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## **Magnesium, Health, and Disease Prevention**

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Magnesium is one of the major mineral nutrients in the human body. Containing approximately 20 to 28 grams of magnesium, 60 percent is found in the bones and teeth, while the remaining 40 percent is found in muscle. Serum levels of magnesium range from 1.5 to 2.1 mEq/L; magnesium is the second-most plentiful positively charged ion found within the cells of the body, signifying its importance in the multitudes of physiologic cellular functions. One of the most important metabolic processes, the synthesis and consumption of ATP is directly linked to magnesium. Magnesium-linked ATP processes activate approximately 300 different enzymes which are involved in diverse functions such as DNA and RNA synthesis, glycolysis, intracellular mineral transport, nerve impulse generation, cell membrane electrical potential, muscle contraction, blood vessel tone, and the regeneration of ATP.<sup>1</sup>

The adult Recommended Dietary Allowance (RDA) for magnesium is 350 mg per day for men and 280 milligrams for women. The typical American diet provides approximately 120 milligrams per 1,000 calories, meaning that a person that consumes fewer than 1,500 calories is likely to be deficient in magnesium. The absorption rate of magnesium ranges from 24 to nearly 85 percent, while magnesium derived from metallic sources is less absorbable, whereas magnesium derived from plant sources is more easily absorbed. Factors that increase the need for magnesium due to limited uptake or increased losses include excess phosphate consumption (soft drinks) and alcoholic beverages, high-stress lifestyles, some diuretics, digitalis, strenuous exercise (high-performance athletes lose a considerable amount of magnesium in sweat), pregnant and lactating women, individuals with diabetes, severe diarrhea, or kidney disease. The early signs of magnesium deficiency include vague symptoms such as loss of appetite, stomachache, and diarrhea. Longer-term deficiency symptoms may manifest as confusion, apathy, depression, irritability, arrhythmia, weakness, poor coordination, nausea, vomiting, electromyographic changes, muscle and nerve irritability, and tremors.<sup>2</sup>

Magnesium has many novel uses for common health conditions. As an antacid, magnesium salts react with gastric acid to form magnesium chloride, thereby neutralizing hydrochloric acid. As a laxative, magnesium acts osmotically in the intestine and colon as well as triggering the release of gastrin and cholecystokinin, stimulating gastric motility. The inhibitory effect of magnesium on pre-term labor contractions (tocolysis) is attributed to antagonism of calcium-mediated uterine contractions, while the anticonvulsant actions of magnesium in eclampsia

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may be due to inhibition of neuromuscular transmission, and a resulting depressant effect on smooth muscle contraction.<sup>3</sup>

### **Magnesium and Blood Pressure**

Magnesium has an important role in reducing blood pressure.<sup>4</sup> Magnesium deficiency has been found to allow for increased intracellular concentrations of sodium and potassium, which results in increased peripheral resistance and vasospasm.<sup>5</sup> Additionally, some research points out that hypertensive patients with hypomagnesemia usually require more antihypertensive medications than hypertensive patients with normal magnesium levels.<sup>6</sup> Diets that contain plenty of fruits and vegetables, which are good sources of potassium and magnesium, are consistently associated with lower blood pressure.<sup>7</sup> The effect of various nutritional factors on incidence of high blood pressure was examined in over 30,000 U.S. male health professionals. After four years of follow-up, it was found that a greater magnesium intake was significantly associated with a lower risk of hypertension.<sup>8</sup> The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommends maintaining an adequate magnesium intake as a positive lifestyle modification for preventing and managing high blood pressure.<sup>9</sup>

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### **Magnesium and Heart Disease**

Magnesium may play a role in reducing coronary vascular resistance, increasing coronary artery blood flow parameters, and prevention of arrhythmia. Further, inadequate intake and absorption of magnesium are associated with the development of disease processes such as hypertension, cardiomyopathy, atherosclerosis, and stroke.<sup>10</sup> Evidence exists that indicates low body stores of magnesium actually increase the risk of a person having arrhythmia, which can increase the risk of cardiovascular complications.<sup>11</sup> Surveys of the population in general have associated higher blood levels of magnesium with lower risk of coronary heart disease.<sup>12</sup> Additionally, dietary surveys have suggested that a higher magnesium intake is associated with a lower risk of stroke.<sup>13</sup>

### **Magnesium and Osteoporosis**

Magnesium deficiency may be a risk factor for postmenopausal osteoporosis. This may be related to the fact that magnesium deficiency negatively alters calcium metabolism and the hormone that regulates bone-calcium stores.<sup>14</sup> Several studies have suggested that magnesium

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supplementation may improve bone mineral density, and low intake and impaired absorption of magnesium have also been associated with the development of osteoporosis.

### Magnesium and Diabetes

Magnesium plays an important role in carbohydrate metabolism, influencing the release and activity of insulin, the main hormone that exerts control of blood glucose levels. Elevated blood glucose levels can increase the loss of magnesium in the urine, leading to increased magnesium loss from the body. Commonly, low serum levels of magnesium are often seen in poorly controlled diabetics.

### Magnesium and Asthma

Magnesium plays a dynamic role in lung structure and function. Magnesium acts to block the function of calcium, which, in the lungs, causes bronchial smooth-muscle contraction. The possibility exists that magnesium deficiency may contribute to lung complications. It is interesting to note that the average calcium consumption in the U.S. has increased in the past few years, but this is accompanied by little change in magnesium intake, causing an imbalance in the calcium: magnesium ratio.<sup>15</sup> This deficiency in magnesium also has an effect on the activity of specific white blood cells (neutrophils) that, during an asthma attack, can worsen the condition. Researchers theorize that low magnesium content of white blood cells has an important effect on the pathogenesis of asthma.<sup>16</sup> It is additionally hypothesized that a diet high in magnesium is directly related to healthy lung function and a reduced risk of airway hyper reactivity and wheezing. Low magnesium intake may therefore be involved in the occurrence of asthma.<sup>17</sup>

The beneficial health effects of magnesium and its disease-prevention qualities emphasize the importance of this commonly overlooked mineral. As the fields of nutrition and medicine continue to reveal the benefits of magnesium, it becomes more and more apparent that supplementation with this mineral is vital to maintaining our health. Like all supplements, proper supplementation of magnesium must be emphasized by seeking the advice of a qualified, nutritionally-oriented physician.

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