

MAGNESIUM:

The Key to Health and Life

By James South, M.A.

Aside from the fact that the following conditions are epidemic in modern America, what do these all have in common: Cardiovascular disease (including heart attacks, cardiac arrhythmias, angina and congestive heart failure),[1-3] osteoporosis,[4-6] hypertension,[7-9] insulin resistance and type 2 diabetes,[10-12] inflammation,[13-15] asthma,[16-18] chronic stress,[19-21] noise-induced hearing loss,[22-24] colorectal cancer,[25] alcoholic brain damage,[26] depression,[27] tension and migraine headaches,[28-29] attention deficit hyperactivity disorder,[30-32] preeclampsia (a pregnancy disorder),[1] kidney stones,[33] hyperlipidemia,[34,35] muscle cramps and weakness,[27] and poor memory?[27]

The answer: Every one of these conditions can be caused by or is strongly associated with cellular magnesium deficiency, and many of these conditions have been successfully treated with magnesium supplementation.

Mainstream nutritionists generally assume that magnesium deficiency is rare in America. The phrase “magnesium-deficiency” is somewhat equivocal. It may refer to a dietary deficiency of magnesium, or to significant depletions of total body magnesium stores. Is there any reason to believe either form of magnesium deficiency is common in America? It turns out that a host of factors have conspired to promote a widespread prevalence of at least mild magnesium deficiency in America, and that this magnesium deficiency may be responsible, at least in part, for much of the chronic ill-health of the American population.

Magnesium: Mineral Superstar

Magnesium has not attracted the degree of public attention that has been lavished on its complement/antagonist, calcium. Yet this public relations failure is certainly not due to any biochemical unimportance of magnesium. Magnesium is essential to activate over 300 different enzyme systems critical to life, more than any other mineral.[27]

Magnesium is essential in the glycolytic cycle that converts sugar to ATP (adenosine triphosphate) bioenergy.[36] Magnesium helps stabilize ATP; indeed 80 percent of the magnesium inside the cell is complexed with ATP.[36] Magnesium is intimately involved in nucleic acid metabolism and the synthesis of DNA and RNA.[36] Magnesium plays key roles in the second messenger systems that mediate hormonal effects on cells.[36] Magnesium is a major controller of cellular ion channels, governing the flow of sodium, potassium and calcium in and out of cells.[36]

While physicians frequently use calcium channel-blocker drugs to treat various ailments, magnesium has been called “nature’s physiological calcium channel blocker.”[36] Magnesium plays critical roles in nerve function and in the contraction and relaxation of muscles, including the smooth muscle cells that constrict or relax arteries.[36] In a very real sense, magnesium is the “mineral of life.” Magnesium is the center of the chlorophyll molecule, without which plant life would not exist, and so neither would the oxygen of our atmosphere, and so neither would we. It is hard to overestimate the importance of magnesium.

Magnesium Homeostasis

Because magnesium is so critical to human life, the body works hard to maintain a proper balance of magnesium. Approximately 60 percent of the body’s magnesium is in the skeleton; 39 percent is inside cells (20 percent in skeletal muscle), and less than 1 percent outside the cells (mainly in the bloodstream).[27] The maintenance of the body’s stores of magnesium is a function of three variables:

dietary magnesium levels, intestinal magnesium absorption, and magnesium excretion—which is primarily controlled by the kidneys.[27] And, unfortunately for modern Americans, there are numerous and common problems with these three mechanisms by which the body tries to regulate its magnesium status.

Dietary Magnesium: Not What It Used to Be

As one study noted, “The dietary intake of magnesium declined in the United States from 475 [to] 500 milligrams per day in 1900 to 215 [to] 283 milligrams per day in 1990, possibly owing to an increase in the consumption of processed foods.... [I]t [is] difficult to reach the recommended daily allowance of 400 milligrams through diet alone.”[1] “Evidence suggests that the occidental ‘American diet’ is relatively deficient in magnesium, whereas the ‘Oriental diet,’ which is characterized by a greater intake of fruits and vegetables, is rich in magnesium.”[37]

Wester points out that refining and cooking may diminish the magnesium content of foods substantially, with boiling of vegetables causing a loss of 50 percent of the magnesium, with brown rice losing 80 percent of its original magnesium content when refined into white rice.[27] Magnesium is rarely added back to the soil in modern synthetic fertilizers, thus lowering magnesium levels in food.[27]

Absorption Barriers

There are many factors that inhibit magnesium absorption in the small intestine. A high calcium intake can cause magnesium deficiency. One study’s authors noted, “In subjects on low magnesium intake, calcium supplementation seems to reduce dietary magnesium retention.”[27]

Millions of Americans swallow thousands of milligrams of calcium daily attempting to ward off osteoporosis. Ironically, research shows, “Increasing the magnesium intake improves rather than interferes with calcium utilization.”[27] A high-fat diet (the typical American diet is 40 to 45 percent fat calories) may decrease magnesium retention by 50 percent, even in those consuming adequate magnesium.[38] Magnesium easily combines with phosphoric acid to make magnesium phosphate,[27] which is totally insoluble and precipitates out of the intestinal juices, becoming part of the feces. Americans drink tons of phosphoric acid-containing soft drinks. Oxalates in foods such as spinach, rhubarb and chocolate form insoluble magnesium compounds that cannot be absorbed. Laxatives also promote intestinal magnesium loss.

Magnesium Recycling Barriers

The main way the body conserves its magnesium supply is through the kidneys. Healthy kidneys typically reabsorb as much as 95 percent of the magnesium before it is excreted in the urine.[27] Unfortunately, there are many common factors that promote the kidney’s excretion of magnesium. These include diuretics and digitalis;[1,27] alcohol;[27] high intake of sodium and calcium;[27] high sugar intake;[27] coffee; high blood levels of the stress hormones adrenalin, noradrenalin and cortisol;[1,19,27] aminoglycosides, cisplatin and cyclosporine;[1] and noise stress.[22]

Detecting Magnesium Deficiency

Magnesium is not routinely measured by physicians when they order bloodwork, and usually it wouldn’t matter anyway. “Total body stores and serum levels [of magnesium] are poorly correlated; serum levels can be normal in the presence of low intracellular stores,”[1] research shows. In addition “...alkalotic patients may have low serum magnesium levels without total-body magnesium deficiency, while those with acidosis may have normal serum levels despite deficient intracellular stores.”[1]

Wester points out that “During prolonged fasting a deficit of 20 percent of total-body magnesium may occur but serum magnesium remains unchanged.”[27] How then can one detect a magnesium deficiency problem? The Society for Magnesium Research emphasizes the importance of patient history as well as

clinical symptoms in addition to serum ionized magnesium levels.[39]

Anyone eating the typical high-meat, high-fat, high-sugar-and-white-flour American diet is likely to have a low dietary magnesium intake. Anyone whose life contains the various magnesium absorption-inhibitors mentioned previously is likely to be poorly absorbing the magnesium in their diet. Anyone whose life contains the anti-kidney magnesium recycling factors mentioned above is likely to be urinating away much of their magnesium. Another way to gauge possible magnesium deficiency is to check for magnesium-deficiency symptoms.

Magnesium Deficiency Symptoms

Some of the common symptoms of magnesium deficiency include:[27,40,41]

- Chronic fatigue, weakness and exhaustion
- Excessive noise and pain sensitivity
- High blood pressure
- Headaches
- Irritability, nervousness, anxiety
- Depression and apathy
- Muscle spasms, tics, cramps, tremors (especially of hands, feet, or facial muscles)
- Difficulty with memory and concentration
- Insomnia
- Chronic constipation
- Chronic excessive muscle tension
- Confusion and disorientation
- Anorexia (poor appetite)
- Emotional instability/overreaction
- Ataxia (an impaired ability to coordinate movement)
- Irregular or rapid heartbeat

Wester remarks, however, that in mild magnesium deficiency the "...symptoms are often vague and uncharacteristic." [27]

Magnesium and the Calcium Controversy

Insofar as the American medical/nutritional establishment promotes intake of any supplements, it is calcium that is favored for megadose supplementation these days. Yet as noted earlier, high calcium intake both retards magnesium absorption and promotes magnesium excretion in the urine.

There are further reasons why America's high calcium craze combined with the typical low magnesium diet may be less than a good idea. In a classic 1982 article ("The Calcium Controversy"), Guy Abraham, M.D., pointed out that humans have evolved in a potassium-and-magnesium-rich but calcium-and-sodium-poor environment. As a consequence, the body has evolved mechanisms to absorb and conserve calcium and sodium, but not magnesium and potassium. Vitamin D, generated in the skin from sunlight and cholesterol, is a powerful calcium-conserving agent after it is converted to 1,25 dihydroxy D3.[42]

Normally the body works to maintain calcium inside the cell at a level only 1/10,000 as high as extracellular levels. Excessive intracellular calcium will be taken up by mitochondria, gradually destroying them and leading to cell death.[42] Magnesium stimulates release of the hormone calcitonin, which drives calcium into the bones where it belongs, and out of the soft tissues where it doesn't.[42] A high-calcium, low-magnesium diet and cellular environment will thus tend to favor calcification of soft tissues as osteoporosis gradually develops.[42] Abraham points out that Asian and African diets are low in calcium (300 to 500 milligrams daily), yet high in magnesium, and osteoporosis is not more common in Asia and Africa than in Europe and America, where daily calcium intakes from high-dairy diets are

often 800 to 1,000 milligrams daily, combined with low magnesium.[42]

Abraham notes, “When patients with severe osteoporosis were given massive doses of calcium they went into positive calcium balance, but radiographic studies revealed no change in the osteoporotic process. Where did that calcium go? Obviously into the soft tissues where it does not belong.”[42] Abraham adds, “Magnesium has a calcium-sparing effect and decreases the need for calcium.”[42]

The country of Finland may serve as an object-lesson on the perils of a high-calcium, low-magnesium lifestyle. Marier observes that in Finland the per capita dietary intake of calcium is among the highest in the world at 1,300 milligrams per day, yet Finland has an exceptionally high death rate from cardiovascular diseases.[43] Wester reports that “In Finland the regional death rates from ischemic heart disease are found to be inversely correlated with the hardness and magnesium content of the drinking water and to the content of exchangeable [absorbable by plants] magnesium in the soil.”[27]

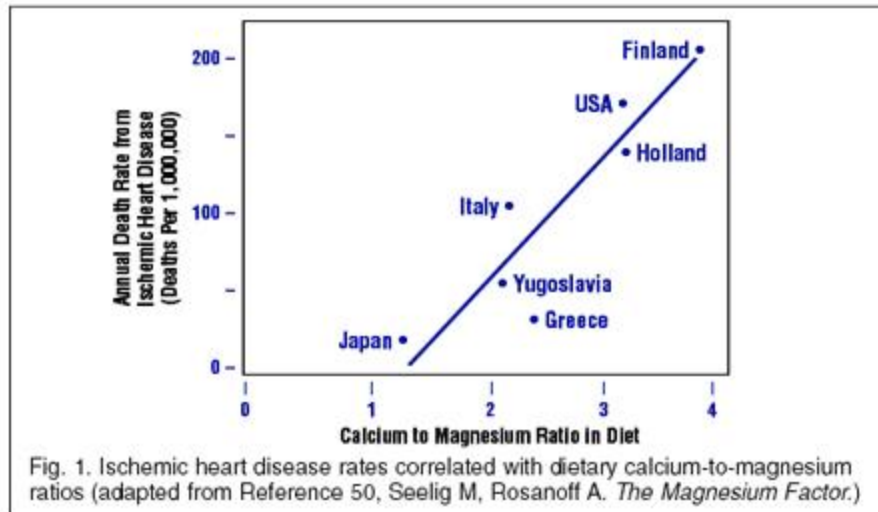
A 1978 study found a strong correlation between the dietary calcium/magnesium ratio and the death rate from ischemic heart disease. At that time, the USA, Finland and Holland had some of the highest heart disease death rates, combined with some of the highest calcium/magnesium dietary ratios (Fig. 1.).[50] Note that Japan, with the lowest heart disease rate, had a roughly 1-to-1 calcium/magnesium dietary ratio.

Magnesium Supplementation

In an extensive 1964 article reviewing magnesium balance studies, magnesium expert Mildred Seelig discovered that for most people, at least 6 milligrams magnesium per kilogram of body weight is necessary to ensure a positive magnesium balance.[44] This is roughly 2.7 milligrams magnesium per pound of body weight. For those under severe chronic stress, or who are engaged in strenuous work/athletic training that promotes intense sweating even higher levels might be required, up to 10 milligrams per kilogram of body weight, or 4.5 milligrams per pound. Those whose lives contain many of the anti-magnesium absorption factors or anti-kidney recycling factors discussed previously might also require higher than the basic 2.7 milligrams per pound to maintain magnesium balance.

Magnesium is generally a safe nutrient. As Carolyn Dean, M.D., N.D., notes, “For the average person, oral magnesium, even in high dosages, has no side effects except loose stools....”[45] What is not absorbed is excreted in the feces. Those with any degree of impaired kidney function should use magnesium supplements only with physician supervision, as the combination of renal dysfunction and magnesium supplementation may lead to potentially dangerous hypermagnesemia (excessive blood levels of magnesium).[36] Dean also lists myasthenia gravis, excessively slow heart rate and bowel obstruction as contraindications to magnesium supplementation.[45]

It is best to spread magnesium supplement intake into at least three daily doses. This will increase absorption and lessen the risk of osmotic diarrhea, a sign that you’re either taking too much total magnesium, or too much at one time, and aren’t absorbing much of it.



Ideally magnesium should be taken separately from calcium, and not with a high-fat meal. If magnesium is taken with calcium, it should definitely not be one of the two parts calcium to one part magnesium as commonly sold in health food stores and drugstores. A ratio of 1-to-1 calcium to magnesium will be less likely to suppress magnesium absorption.

Vitamin B6 has been shown to increase intracellular uptake of magnesium, so it may be useful in getting magnesium where it belongs: inside the cell.[46] Washing a magnesium supplement down with a soft drink is not advised, as the phosphoric acid and sugar in the drink will definitely inhibit magnesium absorption and retention. For those consuming any significant quantity of alcohol, taking at least a modest dose of magnesium at such times may reduce the micro-brain damage alcohol can cause.[26]

Which Form of Magnesium is Best?

Studies have shown that magnesium oxide is the least bioavailable form of magnesium,47,48 yet it has been successfully used in a human clinical trial.[49] In general, organic forms of magnesium such as magnesium citrate, magnesium succinate, magnesium aspartate, magnesium lactate and magnesium taurinate are well-absorbed forms.[47,48] Magnesium chloride is a well-absorbed inorganic form.

When taking magnesium supplements, it is important to realize that it may take six weeks to six months to replenish body magnesium stores through oral supplementation.[1] Thus, if you suffer from many of the listed magnesium deficiency symptoms and they don't immediately disappear, don't be discouraged and assume they aren't magnesium-related after all. Just be patient and watch for gradual changes.

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