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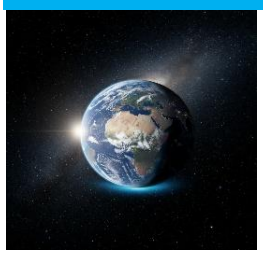

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Non-pharmacological strategies in the management of arterial hypertension in the elderly: A review of dietary, probiotic and physical activity interventions

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Abstract

Background: Arterial hypertension is one of the leading causes of cardiovascular diseases worldwide. While pharmacological therapy plays a central role in management, non-pharmacological interventions are often the first-line approach, particularly in older adults.

Aim: This article aims to review current evidence on the effectiveness of non-pharmacological interventions for managing arterial hypertension in older adults, focusing on diet, probiotic supplementation, and physical activity.

Material and Methods: Data were obtained from publicly available scientific sources, including PubMed, BioMed Central, Google Scholar, and ResearchGate

Results: The literature confirms the effectiveness of the DASH diet in lowering blood pressure and improving metabolic parameters, including insulin sensitivity and lipid profile. Reducing sodium and alcohol intake may delay or partially replace the need for pharmacological treatment. Probiotic supplementation exhibits antihypertensive effects by modulating gut microbiota and reducing inflammation, with minimal side effects. Regular physical activity, particularly aerobic exercise, contributes to significant reductions in blood pressure and improves functional capacity in older adults. The success of non-pharmacological interventions requires individual tailoring to each patient's needs.

Conclusions: A comprehensive approach combining the DASH diet, sodium and alcohol restriction, probiotic supplementation, and regular physical activity forms the cornerstone of effective non-pharmacological management of arterial hypertension in older adults. These strategies can reduce the need for pharmacotherapy, minimize drug-related adverse effects, and improve cardiovascular outcomes.

Key words: arterial hypertension, elderly, non-pharmacological therapy, DASH diet, physical activity, probiotics

Introduction

The progressive aging of society is one of the key health and social challenges of the modern world. In the first half of the 20th century, the average life expectancy was about 47 years, and the population of people aged 60 and over numbered approximately 200 million. Currently, average life expectancy has increased to about 65 years, and the number of people over the age of 60 exceeds 500 million worldwide. Demographic forecasts indicate that by 2050, average life expectancy will extend by another 10 years, which will be associated with a further increase in the number of elderly people and an increased demand for healthcare [1].

Demographic changes observed in most countries of the world have forced the necessity to develop and implement health strategies aimed at the prevention and treatment of chronic diseases, in particular cardiovascular diseases. These diseases remain the main cause of morbidity and premature deaths in the elderly population, and their frequency increases with age [2]. One of the most important health problems in this age group is arterial hypertension, recognized as the main modifiable risk factor for atherosclerotic cardiovascular disease and organ complications [3].

With the growth of the population and the extension of average life expectancy, a dynamic increase in the number of people with arterial hypertension is observed. The number of patients worldwide increased from 648 million in 1990 to 1.278 billion in 2019 [4]. The prevalence of hypertension increases significantly with age and affects about 30% of people under 60 years of age, nearly two-thirds of the population aged 60–79, and about three-quarters of people over 80 years of age [5].

This disease often has an asymptomatic character and an insidious course, which favors its late diagnosis. To make a diagnosis, multiple blood pressure measurements are necessary, performed on at least two different days at appropriate time intervals [6]. Particularly predisposed to the development of the disease are elderly, obese individuals leading a sedentary lifestyle and following an incorrect diet. Symptoms that may suggest arterial hypertension include, among others, headaches, nosebleeds, and visual disturbances [7].

Arterial hypertension is one of the most significant chronic diseases in elderly patients and should not be underestimated, as its ineffective treatment leads to numerous health complications, such as an increased risk of cardiovascular incidents, heart failure, or kidney damage [6–10]. Despite the high prevalence of the disease, insufficient patient awareness of arterial hypertension and non-compliance with recommended pharmacological treatment are still observed [8].

In recent years, increasing attention has been paid to the role of non-pharmacological methods in the treatment of arterial hypertension, especially in the elderly. Lifestyle modification, including changing dietary habits, increasing physical activity, weight reduction, and limiting risk factors, forms the basis of therapeutic management. It can be both a standalone form of treatment and an effective supplement to pharmacological therapy [2,6,9].

Pathophysiology

With advancing age, progressive aging of the vascular system occurs, leading to an increase in blood pressure and increased myocardial oxygen demand. The walls of large arteries stiffen as a result of smooth muscle cell proliferation, calcium deposition, and changes in collagen composition. Consequently, systolic pressure increases, the value of which depends on aortic compliance, elastin content, and stroke volume (SV). The reflected wave, overlapping with the forward wave, further intensifies the increase in systolic pressure, which makes isolated systolic hypertension the dominant form of hypertension in the elderly. Diastolic pressure remains relatively unchanged, leading to an increase in pulse pressure, defined as the difference between systolic and diastolic pressure [6–10].

In the pathophysiology of arterial hypertension in the elderly, the deterioration of renal function is also significant. A decrease in the number of active nephrons causes structural losses, mainly in the renal cortex. Post-mortem studies show that kidney mass in elderly women decreases by about 9%, and in men by as much as 19%. Lost structures are replaced by an increasing number of sclerotic glomeruli, resulting in a decrease in the glomerular filtration rate (GFR). A drop in GFR may impair the body's ability to compensate for excessive sodium load, leading to an increase in circulating blood volume [6,11,12,13].

In a properly functioning renin-angiotensin-aldosterone (RAA) system, an increase in blood pressure or excessive sodium supply causes a decrease in renin secretion, which allows for the excretion of excess sodium and the restoration of normal pressure. With age, the activity of the RAA system weakens, which disrupts the feedback mechanism and leads to impaired suppression of renin secretion. Elevated renin levels promote increased production of angiotensin with vasoconstrictive effects, causing a further increase in arterial pressure [2,9,12]. Additionally, sodium in the extracellular space can bind to glycosaminoglycans and proteoglycans of the skin, becoming osmotically inactive. This mechanism, called the "sodium buffer," shows less effectiveness in the elderly due to the reduced content of glycosaminoglycans and proteoglycans in the skin. The weakening of this compensatory

capacity leads to natremia disorders, excessive sodium load, an increase in plasma osmolarity, and an elevation of arterial pressure [6,11,13].

Diet

Arterial hypertension (HT) is one of the main risk factors for cardiovascular diseases, especially in the elderly population. In this group, isolated systolic hypertension, increased vascular sensitivity to sodium, and the co-occurrence of chronic diseases such as renal failure or diabetes are often observed [7,14,15]. Effective control of arterial pressure allows for the reduction of the risk of cardiovascular incidents, hospitalizations, and mortality [16,17]. In addition to pharmacotherapy, non-pharmacological interventions are of key importance, including modification of lifestyle and diet, which can be used independently in mild forms of HT or as a supplement to pharmacological treatment, increasing its effectiveness and limiting the need for higher doses of drugs [14,18,19,20].

The best-documented dietary strategy in the prevention and treatment of HT is the DASH (Dietary Approaches to Stop Hypertension) diet. This diet is based on increasing the consumption of vegetables, fruits, whole grains, legumes, nuts, and low-fat dairy products, ensuring an adequate supply of potassium, magnesium, and calcium [18-22]. At the same time, it limits the intake of saturated fats, cholesterol, red and processed meat, sweets, and refined carbohydrates [14,21,23].

Clinical studies have shown that following the DASH diet leads to a significant reduction in systolic and diastolic blood pressure values, especially in people with hypertension. After 2 weeks of use, a decrease in systolic pressure by 11.4 mmHg and diastolic pressure by 5.5 mmHg was recorded compared to baseline values [22]. Furthermore, the DASH diet favorably affects the lipid profile by lowering total cholesterol and LDL levels and increasing insulin sensitivity, which consequently reduces the estimated 10-year cardiovascular risk by approximately 13% [23,24]. Studies using 24-hour ambulatory blood pressure monitoring (ABPM) have shown a 24-hour pressure reduction, significant in the therapy of the elderly [7,25].

Reduction of sodium intake is another essential element of non-pharmacological treatment of HT. It is recommended to limit salt to 5–6 g/day [7,26]. Reducing sodium intake by 4–5 g per day over a period from several weeks to several months leads to a significant reduction in systolic and diastolic blood pressure values [27,28]. The combination of the DASH diet with sodium restriction yields a synergistic effect, leading to an even greater pressure reduction [21,29].

Limiting alcohol consumption in those who overconsume also brings a beneficial hemodynamic effect. Studies have shown that alcohol reduction leads to a decrease in both systolic and diastolic pressure. According to recommendations, alcohol consumption should not exceed two standard servings per day for men and one serving for women, where 1 serving corresponds to 14 g of ethyl alcohol. Sensitivity to alcohol may intensify its adverse effect on arterial pressure in the elderly [30,31,32].

The combination of the DASH diet, sodium restriction, moderate alcohol consumption, regular physical activity, and weight control leads to an additive reduction of systolic pressure by several to a dozen or so mmHg, which significantly increases the effectiveness of treatment and improves cardiovascular prognosis in the elderly population [29,30].

Probiotics

Probiotics are live microorganisms, mainly bacteria similar to those naturally occurring in the human digestive tract, which have been used for decades in the therapy of gastrointestinal disorders such as diarrhea, irritable bowel syndrome, constipation, or lactose intolerance [33]. Recent studies indicate that their beneficial effects may extend beyond the digestive system – an influence of probiotics on certain metabolic disorders, including arterial hypertension, is observed [33,34].

The mechanisms of the antihypertensive action of probiotics are complex and multifactorial. One of the significant mechanisms is the modulation of the gut microbiota – an ecosystem of bacteria, viruses, protozoa, and fungi whose composition affects metabolic homeostasis and cardiovascular system functioning. An altered microbiota may increase the translocation of lipopolysaccharides (LPS) into the circulation, leading to vascular endothelial dysfunction, inflammation, and an increase in blood pressure. Probiotic supplementation improves the composition of the microbiota, which limits inflammatory processes acting on the vessel walls [35,36,37].

Another mechanism is the increased biosynthesis of prostaglandins that relax blood vessels. Studies on spontaneously hypertensive rats showed that a polysaccharide-glycopeptide complex (SG L) isolated from *Lactobacillus casei* reduced vascular resistance and increased the excretion of the prostaglandin metabolite 6-keto PGF1α, which translated into a reduction in pressure [38].

In clinical trials involving patients with arterial hypertension, results showed that consuming probiotics can significantly lower systolic pressure by 3.56 mmHg and diastolic pressure by

2.38 mmHg. The reduction is small; however, even a slight reduction in blood pressure can have significant public health benefits and consequences for the cardiovascular system [39,40]. The mechanisms of the influence of probiotics on pressure in humans have been confirmed in numerous randomized clinical trials and meta-analyses [40,41,42]. Systematic reviews and meta-analyses have shown that probiotics can moderately, but statistically significantly, lower systolic and diastolic pressure, especially in people with hypertension or type 2 diabetes. These effects can support other non-pharmacological strategies, such as the DASH diet, sodium restriction, and moderate alcohol consumption, in the comprehensive control of hypertension in the elderly.

In summary, probiotic supplementation constitutes a promising, safe, and well-tolerated method supporting arterial pressure control, especially in the elderly population with hypertension or metabolic disorders. However, further large, well-designed studies in the senior population are still needed to determine the optimal selection of strains, doses, and duration of therapy [41,42].

Physical Activity

Physical activity is one of the key elements of non-pharmacological management in the prevention and treatment of arterial hypertension in the elderly. Regular exercise, especially of an aerobic nature, is consistently recommended in guidelines as an effective lifestyle modification leading to a reduction in arterial blood pressure values and a reduction in cardiovascular risk [45–47]. The mechanisms of beneficial action include, among others, improvement of endothelial function, reduction of oxidative stress, and modulation of the autonomic nervous system activity [43,44,45].

One of the simplest and most frequently recommended forms of activity is walking, including nordic walking. It is a safe, inexpensive form of movement, engaging large muscle groups and possible to use in most elderly people. Studies have shown that regular nordic walking training improves exercise tolerance, promotes weight reduction, and lowers cardiovascular risk factors, although short-term interventions do not always lead to a significant reduction in arterial blood pressure values [46,47].

The effectiveness of aerobic exercise was also confirmed in studies on brisk walking. A twelve-week training program in elderly people with primary hypertension led to a significant reduction in systolic arterial pressure both at rest and during exercise of varying intensity, which may translate into a reduction in the risk of acute cardiovascular incidents. Beneficial effects were also observed in the case of low-intensity exercises such as Tai Chi, which, in addition to

reducing SBP and DBP, positively affect balance, coordination, and waist circumference, which is of particular importance in the geriatric population [48,49].

Another recommended form of physical activity is swimming, especially in elderly people with musculoskeletal diseases or obesity. Regular swimming training shows a hypotensive effect and improves the function of blood vessels, even in previously physically inactive patients with stage 1 hypertension [50].

There is also growing interest in dancing as a form of aerobic exercise. Dancing engages major muscle groups, improves cardiovascular fitness, balance, and coordination. Systematic reviews of studies indicate that dance programs can lead to a significant reduction in systolic and diastolic arterial pressure in middle-aged and elderly people with hypertension, constituting a valuable supplement to classic forms of aerobic training [51,52]. Meta-analyses showed an average reduction in SBP of about 5–10 mmHg and DBP of 2–5 mmHg after regular dance interventions lasting from several to a dozen or so weeks [51,53]. These effects are comparable to other forms of aerobic training recommended in the prevention and treatment of hypertension [54]. Additionally, dance positively affects psychological aspects, such as stress reduction, mood improvement, and quality of life, which may indirectly favor better control of arterial pressure [51,55]. Available studies indicate that dance and dance therapy programs lead to a significant reduction in systolic and diastolic blood pressure in people with hypertension, including the elderly population [51,52,56]. Meta-analyses showed an average reduction in SBP of about 5–10 mmHg and DBP of 2–5 mmHg after regular dance interventions lasting from several to a dozen or so weeks [51,53]. These effects are comparable to other forms of aerobic training recommended in the prevention and treatment of hypertension. Additionally, dance positively affects psychological aspects, such as stress reduction, mood improvement, and quality of life, which may indirectly favor better control of arterial pressure [51,54,55].

According to current recommendations, moderate aerobic physical activity lasting 20–45 minutes on most days of the week and performed at an intensity of 60–75% of maximum heart rate remains one of the most effective non-pharmacological strategies for treating hypertension in people over 65 years of age. Regular exercise significantly lowers arterial blood pressure values, reduces cardiovascular mortality, and improves the overall functional capacity of this population [54,57].

Discussion

The prevalence of arterial hypertension increases with age and constitutes a significant disease burden, especially in the elderly population. Therefore, non-pharmacological therapy strategies,

primarily including lifestyle changes, constitute the first intervention in treatment algorithms [58].

Diet plays a key role in controlling arterial pressure. Numerous studies confirm its effectiveness in lowering blood pressure values. Particular attention is drawn to the DASH diet, which is recommended not only to prevent hypertension or stop its development but also to reduce total cholesterol and LDL fraction concentrations and increase tissue sensitivity to insulin. Additionally, an important element in the diet is limiting sodium intake, which may delay the need to implement pharmacological treatment [19,20,22,23,29,59].

Probiotics constitute another significant intervention in the non-pharmacological treatment of hypertension. Studies show that probiotic supplementation has an antihypertensive effect through, among other things, modulation of the gut microbiota and reduction of inflammatory processes. The use of probiotics lowers blood pressure, and their great advantage is the fact that they work without the side effects typical of pharmacological drugs [36,37,38,60].

According to current guidelines, regular physical activity is recommended as an effective intervention in the prevention and treatment of hypertension and cardiovascular diseases. Studies confirm that physical exercise, especially of an aerobic nature, contributes to a significant reduction in blood pressure, especially systolic. For elderly people with hypertension, forms of movement such as brisk walking, dancing, or swimming are proposed, which, in addition to a beneficial effect on the cardiovascular system, improve performance and functional capacity [43,48,50,51].

There are many methods of non-pharmacological management in patients with hypertension that bring satisfactory clinical effects. However, it should be remembered that elderly people constitute a heterogeneous group with specific biological, psychological, and social characteristics. Therefore, planning treatment and medical care in this population requires an individual approach and particular caution.

Results

The aging of society will undoubtedly be one of the main social challenges in the coming years. The medical sector must therefore increasingly focus on treating the health problems of the elderly and, thus, on improving their quality of life. In the face of the growing number of patients, the use of non-pharmacological interventions becomes a key recommendation in the therapy of arterial hypertension in seniors.

Lifestyle modification through the DASH diet and limiting sodium and alcohol intake forms the basis of effective therapy. Such dietary changes allow for better control of pressure and

improvement of metabolic parameters. Additionally, probiotic supplementation becomes a safe tool supporting the vascular system through a beneficial effect on the gut microbiota.

An equally important element is regular physical activity of moderate intensity. Forms of movement such as nordic walking, swimming, or dancing not only lower blood pressure but also improve the efficiency and coordination of seniors. A comprehensive non-pharmacological approach can significantly limit the need for multiple medications and prevent cardiovascular complications.

Author's contribution:
Conceptualization: DC, RS, AP, DB; **Methodology:** DC, DK, IC, PJ; **Software:** LG, MT, PR; **Check:** RS, AP, DB, DK; **Formal analysis:** IC, PJ, LG; **Investigation:** DC, MT, PR, RS; **Resources:** DC, AP, DB, DK; **Data curation:** DC, IC, PJ, LG; **Writing - rough preparation:** DC, MT, PR, RS; **Writing - review and editing:** DC, RS, AP, DB, DK, IC, PJ, LG, MT, PR; **Visualization:** AP, DB, DK; **Supervision:** DC, IC, PJ, LG; **Project administration:** DC, MT, PR, RS.
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