial.

NOTE: But even before continuing the Top Thirteen List of Magnesium Facts, I will share some huge "Ah Ha! Moments" that I have had discussing the awesomeness of magnesium with my husband, Bob:

1. Energy medicine doesn't work if you're not saturated with fully absorbed magnesium. That's right. Acupuncture, hands-on-healing, magnetic and electric energy gadgets – all require a fully loaded deck of electrolytes. This means magnesium, calcium, potassium, sodium, and chloride. I learned this by listening to customers and patients who said that even their massages were better when taking fully absorbed minerals.

2. Magnesium deficiency lowers the production of ATP in the Krebs cycle, which I think has created a culture of coffee addicts that require the stimulation of caffeine on the adrenal glands to release adrenaline for their morning wake-up call. Besides being addicted to a chemical, your adrenal glands are being weakened and depleted of even more magnesium. Customers tell us that when they become saturated with our picometer magnesium, they no longer "crave" coffee and just use it occasionally because they like the taste. They say the same about sugar, alcohol, and cigarettes – all of which are used as energy boosters in a magnesium-depleted body.

3. Magnesium deficiency is a medical indication of diabetes. Insulin resistance that leads to diabetes is synonymous with magnesium deficiency. When blood sugar is elevated, insulin opens the cells to allow entry. When it is low, the adrenals are triggered to release adrenaline to help raise blood sugar levels. The adrenals require magnesium to produce adrenaline. When you have low blood sugar, there is less metabolism of sugar in the glycolysis cycle to make pyruvate. Pyruvate is the kingpin

that starts the Krebs cycle to make ATP energy molecules. Magnesium is required for this first step and several others in the Krebs cycle.[3,4,5,6]

The above discussions show how incredibly intricate and intertwined all these body processes are and how astonishing that they all seem to require magnesium!

Magnesium's Top Thirteen Facts

The following are several important reasons why Magnesium is my "Best Friend," and it should also be yours:

1. 80% of Metabolism and 18 Main Functions
2. Most People Are Magnesium Deficient
3. Calcium Depletes Magnesium
4. The Many Reasons for Magnesium Deficiency
5. Magnesium Deficiency: A Major Factor in 68+ Conditions
6. Therapeutic Doses: Mostly Impossible to Obtain
7. The Laxative Effect Is a Failsafe for Magnesium
8. Magnesium and Mitochondria
9. Serum Magnesium Testing Is Worthless
10. Telomeres Hold the Key to Aging, and Magnesium Prevents Telomeres from Deteriorating
11. Long COVID Is the New Face of Magnesium Deficiency
12. Magnesium Is Integral to Building Bone Health
13. Magnesium and the Microbiome

I've basically given you the "punch line" to the story of magnesium by listing The Top Thirteen; I will spend the rest of the book filling in the details.

Let's Get Personal

Magnesium is very personal for me because I'm the poster child for magnesium deficiency. I gave a brief indication of this in the introduction, but let me elaborate.

In the late 1990's, I was doing research on alternative therapies for AIDS and Chronic Fatigue in Manhattan. I had written a health book for a local publisher and been invited on local TV shows to give commentary about natural health. I was studying Chinese Medicine and asked a friend to arrange an interview with a publisher at Random House to see if they would accept a book on Chinese Diet Therapy. The answer was, "No," but instead they asked me to write a book on magnesium, as the publisher had relief of her migraine headaches with magnesium.

I was skeptical that I could find enough information to write a 300-page book on one simple mineral, but I accepted the challenge. It wasn't long before I realized that many of my annoying symptoms were related to magnesium deficiency:

1. Neck and upper back pain

2. Lower back pain

3. Charley horse leg cramps

4. Headaches

5. Insomnia

6. Heart palpitations

It was very exciting to learn that supplementing one mineral could cover so many problems, and I was eager to take the cure! That excitement did not last long because I immediately found that when I took even a low dose of magnesium, I would, like many magnesium users, get the laxative effect.

Since so many people have similar experiences, I cannot overestimate the significance of this information. So, this book is about magnesium in general so that you understand its importance and why people are not getting enough in their diet and not taking enough of the right kind in supplement form.

Chapter 1

Exploring Magnesium Facts

Fun Fact One: 80% of Metabolism and 18 Main Functions

Dr. Jayme Workinger wrote the seminal paper, "Challenges in the Diagnosis of Magnesium Status"[7] in 2018, a year after my second edition of *The Magnesium Miracle* was published. It quite literally rocked my world when I saw a poster of the paper at the 2019 NIH Conference on Magnesium. Below is Workinger's full abstract:

> *Magnesium is a critical mineral in the human body and is involved in ~80% of known metabolic functions. It is currently estimated that 60% of adults do not achieve the average dietary intake (ADI) and 45% of Americans are magnesium deficient, a condition associated with disease states like hypertension, diabetes, and neurological disorders, to name a few. Magnesium deficiency can be attributed to common dietary practices, medications, and farming techniques, along with estimates that the mineral content of vegetables has declined by as much as 80-90% in the last 100 years. However, despite this mineral's importance, it is poorly understood from several standpoints, not the least of which is its unique mechanism of absorption and sensitive compartmental handling in the body, making the determination of magnesium status difficult. This review will discuss causes of magnesium deficiency, absorption, handling, and compartmentalization in the body, highlighting the challenges this creates in determining magnesium status in both clinical and research settings.*
>
> *The lack of a standardized laboratory test that accurately describes the status of magnesium remains one of the most vexing challenges associated with the magnesium field and contributes to the relative anonymity of magnesium compared to other macronutrients, which in turn, further contributes to magnesium deficiency and its sequelae.*

If you read every word in this abstract a few times, you will know more about magnesium than most doctors and realize its value. But for those of you who want the details, I will press on.

I had already been studying magnesium intensely since the year 1999, so I knew of its importance, but to learn that it was in control of 80% of the body's metabolism really stunned me. That means, if you are deficient in magnesium, your body is operating without enough energy and fuel to do a proper job of just about every aspect of body performance. Magnesium is undoubtedly the key to a fully functioning body.

Eighty percent of known metabolic functions also means that every part of the body is intimately involved with magnesium. Also, there is no substitute for magnesium, so without it, people with magnesium deficiency symptoms are misdiagnosed as having a disease and mistreated with drugs. Ironically, those drugs will also deplete magnesium.

Even if a doctor considers magnesium deficiency, the form of magnesium they prescribe will most often cause diarrhea and have the patient refusing to take their prescription. The fact that doctors have little formal training in nutrition and nutrients adds to the problem, leaving magnesium deficiency ignored, misdiagnosed, and mistreated.

Magnesium Functions

The 18 major functions of magnesium are listed in *Appendix A*. Many more are still being researched. Appallingly, when these functions are not supported with proper amounts of magnesium, magnesium deficiency-related conditions can result.

Fun Fact Two: Most People Are Magnesium Deficient

The reason why there are so many magnesium deficiency diseases is because most of the population is magnesium-deficient. Sources estimate the range from 60-80%.

I say the rate of deficiency is at least 80% because as far back as 1997, The National Academy of Sciences found that most Americans are possibly magnesium deficient. They found that men, on average, obtain only 80% of the minimum requirement of magnesium to run innumerable body functions, and women, only 70%. Thus, our bodies are just not able to function properly.[8]

Magnesium researchers, back in the late 1990's, determined the daily magnesium requirement according to the side effect of diarrhea in a test group who were given magnesium oxide. This magnesium compound is a serious laxative; it's only 4% absorbed, which means that 96% flushes through the colon pulling in all the water it can to cause diarrhea. Many people have the laxative effect from magnesium oxide, and I certainly do.

So, instead of the RDA for magnesium being judged by the benefits, it's judged by the so-called side effect of diarrhea, which is due to poor absorption. Instead of advising that people use other forms of magnesium so that they can get more benefits from the mineral, the RDA is kept too low to do much good. Remaining magnesium deficiency symptoms are then treated with drugs.

Also, I learned several decades ago at a conference put on by the Office of Alternative Medicine that their job was to oversee vitamin and mineral deficiencies – like scurvy (Vit C) and pellagra (Vit B3) -- NOT to do any research on vitamins and minerals to treat diseases. The Office of Alternative Medicine and the FDA claim that drugs treat diseases, and if you say a nutrient treats a disease, it automatically is called a drug. Then, costly clinical trials are required to make any disease-related claims.

Even though magnesium oxide is minimally absorbed, studies using it show benefits because magnesium is so desperately needed by the body. Magnesium oxide is also the main magnesium product that's recommended by doctors because most of the early research on magnesium used the oxide form. Anecdotally, that happened because of a brilliant move by the owner of a magnesium oxide company who donated truckloads of her product to magnesium researchers.

The RDA is defined as the amount of a nutrient necessary to meet the daily requirements of a healthy individual in order to avoid nutrient deficiencies – like scurvy. If you don't have minimal amounts of vitamin C, you have symptoms of scurvy. Of note, I consider the visible bruising on the arms of the elderly or bleeding gums while flossing to be scurvy, but few have the information to make this connection.

There are no guidelines for the amount of nutrients to use if someone is not healthy or on medications or to protect blood vessels, the adrenal glands, and the eyes. In fact, nutrients are not regarded by allopathic medicine as being able to treat disease at all and unbelievably, in most cases, it's not even legal to say so. I'll cover the few nutrients that have jumped through the hoops to be allowed to have claims made for them.

As I noted above, if a supplement manufacturer "makes a claim" that a nutrient is able to treat a disease, that supplement is automatically recategorized as a drug, and the drug must undergo enormously expensive drug trials, costing billions of dollars, in order to "prove" such a claim. This bizarre approach prevents supplement companies from educating people about nutrients.

Fun Fact Three: Calcium Depletes Magnesium

This is going to be a long section because calcium has been promoted so heavily over the past few decades that people think it is necessary and safe. By the end of this section, you'll understand why it's not your friend.

There is a natural balance between calcium and magnesium, but calcium has gained the upper hand. This means calcium promoters have a lot to answer for because supplemental calcium is responsible for body-wide

calcification conditions that include aging, heart disease, kidney stones, gall stones, cataracts, hypertension, and breast tissue calcification.

Calcium depletes magnesium in the body, and far too many people get far too much calcium, either as supplements, in fortified foods, and/or in dairy products. This is a very important topic because calcium pushes magnesium out of the picture making a two-fold problem: magnesium deficiency diseases and calcification conditions.

Calcium and magnesium have a complex interaction at the biochemical level. Magnesium will keep calcium in solution. This is the dynamic you want to happen in your bloodstream as well as your heart, brain, kidneys, and all the other tissues in your body—except your bones. You want calcium to dissolve in your blood stream and be directed to your bones and teeth and not precipitate out in soft tissues as calcium crystals. Magnesium not only dissolves areas of calcification, but along with vitamin K2, it also directs calcium to your bones and teeth.

If you don't have enough magnesium to help keep calcium dissolved, you can develop muscle spasms, fibromyalgia, calcified arteries (carotid, kidney), dental cavities, and calcium deposits (including bone spurs). Calcium deposited throughout the bladder can make it rigid, lower its capacity, and lead to frequent urination and paves the road to Adult Diapers.

All muscle cells, including those of the heart and of the smooth muscles lining the blood vessels, contain more magnesium than calcium. Magnesium controls the calcium channels that allow only a certain amount of calcium to enter cells. If magnesium is deficient, calcium floods into the smooth muscle cells of blood vessels and causes spasms, leading to constricted blood vessels causing high blood pressure, arterial spasm, angina, and heart attack.[9] A proper balance of magnesium in relation to calcium can prevent these symptoms.

Calcium excess stimulating the cells in the muscular layer of the temporal arteries (located at the temples) can cause migraine headaches. Excess calcium can constrict the smooth muscle surrounding the small airways of the lungs, causing restricted breathing and asthma. Finally, too much calcium, without the protective effect of magnesium, can irritate delicate nerve cells of the brain. Cells that are irritated by calcium fire electrical impulses repeatedly, depleting their energy stores and causing tingling, burning, pain and eventually cell death.

Why So Much Calcium?

Research shows that the ratio of calcium to magnesium in the Paleolithic or caveman diet—the ancient diet consumed by our earliest ancestors as the human body evolved to its current form—was 1:1, compared with a ratio of anywhere between 5:1 and 15:1 in present-day diets.[10]

With an average of ten times more calcium than magnesium in our modern diet, there is no doubt about widespread magnesium deficiency. Also, the emphasis on calcium supplementation has diverted our attention from any other mineral, even though all minerals are crucial to the proper functioning of the body.

Calcium and Heart Disease

It's been proven that calcium supplements can increase the risk of heart disease. However, researchers simply blame calcium without realizing that it's the imbalance of calcium and magnesium that's actually causing the problem. It's not sufficient to just stop supplementing with calcium. We must begin supplementing with magnesium and focus on getting our calcium from foods or from a highly absorbed, but low potency calcium supplement.

Five studies published in several prestigious journals between 2008 and 2015 by lead author Dr. Mark Bolland provide enough evidence that an excess of calcium produces an increased risk of heart disease in women. To impress upon you the importance of Bolland's research and the conclusions that many doctors have not yet embraced, I'm including a shortened abstract from Dr. Bolland's fourth paper, "Calcium Supplements and Cardiovascular Risk: Five Years On:"

> *Calcium supplements have been widely used by older men and women. However, in little more than a decade, authoritative recommendations have changed from encouraging the widespread use of calcium supplements to stating that they should not be used for primary prevention of fractures. This substantial shift in recommendations has occurred as a result of accumulated evidence of marginal antifracture efficacy, and important adverse effects from large randomized controlled trials of calcium or co-administered calcium and vitamin D supplements. In this review, we discuss this evidence, with a particular focus on increased cardiovascular risk with calcium supplements, which we first described 5 years ago. Calcium supplements with or without vitamin D marginally reduce total fractures but do not prevent hip fractures in community-dwelling individuals. They also cause kidney stones, acute gastrointestinal events, and increase the risk of myocardial infarction and stroke. Any benefit of calcium supplements on preventing fracture is outweighed by increased cardiovascular events. Because of the unfavorable risk/benefit profile, widespread prescribing of calcium supplements to prevent fractures should be abandoned. Patients at high risk of fracture should be encouraged to take agents with proven efficacy in preventing vertebral and nonvertebral fractures.*[11]

Of course, Bolland and his team do not mention that dropping calcium is only half of the picture. Adding a picometer magnesium supplement is the other half of the story.

A 2016 study showed that calcium supplements make people more prone to plaque buildup in arteries, which contributes to the risk of heart attack.[12] The report recommends that people get their calcium from foods such as dairy products, leafy green vegetables, fortified cereal, and juices. The scientists said they wanted to build on previous research findings that the calcium in supplements never actually makes it to a patient's bones and instead accumulates in soft tissue and muscles, including the heart.

Calcium Precipitation

Let me summarize the extent of the problems that result when calcium precipitates in the soft tissues of the body.

1. In the large intestine, calcium interferes with peristalsis (the waves of muscle contractions that push food through the bowels) by causing magnesium deficiency and also because it is physically "binding," which results in constipation.

2. When calcium settles out in the kidneys and combines with phosphorous or oxalic acid, kidney stones form.

3. Calcium can deposit in the lining of the bladder and prevent it from fully relaxing, and therefore from filling completely with urine. This leads to urinary frequency and infections, especially in older people.

4. Calcium can precipitate out of the blood and deposit in the lining of arteries, causing hardening of the arteries (arteriosclerosis). The new term for this is vascular calcification, which in the coronary arteries can lead to heart attack; in the carotid arteries, it can lead to stroke; and in the renal arteries, it can lead to kidney failure.

5. Calcium can also deposit in the brain. Many researchers are investigating it as a possible cause of Dementia, Alzheimer's, and Parkinson's disease.

6. Calcium can deposit in the smooth muscle lining the bronchial tubes and cause symptoms of asthma.

7. Calcium precipitation in the cell membranes can impair their permeability. This makes it increasingly more difficult for glucose (a very large molecule) to pass through the cell membrane to be converted into ATP in the cells' mitochondria. High glucose levels created by excess calcium may be misdiagnosed as diabetes.

You can see from the above list that these descriptions of excess calcium are "a mirror image of descriptions of magnesium deficiencies."

An even more damaging result of calcium excess happens in the mitochondria. According to Dr. Guy Abraham, in acute situations, in order to protect the cell from taking on too much calcium (resulting in excessive cell spasms – either muscle or nerve), a magnesium-dependent mechanism shunts calcium into the mitochondria. Chronic uptake of calcium in the mitochondria will inhibit ATP synthesis and eventually result in cell death.[13]

Calcium to Magnesium Ratio

I've always been wary of calcium supplements, and I went out on a limb when I wrote in the first edition of *The Magnesium Miracle* that we should be getting equal parts of calcium and magnesium (a ratio of 1:1) in our diets and if we take supplements. Back in the late 1990's when I was reading everything I could about magnesium, I saw that there was an unexplained consensus that you had to take 2 parts calcium for every part of magnesium. This 2:1 ratio is still evident in the composition of most calcium-magnesium supplements and in most health books and articles I read.

I traced this 2:1 calcium to magnesium ratio back to a 1989 report in the journal, *Magnesium Research,* by the famous French magnesium scientist Dr. Jean Durlach.[14] His actual words, mistranslated from French, were that we should never exceed the 2:1 ratio of calcium to magnesium intake from all sources (food, water, and supplements). This was obviously misunderstood as a recommendation, not as an absolute cut-off point.

It's likely that people who eat dairy can obtain 600 mg of calcium from their diet. However, many people avoid dairy and don't get enough calcium. I suggest keeping a food diary of calcium rich foods, and if you don't get 600 mg of calcium on average per day in food, you can supplement the difference with a picometer calcium supplement.

The National Institutes of Health's "2011 Dietary Supplement Fact Sheet on Calcium," stated that 43 percent of the U.S. population (and 70 percent of older women) take calcium supplements. However, the NIH admits that less than half of that calcium is absorbed in the gut; the rest is either excreted through the large intestine, causing constipation, or through the kidneys, potentially forming kidney stones; or it is transported to other soft tissues, where it can form gallstones, heel spurs, atherosclerotic plaques, fibromyalgiac calcifications, and breast tissue calcifications.

What the NIH Fact Sheet does not say is that magnesium in adequate amounts is essential for the proper absorption, metabolism, and distribution of calcium and the proper metabolism of vitamin D. Magnesium converts vitamin D supplements or vitamin D in storage form (calcidiol) into its active form (calcitriol), which can be properly absorbed in the gut. Magnesium activates the hormone calcitonin, which helps to preserve bone structure and draws calcium out of the blood and away from soft tissues and into the bones. This necessary action lowers the risk of osteoporosis, some forms of arthritis, heart attack, and kidney stones.

Calcium and Inflammation

Calcium overload is one of the main causes of body-wide inflammation, and magnesium is one of the most important anti-inflammatory nutrients. Although the FDA and drug companies are aware of the importance of treating inflammation, regrettably they are using drugs, with all their side effects, as the primary treatment instead of recommending magnesium. Even worse, anti-inflammatory steroids and many

nonsteroidal anti-inflammatory drugs are fluoride compounds, which means they bind up magnesium. Treating inflammation with ineffective drugs inevitably creates more inflammation.

Calcium Supplementation

Where is all this calcium coming from? Recommendations for calcium intake vary greatly. In the United States, women over fifty are told by doctors and health publications to take up to 1,500 mg daily. However, in the United Kingdom, the RDA is set at 700 mg daily, while the World Health Organization recommends only about 600 mg.

When osteoporosis clinics advise 1,500–2,500 mg of calcium, they don't consider the amount that people are already getting in their food, water, and calcium-fortified foods. Even orange juice may be fortified with calcium.

Many people, especially those consuming dairy products, have very high calcium diets. This can lead to escalating amounts of unabsorbed calcium. As mentioned earlier, food and water have higher amounts of calcium than magnesium, with the standard American intake approaching a 10:1 calcium-to-magnesium ratio. Levels of all minerals have been diminishing because farmers don't use mineral fertilizers and because many of the chemicals used as herbicides and pesticides bind up minerals, especially magnesium.

However, the amount of calcium in the soil is still higher than that of magnesium. A list of the amount of calcium in common foods shows that a mere 7 sardines (with bones), half a can of salmon (with bones), or 20 oysters give you between 284 and 393 mg of calcium. A cup of bok choy nets you 252 mg. I've proven to myself the power of dietary calcium. When I go on a yogurt or goat cheese binge, I'll begin experiencing some of my old heart palpitations and leg cramps and realize that I need more magnesium to balance the extra calcium in my diet!

Fun Fact Four: The Many Reasons for Magnesium Deficiency

There are many reasons for magnesium deficiency. Among the major causes are: magnesium deficient soil, magnesium deficient food, prevalence of processed food use, fad diets, eating sugar, and stress. The following is a more in-depth discussion of these factors.

Magnesium-Deficient Soil

It is quite discouraging that today we are no wiser about the mineral depletion of our farmland which was formally described in a 1936 Senate document that wisely stated:

Do you know that most of us today are suffering from certain dangerous diet deficiencies which cannot be remedied until depleted soils from which our food comes are brought into proper mineral balance? The alarming fact is that foods (fruits, vegetables, and grains) now being raised on millions of acres of land that no longer contain enough of certain minerals are starving us—no matter how much of them we eat. The truth is that our foods vary enormously in value, and some of them aren't worth eating as food.

Our physical well-being is more directly dependent upon the minerals we take into our systems than upon calories or vitamins or upon the precise proportions of starch, protein, or carbohydrates we consume.

Laboratory tests prove that the fruits, the vegetables, the grains, the eggs, and even the milk and the meats of today are not what they were a few generations ago. No man today can eat enough fruits and vegetables to supply his stomach with the mineral salts he requires for perfect health, because his stomach isn't big enough to hold them! And we are turning into a nation of big stomachs.

The above statement was written eighty-six years ago, which means 86 more years of depleting our soil, yet still expecting to get nourishment from our food supply. Mineral depletion of the soil is one of the causes of obesity as people eat more and more calories searching for nutrients.

Grass Tetany

Ranchers and golfers know more about magnesium in the soil than farmers. In the 1930's, André Voisin, a French biochemist, wrote about grass tetany, which is a metabolic disease of cattle and goats caused by magnesium-depleted soil.[15] When animals eat magnesium-deficient grass, they become irritable with staggers, tremors, and spasms. Most dramatically, the animals fall down in convulsions when they are startled by sudden loud noises or otherwise frightened or excited.

Voisin says grass staggers began in the 1930's when high-potassium potash became the fertilizer of choice. Why? Because it's cheap, easily obtained, readily absorbed by plants, and makes plants look green and healthy. Potassium is so easily absorbed that plants favor its uptake above magnesium and calcium. Crops grown with excessive amounts of high-potassium potash have a low content of magnesium and calcium and high potassium levels. However, you will never know that since there is no minimum amount of minerals required by the FDA in our grains, fruits, or vegetables -- the nutrients in such foods are not routinely measured and never labeled.

Even if the magnesium content of soil is high, using potassium fertilizer can prevent its absorption into the plant. But because most agricultural land in America has been overworked for decades and fertilizers don't replace this important mineral, magnesium is rarely found in our soils.

Why do I mention golfers? I live beside a golf course, and I was curious about what was being sprayed on the greens every Sunday morning. So, I rerouted my morning walk to the loading station, and what did I see in the tanks? The biggest tank was filled with a magnesium compound!

Chlorophyll is the blood of plants; magnesium is the mineral inside the chlorophyll molecule just as iron is in the center of the hemoglobin molecule that's part of red blood cells. People whose livelihood depends on green grass diligently spray their grass with magnesium!

Deficient Food from Deficient Soil

Foods that commonly contain magnesium are leafy green vegetables, nuts, seeds, whole grains, and chocolate. However, unlike vitamins, which can be manufactured by plants, if they have sufficient sunlight and water, minerals must be present in the soil to show up in plants. If there is no magnesium in the soil, plants will have none; they cannot manufacture it out of thin air. So don't believe it when someone says that you can get all your nutrients in a good, balanced diet. That may be true only if you eat organic food, and then only if the organic farmers use a full spectrum of minerals in their fertilizer.

Actually, I've tested this theory by eating exclusively from the organic, biodynamic farm that I support. All my magnesium deficiency symptoms began to come back within a matter of days. Therefore, I'm convinced that to get enough magnesium today, you need to take supplements.

Processed Food Lacks Magnesium

We get the food out of the ground and begin refining and processing it, which ends up wasting significant amounts of magnesium. The process of extracting oils from magnesium-rich nuts and seeds strips away this essential mineral. Nearly all the magnesium in grains is lost during the milling process when the bran and germ are removed from whole grain to make white flour.

For example, one slice of whole-wheat bread provides 24 mg of the mineral, while a slice of white bread has only 6 mg. And yet, magnesium is never considered in the fortification of refined foods. Finally, in the kitchen, when vegetables are boiled, magnesium leaches out into the cooking water. Of note is the fact that less calcium than magnesium is lost due to food processing and cooking, another reason the average diet is higher in calcium than magnesium.

Ironically, at a time when there are no more nutrients in the food supply, people seem to be embracing one "fad" diet after another. Young and old alike are "going raw" and drinking green smoothies. I volunteer at my organic farm market twice a week. All ages are buying bushels of kale and collards and handfuls of our turmeric and ginger and bragging about their vegan or vegetarian status. In the opposite extreme, the

Paleo, Keto, and Carnivore diets are reaching cult-like status. I think any effort to improve one's diet is commendable—except, unfortunately, I say it's a little too late – that ship has sailed.

We know this for a fact because there has been a gradual decline of dietary magnesium in the United States, from a high of 500 mg/day at the turn of the century to barely 175–225 mg/day today.[16] You may ask if any of the current fad diets are closing the gap on magnesium deficiency. I say no, because even if the produce is organic and even if you eat a lot of it, you can still be magnesium-deficient if the food comes from magnesium-deficient soil. Let's take a closer look at the current diet fads.

Paleo, Keto, Carnivore Diet Problems

1. Regarding a Paleo Diet, in order to digest a high-protein diet, more magnesium is required. Also, you get less magnesium in a Paleo diet because you avoid grains that can potentially offer some magnesium.

2. A Keto diet is extremely low in carbs, which is where you find the most magnesium (leafy greens and grains).

3. Similarly, the Carnivore diet is high in protein and moderate fat with no carbs.

When a high protein diet is metabolized, lots of homocysteine is produced. This amino acid oxidizes cholesterol, and oxidized cholesterol is the kind that is said to damage blood vessels. The major enzymes involved in breaking down and getting rid of homocysteine are magnesium-dependent. Thus, oxidized cholesterol created from homocysteine builds up when there is a lack of magnesium. The breakdown of homocysteine also requires vitamins B12, B6 and folate (B9).

Sugar's Drain on Magnesium

If there is little magnesium left in plants, even the raw-foodists and green-juicers succumb to magnesium deficiency. For one thing, they eat way too much fruit, even though they may say they avoid sugar – you have to have something to make the green drink palatable. Also, they think they can eat all the fruit they want "because it's natural."

I received an email from a young man who asked if there was anything wrong with him eating sixteen bananas a day on his vegan diet! I told him to do the math. One medium-sized banana has about 27 grams of carbs; sixteen bananas give him a total of 432 grams. A balanced diet should only offer 100–150 grams of carbs a day.

Besides overloading with sugar and overworking his pancreas to make insulin, this fruitarian is using up his magnesium stores to metabolize fruit sugar. Raw-foodists give themselves permission to lace their green drinks with lots of pineapples, mangos, bananas, and apples to try to overcome the bland or bitter taste of

greens. High intake of fruit sugars can trigger Type 2 Diabetes (partly as a result of magnesium deficiency) and can also cause dental caries.

Natasha Campbell-McBride, N.D., in her book, *Gut and Psychology Syndrome*, says that 28 atoms of magnesium are required to process one molecule of glucose.[17] If you are trying to break down a molecule of fructose, you need 56 atoms of magnesium. That's an extremely unbalanced and unsustainable equation that drains magnesium.

As I mentioned earlier, magnesium is the central mineral in "plant blood" or chlorophyll, much as iron is the central mineral in hemoglobin. You would think a diet high in green vegetables would have you covered. Not so. I have consulted with people who are drinking more than 40 ounces of organic green juice a day, yet they are still magnesium deficient, with symptoms such as heart palpitations and leg cramps, which can be immediately relieved with proper magnesium supplementation. Let me repeat this fact: if the food you are eating is not grown on soil replenished with minerals, the food will automatically be mineral deficient—even if it is organic.

The Impact of Stress

Adrenaline-Producing stress or trauma of any type – physical, mental, emotional, environmental – can cause magnesium deficiency. Adrenaline is like an unstable accelerant that gets you all revved up with no place to go! It's not just a theory that stress causes magnesium deficiency and a lack of magnesium magnifies stress. Animal experiments[18] where adrenaline is given intravenously show that it decreases magnesium as well as calcium, potassium, and sodium. This proves that when you are in a revved-up state and burning adrenaline, you are also burning off magnesium.

There are more than a dozen major metabolic processes that are affected by bursts of adrenaline, including heart rate, blood pressure, blood vessel constriction, and contraction of all muscles, including the heart. Each of these functions requires magnesium to bring them back into balance. When IV adrenaline is stopped in these experiments, the body recovers in about thirty minutes, showing a rise in potassium during that time. However, it takes much longer for magnesium to reach normal levels.

Adrenal fatigue follows after a time of chronic stress, anxiety, and panic attacks, and it seems to be occurring in epidemic proportions in recent years. Adrenaline, noradrenaline, and cortisol (elevated in chronic stress) deplete magnesium. Stress causes excess elimination of magnesium through the urine, further compounding magnesium deficiency.[19] "Stress" is such an overworked word, but we all suffer physical, emotional, and mental stress every day, and every bit of it drains magnesium.

Fun Fact Five: Magnesium Deficiency: A Major Factor in 68+ Conditions

These diseases include diabetes, heart disease, high blood pressure, high cholesterol, migraines, irritable bowel syndrome (IBS), and heartburn. The drugs used to treat all these conditions deplete magnesium, often making symptoms worse.

This is a huge topic which I will address in *Chapters 2 through 7: Overview and Magnesium-Deficiency Health Conditions*. And remember, it's not that magnesium deficiency causes these diseases, it's the fact that being without magnesium makes it look like you have these diseases. It's a huge problem that may never be solved by Big Pharma or allopathic medicine because it would totally disrupt the "business" of drug-based medicine.

Magnesium Deficiency Disease Conditions

Through my research and decades of interaction with clients, I currently have identified 68+ magnesium deficiency disease conditions (and still counting). They are listed in *Appendix B*. Additionally, *Chapters 3-7* outline the magnesium deficiency component on each of these diseases and include relevant research. *Appendix C* shows the meager amount of nutrients that the government says we can claim have health benefits.

Fun Fact Six: Therapeutic Doses: Mostly Impossible to Obtain

That's because most people suffer the laxative effect before their magnesium-deficiency symptoms can be relieved. This fact should have been noticed by researchers, clinicians, and public health officials and led to an all-out effort to find a non-laxative magnesium. But that never happened.

When I discovered that I was severely magnesium-deficient but couldn't take magnesium without the laxative effect, I tried to encourage mineral and magnesium companies to deliver a non-laxative source. Nobody accepted the challenge. Eventually, I had to take on the task. Fortunately, I found a chemist who created a picometer-sized, stabilized ion of magnesium that is absorbed so fully into the cells that there is no excess magnesium flooding the intestines as a laxative.

The Fact that people need magnesium to drive 80% of known metabolic functions; the Fact that 80% of people don't even get the minimum amount of magnesium a day; and the Fact that most people have the laxative effect from magnesium before they receive the health benefits have, in my opinion, created chronic disease.

I often talk about the poor absorption of magnesium oxide. It seems that this form of magnesium is best known to allopathic doctors because most of the early studies on magnesium used this formula. However, it's the most poorly absorbed magnesium of all.

A study using 500 mg of magnesium oxide sounds like a robust amount. Well, it's not. First, 500 mg of magnesium oxide contains 300 mg of elemental magnesium. Second, only 4% of the magnesium in magnesium oxide or 12 mg is absorbed – into the blood stream, not even into the cells. Let that sink in – 12 milligrams! I needed 1,200 mg a day of my picometer magnesium to reverse my magnesium deficiency.

Fun Fact Seven: The Laxative Effect Is a Fail-Safe for Magnesium

The cons of magnesium are that the laxative effect can prevent you from becoming saturated. However, the pro of magnesium is that the laxative effect makes it the safest nutrient to supplement; if you take too much at any one time, the excess is lost in the urine or stool.

This fail-safe is likely an evolutionary development because our original source of magnesium was from the ocean. Sea water contains three times the magnesium compared to calcium, so it might have been possible to get too much magnesium. Of course, we've completely turned that ratio upside down as I outlined in *Fun Fact Three: Calcium Depletes Magnesium*.

Once again, the key is to find a non-laxative magnesium that's absorbed efficiently at the cellular level. As you build up your magnesium reserves, you need less magnesium, not more, and if you take more than your cells require, the excess is immediately eliminated. Magnesium is the only nutrient with this failsafe quality.

When I began to use my own non-laxative, picometer, stabilized ionic magnesium, I slowly worked up to taking 1,200 mg per day. With other products, I couldn't take 50 mg without getting the laxative effect. I began to feel better very quickly from my neck and upper back pain, lower back pain, charley horse leg cramps, headaches, insomnia, and heart palpitations that I mentioned earlier. But it took me a year and a half to get to the point that I could stop taking my magnesium for a day or two and not experience symptoms.

About a year into taking 1,200 mg, I gradually reduced the amount of magnesium I took to 600 mg a day. If I took 750 mg, I would start getting the laxative effect. I knew I was saturated. And since the cells of my body didn't need that extra 150 mg, it was eliminated in my stools. Presently, I only require about 450 mg of magnesium per day, which is probably due to the addition of a picometer potassium to my daily minerals.

Using less over time is not the way drugs work, especially addictive drugs where you have to take more and more to feel the same effects. Magnesium is a nutrient that the body requires, and when you give the body the proper amounts, you feel the benefits.

I mentioned earlier that I slowly worked up to taking 1,200 mg of my picometer magnesium. I also put it in a liter of sea-salted water (along with several other minerals) and sip it throughout the day. Additionally, if

you take all your magnesium at once, it will become laxative because the cells are overloaded, making it both an inconvenience and a waste.

Fun Fact Eight: Magnesium and Mitochondria

Mitochondrial dysfunction and mitochondrial failure have been cited as an underlying cause of Chronic Fatigue Syndrome (CFS).[20] (Mitochondria are membrane-bound cell organelles that generate the chemical energy needed to power the cell's biochemical reactions. This energy is stored in a small molecule called ATP.) It is also cited as a factor in chronic disease, and you can be sure we'll hear more about the mitochondria around the topic of Long COVID, which is today's CFS.

But it likely will not be heard in the halls of allopathic medicine until Naturopaths become integral parts of health clinics, because the treatment of mitochondrial failure involves nutrients not drugs. Also, allopathic doctors have a very hard time wrapping their heads around the notion that CFS and Long COVID can cause so many symptoms. They want there to be one symptom indicating one disease, and therefore, one drug treatment. A dysfunction involving energy production means that all the cells in the body are going to be affected causing widespread symptoms that can't be categorized into systems or diseases. They are due to underlying nutrient deficiencies.

NOTE: In my experience, the causes of CFS include magnesium deficiency (which affects the mitochondria) and Yeast Overgrowth. Other mineral deficiencies are involved, but magnesium deficiency hits the hardest. Additionally, here are two fun sidebar facts:

1. Mitochondria contain their own small, circular chromosomes that resemble bacterial chromosomes.

2. Mitochondria, and therefore mitochondrial DNA, are inherited only from the mother.

ATP energy molecules are made inside the mitochondria via the Krebs Cycle and several of the eight steps in that cycle depend on magnesium. The Krebs Cycle is fed by pyruvate from the Glycolysis Cycle, which operates outside the mitochondria but inside the cell. This cycle requires magnesium in 6 of its 8 steps. When pyruvate hits the Krebs cycle, the first enzyme it encounters is pyruvate dehydrogenase, which contains two magnesium ions as well as two potassium ions and vitamin B1 (thiamine). I've always said that if you are lacking energy, then you are lacking magnesium. I'll have to update that statement to include potassium and vitamin B1.[21]

The body doesn't take the threat of excess calcium floating around in the blood stream lying down. In order to protect the fluid inside the cell from becoming saturated with calcium, there is an emergency magnesium-dependent mechanism that shunts calcium into the mitochondria.[22] However, this is a

short-term solution that can backfire because if too much calcium is taken up for too long, the excess calcium in the mitochondria inhibits ATP synthesis.

In *Fun Fact Three*, I talk about body-wide calcification being a huge factor in aging and chronic disease. Perhaps those conditions begin with mitochondrial calcification, because without the intervention of sufficient magnesium, the eventual result is cell death. In fact, calcium excess and magnesium deficiency could be the underlying cause of CFS.

There are 1,000–2,000 mitochondria in each human cell, and ATP is made in each one. However, there is more to the interaction between ATP and magnesium, which is often displayed as Mg2+ATP.

Magnesium triggers production of the body's protein structures by revving up messenger RNA. This combination is also a requirement for the production of DNA, our genetic code.[23] Transmembrane ATPase imports substances necessary for cell metabolism and exports toxins and wastes across cell membranes. A hydrogen-potassium ATPase creates the gastric proton pump,[24] which acidifies the contents of the stomach. Many other pumps and transporters are all directed by ATPases, with magnesium as a necessary cofactor.

In a 2015 review, investigators identified increased oxidative stress produced in the mitochondria and cytosol (free fluid inside the cell) of the heart and brain as a common denominator to almost all cardiovascular and cerebrovascular diseases.[25] Using this review as a guide, I think the best way to reduce oxidative stress in the mitochondria, heart, and brain and to ensure efficient mitochondrial function is to saturate the body with therapeutic levels of magnesium.

NOTE: Let Me Repeat: I've mentioned several times in this book that many steps in the Glycolysis Cycle and the Krebs Cycle in the mitochondria require magnesium in order to make ATP energy molecules. I also quote Dr. Guy Abraham, who said that in order to protect the fluid inside the cell from becoming saturated with calcium, there is a magnesium-dependent mechanism that shunts calcium in and out of the mitochondria. But if calcium goes in and doesn't come out, because there isn't enough magnesium to maintain that shunt, mitochondrial calcification occurs and eventually results in cell death. This research makes me wonder if calcium excess and magnesium deficiency could be the underlying reason for the recent upsurge in mitochondrial dysfunction.

Fun Fact Nine: Serum Magnesium Testing Is Worthless

1. iMg Test: The ionized magnesium blood test is not available to the public even though ionized calcium tests are widely used. This is the definitive test that tells you accurately how much ionized magnesium is in your blood stream. It is magnesium ions that are able to enter into cells because of their picometer size.

2. RBC Mg: The Magnesium RBC Test is helpful but less accurate than iMg. It must be used in conjunction with observing clinical symptoms in order to make a more accurate diagnosis of deficiencies. The test never made a whole lot of sense to me because red blood cells do not have mitochondria – and it's within the 1,000-2,000 mitochondria in each cell where magnesium is active.

3. Serum Mg: The serum magnesium test is highly inaccurate, yet it is still the standard test used in hospitals, clinics, and most clinical trials. Here's the word on the serum magnesium test as stated in reputable medical journals:

> *The measurement of serum magnesium concentration is the most commonly used and readily available method for assessing magnesium status, even if serum levels have no reliable correlation with total body magnesium levels or concentrations in specific tissues.*[26]

That explains why serum magnesium is not even identified on electrolyte panels, even though magnesium is the most important electrolyte in the body. It's important because it's necessary to keep the heart rhythm stable.

A research group published the following study "The Underestimated Problem of Using Serum Magnesium Measurements to Exclude Magnesium Deficiency in Adults."[27] The investigators issued a health warning in their conclusion that I wish doctors would heed:

> *The perception that 'normal' Serum Magnesium excludes deficiency is common among clinicians. This perception is probably enforced by the common laboratory practice of highlighting only abnormal results. A health warning is therefore warranted regarding potential misuse of 'normal' Serum Magnesium because restoration of magnesium stores in deficient patients is simple, tolerable, inexpensive and can be clinically beneficial.*

Dr. Alexander Mauskop and Drs. Burton and Bella Alturas undertook many headache and migraine research studies using sensitive magnesium ion electrodes.[28] During one of their first studies they found a deficiency in ionized magnesium but not serum magnesium in migraine patients. This discrepancy highlighted the lack of correlation between magnesium-deficient states and serum magnesium. This is because only 1 percent of the magnesium in the body is found in the blood (serum). A measurement of magnesium ions, the active form of magnesium, is much closer to the total amount of magnesium in the body and indicative of magnesium-deficiency disease.

Until allopathic medicine dumps the serum magnesium test and starts using the iMg test, we will continue to misdiagnose magnesium deficiency as chronic diseases and continue treating magnesium deficiencies with drugs that may deplete magnesium.

Fun Fact Ten: Telomeres Hold the Key to Aging, and Magnesium Prevents Telomeres from Deteriorating

According to researchers, telomeres, which are components of chromosomes, hold the key to aging, but the real key is magnesium because it prevents telomeres from deteriorating. A fascinating paper titled, "Correcting Magnesium Deficiency May Prolong Life," published in 2012 jumped on the telomere bandwagon and described what happens to humans as they develop magnesium deficiency in the unique environment of space.[29]

The researchers reported that "the International Space Station provides an extraordinary facility to study the accelerated aging process in microgravity, which could be triggered by significant reductions in magnesium ion levels with, in turn, elevations of catecholamines and vicious cycles between the two." They tell us that with space flight there are significant reductions of serum magnesium that have been shown in large studies of astronauts and cosmonauts. It's partly due to the immense stress of such an undertaking as traveling in space. The results of space travel and its effect on magnesium are shown in the loss of the functional capacity of the cardiovascular system with space flight, which is over ten times faster than the course of aging on Earth.

Magnesium is an antioxidant and calcium channel blocker and in space there is oxidative stress, insulin resistance, and inflammatory conditions with evidence in experimental animals of significant endothelial injuries and damage to mitochondria. The paper goes on to report that the aging process is associated with progressive shortening of telomeres, repetitive DNA sequences, and proteins that cap and protect the ends of chromosomes. Telomerase can elongate pre-existing telomeres to maintain length and chromosome stability. Low telomerase enzyme levels trigger increased catecholamines while the sensitivity of telomere synthesis to magnesium ions is primarily seen for the longer elongation products.

Magnesium stabilizes DNA and promotes DNA replication and transcription, whereas low levels of magnesium might accelerate cellular senescence ("decay") by reducing DNA stability, protein synthesis, and function of mitochondria. Telomerase, in binding to short DNAs, is magnesium dependent.

Fun Fact Eleven: Long COVID Is the New Face of Magnesium Deficiency

This section on Long COVID summarizes most of the previous Facts but is also a standalone that you can pass on to people who are suffering from this condition.

From 1979-1992, in my Medical/Naturopathic practice, I treated colds and flus with lots of fluids, vitamin C, zinc lozenges, and homeopathic remedies. There were no drug treatments for colds and flus, and antibiotics were contraindicated for viral infections. In naturopathic training we learned that a bad case of a viral flu can leave you with lingering symptoms that we called post-influenza illness.

I used to advise my patients that a flu or cold is a "beneficial mucus elimination," a way for the body to get rid of toxins and debris. However, I began to observe that colds and flus, instead of being a 24-hour purge, were lasting days, and then weeks. In the early 1980's, I began to see more and more patients with what became known as Chronic Fatigue Syndrome (CFS) and Fibromyalgia (FM). In my Naturopathic training I learned about Yeast Overgrowth and found it to be an additional factor in CFS.

By the time COVID came along, our society was in the midst of a toxic tidal wave. As a nation, we suffer from vitamin and mineral deficiencies, extreme stress, overwork, environmental toxicity, and an inferior diet. All the above result in multiple health complaints including obesity, which are blindly treated with drugs, more drugs, and surgery. Couple that with the immense fear that was whipped up by allopathic medicine and the media about COVID, which created a perfect storm of illness and devastation.

Allopathic doctors never learned that there are natural treatments for colds and flus, so they told patients to stay at home and only go the hospital if they got really sick. Those who were treated medically were given antibiotics, cortisone, and newly developed antivirals; these drugs also opened the door to CFS/FM that we now call Long COVID.

In the 1980's most doctors did not recognize CFS and FM; to them it was all psychological. They called it burnout, depression, or anxiety and medicated patients with sleeping pills, antidepressants, and antianxiety medication. They didn't know what they were dealing with and told sufferers to go out and exercise, which only made them worse.

It was a very difficult couple of decades for these people who became more and more isolated from society developing environmental allergies and leaky gut before those conditions were even recognized. Now CFS/FM is in the spotlight because of Long COVID. Dozens of papers have sprouted up describing Long COVID and comparing it to CFS/FM.

Researchers say that among the top 18 symptoms of Long COVID, half of them are neuropsychiatric: memory problems, sleep problems, brain fog, anxiety, depression, smell or taste disorders, dizziness, and headaches. And this is where magnesium comes into the picture.

Magnesium is required to power 80% of known metabolic functions in the human body, making it the most important nutrient for human health. If you don't have enough magnesium, you can suffer hundreds of symptoms that can be misdiagnosed as medical diseases and treated inappropriately with drugs. Most of the neuropsychiatric symptoms listed above can be found in people who have magnesium deficiency. Other Long COVID symptoms affect heart, muscles, and nerves and can also be due to magnesium deficiency.

The medications being recommended for Long COVID are the same ineffective ones given for CFS/FM, and they can all deplete magnesium. The antibiotics and cortisone medications can cause gut dysbiosis (Yeast Overgrowth), which I consider to be the second major cause of Long COVID.

Medscape, a website providing access to medical information and continuing medical education for clinicians, says that "Despite Extensive Evaluations, Long COVID Causes Remain Unclear."[30] They say that reported symptoms do not match test results. "Exploratory studies found no evidence of persistent viral infection, autoimmunity, or abnormal immune activation." Allopathic medicine does not have a physical test that can diagnose Long COVID but they can't ignore it. Apparently 23 million people carry this diagnosis.

I've been working on the solution to Long COVID since the mid-1980's when I first treated patients with CFS/FM. I start with magnesium and that recommendation was presented in 1998 by Dr. Mildred Seelig, a noted magnesium expert.[31]

What Else Does Magnesium Do?

Symptoms of magnesium deficiency can be in the hundreds, much like the symptoms of Long COVID. They do match the above list of Long COVID symptoms. Fatigue, headaches, chest pain, shortness of breath, heart palpitations, muscle aches and pain are major magnesium deficiency symptoms. There are many more.

I would put brain fog on the list of gut dysbiosis symptoms, and loss of taste and smell are zinc deficiency symptoms. Changes in skin and hair can be related to thyroid weakness that can occur when the adrenal glands are stressed by fear of infection, infection, hospitalization and medications, which puts a secondary strain on the thyroid. All these symptoms I can address in future sections, but let me complete the discussion on Magnesium and Long COVID.

I've been funding research on the need for an accurate blood test for magnesium and on the absorption of a picometer-size stabilized ion of magnesium that allows a person to completely saturate their cells with magnesium without getting the laxative effect. A few results of that study are as follows.[32]

1. iMg (ionized magnesium testing) is the better marker for magnesium. The magnesium measured in a serum magnesium test is bound up and not usable. Magnesium ions, on the other hand, are immediately absorbed and available to use in the cells.

2. Clinical investigations have demonstrated that ionized magnesium, but not serum magnesium, is depressed in a number of clinical conditions such as migraine, individuals with noninsulin-dependent diabetes, patients with asthma, and women with high-risk pregnancies.

3. Using a molecular size analyzer (Malvern Zetasizer Nano ZS, Malvern, UK), we confirmed that the majority of the particle size of the test magnesium chloride formulation is in the picometer range. The test was repeated three times.

4. A picometer-sized magnesium ion, stabilized in its ionized form, is not bound up as a magnesium compound. Its small size allows it to be absorbed higher up in the GI tract and avoid the laxative effect.

5. Magnesium Citrate and magnesium oxide will eventually be ionized somewhat but they revert back to a compound state immediately and therefore don't have as high an absorption efficiency.

6. Elevated ionized magnesium was measurable in the blood within 2-4 hours after ingestion of 300 mg of this picometer-sized magnesium ion.

Since dietary and supplemental nutrients are not a subject in medical school, doctors, unless they study outside the medical field, have no knowledge of the fact that all metabolic processes in the body require vitamins, minerals, and essential fatty acids. Even Naturopathic doctors, who know the importance of magnesium, will prescribe drugs to treat magnesium deficiency symptoms when patients get the laxative effect from poorly-absorbed magnesium supplements. It's become obvious to me that there is a need for magnesium in Long COVID and all other health conditions using a non-laxative formulation.

Fun Fact Twelve: Magnesium Is Integral to Building Bone Health

I'll discuss this Fact by responding to questions that I've been asked over the years about bone health.

Question 1: "When individuals are told they have osteoporosis they are recommended Vit D and calcium. Many naturopathic doctors still prescribe 5000 IUs of Vit D. As you know, studies in the past 5 years have shown that high Vit D levels do not reduce fracture risk but rather can negatively impact bone quality. Do you agree with this advice?"

Let me address all the concerns that were raised with these three simple sentences.

1. "When individuals are told they have osteoporosis they are recommended Vit D and calcium."
    - Most doctors are trained that bones are mostly calcium, and when bones get thin, they want to pack on the calcium. When vitamin D research showed that many people are quite deficient in this vitamin, and it helps the absorption of calcium, doctors begin to pile on the vitamin D. This "standard of care" for people with osteoporosis or to "prevent" osteoporosis is causing calcification in the soft tissues of the body. These deposits include calcium in the arteries (arteriosclerosis), kidney stones, gall stones, heel spurs and scary breast tissue calcification.

    - Bones are not just made of calcium. They require over a dozen minerals and vitamins. The two major nutrients required are magnesium and vitamin K2, both of which direct calcium to the bones and

teeth, away from soft tissue.

2. "Many naturopathic doctors still prescribe 5000 IUs of Vit D."

- This question implies that 5000 IUs of Vit D is too much. Let me start by saying that there is a war being waged against supplements by Big Pharma who wants to maintain monopolistic control of disease-care. This position is unwittingly supported by doctors who don't learn anything about vitamins and minerals in medical school, so they ignore them or actively put them down.

- Let me say that I recommend around 5,000 IUs per day – but the dosage is adjusted based on blood levels of Vit D. I'll add the next question and then answer the whole shemozzle.

3. "As you know, studies in the past 5 years have shown that high Vit D levels do not reduce fracture risk but rather can negatively impact bone quality. Do you agree with this advice?"

- I think some of the negative studies about Vit D resulted from using synthetic Vit D2 instead of Vit D3 and also using Vit D2 at outrageously high doses, like 50,000 IUs. Doctors would give this enormous dose once a week and expect people to benefit. When it appeared that they didn't benefit, they would blame Vit D, not their protocol. Vitamin D, in order to do its assigned tasks, must be taken every day.

Recently, I was on a conference call with the Amish community that I work with, and a practitioner shared a case of a patient who mistakenly took 50,000 IUs DAILY for 2 years. Eventually, she got so calcified that she had a serious heart attack.

Vit D research is only in the beginning stages, and it doesn't have much funding. Most medical research is funded by Big Pharma which seems to be biased against dietary supplements. You might be able to identify the studies on supplements that they do fund, because they seem to conclude that supplements either "don't work" or "aren't safe" or, they "keep people away from proper diagnosis and drug therapy."

I recall one calcium researcher in an interview who admitted that she didn't know anything about magnesium, so she just ignores it. Now that's not an open-minded researcher, but unfortunately that's not unusual. When we did our first magnesium study at Purdue University, it was a calcium research team that supervised our study. They weren't aware of the importance of magnesium in bone health and this team recommends 1,300 mg of calcium a day, whereas I recommend 600 mg a day of calcium in balance with 600 mg of magnesium.

Question 2: "Please share your views with regards to magnesium and bone health."

Sixty percent of the magnesium in the body is located in our bones. So, why aren't doctors interested in that fact? Here is the conclusion of a 1990 study, which led doctors to believe that bone is mostly calcium, and thus, they never consider recommending magnesium to increase bone health. "Magnesium (Mg) makes up 0.5-1% of bone ash and is therefore not a trace element in the skeleton."

Here we have two diametrically opposing facts. Sixty percent of the magnesium in the body is in bone, yet magnesium makes up only 1% of bone ash. Here's the answer. Doctors don't consider the soft tissue matrix that is the lightweight scaffolding for bone deposition and bone formation.

It turns out that magnesium supports the production of collagen which makes up the vast amount of connective tissue in your body. Collagen with added protein, elastin, and hyaluronic acid provides your skin with elasticity and your bones with some flexibility. Bone matrix is 90 to 95% composed of elastic collagen fibers. Magnesium is an important component of the extracellular matrix (ECM) in the human body and, it's also essential for hyaluronic acid synthesis.

If bones were just made from a calcium compound, they would shatter like a piece of calcium carbonate chalk. As people age, or when sedentary, and especially when bed ridden, the soft tissue matrix diminishes because of dehydration and magnesium deficiency. You hear of people losing height as they age or having bone on bone arthritis. That's our soft tissue matrix vanishing. Since magnesium has hydrating properties, an absence of it can prompt dull, dry, and inert looking skin and dried-out and brittle bones.

Bone is not uniformly solid but consists of a flexible matrix (about 30%) and bound minerals (about 70%) which are intricately woven and endlessly remodeled by a group of specialized bone cells – osteoblasts and osteoclasts. This unique composition and design allows bones to be relatively hard and strong, while remaining lightweight.

When I learned about bone composition in medical school, they talked about ossein and ground substance as part of the final bone product, and they didn't identify collagen. So, I never realized that bone has such a major soft tissue component! The elasticity of collagen helps keeps bones protected from fractures.

This scaffolding of soft tissue becomes hardened by the binding of an inorganic mineral salt, calcium phosphate, into what is known as "bone mineral," a form of calcium hydroxylapatite (calcium phosphate with and OH – hydroxyl radical – attached). This mineralization makes bones rigid.

I've mentioned that collagen is the main structural protein in the extracellular matrix found in the body's various connective tissues, and besides magnesium, vitamin C is an essential cofactor for the manufacture of collagen.

There is another aspect of magnesium and bone health that I've never heard from bone researchers. We do know that bone is actively constructed (by osteoblasts) and remodeled (by osteoclasts) throughout life. However, researchers who studied the effect of magnesium on osteoblast activity concluded that:

> *Magnesium ions induced significant increases in cell viability, alkaline phosphate activity and osteocalcin levels of human osteoblasts. These stimulatory actions were positively associated with the concentration of magnesium and the time of exposure.*

Even fewer people seem to know that magnesium deficiency results in an increased formation of osteoclasts leading to loss of bone mass, abnormal bone growth and skeletal weakness.

Question 3: "Can you explain what you mean about the "Dance of Calcium and Magnesium" in your *Magnesium Miracle* book?"

Some of this information you've already read in *Fun Fact Three*, but this is such an important topic that it's worth repeating.

At the biochemical level, magnesium and calcium are known to act antagonistically toward each other. Many enzymes whose activities critically depend on a sufficient amount of intracellular magnesium will be detrimentally affected by small increases in levels of cellular calcium. There is 10,000 times more magnesium inside cells than calcium. Growth of cells, cell division, and intermediary metabolism are also absolutely dependent on the availability of magnesium, which can be compromised if excess calcium is present.

Try this experiment in your kitchen. Open a capsule of calcium powder and see how much dissolves in 1 oz of water; a good amount settles in the bottom of the clear glass. Then open a capsule of magnesium powder and slowly stir it into the calcium water. When you introduce the magnesium, the remaining calcium dissolves; it becomes more water-soluble. The same thing happens in the soft tissues of your arteries, heart, brain, kidneys, etc. but it doesn't happen in your bones.

If you don't have enough magnesium to help keep calcium dissolved, you can develop muscle spasms, fibromyalgia, calcified arteries, dental cavities, and calcium deposits (including breast tissue calcification). Another scenario plays out in the kidneys and bladder. If there is too much calcium in the kidneys and lining the kidney arteries, and not enough magnesium to dissolve it, you can get kidney stones. Calcium deposited throughout the bladder can make it rigid, lower its capacity, and lead to frequent urination. A 2015 study confirms that magnesium has a major role in dissolving calcium crystals in calcified arteries. We know about coronary artery calcification that leads to heart attacks; carotid artery calcification leads to stroke; and don't forget about kidney artery calcification that can initiate the process of kidney failure.

All muscles, including the heart and smooth muscles lining the blood vessels, contain more magnesium than calcium. If magnesium is deficient, calcium floods into the smooth muscle cells of blood vessels and causes spasms leading to constricted blood vessels and therefore higher blood pressure, arterial spasm, angina, and heart attack. A proper balance of magnesium in relation to calcium can prevent these symptoms.

Calcium excess stimulating the cells in the muscular layer of the temporal arteries (located over the temples) can cause migraine headaches. Excess calcium can constrict the smooth muscle surrounding the small airways of the lungs, causing restricted breathing and asthma. Finally, too much calcium, without the protective effect of magnesium, can irritate delicate nerve cells of the brain. Cells that are irritated by calcium fire electrical impulses repeatedly, depleting their energy stores and causing cell death.

Question 4: "Do you recommend that people take a strontium citrate supplement for their bone health?

Apparently, strontium, replaces calcium in the bone. Strontium is a heavier metal, which means it can give a higher DEXA bone density reading. However, the higher reading due to strontium does not correspond to improved bone strength. It would, if strontium was a natural constituent of bone. Scientific sources say that there are 100 micrograms of strontium per gram of bone, which equals .0001 grams. There are 1,000 micrograms in 1 milligram.

So, what is the rationale for there to be dozens of 680 mg strontium citrate supplements on the market? Our bones make up about 15% of our total body weight. If you weigh 100 lbs. you have 6,800 grams of bone, which means you could have a total of 680,000 micrograms of strontium in your body. That's 680 mg of strontium. Lord Sufferin Cats! That's the same amount that's found in all these supplements. That means, you are being offered, on a daily basis, the total amount of strontium that you may already have in your body. This to me is a pharmaceutical amount of strontium that is replacing calcium, and we don't know the long-term consequences.

Here are a few of the side effects of this type of strontium supplementation:

- Blood clotting disorders
- Strontium has been detected in umbilical cord blood.
- Strontium is eliminated via the kidneys, and it can accumulate and damage the kidneys.
- Strontium has a history of causing liver damage.
- Strontium has a history of increasing seizures.
- The bones of people with Paget's disease will hold more strontium.

I'm sure there's much more to be said about magnesium and bone health, but the above are the main questions that I've been asked over the years.

Fun Fact 13: Magnesium and the Microbiome

In my medical and naturopathic opinion, the major cause of chronic disease is a toxic combination of Yeast Overgrowth and magnesium deficiency. I have been talking about the Microbiome for several decades with a focus on the Intestinal Microbiome being disrupted by Yeast Overgrowth.

Our gut bacteria had been doing quite well, thank you very much, for eons, until we decimated them with antibiotics. Antibiotics kill off good and bad bacteria with equal abandon, leaving room for yeast to take over. At the same time, we stopped eating fermented foods that could help replace good bacteria in our gut.

The naturopathic and medical communities have generally realized the importance of the Microbiome, which is great. But they tend to ignore yeast and just investigate the bacterial imbalance.

My awareness of the association between magnesium and Yeast Overgrowth came with my observation of customer service reports. After taking our picometer magnesium for 2-3 months, many customers said they developed strange but mild rashes, coated tongue, itchy orifices, and gut disturbances. I immediately knew that yeast die off was occurring. But why?

Commonsense told me that magnesium had woken up the immune system enough to recognize Yeast Overgrowth and the dangers it posed to overall health. Its 78 different toxins can invade and irritate every organ and tissue of the body and needs to be kept in check.

A surprising number of recent studies show the extent to which magnesium supports the immune system. But I know I haven't taken enough time to talk about this very important aspect of magnesium. The following is probably overkill, and yet it is a small sampling of the relevant studies available:

1. Deficiency of magnesium can lead to temporary or long-term immune dysfunction. Magnesium demonstrates important immune response against cancer cells and infectious agents and regulates inflammation, oxidative stress, cell progression, differentiation, and apoptosis.[33]

2. Researchers have reported that T cells need a sufficient quantity of magnesium in order to operate efficiently. Their findings may have important implications for cancer patients.[34]

3. Magnesium is a cofactor for immunoglobulin synthesis, C3 convertase, immune cell adherence, antibody-dependent cytolysis, IgM lymphocyte binding, macrophage response to lymphokines, T helper-B cell adherence, binding of substance P to lymphoblasts and antigen binding to macrophage RNA. Magnesium deficiency in rodents impairs IgG synthesis and cell-mediated immunity; complications include thymus atrophy, elevated IgE, hypereosinophilia, histaminosis and lymphoma. Abnormal C activation, excess antibody production and susceptibility to allergy and to chronic fungal and viral infections have been reported in magnesium deficiency. Magnesium appears to play a protective role in acute allergic reactions.[35]

4. The key to acid secretion in the stomach is an ATPase "proton pump." This ATPase is magnesium-dependent, as are all ATP energy functions in the body. What does this gastric acid do besides help to digest protein? It kills yeast and parasites that we ingest with our food.

5. Magnesium is a very reactive ion that plays important roles in all the tissues in the body. If it is depleted, heavy metals, drug chemicals and other toxins can take its place. But if it is present, those substances do not have a landing site and are excreted from the body.

6. Magnesium, in its role as a muscle relaxant, encourages normal intestinal peristalsis and promotes normal bowel movements, thus eliminating constipation.

7. C-Reactive Protein (CRP) is a measure of inflammation in the body. CRP is elevated in magnesium deficiency.

8. The Zonulin family is a group of proteins that modulate gut permeability, implicated in chronic inflammatory diseases: autoimmune, infective, metabolic, and tumoral. Zonulin is produced in the liver and the intestinal lining and is stimulated by certain bacteria species and gluten. I suspect that

yeast also produces Zonulin, and I found one resource that says it does. To avoid leaky gut, yeast must be kept under control.

For the above reasons, magnesium sufficiency is integral to maintaining excellent gut health. And a healthy Microbiome is key to building a strong immune system. Therefore, in this post-COVID environment, supplementing highly absorbable picometer magnesium is imperative for sustaining an appropriate Microbiome and immune system.

Summary

The 13 Fun Facts about Magnesium have only opened the gateway to understanding the vital importance of magnesium in building wellness. In *Chapters 3 through 7*, let's expand our exploration of the benefits of appropriate supplementation of well-absorbed magnesium by sharing the 68+ Magnesium Deficiency Conditions that are often misdiagnosed as disease.

Chapter 2

Overview: Magnesium Deficiency Health Conditions

Overview

As I mentioned in the Introduction, I had already been involved in health care for decades before I learned about the effects of magnesium deficiency. Since that time, I have identified almost 70 medical conditions that are associated with magnesium deficiency. Even today, doctors, like me in the past, do not get enough information about the importance of magnesium to believe it is a possible solution for so many symptoms.

Lay people are also skeptical about the importance of magnesium. They hear that magnesium is good for sleep, so they take it. It's not long before they realize that a dozen other symptoms have miraculously cleared up. Some people even feel frustrated that they were never told there was a simple solution to their very serious problems.

Here is how I explain the body-wide nature of magnesium deficiency symptoms. I'll start with a question. How many muscles are there in the body? It turns out that there are 600, and if you have magnesium deficiency, they don't function properly. When it comes to muscles, one of magnesium's jobs is to regulate the amount of calcium that enters each cell. If magnesium is depleted, too much calcium can flood the cell and cause prolonged muscle contraction.

What does prolonged contraction of several muscle cells feel like? Cramping, tightness, spasms, tics, soreness, and pain; if the nerves are similarly affected – seizures can result. Potentially, every muscle in the body could have a disease designation – that's 600 diseases right there.

Nerve cells have the same system for preventing calcium build up – a magnesium gatekeeper. If your magnesium is low and too much calcium enters nerve cells you will get constant firing of the cell that causes nerve symptoms such as burning, tingling, zings of electricity, pins & needles, stabbing, shocking – and then the nerve cells die.

With muscles and nerves, the area in your body that suffers most will invariably be one that has endured a previous injury. That's why muscle and nerve magnesium deficiency symptoms are different for everybody.

What I would like to do with this book is tell you about the major disease conditions that are related to magnesium deficiency and give you scientific references to prove the point. Unfortunately, proper clinical trials to determine where magnesium deficiency plays a role in the diseases I'm going to outline are nearly non-existent. If you read the above *Magnesium Facts*, you know that there isn't a valid magnesium blood test; doctors don't learn about minerals in medical school; and doctors are more comfortable prescribing drugs for symptoms than finding out the true cause.

I was most disappointed doing the research for this book by the lack of studies and reviews of the effects of magnesium on muscles and nerves. The ones that I did find had many flaws, including very few participants in trials and the use of the most poorly-absorbed magnesium of all – magnesium oxide. I repeat for emphasis that a study using 500 mg of magnesium oxide sounds like a robust amount. Well, it is not. First, 500 mg of magnesium oxide contains 300 mg of elemental magnesium. Only 4% of the magnesium in magnesium oxide or 12 mg is absorbed – into the blood stream, not even into the cell.

In contrast, my clinical experience and feedback from patients and customers show an overwhelming positive response to taking a well-absorbed magnesium for muscle cramps and nerve symptoms. Unfortunately, that experience is not reflected in so-called scientific studies.

Magnesium and Pain

Here is the conclusion of a 2020 review titled "Magnesium and Pain" published in the journal *Nutrients*:[36]

> *Evidence of the role of magnesium in analgesic adjuvants against a variety of acute and chronic pain has accumulated over decades. The mechanism of the antinociceptive effect of magnesium is mainly explained by its inhibitory action on NMDA receptors and central sensitization. In addition to the direct action of magnesium on analgesia, attention should be paid to its indirect actions on the disease.*

> *As an essential mineral nutrient, increased magnesium intake or supplementation can improve the course of some disease conditions such as osteoarthritis, neurological disorders, and cardiovascular disease, leading to improved analgesia. It is conceivable that this role of magnesium is much more important than improved analgesia because magnesium can be helpful for disease prophylaxis and treatment. Magnesium injections and preparations will be used more frequently in everyday clinical practice as more consistent and convincing evidence accumulates.*

Of course, the researchers do not draw a clinical conclusion; they just say to wait for more research to be done. In the meantime, many people continue to suffer from magnesium deficiencies because finite clinical conclusions have not yet been reached.

Here is an edited version of the abstract of this same *Nutrients* paper that verifies the importance of magnesium and its role in pain control. My edits just serve to take out the so-called "scientific gobbledygook."

> *The main mode of action of magnesium involves its antagonist effect at the N-methyl-d-aspartate (NMDA) receptor, which prevents pain hypersensitivity and reduces preexisting pain hypersensitivity. Given the pivotal function of NMDA receptors in pain conversion, magnesium has been investigated in a variety of pain conditions. The oral and IV administration of magnesium may alleviate pain and perioperative anesthetic and analgesic requirements. These beneficial effects of magnesium therapy have also been reported in patients with neuropathic pain, such as malignancy-related neurologic symptoms, diabetic neuropathy, postherpetic neuralgia, and chemotherapy-induced peripheral neuropathy. In addition, magnesium treatment is reportedly able to alleviate fibromyalgia, dysmenorrhea, headaches, and acute migraine attacks. Although magnesium plays an evolving role in pain management, better understanding of the mechanism underlying its action and additional clinical studies is required to clarify its role as an adjuvant analgesic.*

Again, in the abstract, the researchers are calling for more research to keep them funded, but they have yet to come to any final clinical conclusion.

Review Articles on Magnesium

I find that the numerous review articles on magnesium are very instructive. These are from researchers who know first-hand the importance of this mineral and hope that the information reaches doctors in clinical practice. Here is a case in point. When I wrote *The Magnesium Miracle*, I decided that I wanted the two most important magnesium researchers in the world, Drs. Burton and Bella Altura, to write a foreword to my book. At that time, in the early 2000's, they had amassed an astonishing 1,000 papers on magnesium, and they have been growing their research ever since. When I mentioned my goal, everyone I spoke with assured me that they would never foreword a book for the public. If you have a copy of my book, you'll see that they did foreword my book, and they chose to do so because they said that for all the time and energy and funding they had put into their research, they felt that it wasn't getting to the public and that practicing doctors weren't getting the message. (I also learned that they used the mostly unabsorbed magnesium oxide as their supplement of choice.)

To demonstrate the scope of magnesium research that is not being applied clinically, I would like to reference several magnesium review articles.

2001: Around the time I was doing research, for the first edition of *The Magnesium Miracle*, an excellent review was published by Fox, et al, citing 67 references.[37] The investigators stated that three

biologic mechanisms could potentially explain how magnesium helps treat hypertension, diabetes and hyperlipidemia.

- First, magnesium deficiency causes a dysregulation of the sodium-magnesium exchange, resulting in higher intracellular sodium and thus higher blood pressure.
- Second, a relatively low magnesium level creates an intracellular imbalance between calcium and magnesium, which results in increased spasms in the smooth muscle of arteries and, therefore, increased blood pressure.
- Third, magnesium deficiency causes insulin resistance, which in turn causes hyperinsulinemia, resulting in hypertension, diabetes, and hyperlipidemia.

Fox and his team cite study after study showing the importance of magnesium in many chronic conditions. They report on studies using IV magnesium therapeutically in critical situations such as acute asthma, torsades de pointes (ventricular tachycardia), and preeclampsia. They know all this, yet their only conclusion is to call for more funding and research. Their actual words are:

> *Randomized controlled trials need to be done to see whether magnesium supplementation will ameliorate the debilitating effects of hypertension, diabetes, and hyperlipidemia, especially in minority populations. The clinical implications of replacement therapy, if successful, would have a profound effect on improving the health of the population.*

Yes, magnesium therapy would absolutely have a profound effect on improving the health of the population. Yet, doctors are reluctant to draw their own conclusions from thousands of papers proving that magnesium is essential to life. Instead, they treat magnesium as if it were a drug to be positioned in randomized clinical trials to make sure there is no placebo effect.

2015: A review by Grober repeated the same information in the Fox paper but with additional references; there were 149 citations.[38] Grober and his team report that 100 years ago the magnesium content of our diet was about 500 mg/day and that has plummeted to 175–225 mg/day. I've referenced this fact for years, but I rarely see it mentioned. They also provided the research proof that magnesium deficiency can cause an alarming number of diseases and disease symptoms. It's a laundry list of our chronic diseases, which cannot be cured by drugs: ADHD, Alzheimer's, Cardiac Arrhythmias, Asthma, Type 2 Diabetes, Heart Disease, Heart Failure, Hypertension, Metabolic Syndrome, Migraine Headaches, Myocardial Infarction, Pre-Eclampsia, Eclampsia, and Stroke. Several avenues that the investigators feel are promising but require further research include Depression, Dysmenorrhea, Fatigue, Fibromyalgia, Hearing loss, Kidney stones, Premenstrual syndrome, Osteoporosis, and Tinnitus.

After all this great information about the importance of magnesium, in their 12,000-word paper, shored up with study after study, what did Grober et. al., recommend? I was very disappointed to see that they

devoted a mere 70 words on how to treat these serious magnesium deficiency diseases. For dosage, they simply repeat the very lowest recommendation of 4–6 mg per kg/day (220-325 mg for a 120 pound person). The first supplement recommendation is the highly laxative magnesium oxide, and the last one on their list is magnesium aspartate, which according to neurosurgeon, Dr. Russell Blaylock can act like a neurotoxin.[39]

2013, 2015: Two Reviews by Volpe are titled "Magnesium in Disease Prevention"[40] and "Overall Health and Magnesium and the Athlete."[41] These papers are very similar to the previous reviews, but the citations are for only the 10 years prior to publication, and there are no magnesium supplement recommendations listed.

2014: A brilliant publication on magnesium and aging was spearheaded by Drs. Burton and Bella Altura.[42] The abstract and introduction alone, provide an in-depth magnesium education and establish magnesium as an anti-aging nutrient. Please follow the reference and read the paper online. The Alturas were early adopters of the ionized magnesium blood test that is the most useful test of cellular magnesium. It is the test I used in our Purdue University research."[43]

2014: Long and Romani wanted their review to "advocate for the necessity of identifying easy and reproducible methods to assess serum and cellular magnesium levels and to identify magnesium deficiency in order to alleviate related pathological conditions."[44] They acknowledge that serum magnesium is a "poor predictor of tissue magnesium content and availability."

2016: This very thorough review by Glasdam, also warned that we aren't using the proper measurement for magnesium.[45] The investigators sought to "present current analytical challenges in obtaining accurate and reproducible test results for magnesium." They maintained that magnesium is a positively charged ion of great physiologic importance. It exists in two states: a form that is bound with another substance as a "compound" and a free ionized form. The form the magnesium is in depends on temperature, pH, ionic strength, and competing ions.

It is the free ionized magnesium form that participates in 80% of the body's biochemical processes and that can be measured by electrodes in the Ionized Magnesium test. They cautioned that too many magnesium studies use Serum Magnesium levels rather than its free bioactive form, making it difficult to correlate to disease states.

I've been working with the stabilized ionic form of magnesium for over 10 years. You can access our study that was done at Purdue University using this form of magnesium by following this reference.[46]

2015: The review by deBaaij, "Magnesium in Man: Implications for Health and Disease"[47] provides an extensive and comprehensive summary of magnesium research over the last few decades, focusing on the regulation of magnesium homeostasis in the intestines, kidneys, and bone. I was ecstatic when I read the authors' assertion that magnesium "is involved in over 600 enzymatic reactions including energy metabolism and protein synthesis."

I used to quote magnesium expert, Dr. Andrea Rosanoff, who says the number is more likely between 700-800.[48] Our director of research Dr. Taylor Wallace recently confirmed the following:

Enzymatic databases list over 600 enzymes for which magnesium serves as a cofactor, and an additional 200 in which it may act as an activator.

There are three citations that support this statement.[49] [50] [51]

I say the number is likely closer to 1,000 since magnesium is necessary for the processing of 80% of known metabolic functions. We have certainly come a long way from the first reports in 1968 that magnesium is responsible for only 300-325 enzymatic reactions in the body. I hope these higher numbers will become the norm and help convince more doctors of the vital importance of magnesium.

de Baaij, et. al highlight the depletion of magnesium caused by drugs. They also cover the genetic mutations that can produce magnesium deficiency. This is one of the first papers I have read that thoroughly discusses the mutations of genes that code for magnesium-transporting proteins and describes a dozen hypomagnesemia genes each with additional dozens of genetic mutations.

As for magnesium's effect on our genes, according to "Magnesium in Man" – this mineral performs numerous functions that produce, repair and stabilize DNA as well as RNA. What if magnesium with its 1,000 enzymatic functions has the ability to stabilize genes and can prevent mutated gene segments from being turned on? Could therapeutic levels of non-laxative magnesium turn off milder mutations of hypomagnesemia genes?

Also, will a true genetic defect be treatable with magnesium supplements? A paper in the journal, *Gene,* began with the following statement: "evidence points to magnesium's antioxidant, anti-necrotic, and anti-apoptotic effects in cardio- and neuroprotection."[52] It concludes that "...because of the antagonistic effects of Ca^{++} and Mg^{++} ions in the presence of high Ca^{++} ion concentration at MtHK (mitochondrion bound hexokinase), MtCK (mitochondrial creatine kinase), and PTP (mitochondrial permeability transition pore), magnesium supplementation may provide cytoprotective effects in the treatment of some degenerative diseases and cytopathies with high intracellular $[Ca^{++}]/[Mg^{++}]$ ratio at these sites, whether of genetic, developmental, drug induced, ischemic, immune based, toxic, or infectious etiology."

I consider the above conclusion a huge breakthrough, which should be headline news!

2012: A paper called "Magnesium Basics" references several studies proving that ionized magnesium has the greatest biological activity because it is the form that readily enters into cells.[53] Yet, doctors mainly recommend magnesium oxide, which is only 4 percent absorbed into the blood stream with no studies to indicate cellular absorption. This paper, featuring an eye-popping 595 references, can be printed up and handed to your doctors to help educate them about the importance of magnesium.

2012: Magnesium researcher Andrea Rosanoff asked an important question in the title of her paper, "Suboptimal magnesium status in the United States: are the health consequences underestimated?"[54] The answer is a resounding, "Yes!" Her team reports that, "Low magnesium intakes and blood levels have been associated with type 2 diabetes, metabolic syndrome, elevated C-reactive protein, hypertension, atherosclerotic vascular disease, sudden cardiac death, osteoporosis, migraine headache, asthma, and colon cancer." They conclude, "Cellular magnesium deficit, perhaps involving TRPM6/7

channels, elicits calcium-activated inflammatory cascades independent of injury or pathogens. Refining the magnesium requirements and understanding how low magnesium status and rising calcium-to-magnesium ratios influence the incidence of type 2 diabetes, metabolic syndrome, osteoporosis, and other inflammation-related disorders are research priorities."

2015: "Magnesium and Dialysis: The Neglected Cation" confirms that magnesium requirements need to be re-evaluated in the treatment of kidney disease and in dialysis patients.[55] The February 2012 issue of *Clinical Kidney Journal* included an extensive paper called, "Magnesium in Disease."[56]

I'd like to include an important section from *The Magnesium Miracle* about magnesium and kidney disease since doctors unanimously warn their patients who have any level of kidney disease to avoid magnesium. I think this warning is harmful for most kidney patients because they suffer greatly from magnesium deficiency.

Magnesium Deficiency in End Stage Renal Disease

The following is a very insightful case history from a customer who emphasizes what end stage renal disease patients are up against in their battle to stay well. This insightful correspondence is from a PhD in Health Sciences who suffers from ESRD (end stage renal disease). She describes the magnesium deficiency caused by her dialysis and her self-treatment with picometer magnesium. Her story will also inform you that you will receive your greatest teachings from your patients.

I am a 60-year old ESRD patient on home hemodialysis for 4 years. I am a type 1 diabetic as well. When I began dialysis I gave the nurse my list of supplements, which included magnesium and I was told in no uncertain terms that dialysis patients should not and cannot take magnesium, our kidneys could be harmed by it. So I complied with their fearful stance as I entered into the unknown realms of kidney failure care, assuming they knew what they were talking about.

Before I began Home Hemodialysis I started off with Peritoneal Dialysis, since they presented it as the more 'natural' mode. (Fluid is introduced through a permanent tube in the abdomen and flushed out the same tube during the night.) I soon developed incredible itching all over my body that they said was from being underdialyzed. But now I also believe that as my magnesium bottomed out, my calcium and phosphorus soared and combined to form calcium phosphate crystals, and who knows where else, which deposited in my skin. Dialysis people have lots of skin issues. Yes, they are due to toxins but perhaps more importantly, due to low magnesium.

I remember seeing things that looked like little white crystals in my skin, which I scratched until I bled. My own dialysis doctors were not even convinced this was due to dialysis! A nephrologist at Vanderbilt gave me a second opinion and had seen it. He said they call it the 'crazy itch' and treat it by putting people under UV lights. Knowing what I do now, I presume the UV would be helpful by raising active vitamin D, which helps lower the calcium phosphate complex levels in the skin by sending the calcium and phosphorous into the bones.

I also began having horrendous nighttime calf and foot cramping on peritoneal dialysis, having to jump out of bed at night to try to soothe the unbearable pain. I was still afraid to take magnesium, so I downed vitamin E, B complex, etc., and whatever else I could find as suggestions online.

Then I was switched to Home Hemodialysis and there must be more magnesium in the dialysis solution they use compared to peritoneal dialysis because my skin improved. However, over a year ago I began to have heart palpitations that would at first come and go but then worsened and became more constant. After reading many recent studies online, I believe that the dialysis liquid they are putting in me is actually pulling magnesium out of my blood and depleting me. I feel my heart begin to palpitate in my chest towards the end of every treatment. Many patients have leg cramping during treatment. Many dialysis patients have heart issues; it's the number 1 killer of dialysis patients, and most likely caused by magnesium deficiency.

During the 4 years since I have been on dialysis, I have broken bones in my feet 3 times; increased the level of calcification in my arteries (showed up on x-ray); had worsening palpitations; brain fog; changes in my teeth; and who knows what else!

Thank goodness, I found Dr. Dean's picometer magnesium and I have been supplementing with it. I find it hard to believe but it totally resolves my palpitations. Of course I bump heads with the powers that be who say magnesium is dangerous for kidney patients but my kidney specialist is finally behind my decision to use it.

Besides eliminating my palpitations, since I have been taking [picometer magensium], my phosphorus levels have dropped to nearer normal levels so they are reducing the phosphate binders that I take with every meal. My hope is to reach a point where I need no binders at all. I have the hope that supplementing with picometer magnesium will reverse many of my symptoms.

Magnesium is rarely measured in the dialysis setting. I went through all kinds of red tape to get pre- and post-treatment Magnesium RBC blood testing. This should be routine! To me this is unbelievable because I'm sure most patients are having their magnesium sucked away through their dialysis treatments. And sure enough, my magnesium levels were lower after dialysis than before it. So, each treatment depletes my magnesium further and further.

The more I look into magnesium deficiency, the more I attribute the majority of my health problems, since beginning dialysis, to the depletion of my magnesium levels. When I bring this up, the dialysis staff gets quite defensive. I seem to know more than they do, which intimidates them, not to mention that it really is the fault of their dialysis liquid that I have suffered these symptoms. They know so little about magnesium and how it interacts with phosphorus, calcium, PTH, and vitamin D3.

I just thank God I have found the studies online saying that I really do need magnesium and then I found picometer magnesium, which really made such a difference, almost immediately. I sometimes wake up in the middle of the night with palpitations, and no way can I sleep with my heart bouncing around in my chest, so I pour a capful of picometer magnesium in a few swallows of water, and I swear, within minutes my heartbeat returns to normal.

I won't list all the review articles I've found, but I'll end with one from 2021.

2021: This paper talks about the potential for magnesium to act as a drug and the fact that it's a "forgotten cation." Here is a partial abstract:

Magnesium (Mg^{2+}) can regulate several cations, including sodium, potassium, and calcium; it consequently maintains physiological functions like impulse conduction, blood pressure, heart rhythm, and muscle contraction. But, it doesn't get much attention in account with its functions, making it a "Forgotten cation". Like other cations, maintenance of the normal physiological level of Mg^{2+} is important. Its deficiency is associated with various diseases, which point out to the

> *importance of Mg^{2+} as a drug. The roles of Mg^{2+} such as natural calcium antagonist, glutamate NMDA receptor blocker, vasodilator, antioxidant and anti-inflammatory agent are responsible for its therapeutic benefits. Various salts of Mg^{2+} are currently in clinical use, but their application is limited. This review collates all the possible mechanisms behind the behavior of magnesium as a drug at different disease conditions with clinical shreds of evidence.*[57]

I find I must comment on this notion of calling magnesium a drug. Perhaps it's a way to get allopaths interested, because they are trained to focus on drug-based medicine. But magnesium is not a drug; it's a vital electrolyte that for multiple reasons has become depleted in our diet and must be supplemented. Making it out to be a drug will just lead to patenting a magnesium compound and only letting doctors prescribe it. Actually, the patenting has already begun with magnesium l'threonate. Here's what I've written about this patented product:

> *The January 28, 2010 issue of Neuron published a paper titled, "Enhancement of Learning and Memory by Elevating Brain Magnesium." This was a rat study and researchers said that, "Our findings suggest that an increase in brain magnesium enhances both short-term synaptic facilitation and long-term potentiation and improves learning and memory functions." The study compares several different forms of magnesium for absorption into the cerebrospinal fluid and found that Magtein measured only 7 percent higher at day 24 of intake than the other forms of magnesium.*

> *With this 7 percent increase of magnesium in the CSF, promoters of Magtein say theirs is the only magnesium that crosses the blood brain barrier. That is an inaccurate statement. Giving superpowers to their product obscures the reality that any magnesium could produce some or all of these same effects. The successful treatment of migraines, seizures, stroke, head injuries and other nervous system problems with even the highly unabsorbed magnesium oxide (at 4%) shows that all magnesium works at the neuron level, which means all or part of it gets into the brain.*

If you want to catch up the very latest research and reviews for 2022, go to *Appendix D*.

Magnesium Books

I'll just mention this one book because it is loaded with references which can help you when presenting your case for magnesium to fellow health practitioners.

2011: A valuable addition to your magnesium education is a free online book from the University of Adelaide called, *Magnesium in the Central Nervous System*.[58] It's 355 pages, and each chapter is a paper

written by a magnesium researcher or expert covering important topics involving the central nervous system. The chapter titles alone show the incredible scope of magnesium research.

1. Free Magnesium Concentration in Human Brain
2. Intracellular Magnesium Homeostasis
3. Magnesium Transport Across the Blood-Brain Barriers
4. Intracellular Free Mg2+ and MgATP2- in Coordinate Control of Protein Synthesis and Cell Proliferation
5. Magnesium and the Ying-Yang Interplay in Apoptosis
6. Brain Magnesium Homeostasis as a Target for Reducing Cognitive Ageing
7. The Role of Magnesium Therapy in Learning and Memory
8. The Role of Magnesium in Headache and Migraine
9. Magnesium in Edema and Blood-Brain Barrier Disruption
10. Magnesium and Hearing Loss
11. The Role of Magnesium in Pain
12. The Role of Magnesium in Traumatic CNS Injury
13. The Use of Magnesium in Experimental Cerebral Ischaemia
14. Magnesium in Subarachnoid Hemorrhage
15. Magnesium in Clinical Stroke
16. Magnesium in Cancer: More Questions than Answers
17. Magnesium in Parkinson's Disease: An Update in Clinical and Basic Aspects
18. Magnesium and Alzheimer's Disease
19. Magnesium and Stress
20. Magnesium in Neuroses
21. Magnesium, Hyperactivity and Autism in Children

22. Magnesium in Psychoses (Schizophrenia, Bipolar Disorder)

23. Magnesium and Major Depression

24. Magnesium in Drug Abuse and Addiction

I'm confident that the material in this book will establish the significance of the role of magnesium in the body and confirm its safety so that your patients can create their own personal "clinical trial" and measure its effects. I often talk about the personal experiment that we all undertake when we take nutrient formulas. We are our own experiment, and you might say we are each a study where N=1. N being the designation of the number of participants in a clinical trial. To my mind, an N=1 trial is completely valid and enlightening for the individual and the practitioner.

What follows is an expanding list of Magnesium Deficiency Conditions that began as a few dozen in the first edition of my book, *The Magnesium Miracle,* and grew to 65 in the second edition. In this book the number has reached 68+. I'm positive there are dozens more magnesium deficiency conditions that will become apparent to the health practitioners that work with picometer magnesium that can be given in high enough dosage to fully saturate the cells of the body and allow it to work optimally in 80% of known metabolic functions.

Chapter 3

Magnesium Deficiency Health Conditions - General Part I

The following general health conditions have been identified as related to magnesium deficiency through research and/or clinical observation.

MgDHC #1 - ACID REFLUX

How & Why:

Magnesium relaxes muscles in a constant push pull with calcium, which tightens muscles to perform an activity. If there is too much calcium and not enough magnesium, muscles will go into spasm anywhere in the body, including the esophageal sphincter.

A spasm of the lower esophageal sphincter at the juncture of the stomach can leave the sphincter open, allowing acid to reflux up into the back of the throat or even into the lungs. Some so-called acid reflux is not acidic but rather an alkaline slurry from the small intestinal contents that flush back into the stomach.

An added feature of stomach function is that the natural gastric proton pump is dependent on magnesium. Specifically, a combination of potassium-magnesium with ATPase creates the gastric proton pump, which acidifies the contents of the stomach.

Ironically and unfortunately, proton pump inhibitor drugs, that wipe out stomach acid, also lower your magnesium levels, which means escalation of esophageal spasms and lack of proper stomach acid to digest foods. The FDA has been forced to warn the public since 2011 that PPIs like Zantac can lower magnesium.[59]

It's interesting to see a new PPI drug called, "pantoprazole magnesium (Protonix)."[60] Ironically, besides magnesium, Protonix contains 2 fluoride molecules, which increase magnesium deficiency when fluoride molecules irreversibly bind with magnesium making a brittle compound called magnesium fluoride (MgF_2). On second thought, maybe the drug chemists know that and introduced it to address the magnesium deficiency that the PPIs cause.

NOTE: Researchers may say that these drugs do not release fluoride in vitro (in the lab); however, intestinal organisms do break down drugs in the GI tract (in vivo), which can release fluoride from the chemical compound and unleash it on the body.

MgDHC #2 - ADRENAL FATIGUE

How & Why:

Adrenal fatigue occurs commonly after a time of chronic stress, anxiety, and panic attacks, and it seems to be occurring in epidemic proportions in recent years. However, allopathic medicine refuses to diagnose adrenal fatigue (likely because there are no drugs for this condition until the diagnosis of Addison's disease is made). This leaves patients feeling helpless and hopeless. Adrenaline, noradrenaline, and cortisol (elevated in chronic stress) deplete magnesium. Stress causes excess elimination of magnesium through the urine. In an animal model, magnesium deficiency was identified as the cause of anxiety and HPA axis dysregulation. However, instead of treating with magnesium, a drug treatment was investigated.[61] Clinical trials using magnesium for adrenal fatigue are needed since there are so few options for treatment. In the meantime, taking a well-absorbed magnesium can be very helpful in alleviating the symptoms of stress.

MgDHC #3 - ALZHEIMER'S DISEASE

How & Why:

Dr. Abram Hoffer, a co-founder of Orthomolecular Medicine with Linus Pauling, cautions that almost half of all cases of Alzheimer's may be dementias caused by simple dehydration, prescription drug intoxication, severe cerebral allergic reactions to foods, chemicals, toxic metals like mercury, vaccines, mercury dental amalgams, and chronic nutrient deficiencies. I would place magnesium deficiency high on that list.

Alzheimer's is described as a profound synapse loss and impairment of learning and memory and is associated with magnesium deficiency.[62,63] Researchers in a 2014 study report that magnesium affects many biochemical mechanisms that are vital for neuronal properties and synaptic plasticity.[64] Recent studies have demonstrated that serum and brain magnesium levels are decreased in Alzheimer's Disease patients.

The online book *Magnesium in the Central Nervous System* has a very useful chapter called "Magnesium in Alzheimer's Disease" with 140 references. In this chapter, magnesium was demonstrated to modulate the trafficking and processing of amyloid-β precursor protein, which is said to play a central role in the pathogenesis of Alzheimer's Disease.[65] In a mouse model, they found that magnesium increased the brain magnesium levels and protected learning and memory capacities; reversed impairments in long-term

potentiation (LTP), dendritic abnormalities, and the impaired recruitment of synaptic proteins; decreased tau hyperphosphorylation; and improved insulin sensitivity.[66] They concluded that magnesium treatment protects cognitive function and synaptic plasticity, which suggests a potential role for magnesium in Alzheimer's Disease therapy.

MgDHC #4 - ANGINA

How & Why:

The lack of sufficient blood flow carrying life-giving oxygen and nutrients to the heart muscle can be due to calcified coronary arteries and magnesium-deficient spasms in these vessels. Magnesium helps dissolve calcium in soft tissue and relaxes the smooth muscles in blood vessels. The highest amount of magnesium in the body is found in the heart. Magnesium is the most important electrolyte to balance the heart rhythm, yet magnesium is not even on a standard electrolyte panel.

Cardiovascular research scientist James J. DiNicolantonio declared that magnesium deficiency is a public health crisis in a 2018 paper in *Open Heart*.[67] DiNicolantonio is the author or co-author of over 200 medical publications and serves as the Associate Editor of British Medical Journal's (BMJ) *Open Heart*. Hopefully his message is heard.

A 2019 paper mentions magnesium deficiency as one of the contributing factors to vasospastic angina.[68] Most of the other factors are also related to magnesium deficiency – vascular smooth muscle cell hyperreactivity, endothelial dysfunction, low-grade inflammation, altered autonomic nervous system response and oxidative stress. In spite of these obvious MgDHCs, the paper says, "the pathogenesis of coronary artery spasm has not been fully elucidated…" and they opine that the "variables…could be modified by genetic factors." By the end of the paper, magnesium is lost and forgotten in the search for a drug solution to coronary spasms. The paper's authors recommend calcium channel blockers (**NOTE**: Magnesium is a natural calcium channel blocker); statins **(NOTE:** which deplete magnesium); nitrates to dilate the coronary arteries (**NOTE:** which magnesium does by increasing nitric oxide in vivo); aspirin (**NOTE:** being debated whether it's even suitable in heart disease); and Alpha 1-adrenergic receptor antagonists (**NOTE:** conflicting results).

References (General):

Teo KK et al. "Effects of intravenous magnesium in suspected acute myocardial infarction: overview of randomized trials." Brit Med J, vol. 303, pp. 1499-1503, 1991.

MgDHC #5 - ANXIETY AND PANIC ATTACKS

How & Why:

Magnesium supports the adrenal glands, which are overworked by stress, leading to combined magnesium deficiency symptoms and adrenal exhaustion symptoms of anxiety, depression, muscle weakness, fatigue, eye twitches, insomnia, anorexia, apathy, apprehension, poor memory, confusion, anger, nervousness, and rapid pulse.[69] Serotonin, the "feel-good" brain chemical that is artificially boosted by Prozac, depends on magnesium for its production and function. Additionally, magnesium deficiency has been strongly linked to sleep disorders, which can either cause or increase anxiety.

In a review of nutrients used to treat anxiety, "all three randomized control trials of magnesium-containing supplements had positive results."[70] In an animal model, magnesium deficiency caused anxiety and HPA axis dysregulation; however, instead of treating with magnesium, a drug treatment was offered.[71]

Boyle's review of magnesium supplementation and anxiety noted the following:

> *Studies in animals and humans suggest that Mg may play an important part in the etiology of affective mood disorders. A relationship between Mg and affective depressive states has been established.*

> *Magnesium plays a key role in the activity of psychoneuroendocrine systems and biological and transduction pathways associated with the pathophysiology of depression. For example, all elements of the limbic-hypothalamus-pituitary-adrenocortical axis are sensitive to the action of Mg. ["This is probably TMI (too much information)"], however, magnesium has also been demonstrated to suppress hippocampal kindling, affect and attenuate the release of adrenocortical sensitivity to ACTH and may influence the access of corticosteroids to the brain at the level of the blood brain barrier via its action on p-glycoprotein.*[72]

MgDHC #6 - ARTHRITIS

How & Why:

According to a study in the journal, *Life Sciences*, magnesium deficiency is a major risk factor for the development and progression of osteoarthritis (OA). They say that magnesium deficiency is "active in several pathways that have been implicated in OA, including increased inflammatory mediators, cartilage damage, defective chondrocyte biosynthesis, aberrant calcification and a weakened effect of analgesics."[73] They referenced laboratory and clinical evidence in animal studies that suggested nutritional supplementation of magnesium could provide effective therapies for osteoarthritis. A study in *the Journal of Rheumatology* followed 2,855 subjects. Investigators measured magnesium using the inferior serum magnesium test, and arthritis was determined by specific X-ray criteria. They found a significant association between low serum magnesium and OA.[74] The following reference shows the increased cardiovascular risk of using NSAIDs for OA.[75]

MgDHC #7 - ASTHMA

How & Why:

The smooth muscles of the bronchial tubes go into spasm when they are magnesium deficient. Magnesium is an antihistamine. Dehydration worsens asthma. There are many studies using IV magnesium formulas for the treatment of moderate to severe asthma in children and adults.[76, 77]

MgDHC #8 - ATHEROSCLEROSIS

How & Why:

Atherosclerosis and arteriosclerosis are interchangeable. I've written in *The Magnesium Miracle* that blood vessel endothelium is damaged because of NO (nitric oxide) depletion due to magnesium deficiency. Cholesterol patches up the damage, but then it's erroneously labeled as the problem. When magnesium is deficient, calcium builds up at the site of the cholesterol patch, narrowing carotid, coronary, and renal arteries, causing stroke, heart attack, and kidney failure. Complications of this preventable condition cause over a third of all deaths in the US. Calcium scans show the problem, but medicine has no solutions

for calcification. The evidence has been mounting for decades that magnesium plays a crucial role in the prevention of both atherosclerosis and arteriosclerosis. [78,79]

Magnesium maintains the elasticity of the artery wall, dilates blood vessels, prevents calcium deposits, and is necessary for the maintenance of healthy muscles, including the heart muscle itself. Specifically, magnesium will solubilize calcium that it finds in soft tissues including building up inside blood vessels. For all these reasons, magnesium is critical for the maintenance of a healthy heart.[80] One of the pivotal metabolic chemicals in the body is nitric oxide. It is a very simple compound made from nitrogen and oxygen, but it packs a powerful punch. Nitric oxide controls vasodilation, but this activity is under the direction of magnesium.[81]

MgDHC #9 - ATRIAL FIBRILLATION

How & Why:

Atrial fibrillation ("AFib") is the most commonly diagnosed heart arrhythmia, and it's currently reaching epidemic proportions. The incidence is increasing as magnesium deficiency becomes more widespread as the population ages and as screening programs, including massive, indiscriminate screening with the Apple Watch, document asymptomatic AFib. Such screening puts doctors and patients in a conundrum because doctors believe that most cases of AFib are secondary to heart disease, so the standard treatment is to medicate those symptoms to try and alter the course of AFib.[82] Unfortunately, heart, cholesterol, and diabetes medications add to the problem by causing more magnesium deficiency.

AFib is caused by an electrolyte imbalance. We do not routinely test for magnesium and never properly test for ionized magnesium available to the cells. I say that most people don't have a heart condition causing AFib, but instead have a magnesium deficiency causing these symptoms.

The use of magnesium in the preoperative and early postoperative periods is highly effective in reducing the incidence of AFib after coronary artery bypass grafting.[83] In one trial, at the end of the 6-hour treatment period, restoration of sinus rhythm was observed in a significantly higher proportion of patients in the magnesium group compared with the Diltiazem group (13 of 23 patients, [57%], versus five of 23 patients, [22%]). The conclusion was that magnesium sulfate favorably affects rate control and seems to promote the conversion of long-lasting episodes of paroxysmal atrial fibrillation to sinus rhythm, representing a safe, reliable and cost-effective alternative treatment strategy to Diltiazem.[84]

> *Low serum magnesium is moderately associated with the development of AFib in individuals without cardiovascular disease. Because hypomagnesemia is common in the general population, a*

> *link with AFib may have potential clinical implications. Further studies are warranted to confirm our findings and to elucidate the underlying mechanisms.*[85]

I never tell people to stop their meds, and I do not deter people from exploring catheter ablation. But I recommend they always keep saturated with magnesium. If the underlying cause of AFib is magnesium deficiency, the symptoms will abate, the EKG will normalize, and they can be weaned off their meds.

AFib is a huge topic so I recommend my book, *Heart Health for Tachycardia, Angina, Atherosclerosis, High Cholesterol, Hypertension and Atrial Fibrillation*, for further reading. If a patient has become so deficient in magnesium that it causes a heart rhythm disturbance, then other minerals are at risk, which necessitates the use of a picometer multi-mineral. If a patient is on medications for AFib, a nutritional product with B Vitamins, L-Methionine, and L-Taurine will be useful to help detoxify the drugs so that they don't unnecessarily remain in the system.

MgDHC #10 - BLOOD CLOTS

How & Why:

Magnesium does not act like a blood-thinning drug. Instead, it prevents calcium buildup in the blood that triggers clots. Magnesium keeps calcium in solution and directs it to the bones and teeth. Thus, magnesium naturally balances the clotting factors in the blood.

Sekiya[86] showed that not only do Ca^{2+} ions but also Mg^{2+} ions play a crucial role in stabilizing the native conformation of coagulation factor IX. They reported that Mg^{2+} ions at physiological concentrations greatly augment the biological activities of factor IX.

MgDHC #11 - BOWEL DISEASE

How & Why:

Magnesium deficiency slows down bowel peristalsis causing constipation, which can lead to toxicity as well as symptoms of colitis, microscopic colitis, IBS, diverticulitis, and Crohn's disease. Magnesium deficiency can also cause intestinal muscle spasms leading to gas and bloating from trapped gas, relieved by episodic diarrhea.

As Naser writes in his 2014 paper:

> Magnesium plays a *key role as an immunomodulator in many pathways leading to homeostasis. Hypomagnesemia is common in patients with Crohn's disease (CD) and may be the cause of upregulation of pro-inflammatory factors leading to aggravating symptoms. Therefore, understanding the role of magnesium in maintaining a healthy immune response is important for effective treatment of patients with CD. Magnesium supplementation for CD patients is strongly suggested by several research data. Maintaining magnesium homeostasis throughout the course of the disease is expected to minimize the inflammatory damage of CD improving the condition of many patients. However, conventional magnesium supplementation itself causes diarrhea which is the main reason magnesium is lost in CD. A therapeutic strategy for magnesium administration is strongly recommended."*[87]

Naser identified the crucial stumbling block in magnesium therapy – the laxative effect. Fortunately, that problem has been solved with picometer, stabilized ions of magnesium. My suggestions for this type of supplement can be found in *Chapter 8, "The Case for Completements."*

MgDHC #12 - CALCIFICATION

How & Why:

Many researchers agree that chronic disease is caused by inflammation and calcification, both of which are clear signs of magnesium deficiency. Calcium enters the cells by way of calcium channels that are jealously guarded by magnesium. Magnesium, at a concentration 10,000 times greater than that of calcium in the cells, allows only a certain amount of calcium to enter to create the necessary electrical transmission or muscle firing, and then immediately helps to eject the calcium once the work is done. Why? If calcium accumulates in the cell, it causes hyperexcitability and eventually disrupts cell function.

Too much calcium entering cells can cause symptoms of heart disease (such as angina, high blood pressure, and arrhythmia), asthma, or headaches. But if there is enough magnesium, it acts as the body's natural calcium channel blocker.[88,89]

As I mentioned earlier, Dr. Guy Abraham details how the body protects itself.[90] He says that in order to protect the fluid inside the cell from becoming saturated with calcium, there is a magnesium-dependent mechanism that shunts calcium into the mitochondria. However, this can backfire, because if too much calcium is taken up for too long, the excess calcium in the mitochondria inhibits ATP synthesis. Mitochondrial calcification without the intervention of sufficient magnesium eventually results in cell death.

Coronary Calcium Scans assess the degree of calcification in the cholesterol plaque of the coronary arteries using CT scanning.[91,92] It has not caught on as a screening tool, probably because there are no drugs to "dissolve" the calcium in coronary arteries. Allopathic medicine continues to use stents, calcium channel blockers, and statin drugs ineffectively, when complimentary use of magnesium supplementation would enhance results. Vascular calcification of the coronary, carotid, and renal arteries is due to a relative lack of magnesium and saturating with magnesium is the most effective treatment for calcium build up in the body.

If you don't have enough magnesium to help dissolve calcium, you will end up with various forms of calcification. The first is the undetected stiffening of blood vessels leading to a decrease in the supply of nutrients throughout the body. Calcium excess causes magnesium deficiency and this translates into muscle spasms, fibrositis, fibromyalgia, atherosclerosis (calcification of the arteries), gall stones, kidney stones, heel spurs, and breast tissue calcification, which in some cases may be mistaken for DCIS (ductal carcinoma in situ). My concern is that breast tissue calcification from overuse of oral calcium supplements can be mistaken for DCIS and involve rounds of x-rays, mammograms, needle biopsies, and surgery to rule out cancer.

MgDHC #13 - CHOLESTEROL

How & Why:

HMG-CoA reductase is the rate-limiting enzyme for cholesterol synthesis. Magnesium regulates this enzyme turning on and off the production of cholesterol as needed. The HMG-CoA enzyme is targeted and destroyed by statin drugs, which curtails cholesterol regulation.

Magnesium is necessary for the activity of an enzyme that lowers LDL cholesterol and TGL and raises HDL. Many researchers refer to magnesium as a natural statin.[93,] Magnesium is also responsible for several lipid-altering functions that are not shared by statin drugs. For example, another magnesium-dependent enzyme converts omega-3 and omega-6 essential fatty acids into prostaglandins, which are necessary for heart and overall health.

MgDHC #14 - CHRONIC FATIGUE SYNDROME ("CFS")

How & Why:

Long COVID is fast becoming the equivalent of CFS, and I say that Long COVID is the new face of magnesium deficiency. Mitochondrial dysfunction is said to be the cornerstone of CFS. This may or may

not be verified – I say that CFS and Long COVID are a combination of magnesium deficiency and Yeast Overgrowth.

I've noted earlier that Dr. Guy Abraham says, when mitochondria are flooded with calcium, they experience dysfunction and there is a short-term cellular mechanism that shunts calcium into the mitochondria. This function is magnesium-dependent.[94] If there is magnesium deficiency, this stop-gap measure does not work. However, this can backfire, because if too much calcium is taken up for too long, the excess calcium in the mitochondria inhibits ATP synthesis – energy production.

Mitochondrial calcification without the intervention of sufficient magnesium eventually results in cell death. I contend that calcium excess and magnesium deficiency can be the underlying cause of mitochondrial dysfunction that many natural medicine practitioners say can trigger CFS, Long COVID and other chronic diseases.[95,96]

MgDHC #15 - CYSTITIS (BLADDER INFECTION)

How & Why:

Magnesium deficiency causes bladder spasms that can cause urinary frequency that is often misinterpreted as a bladder infection. That's why it is important to get a urine C&S (Culture and Sensitivity urine test) to determine infection before prescribing antibiotics.

Magnesium deficiency can also allow calcium to build up in the lining of the bladder and urethra, causing irritation that mimics cystitis and incontinence. We have had many reports of people saturating with picometer magnesium and being able to wean off their adult diapers as their bladder becomes less rigid.

References:

I was not able to find any references for this condition. But magnesium deficiency causes muscle spasms that can affect the bladder. The soft tissue of bladder can build up calcium crystals and saturating with picometer magnesium can eliminate these symptoms.

MgDHC #16 - DEMENTIA

How & Why:

I'm isolating dementia as a stand-alone condition so that it won't be lost in the discussion about Alzheimer's and Parkinson's.

As I noted in the entry about Alzheimer's, the late Abram Hoffer, MD, the co-creator of Orthomolecular Medicine along with Linus Pauling, PhD, declared that dementias can be caused by potentially treatable conditions as dehydration, prescription drug intoxication, severe cerebral allergic reactions to foods, industrial chemicals, heavy metals (e.g., lead from car exhaust and paint, mercury from vaccinations, dental fillings and fish, aluminum from canned food and deodorants), fluorescent lighting, television, computers, video games, cell phones, cell phone towers, and chronic nutrient deficiencies. I place magnesium deficiency high on that list of nutrient deficiencies since 80% of the population is deficient despite magnesium being required by 1,000 enzyme processes and involved in 80% of known metabolic functions.

In the medical research community, magnesium is well known for its diverse actions within the human body. From a neurological standpoint, magnesium plays an essential role in nerve transmission and neuromuscular conduction. It also functions in a protective role against excessive excitation that can lead to neuronal cell death (excitotoxicity) and has been implicated in multiple neurological disorders. Due to these important functions within the nervous system, magnesium is a mineral of intense interest for the potential prevention and treatment of neurological disorders.[97]

Vink states the obvious in his 2016 paper: "...improved central penetration of a magnesium compound that avoids peripheral side effects of high magnesium dosages is clearly a desirable outcome, and should now be investigated in animal models that accurately mimic the complex human condition."[98]

Vink is referencing the side effect of diarrhea with high doses of magnesium. However, there is now a non-laxative form that can deliver high doses to the brain and the rest of the body.

I think the best reference for the relationship of magnesium and the Central Nervous System ("CNS") is the online book, *Magnesium in the Central Nervous System,* from the University of Adelaide. I advise sufferers and their families to print up this 355-page book and gently place it on the desk of their neurologist and ask to be treated with IV Mg.[99]

MgDHC #17 - DEPRESSION

How & Why:

As someone who has retired from private practice and is focusing on researching, writing, and product development, I don't presume to "treat" depression. What I do say is that supplying the cells of the body with highly absorbable nutrients sets the stage for healing on all levels.

If that intervention is not enough, I recommend a Canadian nutrient formula EMPower Plus created by True Hope Nutritional Support. It's a high-dose multiple vitamin, mineral, amino acid formula. Unfortunately, most of the ingredients are synthetic – that's why I recommend taking highly absorbed, natural products and picometer size mineral supplements along with EMPower Plus.

EMPower Plus has had dozens of positive studies attesting to its effectiveness, and unlike antidepressants, it has no side effects. Truehope's customer service representatives are trained to guide people in taking EMPower Plus.

In 2016, a prospective study by Teymoor with an impressive twenty-year follow-up reported the association between magnesium intake and the incidence of depression in men.[100] I think it's worth looking at this study to see the list of references. An earlier study by Jacka, published in 2009,[101] found an association between magnesium intake and anxiety and depression.

MgDHC #18 - DETOXIFICATION

How & Why:

Medicine seems to have no opinion or advice to patients about detoxification. Even though the P450 detox pathways are well known, there is no allopathic intervention to enhance their function. The most likely reason is that there is no drug that enhances detoxification. On the contrary, most, if not all, medications have toxic side effects.

In *The Magnesium Miracle*, I report that magnesium is crucial for the removal of toxic substances and heavy metals such as mercury, aluminum, and lead from our cells. That is likely because magnesium is a cofactor in both the production of glutathione and the function of the P450 detoxification systems in the liver.

If your patient says that magnesium is making them feel worse, here is what is happening. The patient is toxic for one or more of the following reasons: a bad diet, prescription medications, heavy metals, stress, chemicals, Yeast Overgrowth, or environmental toxins. As magnesium enters the cells, it stimulates cellular detoxification and dumps toxins and heavy metals from the cells into the lymphatic system and blood stream, or magnesium supports the immune system to fight Yeast Overgrowth, and toxins are released from the dying yeast. All these toxins are eventually excreted through the skin, kidneys, and colon. Toxins surfacing on the skin can cause skin irritation, inflammation, hives, and rashes. Yeast toxins contribute to vaginitis, sinusitis,

itching ears, and brain fog. These reactions are not a reaction to magnesium but instead are natural detox reactions, as the body is now more able to do its job because it is getting enough magnesium.

The so-called negative reactions to magnesium that I've studied are usually due to IV magnesium sulfate. Specifically, susceptible individuals may have blocked sulfur pathways, and the sulfur in the magnesium compound is not being properly processed. Or, there may be a reaction to the aluminum that is found in IV magnesium products. However, sulfur is likely the culprit, because IV magnesium chloride also contains aluminum, and I have not heard of reactions to this form of magnesium. Because of the aluminum, I would advise against chronic administration of these forms of IV magnesium, especially since an orally administered picometer magnesium that is fully absorbed at the cellular level, because of its picometer size, is available and non-laxative.

There are tens of thousands of medicinal drugs currently in use. Magnesium expert Dr. Mildred Seelig noted that the side effects of many drugs may be associated with magnesium deficiency because magnesium becomes depleted with the effort the body makes to try and detoxify these drugs. Discontinuing medications like Ativan and Neurontin can cause severe withdrawal symptoms such as heart palpitations, exhaustion, insomnia, dissociative feelings, and panic attacks. They may come so unexpectedly that they are not recognized as drug withdrawal but instead as an entirely new illness.

Dr. Sherry Rogers has spent her whole career treating multiple chemical sensitivity (MCS). She has found that symptoms of chemical sensitivity can be wholly or partly due to magnesium deficiency. She says her success derives from implementing magnesium therapy for all her patients.

Dr. Frederica P. Perera, professor of environmental health sciences and director of the Columbia Center for Children's Environmental Health, has indicated that there is as much as a 500-fold difference in the ability of individuals to detoxify the same chemical.[102] One of the key markers of this difference is each individual's magnesium status.

Glutathione is a naturally occurring antioxidant that acts to detoxify chemicals and is produced in all the cells of the body,[103] including neurons. Cells grown in magnesium-deficient conditions, however, have lower glutathione levels. Adding free radicals to a low-magnesium cell culture causes the level of glutathione to fall rapidly as it is used up, making the cells much more susceptible to free radical damage.[104] I recommend using formulas that contains L-methionine, a precursor to glutathione, plus methylated and food-based B vitamins that all play a role in detoxification.

MgDHC #19 - DIABETES

How & Why:

Medicine recognizes magnesium deficiency as one of the signs of diabetes for the following reasons:[105,106,107,108,109]

1. Magnesium is necessary to make and secrete insulin.

2. Magnesium facilitates carbohydrate metabolism.

3. Magnesium allows insulin to transfer glucose into cells. Otherwise, glucose and insulin build up in the blood, causing various types of tissue damage.

4. Tyrosine kinase, an enzyme that allows glucose entry into the cell (along with insulin), is magnesium-dependent.

5. Seven of the ten enzymes needed to metabolize glucose in the glycolysis pathway are magnesium-dependent.

MgDHC #20 - FATIGUE

How & Why:

This is not an infectious and toxic post viral condition; this is the dragging, listless, apathetic fatigue that brings many patients to your office. Magnesium-Deficient patients commonly experience fatigue because hundreds of enzyme systems are under-functioning. The most important factor in energy production is ATP, which must be bound to a magnesium ion in order to be biologically active.

Mg^{2+}ATP is produced in the Krebs cycle, and magnesium is indispensable in several steps including the crucial first one that breaks down pyruvate. The Krebs cycle begins by using pyruvate from the glycolysis cycle and functions exclusively in the mitochondria. Both allopathic and alternative medicine are investigating mitochondrial dysfunction, but any treatment must begin with saturation levels of magnesium.

As outlined by Garfinkel and Garfinkel, magnesium is an important controller of glycolysis and the Krebs cycle. Many of the glycolytic enzymes are activated by Mg^{2+}. The most important effect is due to MgATP2- being a cofactor for a number of these enzymes while other chelation forms are inactive or inhibitory.[110]

MgDHC #21 - HEADACHES

How & Why:

Magnesium has been studied extensively in migraine headaches.[111,112,113] Muscle tension and spasms in neck and head muscles can be alleviated with Mg applied locally or taken orally. The University of Adelaide's online book, *Magnesium in the Central Nervous System,* has a chapter called "The Role of Magnesium in Headache and Migraine."

The abstract for this book chapter reads:

> *Research on Mg has found it to be a potentially well-tolerated, safe and inexpensive option for migraine prevention, while it may also be effective as an acute treatment option for headaches including migraines, tension-type headaches and cluster headaches, particularly in certain patient subsets. ... We review the various aspects of migraine in which Mg plays a part, as well as numerous studies on the use of Mg in both headache prophylaxis and in the acute treatment of headaches, offering recommendations in its use in clinical practice.*

When migraine sufferers with low magnesium ion levels were given intravenous magnesium, they experienced a complete alleviation of their symptoms, including sensitivity to light and sound.[114] Subsequent studies of migraine patients established a common pattern and confirmed the role of magnesium deficiency in the development of headaches.[115] The researchers found that infusion of magnesium resulted in rapid and sustained relief of acute migraine headaches. Because of an excellent safety profile and low cost, they recommend oral magnesium supplementation for migraine sufferers at a level of 6 mg/kg/day.[116]

By 2012, Dr. Mauskop had sufficient clinical success and had published enough about treating migraine with magnesium to title his paper "Why All Migraine Patients Should Be Treated with Magnesium."[117] Dr. Mauskop enthused that "all migraine sufferers should receive a therapeutic trial of magnesium supplementation." As he explains, "A multitude of studies have proven the presence of magnesium deficiency in migraine patients." Double-blind, placebo-controlled trials have produced mixed results, but, as Dr. Mauskop writes, this is "most likely because both magnesium deficient and non-deficient patients were included in these trials."[118]

Clearly, if researchers wish to show that magnesium deficiency is a cause of migraine, it's important to test for magnesium deficiency using the Ionized Magnesium Test beforehand; otherwise, the result is a seriously flawed study.

MgDHC #22 - HEART DISEASE

How & Why:

The heart, specifically the left ventricle, has the highest amount of Mg in the whole body probably because it's essential for regulating the heartbeat. Magnesium deficiency is common in people with heart disease; taking magnesium can reduce that risk. I think magnesium deficiency and calcium excess from calcium supplements should be the first areas of investigation to solve the problem of higher incidence of heart attacks in women.

Research indicates that calcium enters the cells by way of calcium channels that are jealously guarded by magnesium. Magnesium, at a concentration 10,000 times greater than that of calcium in the cells, allows only a certain amount of calcium to enter to create the necessary electrical transmission or muscle firing, and then immediately helps to eject the calcium once the work is done. Why? If calcium accumulates in the cell, it causes hyperexcitability leading to heart arrhythmia and eventually calcification that disrupts cell function. Too much calcium entering cells can also cause angina, high blood pressure asthma, or headaches. But, if there is enough magnesium, it acts as the body's natural calcium channel blocker.

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MgDHC #23 - HYPERTENSION

How & Why:

With insufficient magnesium and too much calcium, the smooth muscles lining blood vessels go into spasm and cause high blood pressure. If cholesterol is elevated, which can also be due to magnesium deficiency, cholesterol can bind with calcium, causing atherosclerosis in the blood vessels and worsening high blood pressure.

Allopathic medicine uses diuretics in combination with salt restriction to help flush fluids from the body, presumably to put less pressure on your blood vessels. Such dehydration can thicken your blood and make you susceptible to clotting-related conditions such as stroke and deep vein thrombosis.

Another side effect of diuretics is increased magnesium deficiency and consequent elevation of cholesterol and blood sugar. When patients are given statin drugs for their cholesterol and drugs for their diabetes, magnesium deficiency can become so severe that they develop atrial fibrillation or have a heart attack. Most drugs used in treating heart disease and hypertension drain magnesium from the body, especially the ones containing fluoride molecules.

One of the reasons doctors want patients to take medications for life is because they don't see their heart patients getting better. Little do they realize that their drugs may be causing incurable heart disease and heart failure.

Here is a common scenario. Jack is 60, and he goes to his doctor for his annual checkup, but he's been under tremendous stress. The doctor finds that his blood pressure is a little high, probably from stress, which causes magnesium depletion. It's been a little high a few times in the past, so he is put on a diuretic drug. When he comes back for a follow up, his pressure is even higher. The doctor doesn't know why, but it's because Jack's magnesium has been driven even lower by the diuretic.

His doctor just thinks he's caught Jack's blood pressure early and has to get more aggressive. The doctor puts Jack on two more antihypertensive drugs. A month later, seemingly out of the blue, but in actuality because of lower levels of magnesium caused by all 3 drugs, his cholesterol levels and blood sugar are elevated. The doctor says he's happy he "caught" Jack's high cholesterol and high blood sugar in time and puts him on a statin drug and a diabetic drug. Both of those drugs drain the body of more magnesium. And so the story

goes: as more and more magnesium is lost, the symptoms of magnesium deficiency escalate into full blown heart failure.

For more information about Migraines and Tension Headaches, go to MgDHC #31 and MgDHC #36.

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MgDHC #24 - HYPOGLYCEMIA

How & Why:

Magnesium helps regulate the production of insulin so that inappropriately large amounts aren't released, which can cause the blood sugar to drop suddenly, resulting in symptoms of low blood sugar.

References:

No clinical research studies are available on magnesium and hypoglycemia.

MgDHC #25 - INFECTION

How & Why:

Even many great proponents of magnesium therapy aren't aware of its anti-infective properties. Chapter 5 in the book, *Magnesium, The Nutrient That Could Change Your Life*, introduces Dr. Neveu and his successful treatment of 15 cases of polio with magnesium chloride (available online at MgWater[119]). Magnesium was used to treat infection in the early 1900's, long before the creation of antibiotics, and when they came along, non-patented, non-drug antibiotic solutions were ignored.

Neveu was so convinced of the effectiveness of magnesium chloride that he insisted that every home should have a solution of magnesium chloride on hand to treat the first signs of sore throat, especially when stiffness

of the neck was involved. His recipe called for 20 grams of magnesium chloride powder mixed in 1 liter of water.

I repeat, when you have enough magnesium to run the 1,000 enzyme processes and 80% of known metabolic functions in the body, the structure and function of every system is supported.

Also see the entries on Arthritis, Chronic Fatigue Syndrome, Cystic Fibrosis, Cystitis, Male Infertility, and Sports Injury for more aspects of treating infection.

MgDHC #26 - INFLAMMATION

How & Why:

Allopathic medicine is now embracing the fact that inflammation, and not cholesterol, may be the cause of heart disease. They don't know what causes inflammation, but traditionally doctors are trained to look to drug companies to develop products to suppress it. When working on reducing inflammation, drug companies don't appear to even take into consideration that calcium is extremely pro-inflammatory, and magnesium is very anti-inflammatory. The entire inflammatory cascade (which involves substance P, interleukins, tumor necrosis factor, chemokines, and cytokines) escalates when magnesium is deficient. The bottom line is that inflammation is triggered by magnesium deficiency and is related to calcium excess.[120]

Moreover, according to Nielsen, "Marginal-to-moderate magnesium deficiency through exacerbating chronic inflammatory stress may be contributing significantly to the occurrence of chronic diseases such as atherosclerosis, hypertension, osteoporosis, diabetes mellitus, and cancer."[121]

MgDHC #27 - INSOMNIA

How & Why:

Insomnia is one of the first symptoms to be alleviated when taking magnesium supplements. There is a saying in magnesium circles that if a person complains that magnesium isn't helping them sleep, then they just aren't taking enough. How does magnesium help us sleep?

- It relaxes twitchy, restless, tense muscles that keep you from falling into a deep sleep. Tight muscles make you hyper-alert and irritable, and in that condition, any noise or even an active dream will wake you up.

- GABA is the main inhibitory neurotransmitter of the central nervous system: activation of GABA(A) receptors facilitates sleep. Magnesium binds to GABA gates and increases their effects.[122]
- The sleep-regulating melatonin pathway production is disturbed without sufficient magnesium.
- Magnesium reverses age-related neuroendocrine and sleep EEG changes.[123]
- Magnesium supplementation improves magnesium deficiency symptoms and inflammatory stress in older adults (over age fifty-one) with poor sleep.[124]
- Magnesium reduces heart rate response to sympathetic nervous stimulation, exercise, and sleep problems.[125]

MgDHC #28 - IRRITABLE BOWEL SYNDROME

How & Why:

Magnesium deficiency that causes fatigue, insomnia, nightly leg cramps, and heart palpitations can also cause cramping of the intestinal muscles. When these muscles spasm, they interrupt peristalsis and cause gas to build up and cause stretching pain and alternating constipation and diarrhea. Stress is implicated because symptoms of IBS get worse with stress, but so does magnesium deficiency. IBS diarrhea manifests when you are very magnesium-deficient and have an extra-stressful event.

References:

No clinical research. Most researchers would say that magnesium will aggravate IBS-D but may help IBS-C. However, taking picometer magnesium that does not cause the laxative effect allows the muscles of the intestines to work properly with a normal peristalsis that allows normal bowel movements that occur once or twice per day.

MgDHC #29 - KIDNEY DISEASE

How & Why:

Magnesium deficiency contributes to atherosclerotic kidney failure because calcium builds up in the renal arteries. Signs of kidney disease include high blood pressure, protein in the urine, and an elevated GFR. High blood pressure is a common cause of kidney disease. However, the most common causes of high blood pressure are magnesium deficiency and calcium excess.

Kidney patients are told to keep their blood pressure under control, but they are also told to avoid magnesium in case it builds up in the blood because it's not being cleared properly by damaged kidneys. Instead, kidney patients are given blood pressure medications that drain more magnesium.

Diabetes is a very common cause of kidney failure. However, magnesium deficiency is a known sign of diabetes. So, if a patient has kidney disease and is told to avoid magnesium, their blood sugar levels are going to keep getting higher as their magnesium levels get lower. Diabetic drugs cause more magnesium deficiency.

I have found that kidney patients, even those on dialysis, can safely take a picometer, stabilized ionic form of magnesium for their debilitating leg cramps and heart palpitations. In my *Magnesium Miracle* book, I am very concerned about this issue, and I included one woman's story about her discovery of picometer magnesium and how much she relies on it because magnesium is depleted during dialysis. See, *"Magnesium Deficiency in End Stage Renal Disease."*

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MgDHC #30 - KIDNEY STONES

How & Why:

About 10 percent of the population will suffer a kidney stone in their lifetime. However, hyperparathyroidism is the number one cause of kidney stones, so every person with a kidney stone should have a blood test for this condition. Nearly half of all people with kidney stones have a benign parathyroid tumor that must be removed, or the kidney stones will return. Many factors may be involved in stone formation:[126,127,128,129]

- Elevated calcium in the urine is caused by a diet high in sugar, fructose, alcohol, coffee, meat, and calcium supplements.
- High urinary oxalate may relate to high-oxalate foods: rhubarb, spinach, chard, raw parsley, chocolate, tea, and coffee, among others. The oxalic acid binds to calcium, creating insoluble calcium oxalate. When you are saturated with enough magnesium, it can bind with oxalate in a much more soluble magnesium oxalate and be excreted without incident.
- Dehydration, which concentrates calcium and other minerals in the urine.
- Soft drinks containing phosphoric acid encourage kidney stones in some people by pulling calcium out of the bones and depositing it in the kidneys.
- Kidney stones and magnesium deficiency share the same list of causes, including a diet high in sugar, alcohol, oxalates, and coffee. An important animal study shows that a high dietary intake of fructose (from high-fructose corn syrup sweeteners) significantly increases kidney calcification, especially when dietary magnesium is low.
- One of magnesium's many jobs is to keep calcium in solution to prevent it from solidifying into crystals. Even in times of dehydration, if there is sufficient magnesium, calcium will stay in solution.
- Magnesium is the pivotal treatment for kidney stones; vitamin B6 assists.

MgDHC #31 - MIGRAINE

How & Why:

I cite the following causes of migraine in my *Magnesium Miracle* book:

- In women who have not yet reached menopause, estrogen rises before a menstrual period, causing a shift of blood magnesium into bone and muscle. As a result, magnesium levels in the brain are lowered.
- When magnesium is low, it is unable to do its job to counteract the clotting action of calcium on the blood. Tiny blood clots are said to clog up brain blood vessels, leading to migraines. Several other substances that help create blood clots are increased when magnesium is too low.
- Similarly, magnesium inhibits excess platelet aggregation, preventing the formation of tiny clots that can block blood vessels and cause pain.
- Low brain magnesium promotes neurotransmitter hyperactivity and nerve excitation that can lead to headaches.
- Several factors that trigger migraines are also associated with magnesium deficiency, including pregnancy, alcohol intake, diuretic drugs, stress, and menstruation.
- Magnesium relaxes blood vessels and allows them to dilate, reducing the spasms and constrictions that can cause migraines.
- Magnesium regulates the action of brain neurotransmitters and inflammatory substances, which may play a role in migraines when unbalanced.
- Magnesium relaxes muscles and prevents the buildup of lactic acid, which, along with muscle tension, can worsen head pain.
- Magnesium is a necessary building block for both the production and uptake of serotonin by brain cells.
- Low levels of serotonin amplify pain.

Dr. Mauskop is a migraine specialist who worked with magnesium experts Drs. Burton and Bella Altura using sensitive magnesium ion electrodes. During one of their first studies, they found a deficiency in ionized magnesium but not serum magnesium in migraine patients.[130] This discrepancy highlighted the lack of correlation between magnesium-deficient states and serum magnesium. By 2012, Dr. Mauskop felt he had

sufficient clinical success, and had published enough about treating migraine with magnesium, to title his paper "Why All Migraine Patients Should Be Treated with Magnesium."[131] Dr. Mauskop advised that "all migraine sufferers should receive a therapeutic trial of magnesium supplementation."[132]

Chapter 4

Magnesium Deficiency Health Conditions - Musculoskeletal

MgDHC #32 - BRUXISM (TEETH GRINDING)

How & Why:

Up to 80 percent of cases of bruxism occur during sleep, and your dentist may be the first to notice that your teeth are being gradually worn down. Bruxism is related to clenching of the jaw muscles during the day and is usually associated with stress or anxiety. Any muscle tension can be the result of magnesium deficiency. One paper recommended nightly magnesium to help with muscle relaxation during sleep.[133]

Moti Nissani, Professor Emeritus at Wayne State University reported that:

> *Magnesium's vital role in nerve and muscle function led at least two researchers to the suspicion that bruxism may be traceable to insufficient consumption, or inefficient utilization, of this metal. A magnesium-deficient diet was found to cause frequent teeth grinding in both sleeping and awake pigs. In humans, the suggested treatment involves magnesium supplements.*

> *According to Ploceniak prolonged magnesium administration nearly always provides a cure for bruxism. This confirms the earlier report of Lehvila, which claimed remarkable reductions (and sometimes even disappearance) in the frequency and duration of grinding episodes in patients who took a daily tablet of assorted vitamins and minerals, including Mg, for at least five weeks. When the supplements were stopped, the symptoms returned.*[134]

See also TMJ, MDHC #66.

MgDHC #33 - FIBROMYALGIA

How & Why:

This condition is characterized by fatigue, painful trigger points, and mood changes, and worsens with exercise. I say fibromyalgia is caused by magnesium deficiency combined with Yeast Overgrowth. My Yeast ReSet Protocol, which is in my book, *ReSet the Yeast Connection*, begins with yeast management. This program consists of:

1. A yeast free diet

2. 2-6 tsps of picometer sized, highly absorbable ionic silver

3. 2 doses of pre-biotics and pro-biotics that include humic/fulvic nutrients and Sacchromyces boulardii

People with fibromyalgia have no energy because their magnesium-driven energy system is bankrupt. Without magnesium to power the Krebs Cycle, ATP is depleted. Exercise intolerance is common in fibromyalgia because of lactic acid build up, which leads to more pain when it is not cleared by a particular enzyme that requires magnesium. Even the work of metabolizing pain medications depletes magnesium. This explains why fibromyalgia patients do not do well on most medications.

If the joints accumulate toxicity, arthritis can occur; if the nerves are irritated by neurotoxins, they begin to lose their myelin sheath, and symptoms that resemble Multiple Sclerosis can result. In fact, autoimmune disease is associated with fibromyalgia and may be the end stage of a buildup of toxicity exacerbated by deficiency of nutrients such as magnesium that are designed to clear toxins from the body.

Patients with fibromyalgia also have chronically low levels of serotonin, which greatly exaggerates their pain. Magnesium is a necessary building block for both the production and uptake of serotonin by brain cells. Yeast overgrowth in the intestines can diminish the production of serotonin in the gut.

According to Shin, et. al.:[135]

> *Beneficial effects of magnesium therapy have been reported in patients with neuropathic pain, such as malignancy-related neurologic symptoms, diabetic neuropathy, postherpetic neuralgia, and chemotherapy-induced peripheral neuropathy. In addition, magnesium treatment is reportedly able to alleviate fibromyalgia, dysmenorrhea, headaches, and acute migraine attacks.*

MgDHC #34 - FIBROSITIS

How & Why:

This type of inflammation affects muscles and connective tissue, mostly that of the back from neck to tailbone. However, it's not a term that is widely used, having been usurped by Fibromyalgia. Chronic inflammation can be caused by magnesium deficiency and excess calcium.

MgDHC #35 - GI SPASMS

How & Why:

The muscles lining the intestinal walls, that perform the peristaltic action that moves intestinal contents to their inevitable end, can go into spasm if you are magnesium-deficient. When that happens, nothing moves forward, including gas, which builds up and can cause excruciating pain.

The worst part of chronic pain from undiagnosed intestinal spasms is that it can lead to inappropriate exploratory surgery. More attention to Irritable Bowel Syndrome ("IBS") as a relatively benign cause of abdominal pain has prevented some of these unnecessary surgeries.

According to Shin et.al.:[136] "Beneficial effects of magnesium therapy have been reported in patients with neuropathic pain, which can be interpreted as IBS pain."

MgDHC #36 - HEADACHES (TENSION)

How & Why:

I addressed headaches in MgDHC #21, but I'd like to reinforce the muscular nature of tension headaches. We know that the latissimus dorsi and neck muscles can tighten up, but there are more than two dozen muscles of the head, neck, and scalp that can also go into spasm and cause head pain.

According to Shin et.al.:[137]

> *Beneficial effects of magnesium therapy have been reported in patients with neuropathic pain, such as malignancy-related neurologic symptoms, diabetic neuropathy, postherpetic neuralgia, and chemotherapy-induced peripheral neuropathy. In addition, magnesium treatment is reportedly able to alleviate fibromyalgia, dysmenorrhea, headaches, and acute migraine attacks.*

MgDHC #37 - JAW SPASMS

How & Why:

A hinge joint connects the jawbone to the cheekbone. The joint can become irritated and inflamed due to arthritis, excessive gum chewing, injury to the teeth or jaw, misalignment of the teeth or jaw, poor posture, stress, and teeth grinding. Most of these factors are aggravated by magnesium deficiency. Jaw pain from muscle spasms can evolve into TMJ, but it begins with magnesium deficiency and is often accompanied by clenching, rippling, twitching of the muscles. The patient may also have an eyelid twitch that indicates magnesium deficiency.

According to Shin, et.al.:[138]

> *Beneficial effects of magnesium therapy have been reported in patients with neuropathic pain, such as malignancy-related neurologic symptoms, diabetic neuropathy, postherpetic neuralgia, and chemotherapy-induced peripheral neuropathy. In addition, magnesium treatment is reportedly able to alleviate fibromyalgia, dysmenorrhea, headaches, and acute migraine attacks.*

MgDHC #38 - MUSCLE CRAMPS

How & Why:

The most common muscle cramp is in the calf muscles and is often called a charley horse when it occurs at night when you stretch in bed. The muscles of the thigh, back, and neck muscles (including the trapezius)

can all be affected. However, any muscle can go into spasm due to magnesium deficiency and relatively high calcium.

I repeat, I was most disappointed doing the research for this booklet by the lack of studies and reviews of the effects of magnesium on skeletal muscles. The ones that I did find had many flaws including very few participants and the use of the most poorly absorbed magnesium of all – magnesium oxide. In contrast, my clinical experience and feedback from customers show an overwhelming positive response to taking a well-absorbed magnesium for muscle cramps. Unfortunately, that experience is not reflected in so-called scientific studies.

MgDHC #39 - MUSCULOSKELETAL

How and Why:

All muscles contain more magnesium than calcium. If magnesium is deficient, calcium floods into muscle cells and after performing a function it refuses to leave and causes spasms and/or sustained muscle contraction in any muscle group in the body. A proper balance of magnesium in relation to calcium can prevent these symptoms.

The following musculoskeletal conditions are all amenable to magnesium therapy. The conditions are mostly muscular; however, those muscles attach to tendons and connective tissue that adhere to bone and can be affected by magnesium deficiency as well. I've seen magnesium deficiency spasms severe enough to move discs and break bones. You only have to think of the Cipro-induced tendon rupture to know this is true.

Note: Fluoroquinolones, including the widely used antibiotic Ciprofloxicin, can cause disabling tendon rupture. The fluoride molecule in Cipro is said to be stable in vitro; however, Cipro can be metabolized by intestinal organisms that release the fluoride, which can bind irreversibly to magnesium. It's obvious to me that the brittleness that MgF_2 imparts to cartilage may be one of the reasons Cipro causes tendon rupture after an escalation of side effects that begin with muscle pain, sore joints, and muscle spasm. Cipro can also be an unrecognized cause of fibromyalgia. The danger from Cipro is that its effects are cumulative, so although the first prescription may not affect you, the next one may.

As noted above, I was most disappointed doing the research for this booklet by the lack of studies and reviews of the effects of magnesium on skeletal muscles. The ones that I did find had many flaws including very few participants and the use of the most poorly absorbed magnesium of all – magnesium oxide. In contrast, my clinical experience and feedback from customers show an overwhelming positive response to taking a well-absorbed magnesium for muscle cramps. Unfortunately, that experience is not reflected in so-called scientific studies.

MgDHC #40 - NECK AND UPPER BACK PAIN, CHRONIC

How & Why:

Along with the major muscle groups of the upper and lower back are the paravertebral or paraspinal muscles. Poor posture, lifting heavy objects improperly, and lack of proper stretching before working out can create chronic muscle spasms that can decrease circulation to the muscle and allow calcium crystals to deposit in the myofascial layer of the muscles. Myofascial release can be helpful, but only works if magnesium is replenished.

According to Shin, et.al.,

> *Beneficial effects of magnesium therapy have been reported in patients with neuropathic pain, such as malignancy-related neurologic symptoms, diabetic neuropathy, postherpetic neuralgia, and chemotherapy-induced peripheral neuropathy. In addition, magnesium treatment is reportedly able to alleviate fibromyalgia, dysmenorrhea, headaches, and acute migraine attacks.*[139]

MgDHC #41 - LOW BACK PAIN

How & Why:

Magnesium deficiency causes muscles that are irritated by poor posture and overwork to go into spasm and could be the cause of chronic low back pain!

In 2013, the journal *Anaesthesia* reported on a study using sequential IV and oral magnesium therapy for chronic low back pain.[140] This study reported that "persistent mechanical irritation of the nerve root sets up a series of events mediating sensitization of the dorsal roots and dorsal horns in the spinal cord. Current evidence supports the role of magnesium in blocking central sensitization through its effect on N-methyl-d-aspartate receptors."

In the study, all patients were already being treated with an array of anticonvulsants, antidepressants, and analgesics. Forty patients in the control group received a placebo for six weeks, while another forty patients in the experimental group received IV magnesium for two weeks followed by oral magnesium capsules for

another four weeks. The researchers found that in a six-month period, a rotating schedule of two weeks of IV magnesium followed by four weeks of oral magnesium reduced pain intensity and improved lumbar spine mobility in this group of patients with intractable low back pain and associated nerve involvement.

Chapter 5

Magnesium Deficiency Health Conditions - Neurological

MgDHC #42 - HYPEREMOTIONALITY

How and Why:

Hyperemotionality is a good overall description for someone with a long list of magnesium deficiency symptoms who no longer feels in control of their health or their life. These symptoms include:

- Anger
- Anorexia
- Anxious behavior
- Apathy
- Apprehension
- Impaired breathing
- Poor concentration
- Confusion
- Depression
- Dizziness
- Fear
- Forgetfulness

- Hyperemotionality
- Irritability
- Light-headedness
- Lump in the throat
- Poor memory
- Nervousness
- Nervous fits
- Sensitivity to bright light
- Sensitivity to EMFs

A 2011 study concludes that "elevation of brain magnesium might be a novel approach for enhancing synaptic plasticity in a regional-specific manner leading to enhancing the efficacy of extinction without enhancing or impairing fear memory formation."[141] In English, that statement simply means that magnesium reduces the physical reaction to fear, which can only be a good thing.

MgDHC #43 - MUSCLE WEAKNESS

How & Why:

Along with muscle weakness, a magnesium-deficient patient may experience a heaviness that is difficult to explain and to overcome. I see it as the push-pull of calcium excess working against magnesium deficiency because calcium tightens muscles and magnesium relaxes them. If you don't have enough magnesium, your muscles remain activated and tense – ready to move but not able to move without the relaxation phase offered by magnesium.

An infant with muscle weakness due to magnesium deficiency is at risk for Sudden Infant Death Syndrome ("SIDS"). Tragically, such a child laid in their crib on their stomach may find that their neck muscles are too weak to lift their head off the pillow and may suffocate.[142] Educating parents to never use the prone position has reduced the incidence of SIDS by 50%.

Potassium deficiency can also aggravate muscle weakness; however, you have to replace deficient magnesium stores before you can overcome potassium deficiency.[143,144]

MgDHC #44 - NEUROLOGIC MANIFESTATIONS

How & Why:

The nervous system is still unchartered territory for most doctors. A paper in the journal *Gene* reported that "evidence points to magnesium's antioxidant, anti-necrotic, and anti-apoptotic effects in cardio- and neuroprotection."[145] It concluded that:

> *because of the antagonistic effects of Ca^{++} and Mg^{++} ions in the presence of high Ca^{++} ion concentration at MtHK (mitochondrion bound hexokinase), MtCK (mitochondrial creatine kinase), and PTP (mitochondrial permeability transition pore), magnesium supplementation may provide cytoprotective effects in the treatment of some degenerative diseases and cytopathies with high intracellular [Ca^{++}]/[Mg^{++}] ratio at these sites, whether of genetic, developmental, drug induced, ischemic, immune based, toxic, or infectious etiology.*[146]

I was taught in medical school that neurological symptoms in older patients were usually due to diabetic neuropathy. Even though one of the signs of diabetes is magnesium deficiency, and even though insufficient magnesium and the relative excess of calcium will cause sustained nerve excitation in any nerve cells in the body, magnesium is never considered as a necessary nutrient in this condition. I was also taught to investigate younger adults with neurological symptoms for multiple sclerosis.

What follows is the possible mechanism for nerve irritation and damage. Calcium channels are jealously guarded by magnesium. At a concentration 10,000 times greater than calcium inside the cells, magnesium only allows a certain small amount of calcium to enter nerve cells to create the necessary electrical transmission. Magnesium immediately ejects the calcium once the job is done. Otherwise, if calcium accumulates in the cell, it triggers hyperexcitability and disrupts cell function, ultimately causing cell death.

Addiction to pain medications complicates the treatment of magnesium-deficient neurologic conditions. Often, patients must enter drug detox clinics to wean off these medications. Magnesium can be helpful in this process as well. See *MgDHC #18: Detoxification*.

Sustained nerve excitation and inflammatory neuritis can occur in any nerve cell in any body part or tissue, causing dozens of different symptoms. For example, occipital neuritis is characterized by electric-like zaps of pain up the back of the head. Similar zaps can occur in the anus and are called "proctalgia fugux." Optic neuritis is inflammation of the eye. Brachial neuritis affects the brachial nerves traveling from the spinal cord to the chest, shoulder, arms, and hands. Ulnar neuritis describes nerve inflammation of the ulnar nerve and affects the arm and hand below the elbow.

MgDHC #45 - NUMBNESS, SKIN SENSITIVITY, TINGLING, TWITCHING, TICS, CRAWLING, CREEPING, ITCHING, PRICKLING

How & Why:

Insufficient magnesium and the relative excess of calcium will cause sustained nerve excitation in any nerve cells in the body, and the symptoms can vary. Muscle twitches and tics may seem like minor irritations to the onlooker, but to the person suffering, it's like water torture, but instead of water slowly dripping on your forehead, your eye or lip or a small muscle in your leg may constantly jump and writhe. The worst part of these bizarre sensations of skin sensitivity, tingling, twitching, tics, crawling, creeping, and itching is that nobody can tell the patient what's going on. When a patient goes to a doctor and says, "these sensations are driving me crazy," they unknowingly put themselves in a mental health category instead of a nutrient deficiency category.

Neurogenic sensations are a sure sign of magnesium deficiency. The nervous system is hyper-excitable and fires off in small muscle groups to try to release tension. The only way to eliminate muscle spasms and twitches is by relaxing the nervous system with the proper amounts of magnesium.

References:

See MgDHC #35, 36 and 37 for references.

MgDHC #46 - PAIN, BURNING; PINS & NEEDLES; STABBING; SHOCKING

How & Why:

I repeat – insufficient magnesium and the relative excess of calcium will cause sustained nerve excitation in any nerve cells in the body. The painful part of nerve irritation is difficult to explain to someone who has never suffered it.

The best example of these symptoms (pins & needles, stabbing, shocking, and burning pain) is shingles, or when the chickenpox virus is reactivated, usually when a patient is under tremendous stress. Severe stress can trigger magnesium deficiency, distracting the immune system enough that the virus surfaces from a dormant state in the nerve root ganglion.

References:

See MgDHC #35, 36, and 37 for references.

MgDHC #47 – RESTLESS LEGS

How & Why:

Over the years, I've received a tremendous number of reports from people whose restless leg syndrome (RLS) improved or even vanished when they took saturation levels of magnesium. RLS causes unpleasant or uncomfortable sensations in the legs and an irresistible urge to move them. The targeted areas are nerves and muscles.

Many of the factors that can cause or worsen restless legs include iron deficiency, Parkinson's disease, kidney failure, diabetes, peripheral neuropathy, pregnancy, and various medications, most of which are related to magnesium deficiency.

Drugs that can cause RLS include antipsychotics, antidepressants (SSRIs), antiemetics, and antihistamines. Since 70% of Americans take one or more medications, RLS can be a drug side effect in a certain percentage of patients. The underlying reason that patients may develop drug-induced RLS could be because of the magnesium deficiency that is a commonly associated with drugs.

A 1998 study showed that magnesium treatment may be a useful alternative therapy in patients with mild or moderate RLS and periodic limb movement syndrome (PLMS).[147] Another study published in 2006 found that magnesium sulfate may relieve restless leg syndrome in pregnancy.[148]

A 2009 review of treatments for restless leg syndrome and periodic limb movement disorder made it clear that drug management is the allopathic medical standard of care for both conditions and the investigators recommended behavioral therapy, not magnesium.[149]

By 2012, it's as if magnesium for RLS never existed. A systemic review and meta-analysis in the journal *Sleep* made no mention of magnesium as a viable treatment for restless leg syndrome.[150] It did mention using iron supplements if the patient's ferritin levels were low. However, the number of drugs used to treat RLS had escalated. I find this greatly concerning because drug toxicity can cause RLS, so it makes no sense to treat possible drug side effects with more drugs unless someone is given a proper trial of therapeutic magnesium.

The unfortunate fact in RLS research is that there is no funding to do proper RLS and magnesium studies.

MgDHC #48 - SEIZURES & CONVULSIONS

How & Why:

The brain is in a state of constant electrical activity that can be measured by an EEG. Brain cells are either stimulated or suppressed in a delicate push-and-pull balance of activity. Switches control these cells; some switches are turned on and some are turned off by neurotransmitters. However, the action of these neurotransmitters could not take place without magnesium, calcium, and zinc, which play various roles in the response of the nerve cells to electrical stimulation.

Brain cells altered by trauma, chemicals, or severe stress can be permanently switched on and fire excessively due to excess calcium in the damaged cells. Repeated firing in groups of nerve cells can result in seizures.

Chapter 7 of *Magnesium: The Nutrient That Could Change Your Life* by J. I. Rodale is about the treatment of epilepsy using magnesium. The book was written in 1963.[151] Rodale writes about the evidence he found showing that seizures could be successfully treated with magnesium. Dr. Lewis B. Barnett, head of the Hereford Clinic and Deaf Smith Research Foundation in Hereford, Texas, learned that magnesium is deficient in people with epilepsy. People with epilepsy have lower magnesium levels than people without epilepsy. In the 1950's, he presented evidence on thirty cases of childhood seizures that responded exceptionally well to high oral doses of magnesium. Barnett found that as his patients' blood magnesium reached normal levels, their seizure activity diminished. He also reported that the treatment was entirely harmless. As a result of his research, Barnett speculated that the main cause for the 3 million clinical and 10–15 million subclinical cases of epilepsy in the population at that time was a deficiency of magnesium.

Even as late as 2012, sixty years after Dr. Barnett proved the importance of magnesium in seizures, there was still only speculation about its use. One review paper said that animal models of epilepsy show that magnesium deficiency decreases seizure thresholds and that low magnesium solutions can generate spontaneous epileptiform discharges from rat hippocampal (brain) slices.[152] They confirm that "Magnesium is a potential modulator of seizure activity because of its ability to antagonize excitation through the N-methyl-d-aspartate receptor."

Intravenous magnesium sulfate for the treatment of seizures and hypertension in pregnancy is safe and effective and universally accepted. Even though large clinical trials using magnesium for other types of seizures and epilepsy have not been forthcoming, many practitioners use oral magnesium as an adjunct to antiepileptic medication.

MgDHC #49 - STROKE

How & Why:

The following excerpt is from my book, *The Magnesium Miracle*.

> *What evidence is there of the importance of magnesium in stroke? All deaths due to stroke among Taiwan residents (17,133 cases) from 1989 through 1993 were compared with deaths from other causes (17,133 controls). It was determined that the higher the magnesium levels in drinking water used by the Taiwanese residents, the lower the incidence of stroke.*[153] *Also, in study of 4,443, men and women aged 40-75, lower dietary magnesium intake was associated with higher blood pressure and stroke risk. The investigators said such results "may have implications for primary prevention."*[154]

> *Decades of research show that withdrawal of magnesium from cerebral arteries causes them to spasm, whereas elevated magnesium produces relaxation.*[155,156,157] *Animal studies show that when there is normal or elevated magnesium in the brain, the damage caused by stroke is reduced and the neurological deficit is lessened. This is because magnesium blocks calcium from flooding the cells and causing injury. Research also indicates that the area of the brain damaged by stroke contains injured neurons that can remain hyperactive (if they don't have enough magnesium) for several hours after the stroke has occurred.*[158]

References (General):

Altura BM et al., "Extracellular magnesium regulates nuclear and perinuclear free ionized calcium in cerebral vascular smooth muscle cells: possible relation to alcohol and central nervous system injury." Alcohol, vol. 23, no. 2, pp. 83–90, 2001.

Li W et al., "Extracellular magnesium regulates effects of vitamin B6, B12 and folate on homocysteinemia-induced depletion of intracellular free magnesium ions in canine cerebral vascular smooth muscle cells: possible relationship to [Ca2+]i, atherogenesis and stroke." Neurosci Lett, vol. 274, no. 2, pp. 83–86, 1999.

Li W et al., "Antioxidants prevent depletion of [Mg2+]i induced by alcohol in cultured canine cerebral vascular smooth muscle cells: possible relationship to alcohol-induced stroke." Brain Res Bull, vol. 55, no. 4, pp. 475–478, 2001.

Li W et al., "Sex steroid hormones exert biphasic effects on cytosolic magnesium ions in cerebral vascular smooth muscle cells: possible relationships to migraine frequency in premenstrual syndromes and stroke incidence." Brain Res Bull, vol. 54, no. 1, pp. 83–89, 2001.

Altura BT et al., "Low levels of serum ionized magnesium are found in patients early after stroke which result in rapid elevation in cytosolic free calcium and spasm in cerebral vascular muscle cells." Neurosci Lett, vol. 230, no. 1, pp. 37–40, 1997.

MgDHC #50 - TRIGEMINAL NEURALGIA

How & Why:

Irritated or damaged nerves may occur anywhere in the body but are very common in the face and neck because of the many nerves in that region. Sitting at computers all day, poor posture, holding a phone to your ear with your shoulder, constantly hunching over your phone, and poor sleep positions are a few of the many triggers that can cause neuritis in the neck, scalp, and face.

Trigeminal neuralgia is the inflammation of the fifth cranial nerve, which innervates the face. It occurs mostly in the over-fifty age group, and up to 95% of cases are caused by an artery pressing on the trigeminal nerve, where the brain stem meets the spinal cord. The current treatment is surgical.

That is "the How," but all sources admit that they do not know why this happens. But I have a theory. What if there is vascular calcification in that particular artery? Evidence shows that most arteries become calcified as we age, especially if there is magnesium deficiency causing a relative excess of calcium. The pressure would have to come from a rigid artery that irritates the trigeminal nerve. If this is the case and the calcified artery is exerting pressure on the trigeminal nerve, the nonsurgical treatment would be to take therapeutic levels of magnesium in order to dissolve the buildup of calcium and direct calcium away from soft tissue into bones and teeth.

According to Shin, et.al., "Beneficial effects of magnesium therapy have been reported in patients with neuropathic pain, such as malignancy-related neurologic symptoms, diabetic neuropathy, postherpetic neuralgia, and chemotherapy-induced peripheral neuropathy. In addition, magnesium treatment is reportedly able to alleviate fibromyalgia, dysmenorrhea, headaches, and acute migraine attacks."[159]

MgDHC #51 - VERTIGO

How & Why:

Most cases of vertigo are due to benign paroxysmal positional vertigo (BPPV), which is caused by the abnormal movement of loose calcium deposits in the semicircular canals of the inner ear when you make

quick head movements. We don't know why the calcium dislodges from specialized sensory sacs that keep our balance by sensing gravity and linear movement. On the inside walls of these sacs is a bed of specialized sensory hair cells embedded with a gel that contains crystals of calcium carbonate. In an area dominated by calcium, it only makes sense that magnesium should be involved to keep calcium from precipitating when it could be causing problems.

BPPV dizziness usually only lasts between a few seconds and five minutes. Over time, the tiny crystals settle inside the semicircular canals and are broken down and the symptoms go away.

References:

Personal experience and observations from patients, clients, and customers.

Chapter 6

Magnesium Deficiency Health Conditions - Ob/Gyn/Pediatric

MgDHC #52 - CEREBRAL PALSY

How & Why:

Cerebral palsy (CP) can occur in an infant who suffers a brain hemorrhage during the final stages of pregnancy, either because of the mother's high blood pressure or through another mechanism that prevents oxygen from getting to the developing baby's brain. Presumably the mother's high blood pressure could be prevented by proper saturation doses of magnesium.

CP can also be caused by low birth weight and prematurity. In CP, the brain is damaged in such a way that it is unable to properly direct muscle function. A damaged brain gives the muscles contradictory signals, and as a result, the muscles lock and become spastic or go limp, creating a disabling condition.

In March 2010, the American College of Obstetricians and Gynecologists issued a Committee Opinion on $MgSO_4$ for fetal neuroprotection. It stated that "the available evidence suggests that magnesium sulphate given before anticipated early preterm birth reduces the risk of cerebral palsy in surviving infants."[160] The 2011 recommendations were repeated in 2019:

> *Antenatal magnesium sulphate administration should be considered for fetal neuroprotection when women present at ≤33 + 6 weeks with imminent preterm birth, defined as a high likelihood of birth because of active labour with cervical dilatation ≥4 cm, with or without preterm pre-labour rupture of membranes, and/or planned preterm birth for fetal or maternal indications. There are no other known fetal neuroprotective agents.*[161]

Since there is no treatment for CP, preventing cerebral palsy would be "very desirable indeed," asserts neurologist Karin B. Nelson of the National Institutes of Health (NIH) in Bethesda, Maryland.

Dr. Nelson and her colleagues concluded a groundbreaking study in 1995 showing that very-low-birth-weight babies in four centers in California had a lower incidence of cerebral palsy when their

mothers were treated with magnesium sulfate shortly before giving birth.[162] The researchers calculated that magnesium sulfate reduced the prevalence of cerebral palsy by an astounding 90 percent and reduced the prevalence of mental retardation by about 70 percent. They speculated that magnesium may play a key role in brain development and possibly prevent cerebral hemorrhage in preterm infants. Several other studies validated these findings.[163,164]

MgDHC #53 - CYSTIC FIBROSIS

How & Why:

A review of 25 studies on magnesium and cystic fibrosis (CF) found the following:[165]

- Hypomagnesemia affects more than half of the cystic fibrosis patients with advanced disease. (**NOTE:** The serum magnesium blood test will be highly inaccurate and miss many people with low magnesium.)
- Magnesium in the blood decreases with age in cystic fibrosis patients.
- Aminoglycoside antimicrobials, used frequently for CF lung infections, induce both acute and chronic renal magnesium-wasting.
- Limited data suggest the existence of an impaired intestinal magnesium balance in CF.
- Observations suggest that magnesium supplements might achieve an improvement in respiratory muscle strength and mucolytic activity.

The researchers concluded, "...the potential of supplementation with this cation deserves more attention." My conclusion is that CF deserves more than just attention but deserves treatment with therapeutic, picometer magnesium.

With respect to clinical observations, I receive very positive feedback from people with cystic fibrosis who supplement picometer, stabilized ions of magnesium.

MgDHC #54 - DYSMENORRHEA

How & Why:

Calcium can act like a painkiller and muscle relaxant, but it may be that it accomplishes this by driving magnesium out of the cells and into the bloodstream to neutralize the extra calcium. So, taking calcium can alleviate menstrual cramps temporarily, until eventually you become even more magnesium-depleted. However, taking magnesium without calcium before your period may forestall the pain altogether. A series of European studies with small groups of women who suffered painful periods consistently showed relief of symptoms when they took high doses of magnesium.[166,167,168]

MgDHC #55 - FEMALE INFERTILITY

How & Why:

Insufficient magnesium and a relative excess of calcium can cause sustained muscle contraction in any muscle group in the body. That fact hits home when you realize that contraction of the smooth muscles lining the fallopian tubes can cause infertility. When the fallopian tubes are in spasm, they will not allow movement of sperm toward the ovary. Taking magnesium relaxes the smooth muscles lining the fallopian tubes, which enhances fertility.

Knowing that infertility is a possible magnesium deficiency condition comes from observing the increased number of women who achieve pregnancy when they begin magnesium supplementation.

Advice passed down through generations of midwives includes giving Epsom salts (magnesium sulfate) throughout pregnancy. Therefore, it comes as no surprise that magnesium is an important part of the whole miracle of ushering new life into the world. Conception, pregnancy, and delivery are times when nature, nutrients, and nurturing are the prescription, not drug intervention.

References (General):

Goldberg B. Alternative Medicine Guide: Women's Health Series 1. Future Medicine, Tiburon, CA. 1998.

Franz KB. "Mg intake during pregnancy." Mg. 1987; 6: 18-27.

Dalton LM et al. "Mg in pregnancy." Nutr Rev. 2016; 74(9): 549-57.

MgDHC #56 - MALE INFERTILITY

How & Why:

Diet and lifestyle can have a tremendous effect on semen and sperm count. Here are some of the known causes: low levels of the amino acid arginine; diminished sperm production by physical restriction of the testicles with tight underwear; overheating the testicles in hot tubs; and toxicity from Yeast Overgrowth, smoking, sugar, coffee, alcohol, and refined foods. More than 90% of male infertility cases are due to low sperm counts, poor sperm quality, or both.

The remaining cases of male infertility can be caused by a range of conditions, including anatomical problems, hormonal imbalances, and genetic defects. Magnesium and zinc are present in significant quantities in healthy semen.

It appears that male infertility is associated with magnesium deficiency. Both magnesium and zinc are found in very significant amounts in seminal fluid. However, infertile men have much lower levels of magnesium, especially when they also have chronic prostatitis or prostate infection,[169] for which the treatment includes a Yeast Detox.

In *The Magnesium Miracle*, I report that "There appears to be no medical cure for swelling of the prostate (benign prostatic hypertrophy, or BPH) that leads to frequent nighttime urination. However, in 1930, Dr. Delbet and a colleague made two separate presentations to the Medical Academy of France showing that magnesium chloride could adequately treat this condition."[170]

MgDHC #57 - PREMATURE LABOR

How & Why:

Premature labor is defined as occurring before the 37th week; it can be caused by high blood pressure or uterine contractions. High BP can be part of the picture of eclampsia, which may be mostly due to magnesium deficiency. Magnesium deficiency can also cause muscle spasms and contractions in the uterine muscles. Perhaps contractions in a magnesium-deficient state can be a natural reaction to the baby pushing against the uterine wall and inciting spasms. I've never heard premature labor described this way, but it makes perfect sense.

Studies show that IV magnesium sulfate or magnesium chloride delay the active phase of labor in mothers with premature rupture of membranes and prevent respiratory distress and other adverse birth outcomes in the baby.[171,172] However, when you search for "magnesium and premature labor," there is an active debate about how long IV magnesium can be used in premature labor. Some evidence points to problems with low calcium levels in the bones of babies after more than 7 days of IV magnesium. Some clinicians are concerned that this finding will prevent doctors from using IV magnesium to help women with premature rupture of membranes save their baby. My recommendation is that women take oral magnesium throughout the pregnancy so they don't develop high blood pressure or premature uterine contractions in the first place.

MgDHC #58 - PREECLAMPSIA AND ECLAMPSIA

How & Why:

High blood pressure, seizures, dramatic fluid retention, decreased urine output, blurry vision, nausea, and abdominal pain are symptoms of preeclampsia moving into eclampsia. A 2002 study found that "Magnesium sulfate ($MgSO_4$) can ease the symptoms of preeclampsia and has reduced seizures stemming from eclampsia by 56 percent when given intravenously in a controlled environment by trained staff."[173] In a 2014 study, the mean serum magnesium of women with mild preeclampsia to severe preeclampsia was significantly decreased compared, with controls with a greater decrease in severe preeclampsia compared with mild preeclampsia.[174] Note that serum magnesium was the test used in the study. If more accurate testing had been used (Magnesium RBC or Ionized Magnesium), I'm sure that more women would have been diagnosed with preeclampsia and properly treated.

Although IV magnesium is the treatment given for pregnancy-induced hypertension, magnesium should be used throughout pregnancy as an oral supplement to prevent symptoms of preeclampsia and eclampsia. Many researchers and clinicians recommend that pregnant women follow up with Magnesium RBC testing and take 300–600 mg of supplemental magnesium.[175,176,177]

If pregnant women routinely take oral magnesium throughout pregnancy, studies suggest that it can prevent complications during delivery and postpartum and help prevent premature births.[178] Clinical trials have demonstrated that mothers supplementing with even the poorly absorbed magnesium oxide have larger, healthier babies and lower rates of preeclampsia, premature labor, sudden infant death, cerebral palsy, and birth defects.[179]

MgDHC #59 - PREMENSTRUAL SYNDROME (PMS)

How and Why:

Mg RBC tests show low levels of magnesium in women with PMS.[180] Even serum magnesium levels, which are low only when there is a severe magnesium deficiency, diminished significantly in the premenstrual week in a group of forty women.[181] In a small trial of thirty-two women, oral magnesium was found to be an effective treatment for premenstrual symptoms related to mood changes.[182] Treatment with magnesium eases headaches, sugar cravings, low blood sugar, and dizziness related to PMS.[183,184] In another innovative research study, magnesium ion levels were tested several times during normal menstrual cycles to determine magnesium and calcium levels in relation to menstrual phases.[185] There was a comparatively high magnesium ion level in the first week after the onset of the period, a statistically significant decrease in magnesium ions midcycle (around the time of ovulation), and a large decrease in ionized magnesium and serum magnesium when the serum progesterone concentration peaked in the third week.

Taking magnesium supplements may be the solution for PMS. One study showed that of 192 women taking 400 mg of magnesium daily for PMS, 95 percent experienced less breast pain and had less weight gain, 89 percent suffered less nervous tension, and 43 percent had fewer headaches.[186] Clinicians often recommend high-dose vitamin B6, usually 50 mg daily with magnesium to assist in its absorption. However, I'm not in favor of high-dose synthetic Vitamin B, but rather methylated & food-based B vitamins.

An elegant study demonstrates that estrogen and progesterone, the female sex hormones, influence magnesium ion levels in the body, which may help explain why magnesium relieves symptoms of PMS, including migraine, bloating, and edema.[187]

MgDHC #60 - SUDDEN INFANT DEATH SYNDROME (SIDS)

How & Why:

The triple-risk model for SIDS describes the intersection of three potential risks:

1. A vulnerable newborn who is magnesium deficient.

2. A critical adjustment and development period in a newborn displaying hyperirritability and unsettled cardiovascular and respiratory control (magnesium deficiency).

3. Inability to cope with an outside stressor such as high-pitched noise, excessive motion or handling, chill, fever, or vaccination (magnesium deficiency).

These risks can trigger a shock-like episode of apnea, unconsciousness, and slow heart rate. Researchers say that SIDS deaths could be prevented by giving pregnant women magnesium and giving infants magnesium during the first critical weeks and months of life.[188]

Mg deficiency has been implicated in sudden infant death syndrome, which has features in common with the sudden cardiac death of adults[189] and may be prevented by giving adequate magnesium to the mother and child. An episode of muscular tension, spasm, or weakness induced by magnesium deficiency could physically prevent a distressed infant from turning its head when lying facedown, thus resulting in suffocation.[190]

Chapter 7

Magnesium Deficiency Health Conditions: General Part II

MgDHC #61 - OSTEOPOROSIS

How & Why:

A 2014 meta-analysis analyzed the association between serum magnesium levels and postmenopausal osteoporosis. Seven studies involving 1,349 postmenopausal women concluded that low serum magnesium is a risk factor for osteoporosis. With drug companies funding most of the osteoporosis research and only focusing on biphosphates and calcium, there are no large clinical trials investigating the magnesium connection in bone production, and there probably never will be.

Reports that the osteoporosis drug Fosamax causes jawbone deterioration are evidence that it causes brittle bones. This side effect of jawbone deterioration has dentists refusing to place dental implants in women who are on Fosamax. This drug destroys osteoclasts and prevents bone from breaking down, but the drug companies did not reckon with the necessary bone-remodeling function of the osteoclast.

Without osteoclasts, bones have no blueprint to follow, and calcium is deposited helter-skelter. X-rays of bones under the influence of Fosamax may appear dense at a glance. But when you look closely, you see that without the remodeling capacity of osteoclasts, the bones' internal structures are in complete disarray. These bones are brittle, and they break easily.

Magnesium deficiency is very common in women with osteoporosis, compared to controls.[191] But what happens when women take enough magnesium? In one study, postmenopausal women with osteoporosis were able to stop the progression of the disease with 250–750 mg of magnesium daily for two years. A group of menopausal women given a magnesium hydroxide supplement for two years had fewer fractures and a significant increase in bone density.[192] Another study showed that by taking magnesium lactate to provide 180–300 mg of elemental magnesium daily for two years, 65 percent of the women were completely free of pain and had no further degeneration of spinal vertebrae.[193]

It is unfortunate that decades ago the treatment for osteoporosis was simplified into the single battle cry "take calcium." Calcium still dominates every discussion about osteoporosis. It is used to fortify dozens of

foods (including orange juice and cereal) and is a top-selling supplement, but its day in the sun seems to be over. One author in the late 1990's cited scientific studies that did not support large doses of calcium after menopause, as the calcifications of soft tissue could be a serious side effect.[194] All that extra calcium was being deposited in soft tissue, causing atherosclerosis, gallstones, kidney stones, heel spurs, and breast tissue calcification, instead of being directed to the bones.

This warning has been bolstered by the multiple studies done by Dr. Mark Bolland,[195] who found that women who take calcium supplements are at greater risk for heart disease as calcium builds up in arteries and causes atherosclerosis. The point to make here is that all the calcium supplementation in the past two decades has not prevented the epidemic of osteoporosis that we are suffering today.

MgDHC #62 - PARKINSON'S DISEASE

How & Why:

Dopamine deficiency results in Parkinson's disease; however, the original insult is the death of the dopamine-producing cells in the substantia nigra section of the brain.

Magnesium is a required cofactor in the production of dopamine. Magnesium blocks the neuroinflammation caused by calcium deposits in the brain. It also helps detoxify the chemicals and heavy metals that damage brain cells.

Unfortunately, there is very little human research on magnesium and Parkinson's, but there has been a flurry of animal research. In the 2015 review "Magnesium in Man: Implications for Health and Disease," the authors state, "Parkinson's patients have low Mg2+ concentrations in cortex, white matter, basal ganglia, and brain stem."[196] According to the writer, "rats with chronic low Mg2+ intake exhibit a significant loss of dopaminergic neurons." They also showed that "in this experimental model, mitochondrial Mg2+ concentrations were decreased." Several other significant findings allowed them to conclude, "Mg2+ supplementation may be beneficial for patients suffering from Parkinson's disease."

As with Alzheimer's, aluminum can be a contributing factor in Parkinson's. In one autopsy study, calcium and aluminum were elevated in the brains of victims of Parkinson's disease as compared to people with normal brains.[197] When I hear that excess calcium is involved, as in this study, I know magnesium therapy should be considered. In another study, magnesium was lower in the brain cortex than in the white matter of Parkinson's brains.[198]

Research indicates that ample magnesium can protect brain cells from the damaging effects of aluminum, beryllium, cadmium, lead, mercury, and nickel. We also know that low levels of brain magnesium contribute to the deposition of heavy metals in the brain that heralds Parkinson's and Alzheimer's. It appears that the

metals compete with magnesium for entry into the brain cells. If magnesium is low in the brain, heavy metals gain access much more readily.

Heavy metals such as cadmium, aluminum, and lead attach themselves to certain enzyme systems in the body. Enzymes function when they have access to the proper cofactors, which are mostly minerals and vitamins, especially magnesium, selenium, vitamin C, vitamin B6, and vitamin E. Displacing minerals such as magnesium either prevents normal enzyme activity or creates abnormal activity leading to cell destruction.

There is also competition in the small intestine for absorption of minerals and heavy metals. If there is enough magnesium, aluminum won't be absorbed. When monkeys are fed diets low in calcium and magnesium but high in aluminum, they become apathetic and begin to lose weight. When their spinal cords are examined under the microscope, they show swelling of the anterior motor cells (movement centers), plus accumulation of calcium and aluminum in these cells.[199]

If you eat from aluminum pots, use antiperspirants containing aluminum, wrap your food in aluminum foil, and drink tap water with high aluminum content, the levels could overwhelm the magnesium in your gut, and aluminum will be absorbed instead of magnesium. This has consequences for the amount of magnesium in your brain and may allow for the buildup of aluminum associated with Alzheimer's and Parkinson's disease.

A number of reports have identified pesticides as another possible cause of Parkinson's disease, with in-home exposure to insecticides carrying the highest risk.[200] Glutathione is a naturally occurring antioxidant made in all the cells of the body, including neurons. Glutathione acts to detoxify the body of certain chemicals and heavy metals. Cells grown in magnesium-deficient conditions, however, have lower glutathione levels. Adding free radicals to a low-magnesium cell culture causes the level of glutathione to fall rapidly as it is used up, making the cells much more susceptible to free radical damage.

Neurosurgeon Dr. Russell Blaylock tells us that a fall in cellular glutathione within the part of the brain called the substantia nigra appears to be one of the earliest findings in Parkinson's disease.[201] You can support the body's glutathione with a formula that contains the amino acid precursor to glutathione, L-methionine, as well as four methylated & food-based B vitamins, all of which greatly assist with the detoxification of heavy metals and chemicals.

MgDHC #63 - RAYNAUD'S SYNDROME

How & Why:

Raynaud's syndrome is a circulatory condition caused by spasms in the smooth muscles of tiny arteries especially in the hands. Spasming blood vessels can cause severe pain, tingling, burning numbness, and white, blue, or red discoloration of the fingers. Other magnesium deficiency symptoms are usually present. Cold

is often the only stimulus that initiates the blood vessel spasms, which may last from minutes to hours. Emotional stress can also play a role in bringing on an attack. Many people who have this condition just put up with it. Even if they consult their doctors for a diagnosis, there is no safe, effective drug treatment for it. Sometimes calcium channel blockers are used, which is ironic because magnesium is a natural calcium channel blocker.

One study found that "the decrease of circulating CGRP (Calcitonin gene-related peptide) after $MgSO_4$ infusion in women with primary Raynaud's provides further evidence that magnesium plays a significant role in its pathophysiology.[202] Another concluded that exposure to cold under standardized conditions may decrease the serum magnesium level in women with primary Raynaud's.[203] Of course, the researchers recommend further studies of the role of magnesium in patients with Raynaud's.

MgDHC #64 - SPORTS INJURIES

How & Why:

Magnesium can help any sort of injury, whether it is from sports or from a trip and fall. Pain, inflammation, muscle spasm, muscle tension, and scarring can all be alleviated with saturation levels of magnesium.

I'll include Traumatic Brain Injury (TBI) in this discussion and reference my *Magnesium Miracle* book. From animal studies, we know that brain magnesium levels fall dramatically at the site of head injury as this mineral is depleted in a nonstop cascade of acute events.[204] In sixty-six human subjects with acute blunt head trauma, the greater the degree of injury, the greater the calcium-ion-to-magnesium-ion ratio. More calcium than magnesium in brain neurons is never a good thing – excess calcium causes ceaseless neuron stimulation, leading to cell death.

Evidence of magnesium ion changes in the blood after TBI can be of both diagnostic and prognostic value in treating a brain injury.[205] Studies of animal and human brain trauma victims suggest that higher magnesium levels are associated with a better recovery.[206] Also, giving sufficient magnesium will create a better healing outcome. Intravenous magnesium sulfate significantly reduces brain edema following brain injury and is used to treat patients with severe TBI without adverse effects.[207] This is important information for any practitioner to know when dealing with TBI.

MgDHC #65 - SPORTS RECOVERY

How & Why:

A review of magnesium and exercise finds that, "Magnesium is involved in numerous processes that affect muscle function including oxygen uptake, energy production and electrolyte balance."[208] When your muscles are engaged in the rapid-fire contraction and relaxation of physical exercise, if there is too much calcium (the initiator of contractions) and too little magnesium (the initiator of relaxation), muscle cramps and a buildup of lactic acid can result.

Magnesium depletion is very common in athletes because so much is lost through sweating, and instead of replacing with proper mineral electrolytes (including magnesium), sports drinks high in sodium and sugar are promoted. Too much sugar and salt can cause brain swelling in the short term and diabetes in the long term.

Even though most athletes and coaches don't know it, magnesium is one of the most important nutrients athletes can possibly take. As noted earlier, mitochondria in our cells make energy molecules called ATP (adenosine triphosphate), which are created under the influence of magnesium.

Volpe (2015)[209] undertook this research paper on "Magnesium and the Athlete" for the following reason:

> *Because of magnesium's role in energy production and storage, normal muscle function, and maintenance of blood glucose levels, it has been studied as an ergogenic aid for athletes. This article will cover the general roles of magnesium, magnesium requirements, and assessment of magnesium status as well as the dietary intake of magnesium and its effects on exercise performance. The research articles cited were limited from those published in 2003 through 2014.*

It is unfortunate that she limits the reference articles to the past two decades.

Volpe gives a very anemic conclusion that more research is needed. She says, "Magnesium is an important mineral with respect to energy metabolism, and thus would seem important with respect to exercise performance. Based on the research presented in this review, it appears that most athletes do not consume adequate amounts of magnesium in their diets. In addition, the computer analyses of diets may overestimate true dietary intake. Although there is some evidence that magnesium supplementation may enhance athletic performance in individuals of all ages, more research is required for longer periods to definitively make the case that magnesium can act as a true ergogenic aid."

Reports from people we know who supplement magnesium are much more encouraging. For example, husband and wife bike racers log 200-mile weekend jaunts with no muscle soreness, no shin splints, and no fatigue. Meanwhile, their fellow athletes suffer for days after an event.

MgDHC #66 - TEMPOROMANDIBULAR JOINT SYNDROME (TMJ)

How & Why:

The temporomandibular joint is a hinge joint that connects the jawbone to the cheekbone. The joint can become irritated and inflamed due to arthritis, excessive gum chewing, injury to the teeth or jaw, misalignment of the teeth or jaw, poor posture, stress, and teeth grinding. One of the most exciting advances in magnesium therapy is the use of magnesium fixation plates and screws for facial trauma or TMJ surgery.[210]

Unfortunately, dentists focus on the joint; whereas, I think the problem originates from spasms of the jaw muscles that put undue pressure on the joint. Taking oral picometer magnesium and applying magnesium lotion to the jaw is recommended.

MgDHC #67 - TONGUE BITING

How & Why:

In a magnesium-deficient person, the muscles of the tongue and the muscles lining the inside of the mouth can go into spasm while the person is eating, causing the teeth to suddenly and inadvertently clamp down on the tongue or the lining of the inside of the mouth. I personally experienced this symptom until I became saturated with magnesium.

Worse than the immediate pain was the ulceration that developed as a result of breaking the skin of my mucus membranes. It wasn't until I began taking my food-based Vitamin C that I could quickly heal those wounds.

References:

My personal experience and observations from patients, clients, and customers.

MgDHC #68 - TOOTH DECAY

How & Why:

Magnesium deficiency creates a relative excess of undissolved calcium that precipitates in dental plaque, hardening the soft, sticky film that builds up on the gums and teeth and contains millions of bacteria. The bacteria cause tooth decay and gum disease if they are not removed regularly through brushing and flossing. A diet high in sugar escalates tooth decay because bacteria that feed on the sugar produce acid that etches into the tooth enamel, making way for dental cavities.

With the proper amount of magnesium in the body, calcium would be directed to the bones and teeth and would not precipitate in soft tissue or plaque. Vitamin K2 also plays a role in properly placing calcium where it belongs.

The paper cited below, "Oral Manifestations of Magnesium and Vitamin D Inadequacy," shares the following information.[211]

> *Adequate nutrition is essential for maintaining good oral health. Minerals such as magnesium, calcium, and phosphorus found in the diet constitute the main structural components of the tooth. Their inadequacy leads to absorption impairment, increased bleeding tendency, bone resorption, looseness, and premature tooth loss. Inadequacy of those essential minerals is associated with delayed tooth eruption and with enamel or dentin hypoplasia (inadequacy).*

> *Taking calcium without magnesium results in soft dental enamel, which cannot resist the acids causing tooth decay. In addition to magnesium, calcium, and phosphorus, adequate vitamin D is needed to maintain optimal oral health. Vitamin D exerts anti-inflammatory effects and helps in calcium absorption and bone remodeling. Moreover, adequate vitamin D status could reduce formation of dental caries by delaying its onset and progression. This paper summarizes the oral manifestations of vitamin D and magnesium inadequacy.*

I wish more dentists would pay attention to the words in that abstract: "Taking calcium without magnesium results in soft dental enamel, which cannot resist the acids causing tooth decay."

Chapter 8

The Case for Completements

RnA ReSet products are called *Completement Formulas* for a reason – because they complete the work of most, if not all, the metabolic-biochemical functions in the body. We don't call them supplements – that name implies that they add something to the metabolic equation; whereas, *Completement Formulas* complete the equation. Our mineral formulas are picometer-sized, stabilized mineral ions; the vitamins are food-based and in the case of 4 B Vitamins, methylated, which means they can also be low potency. Our Omega-3 fatty acid is derived from algae. Low dose formulas are very important because if government regulation comes to the supplement industry, they will go for high potency supplements first. Because our formulas are food-based and low dose, they can be taken by a person with any health condition or on any medication. They can, in fact, help medicine work better allowing people to use less, which can decrease side effects and also support the liver to help clear drug chemicals.

Every biochemical function requires vitamins and minerals as metabolic cofactors to act as catalysts and incentivizers. Essential fatty acids are nutrients that also act as cofactors and are required as structural components of cell membranes, are precursors to bioactive lipid mediators, and provide a source of energy. Without them, body processes slowly grind to a halt and symptoms develop.

Unfortunately, our attention has been on macromolecules like the proteins that make up the structural tissues of our body and protein enzymes that run biological and biochemical functions. Frustratingly, vitamins and minerals have been made so insignificant that they are not even part of our standard medical education. Even the name cofactors diminishes their importance. They should be called Factors. My attention has always been on these so-called 'underdogs' because their value is priceless.

Magnesium: The Master Factor

It's true, my major focus is magnesium. I think of it as the biochemical glue that holds the whole body together. I'll outline the relationship of magnesium and many other cofactors below.

It was fate and serendipity that got me involved with writing a comprehensive book on magnesium, *The Magnesium Miracle.* Because of my own magnesium deficiency symptoms and the laxative effect I was getting from magnesium supplements, I was motivated to find the right form of magnesium to help overcome the wide-spread magnesium deficiency in our population.

Magnesium is not the only factor that can make or break our biology. Yet, it's fairly safe to say that it holds the key to metabolism, and without magnesium the body would not be able to function. There are the magnesium binding sites on protein; magnesium's association with RNA and DNA; magnesium's activation of vitamin D; and how it primes the Krebs cycle that makes ATP energy.

I often quote the Workinger paper[212] which says that magnesium is necessary for the function of 80% of known metabolic processes. I learned the true importance of magnesium in overcoming misdiagnosed diseases when I and my customers could finally take enough to become saturated and not get the laxative effect when we used a picometer-sized, stabilized ion of magnesium. With true saturation of magnesium, all our magnesium deficiency symptoms dropped away.

Epigenetics is the study of the environment both outside our bodies and the internal environment that surrounds our genes that allows them to be turned on or off. An important aspect of epigenetics is the study of cofactors.

What follows is the conclusion of a study published in the *American Journal of Clinical Nutrition*[213] regarding magnesium and gene expression:

> *We observed that magnesium treatment significantly decreased fasting C-peptide concentrations after magnesium treatment compared with placebo treatment and appeared to decrease fasting insulin concentrations. Gene expression profiling revealed up-regulation of 24 genes and down-regulation of 36 genes including genes related to metabolic and inflammatory pathways. Urine protein profiling showed significant differences in the expression amounts of several peptides and proteins after treatment.*

The above study confirms that magnesium can up-regulate 24 genes and down-regulate 36 genes including ones that relate to metabolic and inflammatory pathways. This is a huge breakthrough in diabetes and obesity research, but I imagine not many doctors have read this study or would begin using magnesium even if they had.

Magnesium has an interesting push-pull relationship with heavy metals. Detrimental heavy metals such as cadmium, aluminum, and lead bind to enzyme systems in the body totally disrupting their function. Heavy metal binding sites do not exist in the body but when mineral cofactors are deficient, heavy metals rush in to take their place. Displacing minerals such as magnesium with heavy metals either prevents normal enzyme activity or creates abnormal activity leading to cell destruction. Sufficient saturation with magnesium will not favor displacement. If you are already magnesium-deficient, those enzyme systems requiring magnesium, but not filled with magnesium will be most vulnerable to heavy metal infiltration. That's right, enzymes function properly and do not give access to heavy metals in the presence of the proper cofactors.

Vitamin and Mineral Cofactors

What other cofactors are important building blocks for optimum health? I have written several books about multiple minerals, Potassium, B Vitamins, and the immune system, but in this section I will give an overview of various nutrients that make up my formulas.

The 12 most common mineral cofactors, besides magnesium, are boron, calcium, chromium, copper, iron, manganese, molybdenum, potassium, selenium, sodium, and iron. I include all 12, except iron, in my multiple mineral formula. I think these are referred to as the most common because they are the ones that have been studied most.

In 2014, I created a multiple mineral formula of picometer-sized, stabilized ions and was amazed that 9 of the 12 minerals I chose are necessary for thyroid hormone production. All of them are cofactors that go unrecognized by allopathic doctors in the production of thyroid hormone. Of course, those 12 minerals do a lot more than produce thyroid hormones, they assist metabolic processes throughout the body.

However, the complexity of the human body suggests that any mineral may be involved in the co-factoring business, which is to assist with a biological chemical reaction. We just haven't studied enough of them to find out. That's why I recommend using sea salt in your drinking water. Our multiple mineral also contains a small amount of sodium.

Hydration and mineralization go together. Sea salt is not just sodium chloride, it contains upwards of 72 minerals which can help replace the minerals that are very much lacking in our drinking water due to heavy filtration and chlorination practices. Remember, table salt is just sodium chloride, which can be detrimental when taken in large amounts on its own.

Here are my Water Intake Guidelines:

> *Take your weight in pounds and divide it in half; drink that many ounces of water a day; into each quart/liter of water put ¼ tsp of sea salt.*

NOTE: Use a sea salt that has some coloration, which means the minerals are still in the product and not refined out to pure white sodium chloride.

Mineral ions move into cells through cell mineral ion channels. Once inside the cell they attract water in an osmotic fashion, and the real work of the cells begins. Without minerals, the cells become dehydrated, depleted, and dysfunctional and you can develop edema, which is fluid retention in your extremities.

Our mineral cofactors come from our diet; they can't be made in our cells. Vitamin cofactors are organic compounds that we also cannot make and also come from our diet. So, we see that the limiting factor for the body having sufficient cofactors is our diet. I've been saying for many years that our diet is severely lacking, and we can no longer depend on a so-called "good diet" to provide us with all the nutrients our body needs. Supplementation is required.

Magnesium's Friends

Science says that magnesium assists in the absorption of calcium, phosphorus, potassium, and sodium. Practitioners who perform tissue hair mineral analysis have demonstrated mineral associations with magnesium that also includes manganese. Manganese, calcium, potassium, and sodium are all included in my multiple mineral formula.

We also hear that minerals and vitamins must be in the proper environment and certain conditions have to be met for your body to absorb them properly. However, this is where the *Completement Formulas* have completely changed the rules of engagement. Because *Completement Formula* minerals are picometer-sized, stabilized mineral ions, nothing is needed to help absorption and nothing gets in the way of cellular absorption. So, with our magnesium and our multiple minerals in their stabilized ionic form, that is all that's required for maximum absorption.

Magnesium and Vitamin D

This relationship could have made #14 of my Fun Facts about Magnesium because it is so important. I encourage my customers to use our picometer magnesium and D3K2 supplement together because magnesium is necessary for the activation of vitamin D.

GrassrootsHealth (a vitamin D research organization) using nutrient intake data and blood test levels from over 3,000 participants asked the question "Is supplemental magnesium important for vitamin D levels?"[214] Here is their commentary:

> *We plotted every participant's supplemental vitamin D intake (dose) and blood level (response) and determined the average trends for participants who reported taking no supplemental magnesium, those who reported taking 1 to 399 mg/day, and those who reported taking 400 mg/day or more.*

> *A dose-response chart shows that on average, those taking more supplemental magnesium have a higher vitamin D level for any given vitamin D intake amount than those taking less supplemental magnesium. Specifically, 146% more supplemental vitamin D was needed for 50% of the population to achieve 40 ng/ml (100 nmol/L) for those not taking supplemental magnesium compared to those who took 400 mg/day or more.*

Vitamin D3 assists the absorption of calcium, and any vitamin D formula should include vitamin K2, which directs calcium to the bones. Magnesium also assists in this function. So, all four nutrients work together.

Magnesium and Calcium

Magnesium opens the cells to calcium to create muscle activity and nerve firing, including a regular heartbeat. As mentioned in Fun Fact #3, magnesium and calcium have an antagonistic relationship. Too much calcium will deplete magnesium causing magnesium deficiency symptoms. Magnesium helps solubilize calcium and keeps it out of soft tissues and directs it to the bone. Too much calcium with too little magnesium is associated with kidney stones, gall stones, atherosclerosis, bone spurs, and breast tissue calcification.

I recommend equal amounts of magnesium and calcium – 600 mg each. However, I find that people can get much or most of their calcium from their diet if they are eating dairy products, leafy greens, grains, nuts, and seeds. We refer people to our dietary Cronometer to determine the amount of nutrients their diet contains. If you are not getting 600 mg of calcium, you can take our liquid picometer calcium in the amount you need to make up the total.

Magnesium and Vitamin B Complex

I became a true fan of cofactors when I read a 2014 study called "Epigenetics in Adipose Tissue, Obesity, Weight Loss, and Diabetes." The researchers found that mice fed a fast food diet – high in sugar and fat and low in fiber and lacking vitamins B and D – became obese and developed diabetes.[215] The investigators also found alterations in DNA methylation that could escalate into type 1 and type 2 diabetes.

Suzy Cohen, who wrote *Drug Muggers,* comments on the MTHFR gene SNP mutations that seem to be reaching epidemic numbers.[216] She says "Poor magnesium levels can lead to methylation problems, and that increases depression, whether or not you have the A1298 or C677T SNP (polymorphism)." This means magnesium can have as much to do with methylation as the offending SNP itself. You may have the SNP, but if you are properly saturated with magnesium, you won't express that gene variation.

When I worked on a B complex formula, I knew it had to include methylated and food-based Bs. There are eight B vitamins, four of which are methylated, and they all contribute to your metabolism, allowing your body to convert the food you eat into energy. They each have unique properties.

Vitamin B1: Enabling organs to develop and function properly

Vitamin B2: Phase I liver detoxification pathway

Vitamin B3: Aiding digestion, Phase I liver detoxification pathway

Vitamin B5: Promotes healthy skin, the synthesis of Coenzyme A, which aids respiration

Vitamin B6: Supporting the production of insulin, Phase II liver detoxification pathway, methyl donor

Vitamin B7: Promotes healthy hair, skin and nails. Important for fetal development.

Vitamin B12: Helping in the formation of red blood cells, Phase II liver detoxification pathway, methyl donor

Folate: Phase II liver detoxification pathway, methyl donor

When the B vitamins and magnesium work together, they assist in the following functions:

- Promote normal function of the nervous system
- Support normal psychological function
- Contribute to energy production and metabolism
- Reduce tiredness and fatigue

My B vitamin formula also contains two sulfur amino acids, L'Taurine and L'Methionine. The sulfur assists in the sulfation detoxification pathways in the liver. Taurine supports heart function and methionine is the precursor to the body's most important antioxidant, glutathione.

It's often said that vitamin B6 helps the absorption of magnesium. There are even supplement formulas that combine the two nutrients and claim superior absorption. I searched and couldn't find a study to support this assertion. What I did find was this 1986 study in the journal *Magnesium* and the following abstract:[217]

> *Administration of vitamin B6 at doses of 1 and 1.5 g/day, for 2-7 weeks, showed that only the high doses increased erythrocyte magnesium. Similarly, magnesium balance studies in subjects receiving 500, 1,000 and 1,500 mg/day of vitamin B6 for 8 days showed that doses of 1 g or less had no effect upon the intestinal absorption of magnesium. In view of the existence of reversible neurological complications in subjects taking 2 g of pyridoxine per day, the use of very high doses of vitamin B6 must be considered as inadvisable, even if effective.*

The abstract speaks for itself. The RDA of B6 is 1.5mg for women over 50. So, this study is using one thousand times the RDA to force a possible benefit and there are known neurological side effects with high dose vitamin B6.

This study was from 1986, and I couldn't find any recent studies showing that vitamin B6 helped magnesium absorption. I did find studies showing that B6 and magnesium together showed clinical benefits, but that's to be expected.

As noted earlier, picometer magnesium does not require any assistance since its size allows for full absorption at the cellular level.

Magnesium and Zinc

The relationship between magnesium and zinc is antagonistic. A study of the "Inhibitory effects of zinc on magnesium balance and magnesium absorption back in 1994 stated:[218]

> *Both zinc (Zn) and magnesium (Mg) are widely used as nutritional supplements and the possibility was considered that Zn may interfere with the absorption of Mg, similar to previously reported results obtained with the same dose of supplemental Zn on the absorption of calcium (Ca).*

The study concluded that zinc supplements of 142 milligrams a day decreased magnesium absorption in male subjects. Once again, this is a very high dosage. You might say it's a medicinal amount, which is where some doctors tend to go with dietary supplements. Perhaps they think that vitamins and minerals are not as strong as drugs, so they have to use large amounts to get an effect.

If doctors don't see a result with lower doses, they just keep upping the ante. Our research study at Purdue shows that a picometer-sized, stabilized mineral ion will be preferentially absorbed through the picometer-sized mineral ion channels in the cells.[219] Thus, you don't need to pound the body with high doses of minerals to get the desired effect. In fact, that much zinc will have a negative effect on the copper levels in the body causing copper depletion.

I think of zinc as the skin, hair and nails mineral. It also has the following important functions:

- processing food
- healing wounds
- boosting your immune system
- synthesizing proteins and DNA
- keeping bones strong and healthy
- antiviral

Magnesium and Potassium

Magnesium and potassium are close cousins and share many of the same functions and have many deficiency symptoms in common. You'll constantly hear that most people are able to get their recommended dietary allowance of potassium by eating bananas, dark green leafy vegetables, fish, red meat and poultry. However, when you do the math and see that the RDA of potassium is 4,700 mg and the amount of potassium in a

7-inch banana is only 422 mg; 3 oz of kale has 385 mg; 3 oz of chicken has 322 mg, it's easy to see that you may not be getting enough of this important mineral electrolyte.

Magnesium and Vitamin C

Carole Baggerly, the founder of GrassrootsHealth (Vitamin D research) announced on my April 6, 2020 Radio Show that:

We already see scientifically that people who are taking up to about 1,000mg of vitamin C per day can take considerably less vitamin D to achieve a given serum level of vitamin D. The same seems to be true with magnesium, but GRH is amassing more data to draw conclusions and give us the amount of magnesium that makes a difference.

This is what I've often said, that if you take modest amounts of the necessary nutrients that your body requires, you won't need massive doses of individual nutrients. Of course, my caveat is that I recommend around 600 mg of picometer magnesium because it's necessary for 80% of known metabolic functions. Also, there is a fail-safe that if you take "too much" you will get the laxative effect, preventing a build up of magnesium in the blood. Stories that too much magnesium can cause heart rhythm disturbances come from the misuse of IV magnesium in hospital settings, not from oral supplementation.

Vitamin C is a cofactor in the production of collagen, which is the major component of connective tissue. Scurvy is a severe form of vitamin C deficiency that causes muscle weakness, muscle soreness, and unexplained bleeding as the connective tissues of blood vessels cannot be repaired or replaced. I consider the disfiguring bruising on the arms of the elderly a form of scurvy.

There is a controversy whether food-based vitamin C is superior to ascorbic acid (which is also called vitamin C). I used to favor food-based vitamin C, but I now carry both forms because they each have important uses.

For more information on vitamin C, you have access to several vitamin C experts, Dr. Thomas Levy, Dr. Michael Gonzalez, Dr. Mignonne Mary, and before February 2022, the late Dr. Charles Mary, who were all on my Radio Show on March 30, 2020. We talked about supporting the immune system against viruses. All of these doctors use or have used intravenous vitamin C, ascorbic acid, for the treatment of a myriad of health conditions.

Many customers have told us that they learned so much practical information on this show that they could take care of their health with

confidence using our *Completement Formulas* including vitamin D, vitamin C, picometer zinc, and picometer silver – all of which we are offering to our customers.

Summary

Giving patients low potency nutrient building blocks that are well absorbed at the cellular level is the best form of patient care you can possibly offer. Immediately instituting diet restrictions, forcing detoxification and limitations on coffee, alcohol, or cigarettes are not the way to win over a patient. However, simply taking picometer magnesium will increase ATP production and create vital energy; it will calm the gramophone thoughts in the brain; it will relax muscles to allow a deeper sleep; and act as an anti-inflammatory decreasing pain. With more energy, better sleep and less pain, your patient will be ready to tackle an exercise program and dietary changes and then add the rest of *the Completement Formulas*. It's a protocol that has helped thousands of our customers happily regain their health.

Let me say it another way. My philosophy is to provide the necessary building blocks for body processes so that the body can determine where it will direct its resources in a hierarchy of priorities. Otherwise, practitioners giving high doses of drugs, or nutrients, detox flushes, heat shock sauna therapy, or cold shock therapy can be forcing the body to forgo its priorities. The body can experience cold shock therapy as a life-and-death situation where a survival response is mounted. The increase in growth hormone, or norepinephrine, or white blood cells makes researcher think that the therapy is causing positive changes, but it has to be recognized that participants are using up nutrients that produce these changes and they must be replaced. Similarly, with heat shock therapy using saunas, the water and minerals lost through sweating need to be replaced. However, the precise amount to be replaced is very difficult to measure.

Your body is waiting for the perfect nutrient building blocks to create healthy cells in a healthy body.

Appendix A

1. Responsible for transmissions of energy along nerves
2. Regulates muscle contraction
3. Makes energy for transfer, storage, and use
4. Helps synthesize nucleic acids (DNA & RNA)
5. Facilitates protein, carbohydrate, and fat metabolism
6. Maintains normal cell membrane function
7. Maintains cellular mineral balance
8. Influences all enzymatic processes
9. Uses ATP as an energy source
10. Controls blood pressure
11. Maintains peripheral vascular resistance
12. Regulates the parathyroid gland (key to bone health & proper bone matrix)
13. Normalizes hormone secretion throughout the endocrine system
14. Responsible for muscle relaxation following contraction triggered by calcium
15. Regulates body temperature
16. Influences proper arterial function
17. Reduces inflammation

18. Promotes systemic detoxification

Appendix B

1. Acid reflux
2. Adrenal fatigue
3. Alzheimer's disease
4. Angina
5. Anxiety and panic attacks
6. Arthritis
7. Asthma
8. Atherosclerosis
9. Atrial fibrillation
10. Blood clots
11. Bowel disease
12. Calcification
13. Cholesterol elevation
14. Chronic fatigue syndrome
15. Cystitis
16. Dementia
17. Depression
18. Detoxification
19. Diabetes
20. Fatigue
21. Headaches
22. Heart disease
23. Hypertension
24. Hypoglycemia
25. Indigestion
26. Infection
27. Inflammation
28. Insomnia

29. Irritable bowel syndrome
30. Kidney disease
31. Kidney stones
32. Migraine

33. Musculoskeletal Conditions

a. Bruxism – teeth grinding
b. Fibromyalgia
c. Fibrositis
d. GI spasms
e. Headaches, tension
f. Jaw tension
g. Muscle cramps
h. Muscle spasms
i. Pain, Neck, upper back, chronic
j. Pain, Back, lower chronic

34. Neurologic Conditions

a. Hyperemotionality
b. Muscle weakness
c. Numbness
d. Pain, burning
e, Pain, pins-and-needles
f. Restless Legs
g. Seizures and Convulsions
h. Trigeminal neuralgia
i. Vertigo

35. Ob/Gyn/Pediatric Conditions

a. Cerebral palsy
b. Cystic Fibrosis
c. Dysmenorrhea
d. Infertility – Female
e. Infertility – Male
f. Premature labor
g. Premenstrual syndrome (PMS)
h. Preeclampsia and eclampsia
i. Sudden infant death syndrome (SIDS)

36. Osteoporosis
37. Parkinson's disease

38. Raynaud's syndrome
39. Sports injuries
40. Sports recovery
41. TMJ syndrome
42. Tongue biting
43. Tooth decay

Appendix C

In January 2003, I released the first version of *The Magnesium Miracle,* and with it, the magnesium deficiency awareness revolution began. From that time forward, people who were truly seeking a solution for the missing link to their health could read my book and learn the answer.

In 2017, I was asked to update *The Magnesium Miracle*, and at that time I provided a full revision. But, in 2020, we encountered a very strange thing called COVID, and I felt it was important to update my work with a clearer understanding of how magnesium deficiency contributes to pre-and post-COVID health outcomes, including Long-COVID.

Once a person encounters this information, it would follow that the next question is, "What magnesium do you recommend?" It is an answer that I would love to provide for you here. But I have been advised by my highly experienced natural health industry attorney not to, because in so doing I am marrying my product recommendation with disease discussions, which implies that my products are a cure for disease, which they are not. Their function is to help overcome nutrient deficiencies. Nutrient sufficiency is poorly recognized, and nutrients can help support the structure and function of the body at any level of wellness or illness.

In this Appendix, I would like to challenge both consumers and practitioners to consider ideas that I've been contemplating since COVID started.

Idea #1 - Restorative and Preventative Supplementation is Imperative.

The following abstract, from the journal *Nutrients*, defines the importance of nutrients in supporting the structure and function of the immune system against viruses and bacteria as indicated by the title: "Optimal Nutritional Status for a Well-Functioning Immune System is an Important Factor to Protect against Viral Infections."

The role nutrition plays in supporting the immune system is well-established. A wealth of mechanistic and clinical data show that vitamins, including vitamins A, B_6, B_{12}, C, D, E, and folate; trace elements, including zinc, iron, selenium, magnesium, and copper; and the omega-3 fatty acids, eicosatetraenoic acid and docosahexaenoic

acid, play important and complementary roles in supporting the immune system. Inadequate intake and status of these nutrients are widespread, leading to a decrease in resistance to infections and consequently an increase in disease burden. Against this background the following conclusions are made:

(1) supplementation with the above micronutrients and omega-3 fatty acids are a safe, effective, and low-cost strategy to help support optimal immune function;

(2) supplementation above the Recommended Dietary Allowance (RDA), but within recommended upper safety limits, for specific nutrients such as vitamins C and D is warranted; and

(3) public health officials are to be encouraged to include nutritional strategies in their recommendations to improve public health.

Although most readers will not think that the above abstract is extreme or even out-of-bounds, it is in sharp contrast to current medical and government opinion. I was very excited when the Office of Alternative Medicine (OAM) was established in October, 1991. I thought that finally alternative medicine would be properly studied and claim its rightful place in the medical system.

I was shocked and dismayed when I attended an early meeting of the OAM. My question about nutrients being used to prevent and treat disease evoked the standard answer, which was and still is that the purpose of this agency is to ensure that Americans are meeting their RDA nutrient requirements; that drugs treat disease, and nutrients do not.

Idea #2 - Natural health strategies and guidance by doctors will continue to diminish or disappear.

How do you make an informed decision about your body and its health potential without being able to clearly study all the facts? You cannot make a good decision without clear information. And today, consumers, healthcare practitioners, doctors, and even educational entities, such as naturopathic schools, medical schools, and other advocacy groups are unable to provide clear and prevailing guidance because of the limitation and restrictions being placed on them at every turn.

When it comes to the dietary supplement industry, many credible companies, like mine, are locked out of the health care system and the consumer marketplace because we are not allowed to communicate any benefits of restorative health or disease prevention through natural medicine and its attendant strategies. In my particular case, the problem comes to roost in identifying the problem and providing a solution. In my scientific and medical mind, it makes perfect sense that a magnesium deficiency can be solved with magnesium sufficiency. Thus, it follows that if my clinical mind was able to develop a formulation that would relieve those symptoms in a highly efficacious way, that my formula would be first and foremost my recommendation.

However, this is actually forbidden by the FDA and the FTC, not only for myself as a medical doctor and naturopath, but also for you and even your neighbor. In spite of the First Amendment, which guarantees Freedom of Speech, I am not allowed to display your testimonial about the effectiveness of my formulas. Neither you nor I can claim that any dietary supplements can enhance health.

In fact, there are only about 13 authorized health claims that can be used in food or dietary supplement labeling to show that a food or a food component may reduce the risk of a disease or a health-related condition. If a food or nutrient company wants to make a health claim for a nutrient that has not already been approved, the manufacturer or medical entity must submit a petition to the FDA and move through an extensive and expensive review process for approval.

Yet, every year there are thousands and thousands of scientific studies that are initiated on behalf of dietary supplement companies and food manufacturers to substantiate the validity and beneficial nature of their products. When you dig deeper into the health claim approval process, you finally discover that the only studies that really count are randomized control trials. The FDA and FTC declare that no other studies are rigorous enough to meet their stringent criteria.

Additionally, health claims are limited by the fact that anecdotal compilations conducted in support of a health claim must be related to an already-approved biomarker, for example, LDL cholesterol or blood pressure are approved biomarkers.

Health claims that purport to reduce the risk of cancer, for example, are nearly impossible to make because even if the supplement company invested in a randomized clinical trial to support the claim, there is only one biomarker on the FDA's short list approved for health claims, and that involves intestinal polyps.

Even in the treatment of breast cancer, vitamin D is not an approved nutrient and cannot be claimed as a benefit to those who have breast cancer. What can be claimed is that vitamin D lowers the risk of osteoporosis for women, who are undergoing breast cancer treatment and taking estrogen lowering drugs, because the claim is related to vitamin D and osteoporosis which is a qualified health claim the FDA has approved.

The complexity of the constraints placed on the natural health industry, once pointed out, is easy to see. Hopefully, this new awareness will help you navigate this medical and bureaucratic minefield. We are biologically tied to the Earth and its many benefits, but the regulatory aspects of our industry do not favor natural medicine, even though many drugs were originally derived from plants.

These regulations put the doctor, naturopath, chiropractor, herbalist, acupuncturist, and other health care practitioners in the middle of the pressure cooker that comprises the FDA's regulation of health claims. The doctor's or naturopath's professional expertise; their constitutional right to free speech [FTC]; and the consumer or client whose health condition and health recovery should be foremost, instead, come last.

Idea #3 - The dietary supplement industry can be its own worst enemy.

Consumers and health care practitioners should be able to discover the scientifically proven benefits of dietary supplements without conflict or contradiction. As an advocate for clinical research on human subjects, I have submitted my own products to rigorous clinical study. Yet, even with clinical validation, companies within the dietary supplement industry exaggerate the benefit of their products and confuse the consumer with absurd marketing tricks.

A perfect example of this is the blatant promotion of Magnesium L-Threonate as "the only" magnesium to cross the blood-brain-barrier.

In 2009, a rat study was published, "Enhancement of Learning and Memory by Elevating Brain Magnesium." Everyone heard about this study because the news that a patented magnesium was able to get into the brain and cerebrospinal fluid – of rats – was promoted relentlessly. The study authors implied that only their magnesium was able to penetrate the impenetrable blood brain barrier (BBB). I immediately knew this was an incredible exaggeration because even magnesium oxide with a 4% absorption into the blood can have positive effects on the brain.

I carefully read the Magnesium L-Threonate study to confirm that there was only a 7% increase in magnesium in the cerebral spinal fluid compared to magnesium citrate. With that tiny, tiny difference (that could be declared to be within the normal 10% study error), the study authors declared their product to be The Holy Grail that conquered the BBB.

Here is what I wrote in an Aug 2014 blog about the Magnesium L-Threonate study:

I've been asked about the newest magnesium on the block—Magnesium L-Threonate. The manufacturers are on record as saying theirs is the only magnesium that crosses the blood brain barrier. However, that is definitely NOT an accurate statement. The treatment of migraines, seizures, stroke, head injuries, and other nervous system problems with even the highly unabsorbed

magnesium oxide (at 4%) shows that all types of magnesium work at the neuron level, which means they all get into the brain to some extent.

To this day, I remain concerned about marketing claims for Magnesium L-Threonate. Not only have they not corrected this misconception, their product has become so expensive that it can be an excessive burden on a consumer who has a genuine concern about their cognitive health and may be on a fixed income.

Most Magnesium L-Threonate products have deceptive labeling. They say on the front of the label "2,000 mg of Magnesium L-Threonate." So, you think you are getting 2,000 mg of magnesium and do not mind paying the exorbitant price. But then the Supplement Facts on the back say you have to take 4 capsules to get a meager 144 mg of elemental magnesium. The rest of the capsule contains L-Threonate, which has neurobiological effects by itself that you may be attributing to the small amount of magnesium.

The importance of supplementation for brain health cannot be overestimated. Chapter 3, "Magnesium Transport Across The Blood-Brain Barriers," excerpted from the book, *Magnesium in the Central Nervous System*, shows that any form of supplemental magnesium has access to the brain.

The following edited abstract shows you why: (Bracketed words are my additions.)

The finding that magnesium levels are reduced in acute and chronic brain diseases has led to a recent surge in interest in the role of magnesium in the normal and injured nervous system, although the mechanisms of magnesium decline in pathological conditions, and its availability in the neural tissue after administration are not fully understood. The brain has two main barrier systems:

(1) the blood-brain barrier (BBB) formed by brain capillary endothelial cells which separate the blood from the extracellular fluid in the neuropil (a dense mass of unmyelinated axons, dendrites and glial cell processes); and

(2) the blood-CSF barrier (BCSFB) formed by choroidal epithelial cells which separate the blood from the CSF.

Recently, transient receptor potential melastatin members have been identified as cation channels for magnesium transport. Although it is not known if choroidal epithelial cells express these molecules, they are expressed by brain endothelial cells, and may play a role in magnesium transport. It is evident that magnesium enters the CNS through the BBB and is actively transported by choroidal epithelial cells into the CSF.

This abstract very clearly shows us just how vital magnesium is to the brain because it has its own transport mechanism in place. It is imperative that well-made magnesium supplements are represented accurately within the industry to support the consumers it serves. In this regard, the dietary supplement industry can be just as negligent as big Pharma, competing for profits at the expense of the consumer, instead of rallying behind the naturopath's creed, "To Do No Harm." Having scientifically validated information and affordable products should be our primary purpose.

Idea #4 - Consumers are at a disadvantage.

My regular followers have heard me say that when I was in medical school in 1979, I became a naturopath because it was the most logical path to my success as a doctor. I believed that the marriage of medicine and nature was so clear that by the time we got into the 90's, every doctor would be a naturopath as well.

It seemed to me that teaching my patients how to focus on diet, lifestyle, and using supplemental nutrients, along with the moderate use of drug therapies for critical care and selective surgeries for trauma and life-threatening illnesses, was the way of the future.

Instead, the opposite has happened. Our country is living under the burden of a completely bloated and out-of-control medical system that is placing an unsustainable financial burden on our country. Medical errors are generally ranked third as the cause of death in America. While clinical research demonstrates that lifestyle changes and food-based nutrients work, many consumers rely on drugs and devices for their health care, and their health maintenance, often to their peril.

In the meantime, US Center for Disease Control and global health organizations like the WHO continue to provide research that demonstrates that many Americans and global citizens are clinically deficient in necessary nutrients, including magnesium, vitamin D, vitamin A, vitamin E, folate, zinc, iodine, and iron.

It is an incredible contradiction. The federal government studies and reports on the problem, and then suppresses the solutions.

Death by Modern Medicine is a book that I wrote in 2005 to expose the dark side of medicine. I had hoped the book would have some impact and improve the general state of affairs. Instead, we have a state of chaos.

Here is how we win; here is the solution: If the mission of allopathic medicine is to keep the population sick and hooked on drugs, we win by staying healthy and aware – it is as simple as that!

Idea # 5 - Health freedom and personal choices must be secured by individuals and families.

As a doctor, naturopath, researcher, public health advocate, and CEO of my own dietary supplement company, I have been at the center of the practice of natural and allopathic medicine for 45+ years. I am grateful that my path led me through this challenging landscape and dropped me off at the door of magnesium deficiency. Necessity is the mother of invention for sure.

I diagnosed myself as severely magnesium-deficient while I was writing *The Magnesium Miracle*, and I became laser-focused on the role of magnesium for my health, and the health of everyone else! For a person to be truly healthy, I realized they had to eliminate magnesium deficiency as a root cause of disease through proper supplementation. My mission is to spread this information far and wide.

In the post-COVID environment, it is imperative that you secure your own health freedom now. Health freedom means staying healthy and free from disease and free from unnecessary medical intervention. Please do all you can to protect your health choices and those of your family in these challenging times.

General Research

Costello, Rebecca B. and Rosanoff, Andrea; "Increasing public health awareness of magnesium: one step at a time;" Magnesium Research 2022; 35 (1): 29-31.

Appendix D

Overview

The journal *Nutrients* just released a Special Issue called "Magnesium: From In Vitro to Clinical Research" covering 15 studies published in 2022 showing the current focus of magnesium research. Below are the 15 studies but not in the normal citation format. They include part of the abstract and the link to read more, and sometimes the link will deliver the whole article. The topics run the gamut of COVID-19, inflammation, cardiovascular disease, IBD, cystic fibrosis, diabetes, cerebrovascular disease, metabolic disorders, and migraine. As I've noted before, there is no shortage of magnesium research to prove the importance of magnesium, but there must be a way to bring this information into clinical practice. Perhaps this book will help.

The Research

Subclinical Cardiovascular Disease Markers in Relation to Serum and Dietary Magnesium in Individuals from the General Population – The KORA-MRI Study- Several studies have implied a role of magnesium in the development of cardiovascular disease (CVD). Thus, magnesium might serve as a potential risk marker for early CVD. Therefore, we investigated the association of serum magnesium and dietary magnesium intake with markers of subclinical CVD in a population-based study[...][220]

Reduction in Serum Magnesium Levels and Renal Function Are Associated with Increased Mortality in Obese COVID-19 Patients - Several studies provide evidence that obesity is a significant risk factor for adverse outcomes in coronavirus disease 2019 (COVID-19). Altered renal function and disturbances in magnesium levels have been reported to play important pathophysiological roles in COVID-19. However, the relationship between obesity, renal function, circulating magnesium levels, and mortality in patients with COVID-19 remains unclear[...][221]

The Response of the Human Umbilical Vein Endothelial Cell Transcriptome to Variation in Magnesium Concentration - Vascular endothelial cells have a critical role in the maintenance of cardiovascular function. Evidence suggests that endothelial function may be compromised under conditions of magnesium deficiency, which increases vulnerability to inflammation. Whole genome transcription analysis was used to explore the acute (24 h) effects of magnesium on human umbilical vascular endothelial cells (HUVEC) cultured in low (0.1 mM) or high (5 mM) concentration[...][222]

Magnesium—A Potential Key Player in Inflammatory Bowel Diseases? - The altered magnesium status in inflammatory bowel disease (IBD) patients may have a significant clinical imprint considering its role in cell signaling and genomic stability, as well as its involvement in IBD patients' fatigue. Our study pioneers the investigation of magnesium hair concentration patterns in an adult population of IBD patients[...][223]

Effect of a Combination of Magnesium, B Vitamins, Rhodiola, and Green Tea (L-Theanine) on Chronically Stressed Healthy Individuals—A Randomized, Placebo-Controlled Study - The effect of a combination of magnesium, vitamins B6, B9, B12, rhodiola and green tea/L-theanine (Mg-Teadiola) on stress was evaluated in chronically stressed, otherwise healthy individuals. Effects on stress-related quality-of-life parameters (sleep and perception of pain) were also explored[...][224]

Magnesium Status and Calcium/Magnesium Ratios in a Series of Cystic Fibrosis Patients - Magnesium is an essential micronutrient that participates in various enzymatic reactions that regulate vital biological functions. The main aim was to assess the magnesium status and its association with nutritional indicators in seventeen cystic fibrosis (CF) patients. The serum magnesium and calcium levels were determined using standardized methods and the dietary magnesium intake by prospective 72 h dietary surveys[...][225]

Magnesium-to-Calcium Ratio and Mortality from COVID-19 - Obesity, type 2 diabetes, arterial hypertension, decrease in immune response, cytokine storm, endothelial dysfunction, and arrhythmias, which are frequent in COVID-19 patients, are associated with hypomagnesemia. Given that cellular influx and efflux of magnesium and calcium involve the same transporters, we aimed to evaluate the association of serum magnesium-to-calcium ratio with mortality from severe COVID-19[...][226]

Effect of Magnesium Supplementation on Inflammatory Parameters: A Meta-Analysis of Randomized Controlled Trials - Magnesium (Mg) may have several beneficial effects on human health outcomes. One hypothesized mechanism eliciting such effects is the action of Mg on serum inflammatory parameters. However, studies on this topic to date have several important limitations. Therefore, the present systematic review and meta-analysis aimed to summarize the current state of the art of all randomized control trials (RCTs) investigating the effects of Mg supplementation versus placebo on serum parameters of inflammation[...][227]

Associations of Serum Magnesium with Brain Morphology and Subclinical Cerebrovascular Disease – The Atherosclerosis Risk in Communities-Neurocognitive Study - Circulating magnesium has been associated with a lower risk of dementia, but the physiologic effects by which magnesium may prevent neurological insults remain unclear. We studied 1466 individuals (mean age 76.2 ± 5.3, 28.8% black, 60.1% female) free of prevalent stroke, with measured serum magnesium and with available MRI scans obtained in 2011–2013, participating in the Atherosclerosis Risk in Communities Neurocognitive Study (ARIC-NCS)[...][228]

Oral Magnesium Supplementation for Treating Glucose Metabolism Parameters in People with or at Risk of Diabetes: A Systematic Review and Meta-Analysis of Double-Blind Randomized Controlled Trials - There is a large and growing body of literature focusing on the use of oral magnesium (Mg) supplementation for improving glucose metabolism in people with or at risk of diabetes. We therefore aimed to investigate the effect of oral Mg supplementation on glucose and insulin-sensitivity parameters in participants with diabetes or at high risk of diabetes, compared with a placebo[...][229]

The Role of Magnesium in the Pathogenesis of Metabolic Disorders - Magnesium (Mg) is an essential nutrient for maintaining vital physiological functions. It is involved in many fundamental processes, and Mg deficiency is often correlated with negative health outcomes. On the one hand, most western civilizations consume less than the recommended daily allowance of Mg[...][230]

Magnesium Orotate and the Microbiome–Gut–Brain Axis Modulation: New Approaches in Psychological Comorbidities of Gastrointestinal Functional Disorders - Magnesium orotate has been cited in the medical literature for the past three years as a possible adjuvant in some pediatric and adult gastroenterological disorders associated with dysbiosis. Studies also focus on the possibility of adding magnesium orotate in psychiatric disorders' treatment, such as major depression and anxiety[...][231]

Magnesium as an Important Factor in the Pathogenesis and Treatment of Migraine—From Theory to Practice - So far, no coherent and convincing theory has been developed to fully explain the pathogenesis of migraine, although many researchers and experts emphasize its association with spreading cortical depression, oxidative stress, vascular changes, nervous excitement, neurotransmitter release, and electrolyte disturbances. The contribution of magnesium deficiency to the induction of cortical depression or abnormal glutamatergic neurotransmission is a likely mechanism of the magnesium–migraine relationship[...][232]

Reply to Scarpati, G.; Piazza, O. Comment on "Guerrero-Romero et al. Magnesium-to-Calcium Ratio and Mortality from COVID-19. Nutrients 2022, 14, 1686"- We thank Dr. Scarpati and Dr. Piazza for their interest and comments and Dr. Piazza for their interest and comments regarding our article on sMg-to-sCa ratio as a biomarker for identifying individuals at high risk of mortality from COVID-19[...][233]

Comment on Guerrero-Romero et al. Magnesium-to-Calcium Ratio and Mortality from COVID-19. Nutrients 2022, 14, 1686 - We read with great interest the article by Romero et al[...][234]

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Meet Dr. Dean

Dr Carolyn Dean MD ND is the author of over 50 books including best seller *The Magnesium Miracle* and other noted publications including *IBS for Dummies*, *Hormone Balance*, *Death by Modern Medicine*, and 110+ Kindle books to date. Dr Dean is committed to helping anyone understand more about nutrients, their requirements in the body, and ways to promote health and vitality in a proactive manner.

In 2015, Dr Carolyn Dean MD ND launched *the RnA ReSet* brand based on nutrient protocols she built through 40+ years of experience in private healthcare practice. Dr Dean's career as a medical doctor and naturopath resulted in a collection of unique, proprietary formulations that support precise applications while remaining safe for everyday use.

Dr Dean continues to provide her leadership and vision for enabling people to take control of their own health. This includes her 45+ years of educational resources including guidebooks, presentations, and a history of other audio, video, and written assets for anyone wanting to learn more about nutrients and their health.

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Disclosure

Dr. Dean has a creative and economic interests in the innovative products of *RnA ReSet*, including, but not limited to: *RnA ReSet Drops, ReMag, ReMyte, ReAline, ReCalcia, Pico Potassium, ReStructure, Pico Silver, Pico Zinc, Flora ReVive, Flora ReVive Lite, Whole C ReSet, Vitamin C ReSet, D3K2 ReSet, Omega-3 Algae A+E, ReNew Serum,* and our agricultural product, *Mighty Mash*. For more information regarding all *the Completement Formulas*, go to the product website *RnA ReSet*. If you have questions, email Customer Service at support@rnareset.com. If you wish to place an order by phone, call 1-888-577-3703.