Magnesium: The Mighty Mineral with Multifaceted Benefits

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Recent studies indicate magnesium’s growing importance for mental health, arterial flexibility, and metabolic function.

The human body requires a steady and adequate supply of essential nutrients in order to maintain balance—or homeostasis—to continue operating as a finely tuned machine. Of these required nutrients, vitamins and minerals are foundational. They are the sparkplugs that make our metabolic engines run, working as cofactors for enzymes and participating in the process of energy production. One mineral, magnesium, holds a special place within the group of absolutely essential nutrients. As an indispensable mineral that acts as a cofactor for hundreds of enzymes in the body, magnesium is required by every cell in the body. Unfortunately, it’s also a mineral that many of us don’t get enough of. Studies indicate that nearly 50% of the U.S. population consumes an inadequate amount of magnesium from the diet, not meeting the estimated average requirement (EAR) for this mineral.\(^1\)

For adults over the age of 30, the EAR for magnesium is 350 mg/day for men and 265 mg/day for women, while the recommended dietary allowance (RDA) is 420 mg/day for men and 320 mg/day for women.

As the incidence of chronic diseases—including cardiovascular disorders, diabetes, and osteoporosis—continues to rise, one can’t help but wonder how much of a contributory factor the population’s insufficient intake of magnesium has played. After all, low levels of magnesium have

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been linked to all of these aforementioned conditions, and some feel that even the RDA levels of magnesium are not high enough given that certain disease states, stress, and medications often further deplete bodily stores of magnesium. In such cases, they would argue, ensuring an adequate magnesium intake is even more critical. Research continues to highlight the benefits of this magnificent mineral. Recent studies summarized here indicate magnesium’s growing importance for mental health, arterial flexibility, and metabolic function.

**Mental Health**

Mood disorders are now highly prevalent globally, with depression alone affecting 350 million people worldwide. One of magnesium’s key benefits seems to be supporting healthy neurological function and mental health. Research points to magnesium insufficiency as a potential causative factor in mood disorders, anxiety, and stress-related conditions. Fortunately, recent clinical evidence suggests that magnesium supplementation can be beneficial for these conditions.

A randomized, controlled, crossover clinical trial was conducted by Emily Tarleton and colleagues from the University of Vermont (Burlington, VT) to assess the effect of magnesium supplements in the treatment of depression. The study included 126 adults with an average age of 52 diagnosed with mild to moderate depression. Participants were assigned to six weeks of magnesium chloride supplementation (248 mg of elemental magnesium/day) or control, and the treatments were then crossed over. Assessments of depressive symptoms were performed over the phone every two weeks and improvement was evaluated via Patient Health Questionnaire-9 scores. Anxiety symptoms were also evaluated using Generalized Anxiety Disorders-7 scores.

According to researchers, six weeks of magnesium supplementation led to clinically significant improvements in depression symptoms as well as statistically significant improvements in anxiety. Moreover, the authors noted that improvements became evident within two weeks of the onset of supplementation. The supplements were well tolerated, with no significant adverse events noted. A second trial led by researchers from Shahid Sadoughi University of Medical Sciences (Yazd, Iran) included 60 adults with diagnosed depression and magnesium deficiency. In the double-blind, placebo-controlled, eight-week trial, participants received 500 mg of magnesium oxide or placebo daily. The Beck Depression Inventory-2 assessment was used, and serum magnesium levels were followed from baseline to the end of the study.

Beck scores declined in both groups over the eight-week period, indicating less-severe depression symptoms; however, this decline was significantly greater in the magnesium group. Concurrently, serum magnesium levels also significantly improved over the study period in the magnesium group, with 88.5% of participants reaching normal levels at the end of the study. These results support the positive benefits of magnesium supplementation in depressed individuals.

In fact, a recently published review article authored by Anna Serefko and colleagues from the Medical University of Lublin (Lublin, Poland) highlights clinical studies indicating that magnesium administration helps with major depression as well as depression and anxiety-related symptoms secondary to premenstrual syndrome, chronic fatigue syndrome, epilepsy, and type 2 diabetes. The authors cite possible mechanisms, including balancing and counteracting elevated levels of calcium and glutamate in the hippocampus, which leads to altered function of synapses in the brain, resulting in mood disorders and depression. A sufficient supply of magnesium would, by contrast, support the normal function of these neuronal synapses. Magnesium is also involved in both the noradrenaline and dopamine systems, which are important neurotransmitters. It further plays significant roles in modulating the stress response by controlling the access of corticosteroids to brain tissue, and it has documented anti-inflammatory activity. Both of these factors otherwise potentially contribute to mood disorders and depression.

Additionally, two recent preliminary studies in mice conducted by researchers in Denmark point to a novel mechanism of magnesium’s impact on depression and anxiety. Comparing mice fed a standard diet or a diet deficient in magnesium for six weeks, researchers noted that magnesium-deficient mice exhibited depressive behavior as well as anxiety symptoms. The investigations revealed that magnesium deficiency impacted the gut microbiota in these animals, leading the researchers to hypothesize that magnesium deficiency possibly contributes to depression and anxiety via an impact on the gut-brain axis and by influencing immune function. While further research is required to investigate the influence of magnesium on the gut microbiota, it is clear that magnesium influences several aspects of healthy neurological function and contributes greatly to the maintenance of mental health.
**Arterial Flexibility and Preventing Vascular Calcification**

Magnesium intake is linked to improved cardiovascular health. For example, a meta-analysis published in 2013 including 16 studies with over 313,000 individuals found that for every 200 mg/day increment in magnesium intake, there was a 22% reduced risk of ischemic heart disease; moreover, higher circulating levels of magnesium were associated with a 30% reduced risk of overall cardiovascular disease. Given that dietary magnesium intake has been associated with a significant risk reduction in ischemic heart disease, Peter Joris and colleagues from the Maastricht University Medical Center (Maastricht, The Netherlands) sought to investigate the ability of supplemental magnesium to maintain arterial flexibility. In this double-blind, placebo-controlled, 24-week study, 52 healthy obese and overweight adults with an average age of 62 were assigned to either supplement with magnesium (350 mg/day elemental magnesium as magnesium citrate) or placebo. Measurements were taken at baseline, at week 12, and upon study completion, and included serum magnesium concentrations, 24-hour blood pressure readings, as well as carotid-to-femoral pulse wave velocity (PWV) assessments, which is considered the gold-standard measure of arterial stiffness.

While the study results did not show a significant effect of magnesium supplementation on blood pressure (average blood pressure in both groups was already within normal limits at baseline), at the end of the study, the group supplementing with magnesium had a significant change in carotid-to-femoral PWV measurements, showing a reduction of 1.0 meter/second (m/s) and indicating an important reduction in arterial stiffness. Previous epidemiological research has shown that a decrease in carotid-to-femoral PWV of 1.0 m/s is associated with a 14% decrease in risk of cardiovascular events, highlighting the significance of the findings in the current study and demonstrating the benefits of daily magnesium supplementation.

One possible explanation for the ability of magnesium to help support arterial flexibility is that magnesium helps prevent vascular calcification. In a recent review, Anique ter Braake and colleagues from Radboud University Medical Center (Nijmegen, The Netherlands) summarize experimental evidence suggesting that magnesium prevents vascular calcification through multiple mechanisms. Magnesium’s effects can be divided into two unique pathways. The first pathway is passive interference, suggesting that the presence of magnesium in circulation favorably alters the environment to prevent vascular calcification processes. Research points to the fact that dietary magnesium reduces the absorption of inorganic phosphate molecules by binding to them in the intestines. These phosphate molecules would otherwise be necessary to stimulate the calcification process in vascular smooth muscle cells. Additionally, magnesium passively interferes with hydroxyapatite maturation and formation in the blood vessel itself. Hydroxyapatite crystals (containing calcium and phosphorus) are otherwise linked to calcification in blood vessels. A second pathway by which magnesium prevents vascular calcification is through direct cell-mediated mechanisms. Magnesium appears to prevent transcriptional changes in vascular smooth muscle cells that favor calcification, thereby halting this process. Specifically, magnesium prevents the expression of factors associated with matrix mineralization and supports against the loss of calcification inhibitors, which serve to protect smooth muscle cells. By acting via these two distinct pathways, magnesium plays an essential role in supporting the normal function and morphology of vascular smooth muscle cells and thereby promoting arterial flexibility.

**Metabolic Maintenance**

Magnesium plays a critical role in supporting numerous facets of health in metabolic conditions, including metabolic syndrome, lipid parameters, and diabetes. For instance, as a cofactor, magnesium is involved in the function of several enzymes related to glucose metabolism, and decreased serum magnesium levels have been identified as a risk factor for the development of prediabetes. Furthermore, based on recently published meta-analyses, there is convincing evidence that magnesium levels are lower in individuals with metabolic syndrome than controls. Studies also show that individuals with type 2 diabetes are at significant risk of magnesium deficiency and insufficiency. Several recently published systematic reviews highlight the benefits of magnesium for parameters related to cardiometabolic health. Luis Simental-Mendia from the Mexican Social Security Institute (Durango, Mexico) led a meta-analysis of randomized controlled trials to evaluate the effect of magnesium supplements on insulin sensitivity and glucose control. The analysis found that magnesium supplementation overall had a significant effect on reducing insulin resistance (as assessed by the common measure, HOMA-IR index)—although the review failed to show significant
effects on plasma glucose levels, hemoglobin A1c, or fasting insulin. When the authors performed a subgroup analysis comparing those studies with a duration of less than four months to those studies with a duration of greater than four months of supplementation, they observed a significant benefit in favor of the longer-duration studies on fasting glucose levels. These benefits were noted in both diabetic and non-diabetic subjects, suggesting the beneficial effects of magnesium supplements for individuals with metabolic disorders.

A second review of randomized, double-blind trials conducted by the same group out of Durango, Mexico, looked at the effect of magnesium supplementation in metabolic syndrome. Of the 27 trials identified for inclusion in the analysis, 18 showed a benefit of magnesium supplementation on at least one parameter of metabolic syndrome. These included reductions in insulin resistance and fasting glucose, improvements in lipid parameters (including HDL cholesterol and triglyceride levels), and support for blood pressure levels. Daily supplemental doses of magnesium over the spectrum of studies ranged between 300 and 600 mg/day. Of the remaining nine studies showing no benefits on any parameter of metabolic syndrome, seven were conducted in healthy individuals. Overall, the results of the analysis point to significant benefits associated with magnesium supplementation for metabolic syndrome.

Researchers from IKG Punjab Technical University (Kapurthala, India) recently conducted a meta-analysis to assess the effects of magnesium supplementation on type 2 diabetes and associated cardiovascular risk factors. They included randomized controlled trials published before June 30, 2016. On the basis of their analysis, the authors concluded that magnesium supplementation significantly improved fasting blood glucose levels (average decrease of 6.4 mg/dL) in diabetic individuals. Furthermore, magnesium supplements raised HDL cholesterol levels (by an average of 3.2 mg/dL), reduced LDL cholesterol (by an average of -10.7 mg/dL), and reduced triglycerides (by an average of -15.3 mg/dL), while also reducing average systolic blood pressure readings by 3 mm Hg. Thus, magnesium supplementation benefits diabetics and reduces several risk factors for heart disease in this population.

More Magnesium
Magnesium is a nutrient required by all cells and participates in a broad range of physiological processes. Since magnesium levels are often insufficient, ensuring an adequate intake is essential for the body to function as designed. From cardiovascular health and metabolic function to mental health—or any other number benefits magnesium is associated with—magnesium is the spark that makes the body go. Doing without this crucial element is like driving a car that isn’t firing on all cylinders. Without the spark, the fuel is useless.

Also read:  
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References:
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11. Ter Braake AD et al., “Magnesium counteracts vascular calcification: passive interference or active modulation?” *Arteriosclerosis, Thrombosis, and Vascular Biology*, vol. 37, no. 8 (August 2017): 1431-1445


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