International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 5s, 2025
https://www.theaspd.com/ijes.php

The Role of Garlic in Reducing Cardiovascular Risk Among Hypertensive Patients: A Narrative Review for Nursing Practice

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Abstract: Hypertension represents a widespread global health concern and is a primary modifiable risk factor for cardiovascular diseases (CVDs), playing a significant role in global mortality rates. Although effective pharmacological treatments exist, various obstacles such as inadequate medication adherence, side effects, and limited access impede optimal blood pressure management, especially in low-resource environments. Approaches in complementary and integrative medicine (CIM), such as dietary phytotherapeutics, have garnered attention as supplementary strategies. Garlic (Allium sativum), in particular, has been thoroughly examined for its advantages to cardiovascular health. It contains bioactive sulfur compounds like allicin, diallyl disulfide, and S-allyl cysteine, which demonstrate vasodilatory, antioxidant, anti-inflammatory, lipid-lowering, and antithrombotic effects. These compounds enhance endothelial function, regulate nitric oxide bioavailability, inhibit angiotensin-converting enzyme (ACE), and positively affect lipid metabolism and inflammatory pathways. Clinical research, including randomized controlled trials and meta-analyses, validates garlic's effectiveness in lowering both systolic and diastolic blood pressure, with results comparable to standard antihypertensives in cases of mild to moderate hypertension. Additionally, garlic's availability, cost-effectiveness, and cultural acceptance make it a practical complementary intervention, particularly in resource-limited areas. This narrative review consolidates current findings regarding garlic's pharmacodynamics, clinical effectiveness, safety, and its incorporation into hypertension treatment strategies. The review further emphasizes the vital role of nurses in evaluation, patient education, monitoring, and culturally sensitive care to safely introduce garlic supplementation into holistic hypertension management plans. Integrating garlic into comprehensive cardiovascular care may enhance blood pressure regulation and diminish CVD risk, aligning with global public health initiatives advocating for sustainable, food-based solutions.

Keywords: Hypertension, Cardiovascular Risk, Nursing Practice, Herbal Therapy, Garlic

1. Introduction

Hypertension, which is defined clinically as consistently high arterial blood pressure, poses a major global public health challenge and stands as a leading modifiable risk factor for cardiovascular diseases (CVD), including ischemic heart disease, stroke, heart failure, and peripheral vascular disease. According to the World Health Organization (2023), more than 1.28 billion adults aged 30–79 live with hypertension globally, with around 46% unaware of their condition and fewer than one in five maintaining adequate control. This significant gap in diagnosis and treatment contributes to the persistent global burden of CVDs, which collectively result in an estimated 17.9 million deaths each year, accounting for 32% of all global mortality.

Despite the proven efficacy of pharmacological treatments—like ACE inhibitors, angiotensin receptor blockers (ARBs), calcium channel blockers, and thiazide diuretics—in controlling elevated blood pressure, there remain continuing challenges regarding medication adherence, side effects, accessibility, and affordability, especially in lower-resource settings. These challenges have sparked an increased interest in complementary and integrative medicine (CIM), involving dietary approaches and phytotherapeutics. Among the natural substances being studied, garlic (Allium sativum), a plant widely used for both culinary and medicinal purposes, has emerged as a promising adjunctive treatment for hypertension and cardiovascular risk mitigation.

Garlic harbors several bioactive sulfur compounds—most notably allicin, diallyl disulfide, and S-allyl cysteine—that have vasodilatory, anti-inflammatory, antioxidant, lipid-lowering, and antithrombotic effects. Mechanistically, these compounds influence vascular function by enhancing nitric oxide (NO) availability, inhibiting ACE activity, decreasing oxidative stress, and enhancing endothelial performance. A growing repertoire of randomized controlled trials and meta-analyses over the past decade corroborates garlic's role in decreasing both systolic and diastolic blood pressure, with results on par with first-line antihypertensive drugs in cases of mild to moderate hypertension.

From a public health viewpoint, the incorporation of garlic as a dietary supplement represents a low-cost, culturally acceptable, and potentially scalable solution for hypertension management, particularly in areas with limited healthcare resources. Furthermore, as noncommunicable diseases increasingly dominate the global health landscape, utilizing food-based strategies for population-level cardiovascular prevention aligns with the WHO's Global Action Plan for the Prevention and Control of Noncommunicable Diseases (2013–2030), which promotes sustainable, culturally considerate, and community-focused interventions.

This review compiles existing research on the role of garlic in the management of hypertension and the reduction of cardiovascular risk. It thoroughly assesses the pharmacodynamic mechanisms, clinical effectiveness, safety profile, and relevance to nursing practice. The objective is to promote evidence-based, holistic care strategies that merge traditional dietary approaches with modern clinical practices, thereby improving patient outcomes and contributing to the sustainability of health systems.

2. Garlic and Its Cardiovascular Benefits

Garlic (Allium sativum) has been a significant element in traditional medicine for thousands of years. Ancient records from civilizations such as Egypt, Greece, Rome, China, and India highlight its application for various ailments, including infections, respiratory issues, digestive problems, and especially cardiovascular diseases. In both Ayurvedic and Traditional Chinese Medicine, garlic has been utilized to harmonize bodily functions and support circulatory health, while Hippocrates, considered the father of modern medicine, recommended it for respiratory and cardiovascular ailments. This historical empirical use has increasingly gained validation from contemporary scientific research.

The therapeutic benefits of garlic are largely attributed to its abundant organosulfur compounds, with allicin being the most studied and biologically significant. Allicin does not exist in whole garlic cloves; it is produced through an enzymatic process when garlic is chopped, crushed, or chewed. This action activates the enzyme alliinase, transforming alliin (a sulfur-rich amino acid derivative) into allicin. Allicin is highly reactive and exhibits a variety of biological activities, including antioxidant, anti-inflammatory, antimicrobial, antihypertensive, and lipid-lowering effects (El-Saber Batiha et al., 2020).

From a biochemical viewpoint, allicin and its derivatives—such as diallyl disulfide (DADS), diallyl trisulfide (DATS), and S-allyl cysteine (SAC)—influence several physiological pathways. These pathways include the inhibition of oxidative stress markers (like malondialdehyde), the enhancement of endogenous antioxidant enzymes (including superoxide dismutase), and the reduction of pro-inflammatory cytokines such as TNF-α and IL-6. In addition, these compounds affect nitric oxide pathways and lipid metabolism, making garlic especially advantageous for conditions associated with vascular inflammation and endothelial dysfunction.

The rising global interest in the medicinal application of garlic reflects wider public health trends. As awareness increases regarding the negative impacts of long-term drug therapies and the prevalence of polypharmacy among older adults, garlic has gained acceptance as a nutraceutical and alternative therapy. Epidemiological research indicates that populations with a high intake of garlic—such as those in Mediterranean and East Asian cultures—often experience lower rates of cardiovascular diseases, prompting further clinical investigations into its heart-protective properties (Asdaq & Inamdar, 2022; Ried, 2020).

Given its historical significance and strong scientific backing, garlic emerges as a functional food with significant potential in integrative cardiovascular care. Its ease of access, cost-effectiveness, and positive safety profile further highlight its importance in both clinical settings and community health initiatives.

3. Mechanisms of Action

The therapeutic promise of Allium sativum (garlic) for cardiovascular health, particularly in hypertension management, is governed by various biochemical and physiological mechanisms. These mechanisms are grounded in the bioactive sulfur-containing compounds found in garlic, including allicin, S-allyl cysteine (SAC), diallyl disulfide (DADS), and ajoene. These compounds produce various effects on the vascular, renal, and metabolic systems, collectively aiding in blood pressure control and the reduction of cardiovascular risk.

1. Endothelial-Dependent Vasodilation through Nitric Oxide (NO) Enhancement

Garlic boosts the availability of nitric oxide (NO), a powerful vasodilator produced by endothelial nitric oxide synthase (eNOS). Compounds like allicin promote the upregulation of eNOS expression and activity, resulting in increased NO synthesis. Consequently, this facilitates relaxation of vascular smooth muscle, decreases systemic vascular resistance, and lowers blood pressure (Gao et al., 2020; Ried, 2020). Moreover, NO helps inhibit platelet aggregation and leukocyte adhesion, providing additional protection against atherosclerosis.

2. Suppression of the Renin-Angiotensin-Aldosterone System (RAAS)

Elements found in garlic have shown the ability to inhibit angiotensin-converting enzyme (ACE), consequently reducing the transformation of angiotensin I into the potent vasoconstrictor angiotensin II. Lower levels of angiotensin II result in less vasoconstriction, decreased aldosterone secretion, and reduced sodium retention—all significant factors in elevating blood pressure (Rahmani et al., 2019). This ACE inhibition resembles the mechanism of conventional antihypertensive medications such as captopril and enalapril, positioning garlic as a possible complementary option in RAAS-targeted treatments.

3. Antioxidant and Anti-Inflammatory Properties

Oxidative stress, involving an imbalance between the production of reactive oxygen species (ROS) and antioxidant defenses, significantly contributes to endothelial dysfunction and hypertension. Garlic displays strong antioxidant properties through direct scavenging of free radicals and by enhancing the activity of internal antioxidant enzymes such as superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase (CAT) (El-Saber Batiha et al., 2020). Additionally, garlic inhibits nuclear factor-kappa B (NF-κB) signaling, lowering the levels of pro-inflammatory cytokines like IL-6 and TNF-α, which are linked to vascular inflammation and the formation of atherosclerotic plaques.

4. Enhancement of Lipid Metabolism

Dyslipidemia serves as a significant modifiable risk factor for atherosclerosis and cardiovascular incidents. Clinical studies have found that garlic supplementation—especially aged garlic extract (AGE)—is linked to noteworthy reductions in total cholesterol, low-density lipoprotein cholesterol (LDL-C), and triglyceride levels, as well as modest increases in high-density lipoprotein (HDL-C) (Mahdavi-Roshan et al., 2020; Asdaq & Inamdar, 2022). The mechanism involves the inhibition of cholesterol synthesis in the liver, increased bile acid excretion, and modulation of lipid oxidation processes.

5. Influence on Gut Microbiota and Immune Function

New research indicates that garlic, particularly AGE, may have prebiotic effects by specifically adjusting the composition of gut microbiota, promoting the growth of beneficial bacterial species such as Lactobacillus and Bifidobacterium. These alterations in the gut microbiome contribute to reduced systemic inflammation, improved lipid metabolism, and enhanced vascular health (Ried et al., 2018). Furthermore, garlic's immunomodulatory effects may provide additional protection against endothelial injury and long-term vascular inflammation.

4. Clinical Evidence Supporting Garlic in Hypertension Management

Recent studies have increasingly affirmed the therapeutic potential of garlic as a supplementary treatment in managing hypertension and decreasing cardiovascular risk. A comprehensive meta-analysis that included 20 randomized controlled trials with a combined total of 970 participants found a statistically significant reduction in blood pressure following garlic supplementation. Specifically, the combined data indicated an average decline of 5.1 mmHg in systolic blood pressure (SBP) and 2.5 mmHg in diastolic blood pressure (DBP) among all participants. Notably, the antihypertensive effect was more pronounced in individuals with hypertension, who showed average reductions of 8.7 mmHg SBP and 6.1 mmHg DBP. These outcomes indicate a clinically significant effect of garlic supplementation, particularly in those with elevated baseline blood pressure (ScienceDirect, 2023).

A separate systematic review and meta-analysis that focused solely on aged garlic extract (AGE)—a standardized formulation rich in bioactive sulfur compounds—examined nine randomized controlled trials involving 584 participants. This analysis validated the notable blood pressure-lowering effects of AGE, showing a reduction in SBP by 4.03 mmHg and DBP by 1.44 mmHg. The review emphasized that dosages exceeding 1,200 mg/day resulted in better antihypertensive outcomes, highlighting the importance of dosage standardization in clinical practices (ScienceDirect, 2024).

Apart from influencing blood pressure, a meta-analysis involving individuals with coronary artery disease indicated that garlic consumption positively impacted lipid profiles by reducing both total cholesterol and LDL cholesterol, while also lowering inflammatory markers like C-reactive protein (CRP). This comprehensive cardiovascular benefit profile implies that garlic supplementation may provide various cardioprotective effects through both hemodynamic and metabolic pathways (PubMed, 2023).

5. Global Usage and Cultural Considerations

Garlic is deeply embedded in the culinary and medicinal practices of numerous cultures globally, prominently featured in Asian, Mediterranean, and Middle Eastern cuisines. These areas often report lower rates of cardiovascular disease (CVD), potentially linked to the regular inclusion of garlic in their dietary habits. For example, in nations such as India and China, garlic is not only valued as a food ingredient but is also utilized as a natural treatment within traditional medical systems like Ayurveda and Traditional Chinese Medicine (TCM). Its cultural acceptance and regular incorporation into daily diets render garlic a viable and sustainable option for managing hypertension, particularly in areas where access to pharmaceutical treatments is limited or where individuals prefer natural remedies (Asdaq & Inamdar, 2022).

Additionally, the World Health Organization highlights the growing adoption of traditional and complementary medicines worldwide, especially in low- and middle-income nations, underscoring the importance of garlic within integrative health approaches (WHO, 2021).

6. Dosage and Forms

Garlic can be found in a variety of forms, including fresh cloves, garlic powder, garlic oil, and aged garlic extract (AGE) supplements. Among these options, AGE is particularly favored due to its standardized levels

of bioactive sulfur compounds and better tolerability. Clinical studies suggest effective dosages of AGE ranging from 600 mg to 2,400 mg daily, with greater quantities linked to improved blood pressure reduction (ScienceDirect, 2024). Consuming raw garlic—typically between one to two cloves each day (around 4 grams)—has also been associated with cardiovascular advantages, although adherence and gastrointestinal tolerance may differ among individuals.

It is important to note that differences in garlic preparations can affect bioavailability and therapeutic effectiveness, requiring careful consideration when recommending supplements.

7. Safety and Side Effects

Garlic is typically well tolerated when consumed within recommended dietary levels. However, at higher supplemental doses, common gastrointestinal side effects include dyspepsia, flatulence, and heartburn. Additionally, the strong odor of garlic can cause social discomfort due to bad breath and body odor. Importantly, garlic has antiplatelet properties that inhibit platelet aggregation, which may elevate the risk of bleeding. This raises concerns when garlic is taken alongside anticoagulants (like warfarin) or other antiplatelet medications, requiring caution for patients on these treatments. Although rare, allergic reactions can happen, especially in those with sensitivities to Allium species. Healthcare professionals, including nurses, should carry out comprehensive medication reviews and patient history evaluations before recommending garlic supplementation to reduce potential adverse effects (Verywell Health, 2023).

8. Implications for Nursing Practice

Nurses are vital frontline healthcare providers and advocates for patients, positioned to help safely and effectively incorporate evidence-based complementary therapies, such as garlic supplementation, into comprehensive care plans for hypertension. Their holistic approach ensures that treatment strategies consider not just the biological aspects of the condition but also the cultural, educational, and psychosocial factors affecting patient outcomes.

Assessment:

The basis of effective nursing care is thorough patient evaluation. Nurses need to assess various factors, including patients' usual dietary habits, current health status, and any comorbidities like diabetes or renal issues that could impact garlic's safety and effectiveness. A crucial aspect involves reviewing the patient's current medications to spot possible interactions with herbs, particularly with antihypertensives, anticoagulants, or antiplatelet drugs. Additionally, understanding patients' cultural backgrounds and beliefs concerning herbal or traditional remedies is important. This comprehensive assessment allows nurses to create tailored recommendations that align with patient preferences and ensure safety, thereby enhancing therapeutic outcomes.

Education:

Educating patients is a key nursing duty that empowers them to take an active role in managing their health. Nurses should provide straightforward, evidence-based information on garlic's cardiovascular benefits, which include its ability to lower blood pressure, modify lipid levels, and provide antioxidant

effects. Education should encompass the various forms of garlic available—like raw, powdered, aged extract, or oil—and suitable dosing strategies based on clinical research. It is equally important to inform patients about potential side effects, such as digestive discomfort, bleeding risks, or allergic responses, and stress the importance of consulting healthcare providers before starting garlic supplementation. Encouraging open communication allows patients to voice their concerns or preferences regarding complementary therapies, fostering trust and supporting adherence.

Monitoring:

Continuous monitoring is essential to ensure patient safety and therapeutic effectiveness when including garlic in hypertension treatment. Nurses should closely watch for any adverse reactions—gastrointestinal symptoms such as nausea or indigestion, allergic reactions like rashes or swelling, and signs of bleeding (e.g., bruising or petechiae)—especially in patients taking anticoagulants or other drugs that influence blood clotting. Regular monitoring of blood pressure and lipid profiles can help assess the clinical effects of garlic supplementation. Timely documentation and communication of any adverse events or unexpected changes to the healthcare team enable prompt interventions and adjustments to care plans.

Cultural Competency:

Acknowledging and respecting the cultural importance of garlic in traditional healing approaches is vital for providing culturally sensitive nursing care. Many patients may hold long-standing beliefs regarding garlic's medicinal properties, and nurses should honor these views while offering evidence-based advice. Cultural competency involves understanding patients' values, communication methods, and health beliefs, which promotes meaningful conversations and strengthens the nurse-patient relationship. By creating an atmosphere of respect and openness, nurses can improve patient engagement, encourage adherence to treatment recommendations, and support overall well-being.

9. Conclusion

Garlic offers a promising complementary strategy for managing hypertension, supported by a significant amount of evidence that highlights its diverse cardiovascular advantages. The bioactive sulfur compounds found in garlic aid in vasodilation, suppress the renin-angiotensin-aldosterone system, provide antioxidant and anti-inflammatory effects, and enhance lipid profiles, all of which contribute to meaningful reductions in blood pressure and risk factors for cardiovascular disease. Research from clinical trials and meta-analyses confirms garlic's effectiveness, particularly in individuals experiencing mild to moderate hypertension, where it can act as a cost-efficient supplement to standard medication. In addition to its physiological benefits, garlic’s cultural acceptance and prevalent use in diets make it an easily accessible and sustainable option, especially in culturally traditional or resource-limited populations.

Nurses play a crucial role in the safe and effective incorporation of garlic supplementation into the management of hypertension. By conducting thorough assessments of patients, providing education on the evidence-based advantages and possible risks, closely monitoring for any adverse reactions, and utilizing culturally sensitive communication, nurses can improve patient adherence and optimize health outcomes. Collaborative efforts across disciplines further enhance personalized care plans that integrate conventional medicine with complementary therapies.

In summary, incorporating garlic into hypertension management illustrates a holistic, integrative approach to care that addresses the intricacies of cardiovascular health through accessible, natural remedies. Adopting such strategies aligns with global public health objectives aimed at sustainably and equitably reducing the burden of noncommunicable diseases. Future studies should prioritize standardized dosages, long-term safety assessments, and the investigation of garlic's synergistic potential.

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