

Research Progress on the Effect of Nutritional Intervention on Blood Pressure Improvement in Elderly Hypertensive Patients

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ABSTRACT

With the intensification of population aging, the prevention and control of hypertension in the elderly has become a major public health challenge. This review systematically analyzes the mechanism and practical strategies of nutritional intervention in regulating blood pressure and improving quality of life in elderly hypertensive patients. Studies have shown that the DASH diet (with a systolic blood pressure reduction of up to 25.52 mmHg) and the Mediterranean diet (with an average systolic blood pressure reduction of 1.4 mmHg) effectively optimize blood pressure and metabolic indicators through a dietary structure rich in potassium, low in sodium, and high in unsaturated fatty acids. For the high incidence of comorbidities (such as hypertension combined with diabetes or frailty), individualized nutritional plans can synergistically manage multiple diseases. The personalized intervention model based on Comprehensive Geriatric Assessment (CGA), which integrates nutritional support, health education, and multi-dimensional management, significantly improves the blood pressure compliance rate (96.67% vs 83.33%) and reduces the risk of frailty ($P < 0.001$). In the future, it is necessary to deepen research on precise nutritional targets and explore digital technology-driven intervention pathways to provide evidence-based basis for optimizing the comprehensive management of elderly hypertension.

KEYWORDS

Nutritional intervention; Elderly hypertension; DASH diet; Mediterranean diet; Comorbidity management

1 Introduction

The aging problem in China is becoming increasingly serious, and it is expected to enter a stage of advanced aging, characterized by a large elderly population, rapid aging process, significant differences, and heavy challenges. Hypertension is one of the common cardiovascular diseases in the elderly and the leading cause of global mortality. The prevalence of hypertension in the elderly population in China is as high as 49.1% and is showing a continuous increasing trend^[1].

Studies have shown that single-drug therapy has poor control effect on hypertension in the elderly, and often requires combination therapy with two or more drugs^[2]. However, as a special group, the elderly are more prone to adverse drug reactions due to the decline in physical function caused by aging, which affects their quality of life. Therefore, how to effectively control blood pressure levels, reduce complications, and improve quality of life in elderly hypertensive patients through personalized non-pharmacological therapies has become an important issue in the current public health field. This study aims to provide a scientific basis for further optimizing nutritional intervention programs by systematically analyzing the impact of nutritional intervention on blood pressure improvement in the elderly, thereby enhancing the overall health level and quality of life of elderly hypertensive patients.

2 Common nutritional intervention programs

2.1 DASH Diet

2.1.1 Characteristics of the dash diet

In 1994, a randomized controlled study by the National Heart, Lung, and Blood Institute found that increasing the intake of fruits, vegetables, nuts, legumes, whole grains, and low-fat dairy products while reducing the intake of red meat, processed meats, sugary drinks, and sodium could achieve significant blood pressure-lowering effects, which was named the DASH diet^[3]. It is characterized by high calcium and high potassium content.

2.1.2 Effect of the DASH diet on blood pressure improvement in the elderly

Multiple clinical studies have shown that the DASH diet, alone or combined with other lifestyle changes such as sodium restriction or physical exercise, can effectively reduce blood pressure at various levels. In addition to its direct impact on blood pressure, the role of specific healthy dietary patterns in improving physical indicators of elderly hypertensive patients has also been confirmed by studies. A study on dietary status and cardiovascular disease risk in elderly hypertensive populations in Chongqing found that 435 elderly hypertensive patients were evaluated using the

DASH score. Multiple linear regression analysis showed that DBP, TC, TG, LDL-C, HDL-C, and WC levels were closely related to the DASH score. The higher the DASH score (i.e., the closer the dietary pattern is to the DASH pattern), the lower the DBP, TC, TG, LDL-C, HDL-C, and WC levels in hypertensive patients ^[4]. The improvement of these physical indicators undoubtedly lays an important foundation for improving the quality of life of elderly hypertensive patients.

A RCT study by Wang Zhihong et al. ^[5] explored the relationship between the DASH diet and quality of life using the SF-36 scale. The study showed that implementing 12-month DASH diet intervention in patients with essential hypertension could reduce the risk of cardiovascular and cerebrovascular events by 68.75% (10.0% vs 32.0%), and significantly increase the scores of 7 dimensions in the Short Form Health Survey (SF-36), such as physical function (PF) and mental health (MH) ($P < 0.05$), confirming that this model has dual benefits of cardiovascular protection and quality of life improvement.

The combined therapy of the DASH diet and exercise also has a positive effect on improving blood pressure and quality of life in elderly hypertensive patients. A clinical study by Miao Liyun ^[6] showed that the integrated intervention model of the DASH diet combined with personalized exercise (such as Baduanjin and aerobic walking) reduced the systolic blood pressure of elderly hypertensive patients by 25.52 mmHg (from 158.97 mmHg to 133.45 mmHg) within 3 months, increased the quality of life score by 82% ($P < 0.05$), and the incidence of adverse cardiovascular events was significantly lower than that in the traditional care group (7.5% vs 25.0%, $P = 0.034$), highlighting the clinical advantages of synergistic intervention of nutrition and exercise.

2.2 Mediterranean diet

2.2.1 Characteristics of the mediterranean diet

The classic model of the Mediterranean diet (MD) emphasizes the following characteristics: using olive oil rich in unsaturated fatty acids as the main fat source; prioritizing the intake of whole grains (such as brown rice, whole wheat bread, millet), vegetables, fruits, and legumes; appropriately supplementing seafood, poultry, nuts, and dairy products (mainly cheese and skim milk), supplemented with a small amount of red wine; and strictly limiting red meat consumption ^[7].

2.2.2 Effect of the mediterranean diet on blood pressure improvement in the elderly

A 12-month controlled study by Jennings A et al. ^[8] on 1,294 healthy elderly Europeans showed that after intervention with the Mediterranean diet (MD), both systolic and diastolic blood pressures of the subjects decreased significantly (especially in men), accompanied by a reduction in 24-hour urinary sodium excretion and an increase in urinary potassium levels. This result suggests that MD may effectively prevent and control abnormal blood pressure by regulating sodium and potassium metabolism pathways.

A large randomized controlled trial (PREDIMED) ^[9] confirmed that the Mediterranean diet (supplemented with extra virgin olive oil or nuts) significantly reduces systolic blood pressure (1.4 mmHg) and diastolic blood pressure (1.5 mmHg) in elderly hypertensive patients by increasing nitric oxide bioavailability, inhibiting endothelin-1 activity, and reducing oxidative stress and inflammation. The polyphenols and monounsaturated fatty acids (such as oleic acid) it contains synergistically improve vascular endothelial function, providing an effective nutritional strategy for delaying vascular aging.

3 Nutritional intervention in elderly hypertensive patients with comorbidities

3.1 Mechanism of common comorbidities in elderly hypertensive patients

The increase in average life expectancy leads to the accumulation of chronic diseases, resulting in comorbidity, i.e., individuals suffering from two or more diseases simultaneously. Comorbidity is closely related to functional decline and quality of life reduction in patients, and often leads to prolonged hospital stays and increased medical costs, causing a significant disease burden. Data show that in the elderly population in China, hypertension not only exists as an independent disease but also tends to be complicated with other chronic diseases such as diabetes, coronary heart disease, and stroke, forming a complex comorbidity pattern. A study based on 10 regions in China pointed out that overweight/obesity, hypertension, diabetes, stroke, and coronary heart disease constitute the most common comorbidity combinations ^[10], indicating that hypertension plays a crucial role in the multi-morbidity pattern of the elderly in China.

The pathogenesis of comorbidities in elderly hypertension is complex, involving multiple pathophysiological processes. In the case of long-term elevated blood pressure, it is easy to cause coronary circulation obstruction, which in turn leads to serious complications such as coronary heart disease ^[11]. In addition, insulin resistance, inflammatory response, endothelial dysfunction, and autonomic nervous dysfunction may lead to the comorbidity of hypertension and

diabetes^[12]. At the same time, foreign studies have confirmed that the proportion of hypertensive patients with frailty is significantly higher than that of patients with other diseases, and age, comorbidity, and decreased daily activities are risk factors for frailty in elderly hypertensive patients^[13]. These pathophysiological mechanisms together form the basis of comorbidities in elderly hypertension and provide a theoretical basis for subsequent nutritional intervention research.

3.2 Role of nutritional intervention in elderly hypertensive patients with comorbidities

Elderly hypertensive patients often have multiple chronic diseases such as diabetes and frailty, which not only increase the complexity of the disease but also pose a serious threat to the health prognosis of patients. Nutritional intervention has shown important value in controlling comorbidities.

For elderly patients with diabetes, reasonable control of carbohydrate intake is one of the key strategies. Studies have shown that dietary fiber can improve blood glucose control, reduce blood lipid levels, promote intestinal health, reduce weight, lower blood pressure, and regulate the immune system. Reasonable intake of dietary fiber has multiple positive effects on the health of patients with hypertension combined with diabetes^[14].

Studies on elderly hypertensive patients with frailty^[15] have shown that comprehensive nutritional assessment (such as MNA score, serum albumin, and 25(OH)D levels) can early identify the risk of malnutrition, and targeted nutritional intervention can delay the progression of frailty, indirectly optimize comorbidity management, and improve clinical prognosis. Hypertension is a disease closely related to lifestyle. Elderly patients with essential hypertension combined with frailty have more obvious unhealthy lifestyles due to advanced age, decreased physical fitness, appetite, and sleep quality. Studies have shown that the intake of essential amino acids rich in leucine can prolong the metabolic response of skeletal muscle in the elderly and reduce the occurrence of frailty^[16]. Nutritional intervention can not only directly improve blood pressure levels but also regulate comorbidities through multiple pathways, providing comprehensive health management support for elderly hypertensive patients.

4 Personalized management measures based on nutritional intervention

The elderly population faces special physiological challenges due to aging, including changes in body metabolism, organ function degradation, cellular degenerative changes, and secondary health problems. Therefore, the treatment strategy for elderly hypertension must pay special attention to the principle of individualization.

4.1 Individualized nutritional intervention

Studies have pointed out that dietary adjustment and exercise therapy are key blood pressure-lowering means for hypertension management, and improving patients' relevant cognitive level and health behaviors is the premise of effective management. In view of the differences in symptoms and lifestyle diversity of hypertensive patients, the implementation of individualized nutritional intervention programs helps them achieve long-term stable health management in the community environment^[17].

Data from a study based on community health care services showed that patients receiving individualized nutritional intervention (introducing health care in the community, cooperating with nearby hospitals, regularly holding community medical services, signing personalized service agreements with community residents, and arranging individualized nutritional interventions according to different personal physical qualities of patients) had significantly higher BMI compliance rate and blood pressure control compliance rate than those receiving ordinary group intervention^[18]. A study by Shen Youdan et al^[19] implemented a "dietary nutrition conditioning intervention" program on 200 elderly hypertensive patients. While patients received targeted treatment, a targeted dietary conditioning program was formulated to guide patients to avoid or reduce the intake of intolerant foods in their daily diet, so as to control the disease and maintain stable blood pressure. The study found that dietary conditioning measures such as limiting total calorie intake and reducing salt intake help hypertensive patients achieve nutritional balance and healthy diet, which not only helps optimize patients' vascular health and maintain stable blood pressure but also effectively improves patients' rehabilitation expectations and helps them recover their health.

4.2 Health education

Among elderly hypertensive patients, those with low educational level and low consumption level account for the majority, with weak awareness of hypertension and related health behaviors, difficulty in accepting correct health concepts and behaviors, and difficulty in changing unhealthy behaviors formed over the years, resulting in low treatment and control levels.

A study by Li Yuhong et al.^[20] showed that in the nutrition score, the difference between the control group and the intervention group mainly focused on the item "I can eat nutritionally balanced food", indicating that elderly hypertensive patients pay more attention to nutritional intake, but have insufficient understanding of the concept of balanced nutritional intake and fail to recognize that a low-salt, low-fat, and low-cholesterol diet can effectively control blood pressure. It can be seen that health education plays a positive role in promoting the health behaviors of elderly hypertensive patients by popularizing the salt, oil, cholesterol, etc., content of various foods and the recommended daily intake to patients, and providing written prompts to help patients form a balanced diet habit.

In the health education of elderly hypertensive patients, the participation of community members plays an important role. According to a study by Li Mingzhu et al.^[21], the involvement and supervision of family members can promote hypertensive patients to change unhealthy living habits, maintain emotional stability and blood pressure control effect, and ultimately improve the quality of life of elderly hypertensive patients. At the same time, community health care services highly rely on the knowledge and skills of professionals. The personalized health education they provide not only improves patients' awareness of hypertension but also enhances their confidence in managing blood pressure and maintaining health, guiding patients to improve diet and exercise behaviors, thereby effectively implementing personalized nutritional intervention at the community level^[18].

4.3 Personalized management based on geriatric assessment

The personalized management model based on Comprehensive Geriatric Assessment (CGA) has shown significant advantages in the management of elderly hypertension, whose core is to formulate targeted intervention programs through multi-dimensional assessment (including nutritional status). A study by Meng Hua et al.^[22] showed that when implementing CGA-oriented personalized management for elderly patients with hypertension and diabetes, it is necessary to prioritize the assessment of their nutritional status (such as using the Subjective Global Assessment Scale/SGA) and design personalized diet plans based on individual differences: strictly control the intake of high-salt, high-fat, and high-sugar foods, and customize nutritionally balanced recipes according to patients' eating habits. This model not only significantly reduces patients' systolic blood pressure (135.74 ± 7.48 vs. 140.68 ± 8.55 mmHg), diastolic blood pressure, and blood glucose levels (all $P < 0.05$) but also improves quality of life scores and satisfaction (96.67% vs. 83.33%).

Liu Meihua et al.^[23] further verified the importance of nutritional intervention under the CGA framework. The study found that for elderly hypertensive patients, formulating scientific diet plans based on nutritional assessment results (such as increasing high-quality protein and optimizing food structure) is a key part of comprehensive intervention. After combining medication guidance, exercise programs, and psychological counseling, patients' systolic blood pressure (136.55 ± 6.79 vs. 145.32 ± 7.65 mmHg) and diastolic blood pressure improved significantly, and the body frailty score (Tilburg scale) also decreased significantly ($P < 0.001$), confirming that personalized nutritional management can synergistically improve blood pressure control effect and delay the progression of frailty, which is an important measure to effectively improve the condition of elderly hypertensive patients.

Nutritional intervention, as a key non-pharmacological strategy for elderly hypertension management, has shown dual benefits of improving blood pressure and enhancing quality of life. The DASH diet and Mediterranean diet effectively regulate blood pressure and improve metabolic indicators by optimizing dietary structure. For the elderly population with a high incidence of comorbidities, such as hypertension combined with diabetes or frailty, individualized nutritional plans can synergistically manage multiple diseases. The personalized management model based on Comprehensive Geriatric Assessment (CGA), which integrates nutritional intervention, health education, and multi-dimensional support, can significantly improve the blood pressure compliance rate and reduce the risk of frailty. In the future, it is still necessary to deepen research on precise nutritional mechanisms and explore digital technology-driven intervention pathways to optimize the comprehensive health management of elderly hypertension, and ultimately achieve the public health goal of improving blood pressure through nutrition and empowering the elderly with health.

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