Magnesium is one of the essential minerals although only about one ounce is present in the body of a 130-pound person. Its name is derived from the Greek city, Magnesia where large deposits of magnesium carbonate were found. In humans, magnesium (Mg) is the fourth most abundant mineral found in the body. It makes up approximately 0.05% of the body weight. Approximately 50-60% of this magnesium is found stored in the bones and teeth. Most of the remainder is found in muscles and soft tissues with the brain having a high concentration and the heart a significant amount. About 1% of magnesium is present in extracellular tissue.

Functions of Magnesium

- Magnesium is involved in hundreds of enzyme-driven biochemical reactions in the body. Many of these reactions are involved in energy production (ATP) and proper functioning of the heart, circulatory systems and the nerves and is essential for the maintenance of bone structure. Magnesium is also necessary for the utilization of ATP, activating enzymatic reactions involving ATP. These reactions are important in the metabolism of carbohydrates, fats and proteins and the synthesis of DNA.

- To function optimally in the body, magnesium must be balanced with phosphorus, calcium, potassium and sodium. Together with calcium, magnesium is involved in muscle contraction and blood clotting. Calcium promotes the processes while magnesium inhibits them. It is this interaction that helps to regulate blood pressure and the functioning of the lungs. Magnesium is also involved in preventing dental caries by holding calcium in tooth enamel. Along with other nutrients, magnesium supports the normal functioning of the immune system.
Absorption and Use

Magnesium is absorbed by the body mainly in the small intestine or in the acidic stomach environment. The body may absorb 25% to 75% of dietary magnesium, depending on the body's needs and dietary habits. Magnesium absorption is increased or decreased by certain nutrients and factors.

**Absorption is increased by:**
- Body needs – growth, pregnancy, lactation
- Vitamin D
- Lactose
- Acid environment-hydrochloric acid, citric acid, ascorbic acid (vitamin C)
- Protein intake and amino acids such as lysine and glycine
- Fat intake
- Exercise
- Phosphorus balance

**Absorption is decreased by:**
- Vitamin D deficiency
- Gastrointestinal problems
- Hypochlorhydria (low stomach acid)
- Stress
- Lack of exercise
- High fat intake
- High protein intake
- Oxalic acid foods (beet greens, chard, spinach, rhubarb, cocoa)
- Phytic acid and fibre (present in whole grains)
- High phosphorus intake
- High dietary calcium or calcium supplements

Too Much/Too Little?

The kidney excretes or conserves magnesium according to the body's needs. Toxicity due to magnesium overload from food is virtually unknown since excess is usually eliminated in the faeces as long as there is normal kidney function. However, if calcium intake is low, symptoms of magnesium toxicity may occur. Toxicity can occur in association with high intakes from non-food sources such as supplements or magnesium salts. Symptoms include muscle weakness, fatigue, sleepiness or hyper-excitability – due to depression of the
central nervous system. In addition, there may be difficulty breathing, very low blood pressure and irregular heartbeat. In extreme states this can lead to death. The risk of magnesium toxicity increases with kidney failure because the body loses its ability to remove excess magnesium.

Magnesium deficiency is, however, very uncommon but is likely to occur in association with alcoholism, general malnutrition, kidney disease, gastrointestinal disease and in persons who use diuretics or consume excess sugar or caffeine that could increase magnesium loss via the urine.

Initial symptoms of magnesium deficiency include fatigue, loss of appetite, irritability, insomnia and muscle tremors or twitching as well as apathy, apprehension, decreased learning ability, confusion, and poor memory. Tachycardia (rapid heartbeat) and other cardiovascular changes can occur with moderate deficiency. With severe magnesium deficiency, the individual may experience numbness, tingling, and tetany (sustained contraction) of the muscles as well as delirium and hallucinations. Severe magnesium deficiency can result in low levels of calcium in the blood (hypocalcaemia). Magnesium deficiency is also associated with low levels of potassium in the blood (hypokalaemia). Arterial spasm, specifically of the coronary arteries, is a significant recent concern with magnesium deficiency. This could lead to angina symptoms or even a heart attack. Blood pressure can rise with magnesium deficiency, while an increased likelihood of kidney stones and other tissue calcification is possible.

**Magnesium and Blood Pressure**

Epidemiologic evidence suggests that magnesium may play an important role in regulating blood pressure. With magnesium deficiency, the walls of the arteries and capillaries tend to constrict, a possible explanation for the hypertensive effect. Fruits and vegetables are good sources of magnesium. Diets that include plenty of these foods are consistently associated with lower blood pressure. However, foods high in magnesium are frequently high in potassium and dietary fiber, and this makes it difficult to evaluate the independent effect of magnesium on blood pressure. However, newer scientific evidence states that magnesium-rich diets are beneficial for individuals with hypertension.

**Magnesium and Diabetes**

Magnesium plays an important role in carbohydrate metabolism. It may influence the release and activity of insulin, the hormone that helps control blood glucose (sugar) levels low blood levels of magnesium (hypomagnesaemia) are frequently seen in individuals with Type 2 diabetes. However, the evidence showing magnesium or adequate magnesium status as having a preventive effect or therapeutic effect on diabetes is inconclusive. Additional research is needed to better explain the association between blood magnesium levels, dietary magnesium intake, and Type 2 diabetes.
Magnesium and Cardiovascular Disease

Observed associations between magnesium metabolism, diabetes, and high blood pressure increase the likelihood that magnesium metabolism may influence cardiovascular disease.

There have been studies with encouraging results, but the sample sizes were small. Like magnesium and diabetes, additional studies are needed to better understand the complex relationships between magnesium intake, indicators of magnesium status and heart disease.

Magnesium and Osteoporosis

Bone health is supported by many factors. Some evidence suggests that magnesium deficiency may be a risk factor for postmenopausal osteoporosis. This may be due to the fact that magnesium deficiency alters calcium metabolism and the hormones that regulate calcium. Deficiency of calcium is a noted risk factor for osteoporosis. Several human studies have suggested that magnesium supplementation may improve bone mineral density. Diets that provide recommended levels of magnesium are beneficial for bone health, but further investigation on the role of magnesium in bone metabolism and osteoporosis is needed.

Magnesium and Other Conditions

Magnesium has also been implicated in the treatment or prevention of other diseases and conditions. This is not surprising given the large number of bodily processes in which it participates. Some common diseases and conditions associated with magnesium are:

- Aggressive Behaviour
- Alcoholism
- Alzheimer's Disease
- Arrhythmia
- Asthma
- Attention Deficit Disorder
- Autism
- Cancer
- Cerebral Palsy
- Chronic Fatigue
- Constipation
- Cramps
- HIV/AIDS
- Menopause
- Migraine Headache
- Multiplesclerosis
Food Sources of Magnesium

Most of our dietary magnesium comes from plant sources. Dark green vegetables are good sources of magnesium. Most nuts, seeds and legumes have high amounts of magnesium, soy products, nuts, whole grains, particularly wheat (especially the bran and germ), millet and brown rice. Avocado and dried apricots are other sources. Hard water can also be a valuable source of magnesium. Bananas, fish, meat, milk and refined grains are poor sources.

Much magnesium can be lost in the processing and refining of foods. Nearly 85% of the magnesium in grains is lost during the milling of flours. Soaking and boiling foods can leach magnesium into the water, so the “pot liquor” from cooking vegetables may be high in magnesium and other minerals. Oxalic acid in vegetables such as spinach and phytic acid in some grains may form insoluble salts with magnesium, causing it to be eliminated rather than absorbed. In other foods that serve as good sources of magnesium, like almonds or peanuts, there is very little loss of magnesium either from roasting or from processing into almond or peanut butter as long as the whole almond or peanut is used.

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