

Mediterranean Diet Versus Dash Diet in the Management of Hypertension

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ABSTRACT

To systematically compare the mechanism of action, dietary characteristics and antihypertensive features of Mediterranean diet and DASH diet in the management of hypertension. Using "Mediterranean diet" OR "DASH diet" AND "Hypertension" as the keywords, PubMed, Web of Science, China Knowledge Network and other databases were searched and screened, and patients with confirmed hypertension, cohorts of Mediterranean diet and DASH diet, systematic reviews, randomized controlled trials were included in the studies, while non-hypertensive patients or people with mixed diseases and studies that did not include the Mediterranean diet and the DASH diet were excluded. The Mediterranean diet is centered on polyphenols (olive oil, red wine) and monounsaturated fatty acids, which regulate blood pressure through anti-inflammatory, antioxidant and activation of the nitric oxide (NO) pathway, while the DASH diet regulates blood pressure through strict sodium restriction, a high potassium-magnesium-calcium intake and metabolism of low-fat dairy products. The two diets have both commonalities and differences, and absence of direct indicating that the DASH diet regulates the flora mechanism and NO mechanism to lower blood pressure.

KEYWORDS

Mediterranean diet; DASH diet; hypertension; comparison

1 Introduction

Hypertension, defined as a persistent elevation of arterial blood pressure above normal levels, refers to abnormally high pressure exerted on the walls of blood vessels due to circulation. According to the GBD 2019 ^[1], it is evident that hypertension stands as the leading global risk factor for premature mortality. It accounts for approximately 10.8 million deaths and 235 million health-adjusted life years lost annually. Besides medications, diet plays a key role in managing hypertension, with the Mediterranean and DASH diets widely recognized as effective for its prevention and treatment ^[2]. However, current research—both domestic and international—lacks a comprehensive comparison of the Mediterranean eating plan and the DASH diet in managing hypertension. This review aims to summarize their similarities and differences in hypertension management, providing insights and a reference for clinical dietary interventions. The findings are presented below.

2 Mediterranean diet and DASH diet origins and characteristics

2.1 Origin and characteristics of the mediterranean diet

The concept of the Mediterranean diet was first proposed by Ancel Keys in the 1950s, who, in the Seven Countries Study, found that residents of Mediterranean coastal countries had lower rates of cardiac morbidity and longer life expectancy, which were closely related to their unique dietary habits ^[3]. The Mediterranean diet is characterized by a high intake of vegetables, fruits, nuts, fish, legumes, and unprocessed grains, characterized by limited consumption of meat, meat products, and dairy, moderate red wine intake, and the primary use of monounsaturated olive oil as the main fat source ^[4-5].

2.2 Origin and characteristics of the DASH diet

The DASH diet was initially formulated based on results from a significant randomized controlled study conducted by the National Heart, Lung, and Blood Institute (NHLBI) in 1994. The aim of this investigation was to assess how general dietary practices influence the management of hypertension. Findings revealed that a nutritional approach focusing on fruits, vegetables, legumes, whole grains, and reduced-fat dairy items—while restricting daily sodium consumption to 3 grams and minimizing intake of red and processed meats as well as sweetened drinks—demonstrated considerably superior outcomes in reducing blood pressure when contrasted with a conventional control regimen. This effective dietary strategy later came to be known as the DASH diet ^[6]. The core features of the DASH diet include a focus on plant-based foods, whole grains, and low-fat dairy, all of which are naturally lower in sodium and fat. Moreover, the plan advises limiting total fat intake, especially trans fats and saturated fats, while recommending restrained consumption of red meat and energy-dense foods ^[7-8].

3 Mechanisms of action of the Mediterranean diet in hypertension

3.1 Antioxidant and anti-inflammatory improvement of blood vessels

The consumption of extra virgin olive oil, red wine, berries and nuts, which are emphasized in the Mediterranean diet,

contain important antioxidant and anti-inflammatory nutrients that act as protectors of the endothelium of the blood vessels, i. e.: polyphenols, vitamin C, and vitamin E. The study by Grosso et al ^[9]. stated that a diet rich in diverse polyphenol-containing foods may enhance vascular health and reduce the likelihood of developing hypertension. Certain polyphenol-rich foods can positively influence blood pressure regulation. The antioxidant effect of polyphenols contributes to oxidized low-density lipoprotein (LDL) and C-reactive protein (CRP) serum values and thus intravascular damage and inflammation, it helps to restore normal vascular reactivity.

3.2 Regulation of sodium, potassium and other elements

Filippou et al ^[10] study noted that the Mediterranean diet does not specify a particular sodium intake level but promotes the intake of inherently low-sodium foods, including fruits and vegetables. Consequently, individuals who closely follow the Mediterranean diet tend to consume less salt following its adoption in dietary interventions^[10]. Although the Mediterranean trial did not provide sufficient data on the changes in sodium intake, The protective role of the Mediterranean diet against hypertension may potentially stem from its enhanced provision of essential micronutrients, macronutrients, and minerals. These dietary components appear to counteract oxidative stress and inflammation, potentially offsetting the negative impact of harmful elements such as sodium ^[10].

Whereas a Mediterranean diet that emphasizes natural ingredients, processed foods (high in salt), and the intake of potassium-rich (e.g., vegetables, fruits, legumes) foods are rich in potassium that promotes the efficient metabolism of sodium and reduces edema and vascular pressure caused by sodium retention. At the same time the magnesium and calcium provided in nuts, whole grains and green leafy vegetables regulate vascular muscle contraction, peripheral resistance and thus blood pressure.

3.3 Improvement of lipid metabolism

Olive oil, the principal fat source in the Mediterranean diet, is abundant in unsaturated fatty acids and is typically used in low-temperature cooking to preserve its antioxidant properties ^[4]. Fish in the Mediterranean diet usually refers to marine fish, which, in addition to being rich in high-quality proteins, is also high in long-chain N-3 fatty acids (eicosapentaenoic acid as well as docosahexaenoic acid, eicosapentaenoic acid and docosahexaenoic acid), and eicosapentaenoic acid is a very important unsaturated fatty acid chemical messenger with an important role in the anti-immune and inflammatory response ^[11].

3.4 Dietary fiber and gut flora regulation

Gut microbes are mediating variables in the dietary modulation of blood pressure and can influence blood pressure ^[2]. At the same time, gut flora can generate short-chain fatty acids when digesting dietary fiber, which have been shown to have vasodilatory properties ^[2]. Dietary fiber from whole grains, legumes, fruits and vegetables, which is emphasized in the Mediterranean diet, has these properties and also prevents atherosclerosis through the ability of cholesterol to be absorbed, as well as reduces vasoconstriction indirectly blood pressure by regulating the renin-angiotensin system.

3.5 Nitric oxide pathway activation

Certain dietary elements, such as monounsaturated fatty acids—mainly derived from olive oil—as well as vitamin E and selected polyphenols like flavonoids and resveratrol, are believed to support improved vascular health. These effects are primarily attributed to their ability to increase nitric oxide availability and encourage blood vessel dilation ^[10]. The Mediterranean diet includes monounsaturated fats from olive oil and omega-3 fatty acids from fish, which help improve endothelial function by enhancing nitric oxide bioavailability. These nutrients also play a role in reducing fat cell formation, contributing to better metabolic and cardiovascular health. Altawili et al ^[12] stated that Endothelial function, Healthy endothelial function is essential for effective blood pressure control. The Mediterranean diet, rich in polyphenols, has been shown to increase nitric oxide (NO) levels, contributing to improved vascular protection. Nitric oxide, a key signaling molecule responsible for vasodilation, is essential for blood pressure regulation ^[12].

4 Mechanisms of action of the DASH diet in hypertension

4.1 Antioxidant and anti-inflammatory protection of vascular endothelium

Chen Yu et al ^[7] concluded that the phytochemicals contained in the DASH dietary regimen are more abundant and have a good antioxidant effect, which can inhibit the release of inflammatory factors and inflammatory response. To achieve the role of diastolic cardiovascular, muscle contractile tone. Wang Zhihong et al ^[13] showed that the DASH diet emphasizes the intake of vegetables and fruits, which are rich in vitamin C and folic acid, and have the effect of regulating dyslipidemia, anti-inflammatory, antioxidant, and maintaining the acid-base balance in the body. Thus, it can protect the endothelial function of blood vessels.

4.2 Sodium, potassium and other elements regulation

Potassium can cause endothelial vasodilatation, respectively and open sodium pumps and potassium channels, intravascular volume, partly through sodium reabsorption, to achieve lower blood pressure^[14]. Fluid retention often increases blood pressure, which is mostly related to excessive sodium intake, and the DASH diet solves this problem by restricting sodium intake and increasing potassium intake^[12]. Decreasing sodium in the body leads to reduced water retention, and increasing potassium intake aids in balancing sodium levels by promoting its excretion. Both processes are essential for effective blood pressure regulation^[12]. By incorporating high levels of potassium and restricting sodium intake, the DASH diet can influence the sodium-to-potassium ratio in patients, stimulate renal sodium excretion, and ultimately assist in the management of blood pressure.

At the same time, Yang Li et al[8] concluded that potassium, magnesium and calcium in the DASH diet are highly effective diuretics, which are also beneficial in promoting, body fluid volume, and also thus achieve the effect of regulating blood pressure. Vegetables, fruits, legumes, whole grains, and dairy products, which are emphasized in the DASH diet, contain potassium and calcium. Dairy products are the main source of dietary calcium and potassium, two minerals that also, can blood pressure.

4.3 Lipid metabolism and vascular health

Most of the dairy products emphasized in the DASH diet are low-fat dairy products. Soedamah-Muthu et al[15] found a small negative association between low-fat dairy products (but not high-fat dairy products), Reduced intake of saturated fats is associated with decreased hypertension risk. Low-fat dairy products typically provide fewer saturated fats, whereas their high-fat counterparts are notable sources of both saturated and trans fatty acids. Oteng et al^[16] Evidence suggests that there is a direct link between higher intakes of trans fatty acids and an increased risk of developing cardiovascular diseases, which is at least partially attributed to their pro-inflammatory effects and ability to induce endoplasmic reticulum stress, contributing to atherosclerosis—although to a lesser extent than saturated fatty acids. In contrast to diets high in red meat and calorie-dense foods, which may exert vascular damage through their content of saturated and trans fatty acids, the DASH diet emphasizes nutrient-rich, low-fat dietary patterns that support cardiovascular health.

4.4 Dietary fiber and gut flora regulation

The DASH diet places a strong emphasis on fruits, vegetables, whole grains, and legumes—each of which is abundant in dietary fiber. A diet rich in fiber has been associated with enhanced blood pressure control. This beneficial impact might be partly facilitated by the breakdown of dietary fiber through gut bacteria, leading to the generation of short-chain fatty acids (SCFAs). Although SCFAs can also be obtained through other metabolic pathways or external sources, microbial fermentation in the intestines remains the primary route of their production in the human body^[17]. A diet rich in dietary fiber can promote gut health by alleviating intestinal dysbiosis, enhancing the population of beneficial components such as short-chain fatty acids and immune cells in the gastrointestinal tract, and reinforcing the protective barrier of the intestinal mucosa. These combined effects may play a role in supporting healthier blood pressure regulation. Although there is no direct evidence that the DASH diet can regulate the mechanism of blood pressure through dietary fiber and intestinal flora, it can be hypothesized from the above studies and based on other high-fiber diets (e.g., the Mediterranean diet) that the DASH diet also has this mediating mechanism.

4.5 Indirect activation of the nitric oxide pathway

Although there is no direct evidence that the DASH diet is regulated by the NO pathway to regulate blood pressure, it can be inferred based on the following studies that the diet indirectly activates the NO pathway to regulate blood pressure. High blood pressure is increasingly recognized as being connected with endothelial dysfunction, a condition predominantly identified by diminished nitric oxide availability. Nitric oxide serves as a critical vasodilator that plays a vital role in maintaining the health of blood vessels^[12]. Various amino acids, with L-arginine being a prime example, can stimulate the synthesis of nitric oxide. L-arginine is commonly present in protein-rich dietary sources. Nitric oxide functions to facilitate the relaxation and widening of blood vessels, which can consequently aid in reducing elevated blood pressure levels. Phenolic compounds, including aryl hydrocarbons and resveratrol found in plant-based proteins from sources like legumes and nuts, have demonstrated the ability to inhibit ACE and elevate NO availability, consequently enhancing vasodilation^[14].

5 Differences between the Mediterranean and DASH diets on hypertension

5.1 Dietary commonalities

1. Plant-based food Emphasize the intake of large amounts of vegetables, fruits, whole grains, legumes and nuts, which provide the body with abundant dietary fiber, vitamins and minerals. 2. Beneficial to cardiovascular health All are recognized as having high blood pressure and protecting cardiovascular health diet. In addition to plant-based foods, also

emphasizes limiting the intake of saturated fatty acids and trans fats, suggests the intake of fried and high-calorie foods, and promotes the intake of healthy fats.

5.2 Differences in the management of hypertension

Differences between the Mediterranean diet and the DASH diet are mainly shown in table 1

Table 1 Comparison of the mediterranean and DASH Diets in hypertension management

Compare di-mensions	The Mediterranean diet is emphasized	The DASH diet is focused on
Dietary characteristics	1. The main sources of fat are olive oil (monounsaturated fatty acids), nuts, fish.	1. Fat sources are mainly low-dairy products, lean meats, and a small amount of vegetable oils.
	2. Sodium is not strictly restricted, but naturally low in sodium.	2. Strict sodium restriction.
	3. Promote the consumption of red wine in moderation.	3. For alcohol, it is recommended to avoid or minimize.
Buck mechanism	4. Cheese and yogurt on dairy products in moderation.	4. Emphasize the intake of low-fat dairy products.
	1. Anti-inflammatory, anti-inflammatory Polyphenols (olive oil, red wine) are more prominent.	1. Anti-inflammatory, anti-inflammatory Dependent on vitamins and phytochemicals.
	2. Sodium, potassium and other elements regulate Naturally low in sodium, emphasizing the synergistic effect of potassium, magnesium and calcium.	2. Sodium, potassium and other elements regulate Strictly limit sodium intake and increase potassium and calcium content.
Antihypertensive features	3. Lipid metabolism It is mainly based on olive oil with high but unsaturated fatty acids.	3. Lipid metabolism Mainly low-fat dairy products to reduce saturated fatty acids.
	A one-year assessment of ambulatory blood pressure in 235 subjects from the PREDIMED study revealed substantial drops in systolic blood pressure for those following a Mediterranean diet fortified with either additional virgin olive oil or nuts, showing reductions of 4.0 and 4.3 mmHg, respectively. Diastolic blood pressure also diminished by 1.9 mmHg in both trial groups ^[18] .	DASH dietary systolic and diastolic blood pressure were significantly reduced by 11.4 mmHg and 5.5 mmHg respectively ^[12] . Schwingshackl et al ^[19] pointed out that compared with other diets, The DASH diet demonstrated the most significant blood pressure reductions, with systolic blood pressure decreasing by 5-7 mmHg and diastolic blood pressure by 3-4 mmHg, This makes it the most effective dietary strategy for individuals with hypertension or pre-hypertension to manage their blood pressure.

6 Discussion

Although certain dietary components such as vitamins and dietary fiber have been shown to reduce elevated blood pressure levels, achieving the dual goal of reducing blood pressure while maintaining nutritional balance may rely on the synergistic effect of specific food combinations from the Mediterranean diet and DASH diet.

Kim et al 's research ^[20] on dietary strategies for managing hypertension indicates that nutritional interventions are more effective than temporary and educational approaches, possibly because participants in the feeding study are more likely to comply with the feeding intervention more easily and conveniently than with the provisional or educational intervention, and although participants in the interim or educational study are required to prepare their own meals, the participants in the feeding study are provided by the researchers, so that the participants in the feeding study do not need additional time or effort to prepare meals or purchase food. Kim's findings provide a new direction for thinking about the future dietary interventions, and whether the future dietary interventions in dietary management of hypertension can make the leap from traditional educational interventions to feeding interventions according to patients' wishes. However, further confirmation of this intervention is needed. Despite extensive research on both dietary patterns, there remain scientific questions that urgently need to be addressed; evidence of direct blood pressure-lowering effects of the DASH diet through dietary fiber and gut microbiota regulation and NO pathway activation is still insufficient.

This study has the following advantages and limitations. Advantages: it systematically integrates randomized controlled trials, cohort studies, and meta-analyses, covering multi-dimensional comparisons of mechanisms, dietary characteristics, and blood pressure-lowering effects; it also analyzes for the first time the differences between the Mediterranean diet and the DASH diet in managing hypertension. Limitations of the study: data bias, as existing evidence predominantly comes from populations in Europe and America, with insufficient research in Asia (especially long-term cohort data); there is reliance on mechanism speculation, Given that current insights into the effects of the DASH diet on

nitric oxide (NO) pathways and gut microbiota regulation are based largely on indirect evidence, further experimental validation is required.

7 Conclusions

The Mediterranean diet and the DASH diet, as two classic healthy eating patterns, show significant advantages in the management of hypertension, yet they possess distinct differences. The Mediterranean diet centers on polyphenolic substances, monounsaturated fatty acids, and dietary fiber, achieving blood pressure reduction through antioxidant, anti-inflammatory properties and the activation of nitric oxide (NO) pathways. The DASH diet lowers blood pressure through strict sodium restriction, rich in potassium, magnesium, and calcium, along with moderate consumption of low-fat dairy products, may be particularly beneficial for individuals with salt-sensitive hypertension.

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