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Mini-Review

Impact of vitamin D deficiency on hypertension; a mini-review on recent insights

Fariba Jafari Khabaz[1], Elahe Zaremoghadam[2], Soleyman Alivand[3], Noorbakhsh Alivand[4], Mahsa Asadollahi Hamedani[1], Sara Dehghan[1], Zahra Aboulfathiyarmohammadyar[5], Mohamad Khaledi[1*]

Abstract

There is increasing evidence that vitamin D deficiency may contribute to hypertension. Low vitamin D levels are associated with an increased risk of high blood pressure, and studies have shown that vitamin D supplementation can help lower blood pressure. However, more research is needed to fully understand the mechanisms by which vitamin D regulates blood pressure and to determine the optimal dosage for supplementation. Nevertheless, ensuring adequate vitamin D levels through diet or supplements may be essential for preventing and managing hypertension.

Keywords: Blood pressure, Hypertension, Renin-angiotensin-aldosterone system, Vitamin D deficiency, Cardiovascular disease

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Introduction

Vitamin D is a necessary nutrient for the proper functioning of the human body. It helps to maintain strong bones, regulate the immune system, and support cardiovascular health (1). However, many people suffer from vitamin D deficiency, which can have significant health implications, including an increased risk of hypertension (2).

Hypertension is one of the leading causes of cardiovascular disease and is associated with many health complications, including stroke, heart attack, and kidney failure (3). The exact causes of hypertension are not entirely understood, but several factors are known to contribute to symptom progression. These include lifestyle factors such as an unbalanced diet, lack of exercise, smoking, and biological factors such as genetic predisposition and hormonal imbalances (4).

Several studies have found a significant correlation between low levels of vitamin D and Several studies have found a significant association between low vitamin D levels and hypertension (5). One meta-analysis study of 11 randomized controlled trials (RCTs) involving over 2000 participants found that vitamin D significantly decreased hypertension (6). Another study examined the correlation of vitamin D levels with hypertension in a population of over 1500 participants and found that individuals with the lowest vitamin D deficiency had the highest rates of hypertension (7).

Several hypertension treatment options are available, including lifestyle changes, medication, and supplementation. Vitamin D supplementation effectively reduces blood pressure in both normotensive and hypertensive patients, with optimal vitamin D correlated with a lower risk of high blood pressure (8). While supplementation will be beneficial in treating vitamin D insufficiency, it should not be considered a replacement for lifestyle changes or medication (9). This study aimed to evaluate the impact of vitamin D deficiency on hypertension, exploring the underlying mechanisms, potential treatments, and preventative strategies.

Search strategy

We searched Web of Science, DOAJ, EBSCO, PubMed, Scopus, Google Scholar, and Embase using various keywords such as; vitamin D deficiency, blood pressure, Hypertension, cardiovascular disease, vitamin D, renin-angiotensin-aldosterone system

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[1]Department of Nursing, Faculty of Nursing and Midwifery, Hormozgan University of Medical Sciences, Bandar Abbas, Iran. [2]Department of Internal Medicine, School of Medicine, Birjand University of Medical Sciences, Birjand, Iran. [3]Department of Biostatistical and Epidemiology, School of Health, Isfahan University of Medical Sciences, Isfahan, Iran. [4]Department of Nutrition, School of Health, Shiraz University of Medical Sciences, Shiraz, Iran. [5]Student Research Committee, School of Pharmacy, Eastern Mediterranean University of North Cyprus, Famagusta, Cyprus.

***Corresponding author:** Mohamad Khaledi, Email: Khaledi.mohamad82@gmail.com

Implication for health policy/practice/research/ medical education

The impact of vitamin D deficiency on hypertension is significant, and increasing awareness of this link is crucial for promoting optimal cardiovascular health. Supplementation with vitamin D can help treat a deficiency, but prevention through a healthy diet and lifestyle is the most effective approach. Individuals can reduce their risk of hypertension and its associated health complications by addressing vitamin D deficiency..

Mechanism of action

Vitamin D insufficiency was defined as a serum 25-hydroxyvitamin D (25(OH)D) level of <20 ng/mL. The optimal level of 25(OH)D for overall health is still a matter of debate, but some organizations recommend a level of at least 30 ng/mL (10,11).

Vitamin D is thought to improve endothelial function by the increase in nitric oxide production, a molecule that dilates vessels and improves blood perfusion. It may also reduce inflammation and oxidative stress, which are known to contribute to endothelial dysfunction and arterial stiffness (12).

Vitamin D has a key role in regulating hypertension by influencing the renin-angiotensin-aldosterone system (RAAS), which is a hormone that regulates blood volume and pressure in the body. When levels of vitamin D are low, the RAAS system is overactive, promoting the constriction of blood vessels and the retention of water and sodium, which can lead to an increase in blood pressure (13,14). In addition, vitamin D insufficiency is correlated with elevated cortisol levels, which can also contribute to hypertension. Vitamin D insufficiency may impair the endothelium's function, and the blood vessel's inner lining, leading to increased arterial stiffness and reduced blood flow (15). Additionally, vitamin D showed a key role in regulating inflammation, and vitamin D deficiency may contribute to a pro-inflammatory state, which in turn can contribute to hypertension (16,17).

Previous studies showed the impact of vitamin D administration on blood pressure in individuals with hypertension. While results have been mixed, some studies demonstrated that vitamin D supplementation may lead to a modest reduction in blood pressure, particularly among patients with lower baseline vitamin D levels (18,19). A meta-analysis of thirteen randomized controlled trials found that vitamin D decreased systolic blood pressure by 2.44 mm Hg and diastolic blood pressure by 1.15 mm Hg (6,20).

A meta-analysis of 46 studies found that low vitamin D levels were correlated with a 64% increased risk of hypertension. The association was stronger in studies that measured 25(OH)D levels rather than dietary or sun exposure measures of vitamin D (21).

Some studies showed that vitamin D can have a greater impact on blood pressure in individuals with severe vitamin D deficiency (<10 ng/mL) compared to those with mild to moderate deficiency (10-20 ng/mL). One study found that vitamin D administration (50 000 IU/wk for 8 weeks) led to significant reductions in hypertension among individuals with severe vitamin D ineffectuality (2,22,23).

Conclusion

In summary, vitamin D deficiency has emerged as a potential risk factor for hypertension. While the exact mechanisms are not fully understood, it appears that vitamin D deficiency may contribute to endothelial dysfunction, sodium retention, and micro-inflammation, all of which can contribute to hypertension. Given the widespread prevalence of vitamin D ineffectuality and hypertension, greater attention should be paid to ensuring adequate vitamin D levels and promoting healthy lifestyle behaviors to lower the risk of hypertension.

Authors' contribution

Conceptualization: EZ and MKh
Validation: SA and SD
Investigation: EZ and ZA
Resources: NA.
Data Curation: FJ and MA.
Visualization: EZ
Supervision: MKh.
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Writing–original draft: EZ, SD, MA, and FJ.
Writing–review and editing: MKh, ZA, SA, and NA.

Conflicts of interest

The authors declare that they have no competing interests.

Ethical issues

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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