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Review

Positive effects of dietary approach for the treatment of hypertension

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Summary

According to the World Health Organization (WHO) and the International Society for Hypertension, elevated blood pressure is defined as the blood pressure the readings of which consistently range ≥140 mmHg systolic and/or 90 mmHg diastolic. Having in mind the fact that hypertension is one of the leading risk factors for cardiovasluar disease, kidney failure and premature mortality, it is clear that preventive measures should be imposed before the diagnosis is established. The main nutritional measures used in preventing hypertension are: weight loss, Dietary Approaches to Stop Hypertension (DASH diet), reducing salt and alcohol intake and increasing potassium intake.

The aim of this paper was to show the preventive effect of the DASH diet on hypertension onset in normotensive patients as well as to highlight that the diet is an integral part of hypertension treatment, in addition to the use of drug therapy for hypertensive patients.

Key words: diet, DASH diet, hypertension

Introduction

Hypertension or high blood pressure is a serious health condition that significantly increases the risk of heart, brain, kidney and other diseases. It is estimated that 1.28 billion adults aged 30–79 worldwide have hypertension, with the majority (two-thirds) living in low-income and middle-income countries. It is estimated that 46% of adults with hypertension are

unaware that they have that condition. Less than half of adults (42%) with hypertension are diagnosed and treated. Approximately 1 in 5 adults (21%) with hypertension has it under control. Hypertension is a major cause of premature death worldwide. One of the global aims for noncommunicable diseases is to reduce the prevalence of hypertension by 33% between 2010 and 2030 [1].

Hypertension is particularly challenging because it is an asymptomatic silent killer and often remains hidden until detected during follow-up or proven to be a hypertension-related disease such as heart failure or stroke.

Blood pressure category	Systolic Blood Pressure		Diastolic Blood Pressure
Normal	<120 mmHg	and	<80 mmHg
Elevated	120–129 mmHg	and	< 80 mmHg
Hypertension			
Stage 1	130–139 mmHg	or	80–89 mmHg
Stage 2	≥140 mmHg	or	≥90 mmHg

High blood pressure is a worldwide problem, but the largest increase in the absolute burden of hypertension is currently seen in East Asia and the Pacific, Latin America and the Caribbean, South Asia, and Sub-Saharan Africa.

In 2017, the American College of Cardiology (ACC) and the American Heart Association (AHA) published new guidelines for controling hypertension and defined high hypertension as blood pressure equal to or above 130/80 mmHg. Stage 2 hypertension is defined as blood pressure equal to or above 140/90 mmHg [3].

Uncontrolled hypertension imposes a huge economic burden on society, in terms of direct health care costs and significant productivity losses resulting from disability and premature mortality. It is estimated that 10% of global spending on health care is directly related to hypertension and its complications [2].

Thus e.g. high blood pressure costs the United States about $ 131 billion each year, averaging 12 years from 2003 to 2014 [4].

According to the Centers for Disease Control and Prevention (CDC), the two main health conditions for developing high blood pressure are prehypertension and diabetes [5].

Many factors increase the risk of high blood pressure. Some risk factors, such as unhealthy lifestyle habits, can be changed. Other risk factors such as age, family history and genetics, race, ethnicity and gender cannot be changed. A healthy lifestyle can reduce the risk of developing high blood pressure.

Lifestyle habits can increase the risk of high blood pressure. These habits include: Frequent consumption of unhealthy food, especially the food with too much sodium and not enough potassium. Some people, including African Americans, older adults, and people with chronic kidney disease, diabetes, or metabolic syndrome, are more sensitive to dietary salt; Consuming too much alcohol or caffeine; Lack of physical activity; Smoking; Insufficient sleep quality [6].

Treatment decisions depend on whether there is cardiovascular disease, diabetes or chronic kidney disease. For patients with

stage I hypertension and without these conditions, the 2017 ACC/AHA guideline recommends calculating an estimated 10-year risk of cardiovascular disease (CVD).

If this risk is less than 10%, it is reasonable to apply life modifications only for a period of 3 to 6 months. For those with stage 2 hypertension or pre-existing cardiovascular disease, diabetes mellitus, chronic kidney disease, or a 10-year risk of KBC disease of 10% or more, lifestyle and treatment changes are recommended [7].

The aim of this study was to show the preventive effect of DASH diet, but also other diets on the development of hypertension in normotensive patients and that diet is an integral part of therapy in the treatment of hypertension in addition to drugs in hypertensive patients.

Epidemiology

According to the WHO, there are 1.13 billion people worldwide with hypertension [8].

The prevalence of hypertension varies depending on the region and groups in the country. The WHO African region has the highest prevalence of hypertension (27%), while the WHO region of the United States has the lowest prevalence of hypertension (18%).

The number of adults with hypertension rose from 594 million in 1975 to 1.13 billion in 2015, with an increase mainly in low-income and middle-income countries. This increase is mainly due to increase in risk factors for hypertension in these populations [1].

In 2019, more than half a million of deaths in the United States had hypertension as the primary or contributing cause [9].

According to the data of the Public Health Institute of the Republic of Srpska from 2019, the first cause of death in the RS is also CVD with a total of 7473 or 49.5% of deaths [10].

The five leading groups of diseases that were the cause of mortality in the Federation of BiH in the period from 2017 to 2019 are the leading diseases of the cardiovascular system with 47%, which decreased compared to 2018 when the parte of CVD in mortality of BiH population was 51.5% [11].

In Croatia, CVD is the leading cause of death. In 2020, they were the cause of death in 40.0% of cases, a total of 22,817 people died, of which 13,106 were women and 9,711 were men [12].

Effects of dietary approach to stop hypertension

Numerous studies have shown that eating habits are able to modify cardiovascular risk factors [13, 14, 15].

They affect endothelial function, favoring inflammatory processes underlying atherosclerosis [16]. Under physiological conditions, the vascular endothelium maintains its tone by releasing signaling molecules with vasodilators (such as nitric oxide (NO)) and vasoconstrictors such as (angiotensin II) [17]. Endothelial dysfunction occurs when there is abnormal production of reactive oxygen species (ROS) of proinflammatory cytokines, such as interleukin I (IL) -1 and tumor necrosis factor (TNF) -α, and decreased release of nitric oxide (NO) [18]. This condition triggers the process of atherosclerosis [17].

For this reason, it is important, if not necessary, to undertake nutritional treatment in patients with high blood pressure [19].

If lifestyle changes cannot normalize blood pressure, it is mandatory to start pharmacological treatment in order to return blood pressure values to normal [20].

Among the dietary patterns studied, the Dietary Approaches to Stop Hypertension (DASH) has been consistently endorsed by the National Heart, Lung and Blood Institute, the American Heart Association, the Dietary Guidelines for Americans, and the United States Guidelines for blood pressure

treatment as an effective diet to control blood pressure [21].

The DASH diet originated in the 1990s. In 1992, the National Institute for Health (NIH) launched several research projects to see if specific dietary interventions were helpful in treating hypertension. Respondents included in the study were advised to follow only dietary interventions and not include any other life modifications, to avoid any confusing factors. They found that dietary intervention itself could reduce systolic blood pressure by about 6 to 11 mmHg. This effect occurs in hypertensive as well as in normotensive people. Based on these results, DASH was advocated as first-line pharmacological therapy along with life modification [22].

Every type of food included in the DASH diet has its purpose:

Whole grain cereals that provide a lot of fiber, potassium, magnesium, and contain antioxidants, all of which help in maintaining CVS health and lower blood pressure.

Fruits and vegetables, which offer an abundance of nutrients suitable for blood pressure including a wide range of vitamins, and antioxidants plus potassium and fiber.

Low-fat dairy products are strongly associated with a lower risk of hypertension, as they are rich in vitamin D, calcium, magnesium and potassium, high in protein, and low in saturated fat and calories.

Lean meats, fish and poultry provide plenty of protein to build a healthy and strong body, while exposure to saturated fats and calories is limited.

Nuts, seeds and legumes contain plant-based proteins suitable for the heart, along with healthy fats, fiber and magnesium [23].

Processed and dried meat products are not recommended, because it has been shown to cause hypertension and also contains carcinogens.

DASH diet, therefore, refers to the inclusion of foods rich in potassium, calcium, magnesium, because they prevent endothelial dysfunction and urge the release of endothelium and smooth muscles [24, 25].

The key fact is that this diet should be promoted to patients. Prior to discharge, nurses are at the forefront of educating all patients and their families about the DASH diet and its benefits. The most important feature of the DASH diet is that it requires a change in lifestyle and the adoption of a healthy diet. Furthermore, patients should be encouraged to stop smoking, abstain from alcohol, and engage in physical activity [26, 27, 28]. The implementation of the DASH diet should be led by an interprofessional team that includes clinicians, mid-level practitioners, nurses, pharmacists and dieticians. This will lead to optimal outcomes for patients during the use of this diet.

One study compared the effects of low versus high sodium intake, the DASH diet versus control diet, and both (the low sodium diet — the DASH diet versus the high sodium diet — the control diet) on systolic blood pressure. Out of the 412 study participants, 57% were women with prehypertension or stage 1 hypertension. In the context of high sodium, the DASH diet compared to the control diet was associated with mean systolic blood pressure differences of -4.5, -4.3, -4.7, and 10.6 mmHg, respectively. The combined effects of the low-sodium - DASH diet versus the high-sodium - control diet on systolic blood pressure were -5.3, -7.5, -9.7, and -20.8 mmHg, respectively [29].

A systematic review of the literature, which included 30 randomized clinical trials with 5,545 participants, monitored the effects of the DASH diet in normotensive and hypertensive adults. Compared to the control diet, the DASH diet reduced both systolic and diastolic blood pressure (difference in mean values: -3.2 mmHg; 95% CI: -4.2, -2.3 mmHg; P< 0.001 and -2.5; 95% CI: -3.5 -1.5 mmHg P< 0.001, respectively). The DASH diet compared to the control diet reduced systolic blood pressure to a greater extent in sodium-intake

> 2400 mg/ day trials than in < 2400 mg/day trials while both systolic and diastolic blood pressure decreased more in middle-aged < 50 than in trials with older participants [30].

Numerous studies, including randomized clinical trials, have investigated the effect of individual nutrients on blood pressure. For example, a recent meta-analysis showed that a reduction in salt intake (sodium chloride) of mean values 4.4 g/day (1716 mg sodium/ day) resulted in a 5/3 mmHg reduction in blood pressure in hypertensive subjects and 2/1 mmHg in normotensive subjects [31]. Similarly, a large meta-analysis involving 29 randomized clinical trials showed that increased potassium intake of 20 mmol per day (780mg/ day) resulted in a decrease of 4.9 mmHg and 2.7 in systolic and diastolic blood pressure, respectively, without the use of antihypertensive drugs [32].

Also, another meta-analysis of seventeen randomized clinical trials evaluated current evidence on the impact of dietary patterns on blood pressure in adults. Significant reductions in systolic blood pressure of 4.26 mmHg and diastolic blood pressure of 2.38 mmHg were observed [33].

Application of other innovative nutritional-dietary approaches in the treatment of hypertension

The Caloric Restriction Diet (CRD) consists of a chronic reduction in daily calorie intake of about 25–30% compared to normal calorie intake, without any effect [3]. As this regime is not standardized, numerous studies show its effectiveness. Currently, according to the Calorie Restriction Society, entities that follow a self-imposed CRD regimen are characterized by extended life expectancy. This regimen consists of a calorie restriction with a daily intake of less than 1800 kcal for an average period of 15 years and with an energy intake 30% less than the group of individuals (homogeneous in age, gender and socioeconomic status) who consumed the Western diet model [34, 35].

The first animal study to assess the beneficial effects of the CRD was carried out in rats in 1900 [36].

Animal studies on CRD have shown that initial food restriction followed by alternating fasting had a positive effect on glycemic control, body weight reduction, insulin sensitivity and blood pressure control [37].

Recent studies have shown that CRD can determine the damaged DNA repair and decrease fat mass, systolic and diastolic blood pressure values, and the production of free radicals [38].

To explain the mechanism underlying the reduction in CRD-induced blood pressure, it has been suggested that it may act through activation of the autonomic nervous system. This hypothesis was investigated by Nakano et al., who observed a reduction in systolic and diastolic blood pressure in obese hypertensive patients in the treatment of CRD (800 kcal/ day) with normal sodium level for two weeks [39].

While CRD focuses on the number of calories consumed, reducing them by 25–30%, the DASH diet mainly focuses on the quality of micro- and macro-nutrients assumed. Numerous studies have shown that the DASH diet induces a greater reduction in blood pressure values than other dietary interventions or physical activity programs [40].

Most of the studies on salt reduction and weight loss were carried out on middle-aged subjects. In particular, the Trial of Nonpharmacological Interventions in The Elderly (TONE) study showed that, in subjects with arterial hypertension, a moderate salt restriction and weight loss reduce the dosage of antihypertensive drugs [40].

A recent meta-analysis conducted by D'Elia et al. examined the impact of dietary sodium restriction on central blood pressure. The authors found a statistically significant

association between the reduction of blood pressure and central pulse pressure, speculating that sodium restriction also impacts on central blood pressure values. For this reason, a diet with a low sodium intake is a useful tool to counteract the onset and/or the progression of CVS disease, especially in normotensive subjects and in prehypertensive patients [19].

Vegetarian and Mediterranean diets are also associated with lowering blood pressure [41, 42]. A meta-analysis of seven randomized control trials with a total number of 311 participants reported that vegetarian diets (defined as diets that never or rarely included meat) were associated with a mean reduction in systolic blood pressure of 4.48 mmHg (95% CI 3.1–6.6) and diastolic 2.2 mmHg (95% CI 1.1–3.5) [41].

The Mediterranean diet is characterized by moderate fat intake (primarily from olive oil and nuts), low consumption of red meat and high consumption of vegetables [42].

A meta-analysis of 6 trials with a total number of 2650 participants reported a modest but significant reduction in systolic blood pressure of 1.7 mmHg (95% CI 0.05–3.4) and diastolic blood pressure of 1.5 mmHg (95% CI 0.8–2.1) in the Mediterranean diet compared to a low fat diet [42].

Probably due to the heterogeneity of Mediterranean diet patterns in different regions and countries, evidence of clinically important effects of the Mediterranean diet and reduced salt intake is limited [43].

Blood pressure is lower in vegetarians than in people who mostly eat meat, and maintaining a vegetarian diet can lower blood pressure. The effect of lowering blood pressure is not the result of a reduction in the intake of animal proteins, but an increase in the intake of vegetables and fruit in combination with a reduction in the intake of saturated fatty acids. In a study in the elderly, blood pressure decreased by 3/1 mmHg when the intake of fruits and vegetables increased alone, but by 6/3 mmHg when combined with a decrease in fat intake [44–46]. As it contains several food groups, the DASH diet is likely to have additional beneficial effects [44, 46, 47]. In Korea, diets consisting of tofu cheese, soy, fruits, vegetables, and fish have been associated with a low prevalence of hypertension with high dietary intake [48].

Negative effects of DASH diet

Bloating is one of the most common gastrointestinal problems. One such randomized clinical study examined the effects of a high-fiber DASH diet and sodium intake on bloating. The study included 412 participants (mean age 48 years) who reported bloating at the beginning. Regardless of diet, high sodium intake increased the risk of bloating (risk ratio = 1.27; 95% confidence interval: 1.06–1.52; R = 0.01). The DASH diet rich in fiber also increased the risk of bloating (risk ratio 1.41; 95% confidence interval: 1.22–1.64; R < 0.001) [49].

The study was of clinical significance because millions of adults in the United States visit a doctor for gastrointestinal disease, with bloating as one of the most common symptoms, reported by approximately 15% to 30% of the general population [50, 51, 52, 53].

The results of the study showed that although a high-fiber diet, such as the DASH diet, may increase the risk of bloating, reducing the sodium intake in such a diet may reduce some of these side effects.

In conclusion, a diet rich in fiber increased the symptoms of bloating, while reduction in sodium decreased these effects. Sodium reduction is an important dietary intervention to reduce bloating symptoms and can be used to improve compliance with healthy high-fiber diets, such as the DASH diet [49].

Conclusion

In order to treat hypertension, one should focus on changes in lifestyle habits and the use of medications. When it comes to lifestyle habits, it is necessary to change the diet, include regular physical activity, limit salt intake, limit alcohol intake and ban the use of cigarettes.

A large number of studies have just confirmed that a diet that has a preventive effect, and also positive effects on the control of this disease as a type of diet that is supportive of drug therapy and has a role in regulating body weight is just described DASH diet.

In the prevention of hypertension and treatment if it occurs, a multidisciplinary approach is needed by physicians and nutritionists to provide patients with a simple way to control blood pressure.

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Pozitivni efekti dijetetskog pristupa za liječenje hipertenzije

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Prema Svjetskoj zdravstvenoj organizaciji (SZO) i Internacionalnom udruženju za hipertenziju, kao povišen krvni pritisak se definiše krvni pritisak kada je nivo sistolnog krvnog pritiska od 140 mmHg ili više i/ili nivo dijastolnog krvnog pritiska od 90 mmHg ili više, u ponovljenim mjerenjima. Kada se ima u vidu činjenica da je hipertenzija jedan od najvažnijih faktora rizika za kardiovaskularne bolesti, bubrežnu insuficijenciju i preranu smrtnost, jasno je da bi se preventivne mjere trebalo preduzeti prije nego se postavi dijagnoza. Glavne nutritivne mjere koje se koriste u sprečavanju nastanka hipertenzije su: smanjenje tjelesne težine, DASH dijeta (Dietary Approaches to Stop Hypertension), smanjen unos soli, povećan unos kalijuma i smanjen unos alkohola.

Cilj ovoga rada je bio da se pokaže preventivni efekat DASH dijete na sam nastanak hipertenzije kod normotenzivnih pacijenata, kao i da dijeta predstavlja sastavni dio terapije u liječenju hipertenzije pored upotrebe lijekova kod hipertenzivnih pacijenata.

Ključne riječi: dijeta, DASH dijeta, hipertenzija