

**Title:**

**Nutritional Deficiencies and Hypertension: Exploring the Role of Potassium, Magnesium, and Vitamin D across Diverse Populations: A Narrative Review Study.**

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**Abstract:****Background:**

Globally, hypertension is a prevalent risk factor for cardiovascular and kidney diseases, and death. It is well recognized that a healthy diet and nutrition are essential to the treatment and control of hypertension.

**Objectives:** to identify the role of potassium, magnesium, and vitamin D in blood pressure regulation and to assess the gaps in nutrition and diverse diets regarding Hypertension management across the globe.

**Methodology:** The Methods of Searching were established on the 10th of April 2024: Scholar chat, Consensus tools for Artificial intelligence searching, and the Use of research databases in PubMed and Google Scholar, and other programs like Grammarly, Endnote, and Quillbot were used.

**Results:** This study explored the connection between dietary deficiencies and hypertension, focusing on potassium, magnesium, and vitamin D. It examined research findings across diverse populations. The Key Findings were: 100% of 46 research stated Lower blood pressure is associated with higher dietary potassium intake. Although the evidence for magnesium and vitamin D is not as strong, 6 studies(13%)stated they reduce systolic blood pressure. 12 studies (26%)stated that Magnesium has affection but is not known 10 Studies (22%)stated that Vitamin D decreases blood pressure alone and 3 Studies (7%)stated that Magnesium and vitamin D have no effect concluding that Fruits, and vegetables, and whole grain-rich diets appear to be protective against hypertension. Research Needs: More investigation is required to determine the causal links between individual nutrients—particularly magnesium and vitamin D—and blood pressure. To account for any variances, research should involve a variety of populations.

**Conclusion:** a diet high in fruits, vegetables, and whole grains appears to protect against hypertension. The cause-and-effect interactions between certain nutrients and blood pressure require further investigation; this is especially the case for magnesium and vitamin D.

**Keywords:**Nutritional Deficiencies, Hypertension, Potassium, Magnesium, Vitamin D,

**Introduction :**

Increased blood pressure in the pulmonary arteries causes pulmonary hypertension (PH), a severe and potentially fatal condition. Getting the proper treatment is difficult, and we believe a more comprehensive approach to care is required. Although it is sometimes disregarded, mental health and other aspects of patient care, like dietary counselling, cardiac rehabilitation, and sexual health, should be essential. In addition to PH “Pulmonary Hypertension” research and activism, PH ‘Pulmonary Hypertension’ patient associations are essential in offering patients and caregivers financial, educational, and social assistance. As patients, we believe it is our responsibility to fight for an accurate diagnosis, prompt referrals, and the best possible care. We support the continued utilisation of patient-reported outcomes and the patient voice in therapeutic development and research initiatives.(Braley et al., 2023)

There is little information available about the frequency of micronutrient deficiencies in PAH pulmonary Arterial Hypertension patients or the potential outcomes of nutritional therapy. Despite the paucity of evidence on nutritional status and micronutrient deficiencies in PAH ‘Pulmonary Arterial Hypertension’, what is known—including from related fields—indicates that dietary intervention to address deficiencies and metabolic changes may lessen the burden of the illness.(Vinke et al., 2018)

e-learning modules on nutrition provide an unique opportunity to change nutritional intake in PAH pulmonary Arterial hypertension patients and by that improve QoL.(quality of life )(Kwant et al., 2023)The non-specific symptoms of pulmonary arterial hypertension (PAH), a chronic, progressive illness with a dismal prognosis, include overall weakness, dyspnea during exertion, and diminished muscle strength and endurance. Many patients continue to have a dynamic course of the disease, a marked decline in physical performance, a steadily declining quality of life, and limited activity in daily life, even in the face of recent notable advancements in PAH ‘Pulmonary Arterial Hypertension’ therapy. Therefore, the major objectives of PAH’ Pulmonary Arterial Hypertension’ therapy are to minimise the progression of symptoms, maintain a reasonable quality of life as early in the course of the illness as possible, and, if feasible, improve the still-poor prognosis.(Wojciuk et al., 2022)

Globally, hypertension is a prevalent risk factor for cardiovascular disease and death. It is well recognized that a healthy diet and nutrition are essential to the

treatment and control of hypertension. Small amounts of bioactive chemicals found in foods like fish and onions are being thoroughly investigated to learn more about their anti-inflammatory, anti-proliferative, antioxidant, and vasoprotective properties. These properties can help to prevent chronic disease and preserve human health.(Valookaran et al., 2022)

In an observational study ;Patients with pulmonary arterial hypertension PAH and chronic thrombo-embolic pulmonary hypertension (CTEPH) patients are very likely to have iron and vitamin D shortages, which emphasises the importance of keeping an eye on their condition.(Vinke et al., 2021)

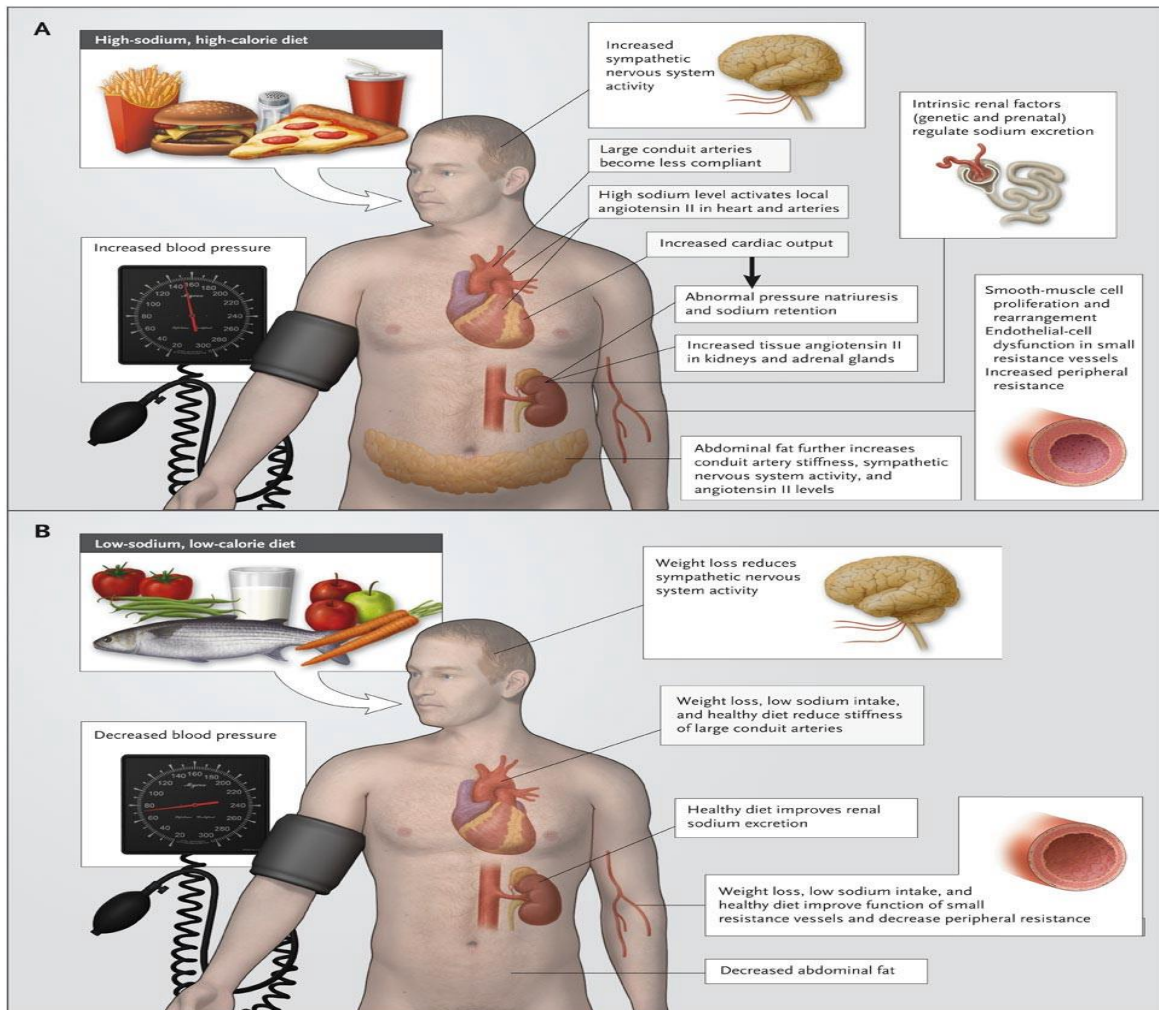
The majority of clinical investigations conducted in normotensive adults have not discovered a reduction in blood pressure caused by these minerals' dietary supplementation. This study found that among normotensive individuals with limited food intake, potassium supplements have a small blood pressure-lowering impact, but not calcium or magnesium supplements.(Sacks et al., 1998)some studies state magnesium lowering systolic blood pressure but VitD has negative relation with systolic blood pressure {Huang, 2022}

The issue of strong intercorrelation among numerous nutrients made it impossible to distinguish the impact of magnesium from that of other factors. Although cross-sectional study recommendations should be interpreted with caution(Joffres et al., 1987); New Studies stated affection of VitD but not Calcium ,Magnesium and Vit E {Alhussain, 2024 }

An essential function of the renin-angiotensin system (RAS) is the control of blood pressure, volume, and electrolyte balance. Hypertension can occur when the RAS is activated inappropriately.(Li et al., 2004)

With differing effect sizes and degrees of proof, the current understanding of enhancing individual nutrient intakes to slow the progression of chronic disease is continuously developing. As a crucial component of their plans to combat NCDs, authorities should put initiatives in place to maximise the intake of vital nutrients.(Bruins et al., 2019)

## 2. Essential Nutrients in Blood Pressure Regulation:



(Figure - 1 )Mechanisms Associated with Blood Pressure Increases and the Therapeutic Benefits of Sodium Reduction, Weight Loss, and a Healthful Diet are shown in this figure. {Sacks, 2010 }

Blood pressure is favourably associated with dietary consumption of sodium, calcium, and magnesium, but potassium intake has no discernible impact on blood pressure management on its own. (Kesteloot and Joossens, 1988) Women's and men's blood pressure is linked to diets high in calcium, potassium, and magnesium. (Van Leer et al., 1995) Lowering sodium consumption and raising potassium and magnesium intake can lessen the need for antihypertensive medications while aiding in the prevention and treatment of arterial hypertension. (Karppanen, 1991)

Lack of magnesium may raise blood pressure and decrease microcirculatory blood flow, which may be involved in the development and management of

hypertensive vascular illnesses. (Altuza et al., 1984) Since hypertension and magnesium insufficiency are related, encouraging older people to consume more magnesium-rich foods and supplements may help avoid the difficulties associated with it. (Dominguez et al., 2020) A possible molecular explanation for the epigenetic alterations and elevated blood pressure in kids resulting from maternal vitamin D insufficiency during pregnancy is Panx1 hypermethylation. (Meems et al., 2016) Dietary protein levels have an impact on hypertension caused by omega-3 fatty acid insufficiency, as seen by elevated blood pressure in animals with low amounts of omega-3 fatty acids. (Begg et al., 2010)

Many Studies talk about Hypertension and Diet like One State: "A possible molecular explanation for the epigenetic alterations and elevated blood pressure in kids resulting from maternal vitamin D insufficiency during pregnancy is Panx1 hypermethylation". (Meems et al., 2016) Other Said : "Rats' blood pressure rises mostly as a result of vitamin B2 complex deficiencies, however other unknown dietary factors may also be involved" (Calder, 1942). Elevated consumption of potassium, protein, and polyunsaturated fatty acids, in conjunction with physical activity and potentially vitamin D, may lower blood pressure. (Savica et al., 2010) Although there may be a little drop in blood pressure with vitamin D treatment, it is still unknown what causes high blood pressure. (Kunutsor et al., 2014)

### **3. Nutrient Influence on Blood Pressure: A Literature Review :**

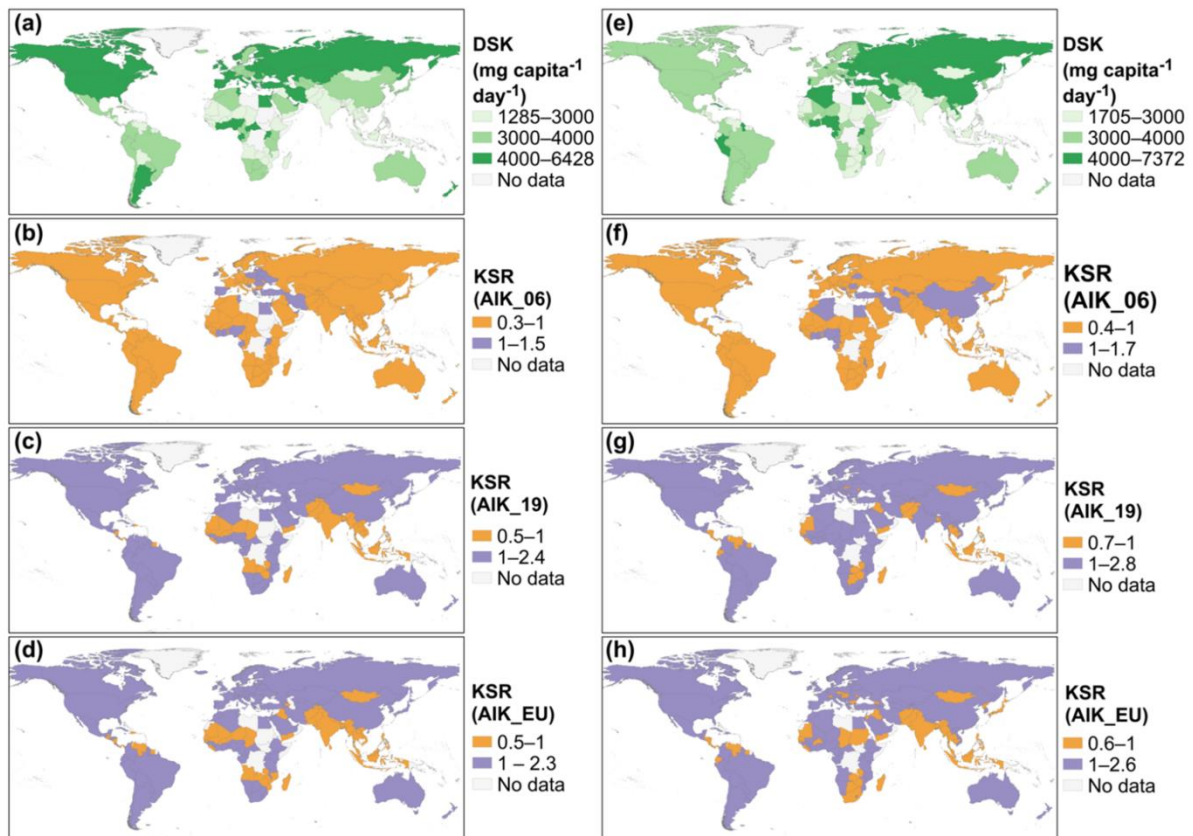
In patients with mild or borderline hypertension, combinations of potassium, calcium, and magnesium supplements did not appear to have a meaningful effect on blood pressure. (Sacks et al., 1995) Adults with primary hypertension were supplemented with calcium, magnesium, and potassium saw non-significant drops in blood pressure; however, a sensitivity analysis revealed a greater reduction in systolic pressure. (Beyer et al., 2006) Compared to calcium or magnesium supplements, potassium supplements have a slight lowering effect on blood pressure in people with poor dietary consumption who are normotensive. (Sacks et al., 1998) Because intracellular magnesium levels are higher and intracellular sodium levels are lower in patients with mild to

moderate primary hypertension, oral magnesium supplementation may lower blood pressure in these patients.(Sanjuliani et al., 1996)Magnesium and potassium supplements used together can provide more protection than either supplement alone against cyclosporine-induced nephrotoxicity and hypertension.(Pere et al., 2000)Raising the daily consumption of potassium from food to 4.7 g lowers blood pressure and lowers the risk of cardiovascular events.(Houston, 2011b)Patients with high blood pressure and low vitamin D levels may benefit from vitamin D supplementation, with those who are vitamin D deficient potentially benefiting the most.(Pilz et al., 2009)

Dietary studies can help prevent and treat hypertension. Dietary consumption of 15 nutrients ,include Water ,biotin ,carbohydrate and other .including riboflavin and tryptophan, is connected with systolic blood pressure; 14 of them have components that are heritable.(Louca et al., 2020)Calcium, fibre, and fat in the diet may play a significant role in determining blood pressure levels in kids whose low-density lipoprotein cholesterol is increased.(Simons-Morton et al., 1997b)For middle-aged women, age, body weight, and alcohol use are major risk factors for hypertension; however, magnesium, fibre, and a diet high in fruits and vegetables can lower blood pressure.(Ascherio et al., 1996)Elevated consumption of calcium, potassium, and sodium has been linked to reduced blood pressure and a decreased likelihood of hypertension in adulthood.(McCarron et al., 1984)In children and adolescents, increased blood pressure is associated with higher sodium intake; however, there is conflicting evidence about the relationship between potassium, calcium, and magnesium.(Couch and Daniels, 2004)Although there is a high correlation between magnesium intake and lower blood pressure, there are also negative relationships between blood pressure and other nutrients, including calcium, phosphorus, potassium, fibre, and vitamin C.(Joffres et al., 1987)B vitamins are significantly inversely correlated with blood pressure; riboflavin and folacin lower blood pressure diastolically, and phosphorus, magnesium, iron, thiamin, and folacin lower blood pressure systolically(Tzoulaki et al., 2012). Blood pressure variations in middle-aged men over the age of eight are associated with a variety of nutrients, alcohol consumption, and calorie imbalance.(Stamler et al., 2002)Adults who consume higher levels of calcium, potassium, vitamin A, and vitamin C are linked to lowered blood pressure and a decreased risk of hypertension(Altura et al., 1984). In Chinese people aged

40-59, there is an inverse relationship between blood pressure and specific amino acids, animal protein, and urine sulphate, although higher salt intake is linked to higher blood pressure.(Zhou et al., 1994)

#### 4.Bridging the Gap: Nutritional Deficiencies, Diverse Diets, and Blood Pressure Management Across the Globe :



(Figure -3) Dietary supply of K (DSK) and K sufficiency ratio (KSR) at the national level in (a–d) 1997 and (e–h) 2017. The K AI guidelines made by the Institute of Medicine in 2006 (AIK\_06), the National Academies of Sciences in 2019 (AIK\_19), the European Union in 2019 (AIK\_EU), and the Institute of Medicine in 2006 (b,f) were used to calculate KSR. {Kumssa, 2021 }

In patients with pulmonary arterial hypertension, nutritional therapies to address metabolic abnormalities and micronutrient shortages may help improve exercise tolerance and lessen fatigue.(Vinke et al., 2018)Iron, vitamin D, vitamin B12, vitamin K1, and selenium shortages are common in patients with pulmonary arterial hypertension, underscoring the need for better nutritional intake.(Kwant et al., 2022)For the purpose of decreasing blood

pressure in individuals with hypertension, WHO guideline suggests calcium supplementation, physical exercise, decreased sodium intake, medical nutrition therapy, and the food Approaches to Stop Hypertension food pattern.(Lennon et al., 2017)Policies to prevent and combat undernutrition in underdeveloped nations are crucial because chronic undernutrition in children raises the risk of obesity and hypertension in later life.(Callejo et al., 2020)For middle-aged women, age, body weight, and alcohol use are major risk factors for hypertension; however, magnesium, fibre, and a diet high in fruits and vegetables can lower blood pressure.(Ascherio et al., 1996)A healthy diet, nutraceuticals, vitamins, minerals, antioxidants, weight loss, exercise, quitting smoking, and moderation in alcohol and caffeine intake can all help many individuals avoid, delay the start of, treat, and manage hypertension.(Houston, 2010)Vitamins, minerals, antioxidants, and nutraceuticals can improve vascular health and lower cardiovascular events, which can help prevent and treat hypertension.(Houston, 2013)Middle-aged Koreans living in rural areas had a higher risk of hypertension than those living in metropolitan areas, which is partly attributed to a lower variety of diets. (Kim et al., 2019)

During the first nine years of type 2 diabetes treatment, there are still ethnic disparities in blood pressure, body weight, and lipid profiles, but glycemic control does not improve.(Davis et al., 2001)Young Black and Hispanic men who are 50 years of age or younger have the lowest quality diets and may be more susceptible to hypertension linked to nutrition.(Bartley et al., 2014)Calcium, fibre, and fat in the diet may play a significant role in determining blood pressure levels in kids whose low-density lipoprotein cholesterol is increased(Simons-Morton et al., 1997a)Blood pressure is successfully lowered by the DASH( dietary approach to stop Hypertension) diet, particularly in hypertensive people, African Americans, and abstainers.(Vollmer et al., 2001)

### **Search Approach**

Search approaches for assorted databases were established on the 10th of April 2024,Scholar chat ,Consensus tools for Artificial Intelligent searching and Use of research databases PubMed and Google Scholar, which were searched for articles that present information on theNutritional Deficiencies and Hypertension: : Exploring the Role of Potassium, Magnesium, and Vitamin D across Diverse Populations . All-inclusive searches consolidate the relevant keywords through

Boolean logical operators ('AND' & 'OR') hence advanced and 'Expert' search options were executed. The screening was performed using the pursuing keywords, which were involved in titles as well as in abstracts of the published Articles: Laboratory markers, tool, diagnose. Malnutrition and Factors interfering. Articles selection were carried out according to inclusion and exclusion criteria, every full text published article written in the English language, of all clinical study designs and case series, all were involved. Moreover, any with insignificant or replicated evidence was excluded. Afterward, another search was carried out on references of all resultant articles, such searching was observed to find additional related articles. The Articles are Cited using Endnote program .

### **Conclusion :**

According to studies, blood pressure and dietary potassium intake are inversely connected, with increased potassium intake resulting in lower blood pressure. Less is known about the benefits of magnesium and vitamin D, while some research points to potential advantages.

Future research must cover a diverse range of populations in order to account for any genetic and environmental variances. For the treatment of blood pressure, dietary interventions that encourage a high potassium intake from fruits and vegetables can be suggested, particularly for groups with low potassium intake. To achieve ideal blood pressure regulation, customised dietary plans may be created based on each person's demands and possible vitamin deficits.

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