ALBION®
HUMAN NUTRITION

RESEARCH NOTES

A COMPILATION OF VITAL RESEARCH UPDATES ON HUMAN NUTRITION

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Magnesium Is a Mineral with Prodigious Impact, But Poor Intake

Magnesium is a crucial macro mineral. The fact that it is involved in hundreds of physiological processes (key to about 325+ of the human body's enzyme systems), clearly validates its importance. It plays a role in a wide range of body functions: energy production, heart rate, glucose metabolism, emotions, and more. Unfortunately, it has been found that magnesium is one of the most frequently encountered dietary deficiencies in the USA, and throughout the world.

Table 1.

Magnesium: Recommended Daily Allowances (RDA) and Estimated Average Requirements (EAR)*

Group	RDA (mg/d)	EAR (mg/d)
Women, 19-30	310	255
Women, 31-50	320	265
Women, >50	320	265
Women, pregnant		
14-18	400	335
19-30	350	290
31-50	360	300
Women, lactating		
14-18	360	300
19-30	310	255
31-50	320	265
Men, 19-30	400	330
Men, 31-50	420	350
Men, >50	420	350
Children, 4-8	130	110
Children, 9-13	240	200
Children, 14-18		
Female	360	300
Male	410	340

*Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Flouride. Washington, DC: National Academy of Sciences; 1997.

In 1997, the Institute of Medicine and the National Academy of Sciences raised the RDA for magnesium by 15% to approximately 6mg/kg/day. For men, this brought the RDA to 420mg/day, and for women 320mg/day (Table 1).

The NHANES study of 1977-78, which included about 40,000 people, found that magnesium consumption met or exceeded the RDA (5mg/kg/day, at that time) in only 25% of those surveyed. According to the USDA 1994 Continuing Survey of Foods Intakes by Individuals, we are still failing, as a society, to take in adequate magnesium. The average magnesium intake in males over 9 years of age, was 323mg/day, and in females over 9 years of age, was 228mg/day. This translates into the average males' intake being 77% of the RDA, while the females' intake came to 71% of the RDA. This indicates that the vast majority of the US populace is taking in levels of magnesium that are considered to be marginally deficient. Chronic intake levels, as low as this, can put people at risk for a wide variety of health problems.

Emotions

As time goes on, evidence is building on the role magnesium plays in the central nervous system. Preclinical and clinical studies have implicated a relationship between magnesium homeostasis and the emotions of fear, anxiety, and depression. The underlying mechanisms for these effects remain largely unknown. Researchers are investigating potential mechanisms by which magnesium influences emotions. One premise involves magnesium being involved with the regulation of neurotransmitters. In a very recent study conducted by Sartori SB, et al [Neuropharmacology 2012 Jan;62(1):304-12], the researchers further investigated the previous evidence that magnesium had an effect on mood, emotions, and reactions to stress. In this study, the researchers observed that magnesium deficiency (mouse model) caused an increase in the

transcription of the corticotrophin releasing hormone in the paraventricular hypothalamic nucleus, and elevated ACTH plasma levels. This indicates an enhanced set point in the HPA axis. They saw that this disregulation of the HPA axis can contribute to hyper-emotionality, as a response to dietary induced hypomagnesemia. Additional studies have pointed to hypomagnesemia's role in a variety of emotional disorders, both depressive and anxiety related problems. Research findings have shown that magnesium deficiency causes N-methyl-D-aspartate (NMDA) coupled calcium channels to be biased towards opening, causing neuronal injury and neurological dysfunction, which gives the appearance of major depression [EbyGA and Eby KL. Med hypothesis 74 (2010) 649-660]. This same review points to research findings that indicate hypomagnesemia as a major cause for treatment resistant depression. As time goes on, research will be looking deeper into the role of magnesium and emotions.

Strength

Magnesium has been looked at for its potential impact on various athletic activities. Shifts in plasma magnesium level have been observed during the performance of sustained muscular activity. Two recent studies looked into the effect of magnesium and its impact on strength. Matias,CN et al [Magnesium Res. 2010 Sep;23(3):138-41] studied the impact of magnesium concentration changes on strength in periods of weight stability prior to competition. The subjects were divided according to changes in ICW during the course of judo competition: losses below 2% and losses greater than or equal to 2%. Magnesium was measured in serum, red blood cells, and urine via atomic absorption. Greater ICW losses and lower magnesium levels were associated with poorer performance on subsequent strength testing. In an additional study, Santos, DA, et al [Magnesium Res. 2011 Oct 10] researchers measured magnesium intake in relation to strength performance in elite athletes. Energy and nutrient intake were assessed over a 7 day period, and strength tests included: maximal isometric trunk flexion, jump test, handgrip, squat, maximal isokinetic knee extension, and flexion peak torques. Regression analysis indicated magnesium was directly associated with maximal isometric trunk flexion, rotation, handgrip, jumping performance, and with all isokinetic strength variables, independent of total energy intake. Observed association between magnesium intake and muscle strength performance is likely to be a result of the role of magnesium in energetic metabolism, transmembrane transport, and muscle contraction/relaxation.

Metabolic Syndrome and Inflammation

Metabolic syndrome, which is a group of medical problems, including insulin resistance that can lead to hypertension, type 2 diabetes, and ischemic heart disease. There are a few reports over the last 5 years that have pointed to a defect in Delta^{6} and Delta^{5} desaturases as a causative factor in the initiation and progression of insulin resistance, the metabolic syndrome and ischemic heart disease [Lipids in Health and Disease 20-08:7-9/Prostaglandins Leukot Essential FA 2007 May;76(5):251-68/Lipids Health Dis2010;9 130]. In these reports, Dr. Undurti N. Das has shown the consequences of a defect in the enzymatic activity of the Delta^{6} and Delta^{5} desaturase enzymes and their relationship to the development of low grade systemic inflammation and insulin resistance, type 2 diabetes, the metabolic syndrome, hypertension, atherosclerosis and ischemic heart disease. There are several factors that can be involved in the conversion of the fatty

Hypomagnesemia and Inflammation: Clinical and Basic Aspects

Weglicki WB.
Annu Rev Nutr; 2012 Mar 8 [Epub ahead of print].

(AA) In recent years, increasing awareness of hypomagnesemia has resulted in clinical trials that associate this mineral deficiency with diabetes, metabolic syndrome, and drug therapies for cancer and cardiovascular diseases. However, diagnostic testing for tissue deficiency of magnesium still presents a challenge. Investigations of animal and cellular responses to magnesium deficiency have found evidence of complex proinflammatory pathways that may lead to greater understanding of mediators of the pathobiology in neuronal, cardiovascular, intestinal, renal, and hematological tissues. The roles of free radicals, cytokines, neuropeptides, endotoxin, endogenous antioxidants, and vascular permeability, and interventions to limit the inflammatory response associated with these parameters, are outlined in basic studies of magnesium deficiency. It is hoped that this limited review of inflammation associated with some diseases complicated by magnesium deficiency will prompt greater awareness by clinicians and other health providers and in turn increase efforts to prevent and treat this disorder. Expected final online publication date for the Annual Review of Nutrition Volume 32 is July 17, 2012.

acids into their anti-inflammatory derivatives, such as prostaglandin E_1, prostacyclin (PGI2), PGI_3, lipoxins, resolvins, protectins, and so on. Magnesium is one of the key catalysts needed for the Delta6 desaturase to do its part in the conversion cascade from fatty acids to formation of the anti-inflammatory derivatives needed to fight against the chronic low grade inflammation, insulin resistance, type 2 diabetes, the metabolic syndrome, hypertension, atherosclerosis, and ischemic heart disease. It also happens to be the factor most often deficient.

In a most recent article abstracted below, the author pleas for more efforts concerning magnesium.

Magnesium's Importance Continues to Grow

In reviewing the research concerning magnesium, it can be seen that it is one of the most far reaching in its impact of all the nutritionally required minerals. Some of the clinical manifestations of severe magnesium deficiency are listed in the Table 2 below:

Studies have been conducted on Albion chelated magnesium products, as well. In these studies, the researchers have found them to have a positive influence on energy, asthma, migraine, PMS, skeletal muscle, and cardiovascular indicators.

Table 2. Fox D, et al; South Med J; 2001; 94(12); 1195-1201.

Cardiac Effects	Metabolic Effects	Neurologic Effects
Atrial fibrillation	Hypokalemia	Grand mal seizures
Atrial flutter	Hypocalcemia	Focal seizures
Supraventricular tachy cardia	Increased Intracellular calcium	Paresthesias
Ventricular tachycardia	Hyponatremia	Dizziness
Torsades de pointes	Increased intracellular sodium	Vertigo
Coronary artery spasm	Hypophosphalemia	Ataxia
Hypertension	Metabolic alkalosis	Nystagmus
Electrocardiogram changes	Hyperglycemia	Tremor
Prolonged PR interval	Hypercholesterolemia	Myopathy
Widened QRS complex		Dysphagia
Prolonged QT interval		Esophageal spasm
Atherosclerosis		Delirium, personality changes, depression, coma

In Summation

More studies need to be done to investigate the potential therapeutic conditions that can benefit from magnesium supplementation. Clearly it has potential for anxiety, depression, cardiovascular problems (hypertension, arrhythmias, atherosclerosis, mitral valve prolapse), PMS, asthma, diabetes, migraine, chronic fatigue, fibromyalgia, hyperlipidemia, pre-eclampsia, muscle performance, asthma, and other disorders related to chronic low inflammatory conditions.

As mentioned, Albion's magnesium amino acid chelate compounds have shown to be of benefit in a variety of conditions, as well. In addition, the Albion TRAACS® brand of magnesium chelates are of demonstrated high bioavailablity, and are an excellent choice whenever magnesium is required in dietary supplements, food fortification, or pharma applications.

These include:

- Magnesium Glycinate Chelate (also available in Buffered and Taste-Free forms)
- Magnesium Lysyl Glycinate Chelate
- Creatine MagnaPower® (magnesium creatine chelate)
- Magnesium Glycyl Glutamine Chelate
- DiMagnesium Malate (non chelate form)

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