Magnesium, Exercise and Health

Redistribution and Excretion of Magnesium During Exercise

Magnesium is involved in numerous biological processes, especially during periods of physically demanding activities, such as sport, or even hard work in the heat. Important roles for Magnesium include the metabolic activity which occurs in energy production, electrolyte balance and oxygen uptake. With these functions being crucial to the elevated functioning during exercise, Magnesium and sport have been researched in depth. (Nielsen, 2006)

When the human body is exercising or otherwise under peak physical demand, Magnesium is redistributed in order to meet the body's metabolic needs for the mineral (Laires MJ M. C., 2001). It has been found that Magnesium is excreted at higher levels through sweating and urination during exercise (Volpe, 200). These two occurrences leave athletes with an increased need to intake more Magnesium.

Short and Long Term Exercise and Mg Redistribution

A study was performed on this distribution of Magnesium in the body by Bohl and Volpe, who found that when a person performed a high intensity short-term, exercise, their concentrations of either plasma or serum magnesium were increased by an average of 10%. The levels decreased within 24 hours back to baseline (Volpea, 2010). Another study was conducted on long term endurance exercise, which found that the concentrations of plasma and serum magnesium were alternatively decreased. The decrease returned to baseline as well, within 24 hours. This was attributed to magnesium moving to other parts of the body during exercise, and its increased excretion level. (Buchman AL, 1988) Additional studies have proposed that the change in magnesium corresponds with an increase of creatine kinase activity, which suggests the magnesium increase was caused by a breakdown of muscle. (Stendig-Lindberg G, 1989)

Mg Deficiency

When dietary Magnesium requirements are not adequately met, the body cannot perform to its optimal ability. Evidence suggests, that physical activity causes an increase in the redistribution of Magnesium where it is needed, which also results in an increased requirement for additional Magnesium intake. If the increased Magnesium requirements are not met, this can over time lead to a deficiency, which can manifest itself in many different ways including reduced oxygen utilization and decreased physical performance.

Mg Deficiency and Sport Performance

The decrease in physical performance has been researched in various studies. First, a study was conducted on rats and those with a magnesium deficiency showed a reduced capacity for endurance on a treadmill. (McDonald R, 1988) Secondly, in post-menopausal women who were untrained, a marginal deficiency in magnesium impaired exercise performance. The women were supplemented with either 150 mg or 320 mg per day of magnesium. The women who took 150 mg had significantly higher heart rate and oxygen consumption rates. (Liu L, 1983) Lastly, a study was done on young men participating in a 7-week strength training program. Those who were supplemented with an additional 250 mg of Magnesium per day, over baseline 250 mg supplement, showed an increased in peak knee extension torque. (Brilla LR, 1992). This research has shown that Magnesium is an active component in the human body during sport exercise, and adequate levels do appear to have an effect on physical performance abilities.

Energy Production and Oxygen Delivery

Ionized magnesium activates the enzymes in reactions which occur in the initial glycolytic pathway for what is known as oxidative phosphorylation. The reactions that Magnesium activates include the ATPases, which split up ATP bonds to create the energy for muscle contraction. Once the energy is created, Magnesium continues its role in muscle contraction by regulating Ca(2+) amounts which are bound in high affinity cellular sites, these control the tension development. Therefore, contractility is directly related to Magnesium. During sport activities, oxidative stress is increased. Oxygen delivery to the working muscles is required for oxygen consumption. One study has found a relationship between plasma magnesium and oxygen consumption in athletes which prompted them to suggest that Magnesium, possibly contributes to the facilitation of oxygen to working muscles by producing 2,3DPG in the erythrocyte. (Nutriture)

Magnesium is also suspected to play an important role in repairing oxidative damage. One study in rodents found that when magnesium is deficient, there are increased reactive oxygen species (ROS) including structural damage in skeletal muscle, inflammatory responses, pro oxidant responses, free radical production and the accumulation of oxidation products. (Laires MJ M. C.-i., 2001)

Benefits of Magnesium to Overall Health

Magnesium is important beyond sports activity, as it is present within more than 300 metabolic reactions within the body. Due to being active in the body's various functions, when Magnesium is not supplied in adequate amounts, health will suffer. Some of the metabolic functions that Magnesium is part of include cellular energy production, cellular energy storage, protein synthesis, DNA and RNA synthesis and mitochondrial membrane stabilization. The mineral is also present in cardiac excitability, blood pressure, glucose metabolism, insulin metabolism, muscular contractions and nerve transmissions.

When levels of Magnesium are low, associations have been made with chronic conditions such as migraine headaches, dementia, strokes, hypertension, type 2 diabetes and cardiovascular disease. The following cases exhibit these effects.

Migraine Headaches

One study was conducted on 133 patients to test the effects of Magnesium on migraine headaches. The patients were split up into 4 testing groups, which received the following supplements: Group 1 received 500 mg per day of magnesium oxide; Group 2 received 500 mg per day of L-carnitine, Group 3 received 500 mg per day of magnesium oxide along with 500 mg per day of L-carnitine and Group 4 was a control group. The test continued for 12 weeks, and migraines were measured by the amount of occurrences per month, how many days per month they occurred and the severity. The magnesium supplement showed a significant declining effect on all migraine indicators. (Tarighat Esfanjani A, 2012)

Dementia

The most common occurrence of Dementia is Alzheimer's disease, which is the 6th most common reason for death in the United States. A correlation has been found between ionized Magnesium and Alzheimer's disease, as patients with Alzheimer's have been found to have much lower levels of ionized magnesium concentration than their counterparts who do not have Alzheimer's. (Barbagallo M, 2011)

Blood Pressure

As mentioned, Magnesium is involved with the function of blood pressure regulation. It relaxes the vascular system which decreases the blood pressure. (Paolisso G, 1997) A study was conducted to find out if magnesium supplementation could in fact decrease blood pressure significantly, and Kass found through various trials, that both systolic and diastolic blood pressure was reduced with Magnesium supplementation. (Kass L, 2008)

Heart Health

Magnesium also plays an important role in the proper functioning of the heart and maintaining its rhythm. It has been found that adequate levels of Magnesium are correlated with a lower occurrence of sudden cardiac death (Chiuve SE, 2011). In one study, a supplementation of magnesium orotate, which was administered for 12 months, also reduced the symptoms and survival rate of patients with congestive heart failure. (Chiladakis JA, 2001)

Type 2 Diabetes

Magnesium plays an important role in glucose and insulin metabolism. It impacts the two by transferring phosphate from ATP, to the protein. A trial was conducted that spanned over 3 months where 60 participants received either a placebo, or 300 mg of Magnesium per day. This continued for 3 months and researchers found and increase in serum magnesium concentrations in the supplemented group, along with significant improvements to the level of insulin sensitivity.
(Guerrero-Romero F, 2004). Researchers have concluded that because Magnesium affected insulin sensitivity for the patients with diabetes mellitus, the supplement may help overweight patients who are developing Type 2 diabetes (Volpe, 200)

As these studies have demonstrated, Magnesium levels play a key role in maintaining the proper functioning of the human body and avoiding health issues and diseases. When levels become inadequate, the body shows signs of malfunction.

Effects of Inadequate or Low Magnesium Diet

Magnesium deficiency as described in the studies above is known to have negative effects on human health. These include decreased athletic performance, heart problems, increased oxidative stress and reduced immune function. It is important to note that these studies have demonstrated if magnesium levels are adequate and supplements are provided improvements occur. As a result it is imperative to eat a diet that provides the proper concentrations of Magnesium and other macro and trace elements.

Fluids, Electrolytes and Exercise

Hydration is very important for optimal functioning of the human body especially during exercise. The reason for this is that exercise causes an increased amount of heat to be produced. The body maintains its natural temperature by sweating, which causes a loss of fluids. This loss of fluids can result in dehydration if they are not replaced. However, not only water that is lost. Additionally, electrolytes and minerals including magnesium are also depleted and equally important to replace. Maintaining the proper balance of water, electrolytes and minerals will allow the body to continue to optimally function at an elevated level for exercise.

In conclusion, many studies have been performed to understand how the body operates while exercising. The search to improve sport performance is sought by many researchers. The findings thus far have suggested that Magnesium plays an important role in the fundamental functions of performing and sustaining physical exercise. Not only is the mineral foundational to overall health and disease prevention, levels must remain adequate to support healthy immune, heart, oxygen and energy functions during exercise. A diet insufficient of proper fluids, electrolytes and minerals will be detrimental to any person, but specifically to an athlete. To ensure peak performance, Magnesium must be a part of the equation.

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