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RESEARCH NOTES

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Magnesium Balance, Can You Juggle?

The importance of magnesium to the human body is quite evident. It may be that magnesium is involved in more aspects of the human body make-up and metabolism than any other mineral. About half of the total body magnesium is found in bone, while the vast majority of the other half can be found inside the cells of body tissues and organs, while approximately 1% of body magnesium is maintained in the blood stream. Magnesium impacts the immune system, cardiac rhythm, nerve function, muscle function, blood sugar regulation, blood pressure, energy metabolism, and protein synthesis through its involvement in more than 300 known biochemical reactions. Its possible roles in the prevention and/or treatment of a wide variety of health problems has made research on magnesium increasingly popular.

Understanding the maintenance of optimal body magnesium levels has been seen to be a very complex undertaking. Magnesium balance involves a variety of considerations, and maintaining one's proper magnesium level requires the juggling of all of these considerations. The body's magnesium balance involves at least these five factors:

- 1) Drugs that deplete magnesium.
- 2) Drugs that have other interactions with magnesium.
- 3) Health and physiological conditions that can deplete magnesium.
- 4) Food and beverages that deplete magnesium.
- 5) Dietary intake of magnesium.

Dietary Intake of Magnesium

As a general guideline, the Institute of Medicine of the National Academy of Sciences developed the Recommended Dietary Allowance (RDA) for magnesium. The RDA tells the average daily intake of nutrients needed to meet the nutrient requirement of nearly all (97-98%) healthy individuals in each age and gender group. Table 1 below lists the RDA for magnesium in milligrams for children and adults.

Due to the fact that there is insufficient data on magnesium to establish the RDA for infants, 0-12 months age, an Adequate Intake (AI) has been developed using the mean intake of magnesium in healthy breastfed infants (Table 2).

In most industrialized countries, it has been shown that dietary magnesium intake is below the recommendations due to increased consumption of refined, fat-rich and processed foods. Ford and Mokdad (J.Nutr. 133:2879-2882, September, 2003) analyzed the 24 hour dietary recall data from 4257 partici-

Table 1. RDA for magnesium in children and adults.

Age (years)	Male mg/day	Female mg/day	Pregnancy mg/day	Lactation mg/day
1 - 3	80	80	N/A	N/A
4 - 8	130	130	N/A	N/A
9 - 13	240	240	N/A	N/A
14 - 18	410	360	400	360
19 - 30	400	310	350	310
30+	420	320	360	320

Table 2. Adequate intake of magnesium for infants.

Age (months)	Males and Females mg/day
0 - 6	30
7 - 12	75

pants (aged ≥ 20) from the National Health and Nutrition Examination Survey (1999-2000). The findings from this study are listed in Table 3, below.

In similar studies in some other industrialized countries, the results have been the same. In a French study called SU.VI.MAX, involving 5448 French volunteers, it was determined that 77% of the women and 72% of the men were taking in less than the French RDA for magnesium (380mg/day for men and 350mg/day for women). More critically, 23% of the women and 18% of the men were consuming less than two-thirds of the RDAs. Another study on magnesium intake in Switzerland showed the mean intakes of magnesium for men and women to be about 20% less than the RDA, with a median intake that was also far less than the RDA (range of intake 110-475mg/day). With the intakes of magnesium being far less than optimal in the countries with the best food supplies, it is clear that magnesium is a potential health problem.

Drugs and Magnesium

Magnesium and drugs have been seen to have a variety of impacts on one another. On one hand, we have a variety of medication categories that will deplete the body of magnesium, and on the other hand we have situations in which the magnesium can interact with the medication to alter the drug's effectiveness, either through a chemical change or absorption inhibition, or the drug itself can cause accumulation

or depletion of magnesium by altering its metabolic patterns.

The medications that are known depleters of magnesium are:

Antacids	Aluminum hydroxide and magnesium hydroxide Calcium carbonate Calcium carbonate and magnesium hydroxide Sodium bicarbonate
Anti-Inflammatories	Beclomethasone, budesonide Dexamethasone, Fluticasone Hydrocortisone, prednisone Methylprednisolone triamcinolone, mometasone
Aminoglycoside antibiotics	Gentamicin Neomycin Tobramycin
Birth control	Ethinyl estradiol + desogestrel Ethinyl estradiol + levonorgestrel Ethinyl estradiol + norethindrone Ethinyl estradiol + norgestimate
Cardiovasculars	Digoxin Hydralazine
Diuretics	Bumetanide, ethacrynic acid Furosemide, torsemide Chlorothiazide, hydrochlorothiazide Indapamide, metazolone Methyclothiazide

Other groups of medications that have varying, but significant interactions with magnesium are:

- Antibiotic categories known as quinolones, tetracyclines, and furantoinis have their absorption diminished when taken with magnesium.
- Calcium channel blockers will have their negative side effects increased when taken with magnesium.
- Diabetic medications like glipizide and glyburide have their absorption increased by the co-administration of certain magnesium supplements.
- Digoxin can have its adverse effects increased by low levels of magnesium.
- Tiludronate and alendronate can have their absorption blocked by magnesium supplements.
- Penicillamine has been seen to inactivate magnesium.

Health Conditions

There are several common medical conditions that are known to give rise to magnesium deficiencies. Intestinal flu with vomiting and diarrhea can cause a transitory magnesium deficiency. Gastrointestinal disorders such as irritable bowel syndrome, Crohn's disease, regional enteritis, intestinal surgery, and celiac sprue are known to cause magnesium deficiency through malabsorption or excessive diarrhea, thus depleting magnesium. Diabetes, hyperthyroidism, kidney malfunction, heavy menstruation, excessive sweating, and prolonged stress can all result in low magnesium.

Food and Beverage

Excessive or chronic intake of alcohol will result in low body magnesium levels. Ingestion of too much coffee, soda, and salt are all known to cause magnesium deficiency, as well. Symptoms of magnesium deficiency include agitation, anxiety, irritability, nausea and vomiting, abnormal heart rhythms, confusion, muscle spasm and weakness, hyperventilation, insomnia, poor nail growth, and seizures.

Table 3. Median daily intake of magnesium by group.

Population group, from USA	Median magnesium intake mg/day
Caucasian American men	326
African American men	237
Mexican American men	297
Caucasian American women	237
African American women	177
Mexican American women	221

Dietary Intake of Magnesium and Performance

In a text written by Brilla and Lombardi (Chapter 13, Magnesium in Sports Physiology and Performance, p 168, Sports Nutrition Minerals and Electrolytes, Kies and Driskell, ED. CRC Press, 1995), the authors developed a chart that is a “Predictive Model for Magnesium and Sport Performance”. Although the authors have used this model to depict the effects on various parameters in athletes, in response to a continuum of magnesium dietary intake from severe deficiency to supramaximal intake, all of the parameters would be impacted in the non-athlete, as well. It is interesting to note that the parameter involving the determination of Serum Magnesium (Mg²⁺), with the exception of the supramaximal intake of magnesium, could only be relied upon to detect the most severe magnesium deficiency. Serum magnesium is typically the only test done on patients to judge adequacy of magnesium in a medical setting. On the other hand, the seldom used Magnesium Loading Test is able to clearly detect the level of the dietary

magnesium intake at all levels of intake. There are many performance parameters that start to be depressed at the marginal deficiency level, and many of these involve critical areas, such as protein synthesis, glucose metabolism, fat metabolism, and factors needed for immune system function. In view of the level of magnesium intake found in industrialized countries, along with the four other factors altering magnesium balance, it is easy to see that many can be marginally magnesium deficient. Figure 1 tells a lot about the wide ranging predictive impact that the level of magnesium dietary intake has on the human body performance.

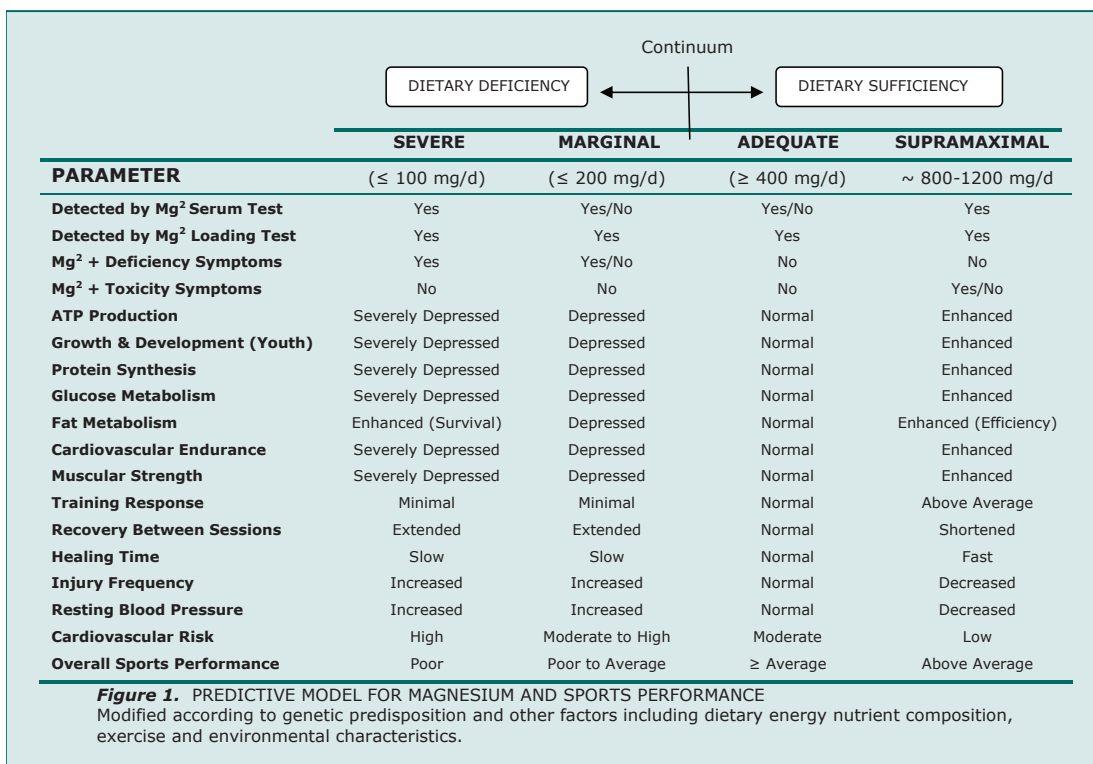
Conclusions

It appears obvious that there are a large variety of factors to consider when one talks about attaining optimal magnesium balance. The typical level of magnesium intake relative to the RDA in industrialized countries tells us that we need to do something to increase our dietary intake of magnesium. However, is the RDA enough? In many cases, given the large variety of factors that deplete or interfere with magnesium absorption or utilization,

getting the RDA on a daily basis could very well not be enough. To determine what is right for any individual, one needs to look at all of the factors mentioned, as they apply to their situation, before determining what they want to do about their magnesium intake. Trying to increase the intake of magnesium via the food supply is not a very easy thing to do, so if you are concerned that you have any of the factors that negatively impact magnesium status, it might be a prudent idea to look to increasing ones’ intake of magnesium through the use of a good dietary supplement of magnesium. Make sure that you are getting at least the RDA of magnesium between your diet and supplement program. If you have any factors that are possibly hurting your magnesium status above the norm, make sure that you make an adjustment for this factor.

Albion Advanced Nutrition manufactures several high quality forms of magnesium for incorporation into foods, functional foods, or dietary supplements. Each has its own different advantages, but they all have advantages over the typical magnesium salt forms. Albion’s magnesium amino acid chelate forms of magnesium are the best possible form of

magnesium for absorption and GI tolerance. These include Magnechel®, Magnesium Chelazome®, Magnesium Amino Acid Chelate Buffered, Magnesium AAC Taste Free, and Creatine MagnaPower® (for enhanced athletic performance). Our newly patented DiMagnesium Malate is also an excellent form of magnesium, and offers advantages for people with fibromyalgia and chronic fatigue. Albion’s magnesium amino acid chelates have been clinically tested and proven to be safe and effective. All of Albion’s chelates and malates have been chemically validated, as well.



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