Mineral Deficiency Concept Paper

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Dr. Baum

**Magnesium Deficiency related to Allergic Disease States**

**(Eczema, Asthma, Rhinitis)**

By Rakhi Chowdhury

**Introduction**

Magnesium, considered the fourth most abundant essential mineral within the human body, plays a vital role in over 300 metabolic functions, including nerve transmission and bronchial dilation of smooth muscle cells.1-2 Due to its antioxidant properties, magnesium also plays an important role in immune function and reducing inflammation, particularly in patients suffering from allergic diseases such as eczema and asthma.2 Eczema, also known as atopic dermatitis(AD), generally manifests in early childhood and can later develop asthma and allergic rhinitis into adolescence and adulthood.3 Atopic dermatitis is an inflammatory skin disease that affects 10% of adults and up to 20% of children.4 It is characterized by dry, scaly, itchy skin and has increased by 2-fold over the past few decades.5 Asthma, considered the most common chronic disease in children, is characterized by wheezing, tightness of the chest, inflammation of the bronchial tubes, and difficulty breathing.6

The mechanism curtailing the progression from atopic dermatitis to asthma is still unclear but it is evident that there is a direct link between genetics and environmental factors. It is hypothesized that inadequate dietary intake of antioxidants such as magnesium could have contributed to the increased prevalence of asthma and allergy in the past few decades.7 Recent studies have incorporated the addition of magnesium into the treatment of asthma with great improvements.8 Magnesium sulfate is often given to asthma patients in nebulizer treatments to open the airways, but it was also found that intravenous delivery of the mineral significantly improved symptoms in comparison to conventional treatments.9 The mineral properties found in Dead Sea water have also been touted to have significant anti-inflammatory effects. High concentrations of magnesium in water solutions (i.e. Dead Sea water) also have been effective in treating the inflammation in rhinitis.10

**Objective**

The purpose of this paper is to explore the role that magnesium plays in allergic individuals and how its deficiency may have a correlation to atopic dermatitis, asthma, and allergic rhinitis. It is of utmost importance to understand the potential of magnesium to treat and reduce allergic-related immune responses. Magnesium holds a key essential element in nutrition and plays an important role in reducing oxidative stress and inflammation.5 Dietary adjustments may hold the key in controlling these disease states, but the methods of treatment remain controversial. This paper will review the concentrations of serum magnesium levels from dietary intake and its effect on atopic dermatitis and asthma. Low antioxidant intake, i.e. Magnesium, has been directly correlated with reduced pulmonary function.11 It has long been hypothesized that maternal antioxidant intake may also affect infant risk of developing atopic dermatitis and asthma later in childhood.7 Due to new findings on this topic, this paper will also investigate the role maternal antioxidant consumption plays during pregnancy and its association with childhood allergic disorders.

Current asthma treatments require the use of corticosteroids, which may take hours to improve lung function.8 They also have side effects related to weight gain, decreased absorption of calcium, vitamin D, protein, potassium, vitamin A, and vitamin C.6 Other conventional treatments such as the use of beta-agonists take a shorter time to take effect8, however may cause gastrointestinal effects.6 Studies have shown beneficial results in the relaxation of bronchial tubes as a result of magnesium treatment, but the role in asthma is not prominently defined. This paper will also explore the efficiency of intravenous magnesium sulfate administration as an alternative due to its low cost and low rate of side effects. In addition to inhaled corticosteroid administration, corticosteroids are commonly found in the treatment creams to alleviate atopic dermatitis. Long-term use however, has shown to have side effects of skin-atrophy.4 This paper will explore the alternative use of a ceramide-magnesium topical cream and its efficacy of treatment.

**Methods**

In 2009, asthma claimed the lives of nearly 250,000 individuals world-wide.9 The increased prevalence has prompted researchers to study the relationship between dietary intake and the potential to improve asthma in adolescents.12 A four day 18-page food diary was completed by 13 to 14 year old adolescents in Norway, 93 of whom had asthma and 76 in the control group who did not. This study included a parental interview, skin prick tests to test for allergen sensitivity, a respiratory test, and skinfold thickness for BMI. A similar cross-sectional study in Greece13 was conducted to assess the nutrient intake of preschool children in relation to the risk of wheezing from asthma. 1964 children, age 24 to 72 months were selected at random nursery schools to be a part of the study. BMI was measured and 3-day diet entries were obtained.

Until now, a dietary antioxidant study related to allergic disease in children has not been thoroughly studied. A Swedish birth cohort study of 2442 8 year olds was taken to evaluate this relationship.2 Parental questionnaires, food frequency questionnaires, and blood samples were collected for analysis for the following antioxidants: vitamin C, α-tocopherol, β-carotene, selenium, zinc, and magnesium. Much of the research conducted has placed an emphasis on studying children after the onset of allergic symptoms, but few have looked at antioxidant intake of the mother. In a Finnish birth cohort study7, researchers collected food-frequency questionnaires from 3253 mothers. At the end of the 5-year diet follow-up, the outcomes of 75% of the participating mothers were documented from maternal diet to the medical history of allergic outcomes of 2441 children.

Asthmatic patients are under chronic oxidative stress due to inflammation and tissue damage within the lungs. To test if oxidative stress could be reduced, a randomized, double-blind, placebo-controlled study conducted by the University of Szeged in Hungary11, monitored 40 children (24 boys, 16 girls) for 12 weeks on an oral magnesium supplement. Diagnosis was determined by a lung function and skin prick test. Elevated IgE levels were also scored. Subjects were recruited if they had a minimum diagnosis of 6 months and were eliminated if serum magnesium levels were less than 0.83 mmol/l. Diet was left unchanged during supplementation. Patients received either a placebo or magnesium capsule during each visit. Children 7 years old or younger received 200 mg of Magnesium, children ages 8-16 received 290 mg of Magnesium citrate daily, or 260 mg glucose as a placebo. At the end of the study, blood samples and urine analysis was collected.

Serum magnesium levels are also affected by vitamin D. Vitamin D metabolism responds to plasma concentration levels of magnesium and is responsible for inhibition of interleukin production of T-lymphocytes and B-lymphocytes that are integral in regulating the immune system.14 A cross-section case study of 60 asthmatic individuals and 60 healthy individuals ranging from 18 to 70 years of age were monitored for serum magnesium levels, 25(OH)D levels, and calcium levels. A pulmonary function test was done to test for the severity of asthma as well. Similarly, a study population of 92 AD patients and 70 control patients age 22-27 years were tested for blood serum levels of magnesium to see if there was any effect on atopic dermatitis improvement.5

Two recent studies tested the use of intravenous magnesium sulfate in comparison to conventional treatment of asthma. The randomized study in Faisalabad9 selected asthma subjects with a respiratory rate >30 with pulse rates >120 over the age of 5. They had a control group and an experimental group. They gave both the control and experimental group a dose of 0.1 mg/kg of the conventional treatment of nebulized salbutamol every 20 minutes for 1 hour, 10 mg/kg of intravenous hydrocortisone, and oxygen. The experimental group was also given 25 mg/kg of intravenous magnesium sulfate over 20 minutes and the control group received a placebo of 50cc intravenous saline over 20 minutes. Their pulse rate and FEV1 were noted after 2 hours. In the other randomized, study (single blind, placebo control)8, the control and experimental groups received 1 mL of 2.5 mg salbutamol, 250 micrograms of 1.5 mL ipratropium in 2.5 mL of normal saline with oxygen at minute 0,20, and 40. At 30 minutes, the experimental group received 2 g of magnesium sulfate given every 20 minutes while the control received a 250 mL placebo saline solution. Spirometry was measured at the 0, 30, 60, 90, and 120 minute marks to see if FEV1 levels had a marked difference.

In a birth cohort study, the blood serum concentration levels of magnesium, vitamin D, selenium, and zinc were analyzed. Allergic sensitization at ages 4(n=372) and 8(n= 328) were collected. Annual questionnaires on asthma prevalence were collected until the age of 8.18

The link between water mineral hardness and atopic dermatitis has also been studied in several studies. The presence of Calcium and Magnesium in water often times react with soap to form soap scum that may build on the skin surface and may tighten the skin of AD patients. In a double-blind placebo-controlled, crossover pilot15, a total of 12 AD patients ages 3 to 6 years were split into 2 groups for a 6-week shower treatment. The experimental group received an ultra-pure soft water (UPSW) shower, where the Calcium and Magnesium were replaced with sodium ions. The control group showered in regular tap water. A second observer-blind randomized study16 and third single-blind, parallel group randomized study17 comprised of 336 AD patients, age 6 months to 16 years and 310 AD patients, age 6 to 16 years respectively also tested for the ion-exchange watering softening units compared with usual care of hard mineral water showers and its effect on AD improvement.

The use of steroids has been prominent in the treatment of AD and allergic rhinitis. A few studies have test the use of magnesium creams in the replacement of steroid-creams and nasal sprays as safer alternatives. In a randomized control study4 100 AD patients age 18-70 were split into groups, one was given ceramide-magnesium cream and the other was given the conventional treatment of hydrocortisone cream. Both were compared for improvements. A randomized perspective double-blind test of 145 rhinitis patients age 18-60 years were split into groups and given Dead Seas Salt nasal irrigation containing magnesium and compared against a control group receiving the conventional intranasal steroid spray.10

**Results**

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**Conclusion**

Magnesium is found in many foods such as leafy greens, nuts, legumes, whole grains, meat, fish and milk.2 Many of the top food allergens are in fact nuts, wheat, fish, and milk.3 Due to this restriction in diet, food allergy-eczema induced sufferers will likely witness a deficiency in magnesium in their diet, hence the results found in the studies associated with dietary magnesium intake. Recent findings have shown that a Mediterranean diet, which is rich in magnesium, may actually reduce the risk of allergic disease.6 Given these findings, registered dietitians can implement diet plans to allergic patients with magnesium deficiencies as a part of their treatment plan.

Likewise in the treatment of asthma, the evidence is clear that intravenous magnesium sulfate would reduce hospital stay and improve lung function of asthma sufferers. With these findings, doctors should utilize the supplementation of IV in their treatment to their patients.

The use of steroid creams and nasal sprays to treat atopic dermatitis and allergic rhinitis can have long-term side effects and if seen by a dermatologist or Ear, Nose, Throat doctor, patients should ask for magnesium alternatives as they are as highly effective and will induce less side effects than the conventional treatments out on the market.

Of all the evidence found supporting the benefits of magnesium in allergic disease treatment, the use of soft-water replacement as a treatment for AD had the most conflicting results. The hypothesis that mineral water hardness from magnesium and calcium could exacerbate AD goes against the previous findings that magnesium is beneficial. In the Japan study15 the theory was that presence of calcium and magnesium in combination with soap would form a layer of soap scum on the skin surface lending to skin tightness in the epidermis of AD patients. The limitation of this study was the small sample group however, because in two other large studies16-17 the findings showed that the use of a water-softener did not improve AD. This could be due to the short 12-wk duration of the trial, and perhaps a longer study time would’ve shown better results. Future studies should investigate the use of Dead Sea Salt Mineral baths and the effect on AD since the use of DSS in the nasal irrigation study seemed beneficial to allergic rhinitis patients and the use of soap in this instance would be eliminated.

Overall, the evidence has shown an overwhelming positive effect for magnesium supplementation in both diet and in treatment when compared to the current pharmacological methods used in treatment. If more natural routes of treatment can be administered this way, patients may see beneficial improvements in this disease area without reliance on the heavy use of drugs.

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