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Effect of Magnesium Intake on Hypertension in Chinese Elderly Population

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Abstract:

Existing studies have found that the prevalence of hypertension in people aged 70 and above is as high as 70%. At present, the prevalence of hypertension among the elderly in China is rising sharply, and these are closely related to magnesium deficiency. This is a review article to demonstrate the association between magnesium deficiency and hypertension by reviewing the literature in recent years. According to the Dietary Recommendations for the Elderly in China, the recommended daily consumption of magnesium for adults would be 330 milligrams (mg), while 74.8% of the population did not meet the recommended intake. Due to the traditional dietary patterns of older Chinese people, who do not have a high uptake of foods such as nuts and seeds, which increases the risk of magnesium deficiency. At the same time, incomplete absorption of magnesium can lead to magnesium deficiency as the absorption rate of gastrointestinal function decreases with age. Studies have found that changing dietary patterns and consuming magnesium supplements are effective in increasing magnesium intake and thus reducing the prevalence of hypertension.

Keywords: Magnesium, Chinese elderly, hypertension.

1. Introduction

As healthcare and technology develop dramatically, statistics and screenings have revealed that hypertension, a chronic disease characterized by a persistent rise in arterial blood pressure, is the most common cause of death globally. According to the Journal of Chinese Cardiovascular Disease, the prevalence of hypertension in people aged 75 years and older in Beijing has been measured to be as high as 70% since 2021, a phenomenon attributed to the aggravation of China‘s population aging trend, which has led to a significant increase in the prevalence of hypertension in the elderly population.

The micronutrient magnesium is the second most abundant cation in cells after potassium. Magnesium acts as a neuromuscular transmitter and vasodilator in the body. More and more studies are now showing that serum magnesium is negatively correlated with cardiovascular disease [1].

However, there are also different insights revealed by research on the relationship between magnesium deficiency and hypertension. A number of studies have demonstrated a negative correlation between magnesium consumption and hypertension, which means that the less magnesium intake, the more prevalent the hypertension [2]. However, other studies have also recognized that the link between magnesium and hypertension is unclear. Although some studies have clarified the correlation between magnesium intake and hypertension, there is a lack of studies on Chinese elderly people, thus it is essential about the study on magnesium deficiency specifically for Chinese elderly people on the management of hypertension. This review aims to bridge this knowledge gap through investigating the factors influencing the relations between magnesium intake and hypertension in Chinese older adults, with the main influences being dietary habits and bioavailability.

2. Physiological Mechanisms of Magnesium

Magnesium is the second most abundant micronutrient in the human body. Magnesium ions are mainly stored in bones, While the other 39% of magnesium ions are involved in muscle and soft structure, a mere 1-2% is available in the bloodstream [3]. Magnesium has many important physiological functions in the human body, such as energy metabolism, blood glucose regulation, antioxidant, anti-inflammatory and cardiovascular health maintenance, the antioxidant, anti-inflammatory and cardiovascular health, these are ways in which endothelial function is affected. The balance of dilation and constriction between blood vessels is maintained by vasoactive molecules produced and released by endothelial cells, which in turn

respond to the whole body [4].

3. Magnesium Deficiency

Magnesium shortage is common among older adults, with the National Health and Nutrition Examination Survey data showing that magnesium intake decreases with age [5]. Research conducted among healthy older adults in Western countries revealed that chronic magnesium deficiency is common and physical requirements for magnesium do not change with age; the lower the intake of magnesium, the more magnesium deficiencies, as well as a variety of diseases, will follow [6]. According to the U.S. Dietary Guidelines, people should intake 320-420mg of magnesium per day [7]. However, several studies have consistently found that 45% of participants consume less than 75% of the RDA for daily magnesium intake [8].

Regarding the pathological process by which magnesium deficiency triggers hypertension, it may due to the fact that magnesium deficiency leads to a dysfunction of the vascular endothelium, which reduces the production of nitric oxide, thus diminishing the vasodilatory capacity of the blood vessels, and enhances vasoconstriction, which ultimately leads to hypertension.

4. Why Magnesium Deficiency Exists in Older Adults

4.1 Eating Habits and Nutritional Intake

As well known, the health of the body is inextricably linked to eating habits. Too little or too many nutrients can overload the body and lead to various diseases, such as severe malnutrition, reduced immune function and obesity. Therefore, good eating habits can maintain a healthy weight, improve digestive health, slow down aging, and enhance immunity. Getting enough vitamins and minerals (like vitamin C and D) strengthens the immune system, which in turn helps the body fight off disease. Notably, enhanced intake of the micro-nutrient magnesium may prevent hypertension, heart disease, cardiovascular disease, with studies finding a higher correlation between high blood pressure and micro-nutrient magnesium. According to the 2013 edition of the Dietary Nutrient Reference Intake (DNRI), Chinese adults are recommended to consume 330 mg of dietary magnesium per day [9]. However, a survey showed that the proportion of Chinese older adults whose dietary magnesium intake did not meet the recommended value was as high as 74.8% [10].

4.1.1 Low dietary magnesium intake in Chinese older adults

The traditional Chinese diet is dominated by cereals and potatoes [11]. Although these foods are satiating, they mainly provide the body with carbohydrate support and have low levels of the micronutrients magnesium,iron and zinc. According to the China Nutrition and Health Surveillance, plasma magnesium reference ratios should be between 0.75 and 1.14 mmol/L in Chinese people aged 45 years or older [12]. In the dietary habits of Chinese older adults, consume magnesium-rich foods as nuts and green leafy vegetables, is relatively low, and this phenomenon is prevalent in the urban elderly population [13]. Furthermore, many older adults are accustomed to traditional diets and are less receptive to newly introduced foods such as nuts and seeds.

4.1.2 Magnesium deficiency and blood pressure increase

Inadequate magnesium intake can lead to magnesium deficiency, it is attributed to the lack of foods rich in magnesium in the dietary structure and dietary preferences of the elderly. Meanwhile, As there is a negative association between the consumption of magnesium and hypertension, i.e., increasing consuming magnesium reduces the chance of hypertension and vice versa. In addition, when plasma magnesium is greater than 0.85 mmol/L, a magnesium network consisting of raised fasting blood glucose, raised blood pressure, and triglycerides is protective [14].

4.2 Absorption and Bioavailability

Bioavailability refers to the extent to which ingested magnesium is absorbed and the utilization of magnesium is dependent on the form of intake and the physiological status of the individual. With aging, functions in the human body (especially the older adults) are degraded to a certain extent. While magnesium is absorbed in the body mainly by the intestinal wall. Only 2%-5% of magnesium ions are excreted through urine, and the rest of magnesium is reabsorbed by the renal tubules [15].

4.2.1 Age-associated Reduction in Magnesium Absorption

In the elderly, magnesium loss is higher than in the young due to increased excretion of magnesium through the kidneys. This is caused by decreased intestinal absorption in the elderly, especially since estrogen deficiency accelerates magnesium loss, leading to chronic magnesium deficiency [16]. Reduced magnesium absorption in old age commonly coincides with reduced vitamin D levels [17]. A number of factors influence magnesium absorption; There is an example of that dietary intake of foods high in calcium, fat or phosphorus could impair magnesium absorption, whereas foods rich in protein and fiber can promote magnesium absorption. Notably, magnesium absorption is significantly lower in older adults with gastrointestinal disorders [18]. Studies have shown that there

is a strong link between serum magnesium and inflammatory bowel disease (IBD), and that with adequate magnesium supplementation, the effects of TNF- α are reduced, which in turn alleviates and mitigates IBD [19]. Then, after reducing magnesium hypoabsorption, it also means reducing the occurrence of magnesium deficiency.

4.2.2 Increased hypertension risk

Even if older adults intake sufficient magnesium from the diet, aging, gastrointestinal absorption, gastrointestinal inflammation, and disease, which are all important factors affecting magnesium absorption. Magnesium status has a dramatic effect on the diastolic capacity of vascular smooth muscle cells and blood pressure, for example, low magnesium absorption has a major impact on magnesium deficiency in the elderly; the lower the magnesium absorption, the greater the risk of magnesium deficiency in the elderly, which in consequence increases the incidence of hypertension [20].

5. Improving Intake of Magnesium and Reducing Hypertension for Chinese Older Adults

5.1 Lowering Blood Pressure through Dietary Changes

Dietary preferences are one of the reasons for the elevated incidence of hypertension in Chinese elderly. However, dietary preferences challenge for older persons increase magnesium intake when only through dietary modification. Dietary magnesium intake can be increased by selecting and consuming magnesium-fortified foods, such as magnesium-fortified milk, cereals, and breads that have magnesium added during production. Local communities can engage the interest of older adults through advertisements, campaigns, and event promotions, utilizing a variety of activities to promote the benefits of magnesium-enriched foods. In addition, food manufacturers can make adjustments to dietary content, such as adding more magnesium-enriched foods to the daily diets of Chinese older adults, which are effective ways to increase dietary magnesium intake.

5.2 Lowering Blood Pressure in the Elderly by Consuming Magnesium Supplements

On the other hand, to address the problem of large magnesium loss due to decreased intestinal absorption capacity in the elderly, local governments and communities should organize regular medical checkups for the elderly to improve their gastrointestinal health. In addition, probiotics and fermented foods such as yogurt may promote the growth of beneficial intestinal flora. Prebiotics such as onions, garlic and bananas can provide nutrients for beneficial bacteria. It is also important to reduce or avoid excessive intake of substances that interfere with magnesium absorption, such as caffeine and alcohol. Besides, decreased absorption of magnesium results in a range of problems, including magnesium deficiency and hypocalcemia, as well as altering the body‘s response to Vitamin D [21]. Also, A meta-analysis examined ultimately 20,119 patients with hypertension and found by comparisons of populations with the maximum and minimum daily magnesium ingestions, Increasing magnesium intake by 100 mg per day could potentially lower the rate of hypertension by 5 percent [22]. Owing to soluble magnesium is more readily absorbed by the gastrointestinal tract than other forms of magnesium, oral magnesium supplements are more effective in increasing magnesium absorption [23].

6. Conclusion

The occurrence of magnesium deficiency is exacerbated by the traditional dietary differences of older Chinese people, who are accustomed to eating carbohydrate-containing foods, such as rice, and have a lower intake of foods with higher magnesium content. In addition, as we age, our body functions deteriorate and gastrointestinal absorption decreases, especially for magnesium. The large loss of magnesium is due to estrogen deficiency, which exacerbates the chronic magnesium deficiency. As a result, hypertension accompanies magnesium deficiency. However, Some researchers have suggested ways to minimize the incidence of hypertension risk, such as ingesting a ration of magnesium supplements can be an effective solution to magnesium deficiency due to gastrointestinal absorption, and some publicity tools can be used to help Chinese older adults to break the traditional dietary habits and gradually embrace the change in dietary habits. Finally, in terms of clinical perspectives and dietary patterns, further research could be expanded in the future to better help people improve magnesium intake and reduce the prevalence of hypertension.

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