Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Community Medicine

Effectiveness of Nutritional Education Programs in Managing Hypertension in Adults

Dr. Hosneara Akhter[1*], Dr. Rehana Sultana[2], Dr. Sharmin Khan[3]

[1]Professor, Department of Community Medicine, Shahabuddin Medical College, Dhaka, Bangladesh
[2]Associate Professor, Community Medicine, Eastern Medical College, Comilla, Bangladesh
[3]Assistant Professor, Community Medicine, US Bangla Medical College, Dhaka, Bangladesh

DOI: https://doi.org/10.36347/sjams.2025.v13i04.009 | **Received:** 21.01.2025 | **Accepted:** 25.02.2025 | **Published:** 07.04.2025

***Corresponding author:** Dr. Hosneara Akhter
Professor, Department of Community Medicine, Shahabuddin Medical College, Dhaka, Bangladesh

Abstract **Original Research Article**

Background: Hypertension (HTN) is a prevalent non-communicable disease marked by elevated blood pressure (BP), increasing risks for cardiovascular diseases, stroke, and kidney ailments. Normal BP is <120/80 mm Hg; pre-hypertension is 120-139/80-89 mm Hg; Stage I HTN is 140-159/90-99 mm Hg; Stage II HTN is ≥160/100 mm Hg. Globally, HTN affects 30-45% of adults, with higher rates in central/eastern Europe. Modifiable risk factors include poor diet, inactivity, and obesity. Early diagnosis, effective management, and lifestyle changes, particularly dietary interventions like the DASH diet, can reduce BP. Educational programs are crucial for fostering healthy habits and managing HTN. ***Aim of the study:*** This study aims to observe the effectiveness of nutritional education on patients with hypertension. ***Methods:*** This randomized controlled study included 350 hypertensive, overweight, or obese patients (BMI >25 kg/m²) from Department of Community Medicine, Shahabuddin Medical College, Dhaka, Bangladesh. Over six months, patients received nutrition education from qualified dietitians, consisting of individual and group sessions based on the DASH diet, tailored to Polish eating habits. Anthropometric measurements and biochemical analyses were conducted at baseline and after the intervention. Statistical analysis using two-way ANOVA showed the effects of nutrition education on body weight, BMI, waist circumference, blood pressure, and biochemical markers, with data analyzed using SPSS. All participants maintained their pharmacological treatments and provided written consent. ***Result:*** This study involved 350 participants with a mean age of 53.3 years (SD = 10.7). The majority were female (68%) and had varied educational levels, with 45.14% completing high school. Most participants were from upper-class income levels (60%). Lifestyle habits showed that 60% were current drinkers, and only 8% smoked. Regular exercise was reported by 90.57%. Significant reductions were observed in systolic blood pressure (137.1 to 126.5 mmHg) and sodium intake (3,123.6 to 2,601.8 mg), with an improved sodium-to-potassium ratio (2.3 to 1.5). Non-significant changes occurred in fasting blood glucose, cholesterol, and anthropometric measurements. Fish intake decreased significantly. ***Conclusion:*** This study assesses nutritional education's impact on adult hypertension management, showing significant reductions in systolic blood pressure and sodium intake. While diastolic blood pressure and biochemical markers showed no significant changes, emphasizing balanced nutrient intake, including potassium, is crucial for sustained hypertension management through tailored educational interventions.

Keywords: Nutritional education, hypertension, adults, BMI, and diet.

INTRODUCTION

Hypertension (HTN) is a non-communicable disease posing a significant public health challenge [1]. It is characterized by elevated blood pressure (BP) beyond the normal range [2]. The Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure guidelines define normal blood pressure as a systolic BP of 120 mm Hg and a diastolic BP of 80 mm Hg. Pre-hypertension is a systolic BP of 120-139 mm Hg and a diastolic BP of 80-89 mm Hg. Stage I hypertension involves a systolic BP of 140-159 mm Hg or a diastolic BP of 90-99 mm Hg. Stage II hypertension is a systolic BP of 160 mm Hg or higher or a diastolic BP of 100 mm Hg or higher [3]. Hypertension significantly increases the risk of cardiovascular diseases, stroke, and kidney ailments [4]. It is the most common risk factor for death and a leading cause of disabilities globally [5]. In 2015, the global prevalence of hypertension among adults was estimated to be around 30-45%, with the highest levels recorded in central and eastern Europe [6]. According

to the World Health Organization (WHO), high blood pressure causes over nine million deaths annually and is projected to affect 1.5 billion people by 2025 [6,7]. Prevalence varies depending on income and living conditions [8]. Hypertension prevalence ranges from 15-35% in urban adult populations in Asia, while in rural areas, the prevalence is two to three times lower [9]. Modifiable risk factors for high blood pressure include an unhealthy diet, a sedentary lifestyle, and excessive body weight [10]. Early diagnosis and effective management can substantially reduce blood pressure and prevent complications [11]. Lifestyle changes, particularly nonpharmacological interventions such as weight loss, a healthy diet, sodium reduction, potassium supplementation, smoking cessation, alcohol moderation, and increased physical activity, are crucial in preventing and managing chronic illnesses like hypertension and obesity [10]. Dietary intervention is a practical therapeutic approach for overweight individuals with high blood pressure [12]. Recognized effective nutritional strategies for preventing and managing elevated blood pressure include the Dietary Approaches to Stop Hypertension (DASH) diet, Optimal Macro-Nutrient Intake to Prevent Heart Disease (OmniHeart) diet, Portfolio diet, Mediterranean diet, and vegetarian diet [10]. Nonpharmacological therapies are less effective if patients lack knowledge about the importance of nutrition. The most significant challenge lies in helping patients make and maintain lifestyle changes [13]. Systematic nutritional education programs are necessary to improve unhealthy diets and adopt proper eating habits for preventing and managing hypertension [14]. Various educational strategies have been proposed, but their effectiveness must still be fully recognized [13]. Hence, it is essential to investigate the effectiveness of nutrition education programs emphasizing proper nutrition to improve hypertensive patients' health index and diet. This study aims to observe the effectiveness of nutritional education on patients with hypertension.

METHODOLOGY & MATERIALS

The randomized controlled study included 350 hypertensive patients with excessive body weight (BMI >25 kg/m²). Conducted at the Department of Community Medicine, Shahabuddin Medical College, Dhaka, Bangladesh, the research implemented a six-month nutrition education intervention program delivered by qualified dietitians. The study, running from January 2021 to December 2024, focused on 350 non-diabetic patients with stage 1 or 2 essential hypertension. All participants were overweight or obese (BMI >25 kg/m²), had documented hypertension, and were on pharmacological treatment before the study commenced. Throughout the study, all medications were maintained at consistent dosages.

Inclusion Criteria:

- Overweight or obese patients (BMI >25 kg/m²), both male and female.
- Patients with documented hypertension that was pharmacologically treated prior to entering the study.

Exclusion Criteria:

- Patients with an average weight (BMI <25 kg/m²).
- Patients with uncontrolled hypertension.
- Patients with chronic kidney or liver disease.

Three hundred and fifty patients initially volunteered to participate in a six-month nutrition education program. Basic demographic information, including income level, educational level, occupation, place of residence, family structure, and lifestyle, was collected through a questionnaire before the first meeting to define the target audience. The program consisted of six one-to-one dietary counseling sessions per patient and monthly group sessions led by two dietitians. Each monthly visit lasted from 55 minutes to one hour, utilizing the transtheoretical model to facilitate behavior changes.

Patients attended one individual meeting followed by five group educational courses. Group sessions, attended by eight to ten patients each, lasted 60 minutes and encouraged active participation. The nutrition education covered general and detailed topics, including the DASH diet principles, food quality, nutritional values of food groups, energy sources, dietary fiber, food preparation, portion size, recipe modification, healthy fat, and salt and sugar reduction. Each patient received a personalized nutritional plan and structured meal plan, with realistic goals set individually.

Patients were provided with written nutrition materials concerning diet therapy for hypertension. They were encouraged to follow dietary interventions based on the DASH diet, which was adapted to Polish eating habits. They were not recommended to change their physical activities but received advice for daily walks or similar activities. Anthropometric measurements, body composition, and biochemical analysis were conducted at baseline and after the study period. All participants provided written consent to participate.

The same research team recorded all anthropometric measurements, namely height, body weight, waist, and hip circumferences, following standardized procedures and calibrated tools. Body mass index (BMI), calculated as the patient's weight (kg) divided by the square of height (m^2), was used to define categories of body weight. According to the WHO classification [15], overweight and obesity were

defined as a BMI ≥25 kg/m^2 and ≥30 kg/m^2, respectively. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by the study physician (cardiologist, JN) using an appropriate arm cuff and a calibrated sphygmomanometer. The blood pressure was taken after the subject sat upright for at least 5 min [16,17]. Plasma concentrations of glucose, 75 g oral glucose tolerance test (OGTT), serum concentrations of total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides (TG), and plasma insulin concentration were measured using routine techniques.

Statistical Analysis:

The effects of different nutrition education methods on anthropometric and biochemical indices were analyzed using a two-way analysis of variance (ANOVA). The linear model included the main effects of nutrition education and gender and their interaction. In the preliminary study, patients' ages were included as a covariate, but this was omitted from the final model as age did not affect any variables. Before applying the final model, data were checked for variance homogeneity, anthropometric and biochemical indices, and potential outliers using graphical methods. The effects of nutrition intervention on anthropometric measurements (body weight, BMI, and waist circumference), blood pressure (systolic and diastolic), and biochemical markers such as fasting plasma glucose (FPG), fasting insulin resistance index (FIRI), two-hour post-oral glucose tolerance test (2h post-OGTT), and homeostasis model assessment of insulin resistance (HOMA-IR) were calculated using SPSS (Statistical Package for the Social Sciences, version 26.0). All variables are expressed as mean±standard deviation or quartiles. The analyses were conducted at a 0.05 significance level.

RESULT

This study includes 350 participants. The mean age of participants was 53.3 years, with a standard deviation of 10.7 years. More participants were female (68%) than male (32%). The participants' educational attainment varied, with 13.43% having education below middle school level, 45.14% having completed high school, and 41.43% having education beyond college level (Table 1). Participants' family income levels were predominantly in the upper class (60%), followed by the middle class (18.57%), upper middle class (13.43%), and lower class (8%). Regarding lifestyle habits, 60% of the participants reported current drinking, while 40% did not consume alcohol. Smoking was less common among the participants, with only 8% being current smokers and 92% non-smokers. Most participants (90.57%) exercised regularly, while 9.43% did not (Table 1). Anthropometric measurements indicated no significant changes in height, weight, BMI, and waist circumference. Blood pressure measurements showed a significant reduction in SBP, decreasing from 137.1±7.4 mmHg in the pre-test to 126.5±9.3 mmHg in the post-test. However, there was no substantial change in DBP, which was 82.9±10.7 mmHg in the pre-test and 82.8±6.4 mmHg in the post-test (Table 2). Fasting blood glucose decreased from 99.2±15.6 mg/dL to 93.9±14.2 mg/dL, and total cholesterol decreased from 201.8±39.5 mg/dL to 188.6±31.4 mg/dL, but both changes were non-significant. Similarly, HDL-cholesterol and LDL-cholesterol levels showed non-significant variations. Electrolyte sodium (Na) and potassium (K) levels also did not change significantly. Additionally, no significant changes are observed in kidney function markers and electrolyte ratios, such as creatinine, Na/Cr, K/Cr, and Na/K. Creatinine levels slightly decreased from 1,133.5±386.7 mg to 1,109.2±324.3 mg, with no significant statistical difference (Table 2). Table 3 shows that the Pre-test energy intake was 1,603.2±525.1 kcal, and the post-test was 1,526.5±351.7 kcal. There were no significant changes in carbohydrate, fat, protein, or fiber intake. Vitamin A intake reduced from 839.0±489.9 µg to 782.5±534.5 µg, whereas vitamin C intake increased slightly. Vitamin B1, Vitamin B2, and niacin intake remained relatively stable, with pre-test and post-test values of 1.2±0.8 mg to 1.1±0.5 mg, 1.1±0.3 mg to 1.1±0.2 mg, and 13.3±6.6 mg to 14.1±4.2 mg respectively. Other micronutrient intakes, such as folic acid, phosphorus, iron, and calcium, did not change significantly post-intervention. Sodium intake significantly reduced with 3,123.6±950.5 mg in the pre-test and 2,601.8±1,033.0 mg in the post-test. The sodium-to-potassium (Na/K) ratio significantly improved, dropping from 2.3±0.9 to 1.5±0.9 (Table 3). Notable improvements are observed in fish and shellfish intake, where the mean consumption decreased substantially from 6.57±5.30 servings in the pre-test to 2.16±3.88 servings in the post-test (P <0.05). Conversely, no statistically significant changes are detected in the consumption of cooked rice, noodles, dumplings, bread, snacks, soup, stew, meats, eggs, soybeans, steamed vegetables, raw vegetables, kimchi, and salted spicy pickled vegetables (Table 4).

Table 1: Demographic characteristics of subjects (n=350)

Variables	Frequency (n)	Percentage (%)
Age (in year)		
Mean±SD	53.3±10.7	
Sex		
Male	112	32.00
Female	238	68.00

Variables	Frequency (n)	Percentage (%)
Education		
Under Middle school	47	13.43
High school	158	45.14
Over College	145	41.43
Family income		
Lower class	28	8.00
Middle class	65	18.57
Upper middle class	47	13.43
Upper class	210	60.00
Current drinking		
Yes	210	60.00
No	140	40.00
Current smoking		
Yes	28	8.00
No	322	92.00
Exercise		
Yes	317	90.57
No	33	9.43

Table 2: Anthropometric measurements and biochemical indicators between before and after-education program

Variable	Pre-test	Post-test	P-value
Height (cm)	164.4±6.5		NS
Weight (kg)	61.9±11.2	62.5±11.8	NS
BMI (kg/m2)	21.7±4.2	22.6±4.3	NS
WC (cm)	80.4±9.1	80.5±9.4	NS
SBP (mmHg)	137.1±7.4	126.5±9.3	S
DBP (mmHg)	82.9±10.7	82.8±6.4	NS
Fasting blood glucose (mg/dL)	99.2±15.6	93.9±14.2	NS
Triglyceride (mg/dL)	151.8±155.3	141.8±111.4	NS
Total cholesterol (mg/dL)	201.8±39.5	188.6±31.4	NS
HDL-cholesterol (mg/dL)	55.3±15.6	57.3±14.1	NS
LDL-cholesterol (mg/dL)	123.2±32.0	115.1±34.4	NS
Na (mmol/L)	140.4±2.8	142.4±1.1	NS
K (mmol/L)	3.4±1.3	4.3±0.8	NS
AI2)	2.5±3.6	3.2±1.6	NS
Creatinine (mg)	1,133.5±386.7	1,109.2±324.3	NS
Na (mg)	3,428.7±1,340.8	3,258.1±1,230.5	NS
K (mg)	2,602.1±788.5	2,498.4±583.7	NS
Na/Cr	3.7±1.1	2.4±2.6	NS
K/Cr	2.9±1.6	2.6±1.0	NS
Na/K	1.3±1.9	2.8±1.5	NS

Table 3: Nutrient intakes between before and after-education program

Variable	Pre-test	Post-test	P-value
Energy (kcal)	1,603.2±525.1	1,526.5±351.7	NS
Carbohydrates (g)	241.7±69.4	251.6±64.9	NS
Fat (g)	36.3±19.2	36.7±11.8	NS
Protein (g)	60.9±21.8	53.2±19.9	NS
Fiber (g)	20.1±10.4	22.1±9.0	NS
Vitamin A (ug, RE)	839.0±489.9	782.5±534.5	NS
Vitamin C (mg)	119.3±67.2	122.8±81.9	NS
Vitamin B1 (mg)	1.2±0.8	1.1±0.5	NS
Vitamin B2 (mg)	1.1±0.3	1.1±0.2	NS
Niacin (mg)	13.3±6.6	14.1±4.2	NS
Folic acid (ug)	499.2±197.1	440.3±124.1	NS
Phosphorus (mg)	982.5±314.4	891.4±238.4	NS

Variable	Pre-test	Post-test	P-value
Iron (mg)	15.3±3.7	12.1±7.3	NS
Calcium (mg)	446.1±181.7	407.5±145.0	NS
Sodium (mg)	3,123.6±950.5	2,601.8±1,033.0	S
Potassium (mg)	2,904.4±1,002.4	2,721.0±761.5	NS
Na/K	2.3±0.9	1.5±0.9	S

Table 4: Intake frequency of dish group between before and after-education program

Dish group	Pre-test	Post-test	P-value
Cooked Rice	0.57±0.79	0.44±0.72	NS
Noodles	1.13±3.88	1.53±1.90	NS
Breads, snacks	0.77±1.55	1.03±1.48	NS
Soup	1.78±2.34	1.59±2.34	NS
Stew	3.53±2.41	3.00±1.19	NS
Fish, shellfish	6.57±5.30	2.16±3.88	S
Meats, eggs, soybeans	1.39±1.88	1.40±2.38	NS
Steamed vegetables, raw vegetables	2.77±4.28	2.78±5.34	NS
Salted spicy pickled vegetables	0.69±1.87	0.01±0.09	NS

DISCUSSION

Hypertension, commonly known as high blood pressure, is a prevalent and serious health condition. Nutritional education plays a critical role in helping individuals understand the impact of their dietary choices on their blood pressure levels and overall health. By providing adults with the knowledge and tools they need to make informed dietary choices, nutritional education can empower them to take control of their health and reduce their risk of hypertension-related complications [14,18]. The data of our study indicate a well-educated and predominantly female cohort with a substantial proportion of individuals from higher income brackets. The lifestyle factors show a high rate of exercise and a relatively low rate of smoking, which could influence the effectiveness of nutritional education programs in managing hypertension. The high percentage of participants who engage in regular exercise suggests a positive inclination towards health-conscious behavior, which may enhance the outcomes of nutritional education. The results of our demographic study are consistent with the results of Lee *et al.,* [14]. The average blood pressure of subjects before nutrition education was at a level of pre-hypertension. After the education, blood pressure decreased to nearly normal levels. It takes 8 to 12 weeks to change the taste of salt [19,20]. A study on hypertension patients in Korea has shown a tendency to decrease systolic and diastolic blood pressures after nutrition education for four weeks and seven weeks, respectively [21,22]. Jung *et al.*, investigated patients with pre-hypertension and found that systolic and diastolic blood pressures decreased significantly after 16 weeks of nutrition education [23]. The present study also showed that both systolic and diastolic blood pressure decreased after 12 weeks of nutrition education, indicating that changes in blood pressure might be associated with the duration of education. Hypertension patients require blood pressure and blood lipid management. Fasting blood glucose, total cholesterol, and LDL-cholesterol levels were decreased after education, resulting in a positive effect of nutritional education. The study on a nutrition education program for hypertension by applying the health belief model has shown decreased serum triglyceride levels and increased HDL-cholesterol levels after nutrition education [24]. The study on the evaluation of nutrition education for hypertension patients aged 50 years and over has shown only a significant decrease in blood cholesterol levels after nutrition education [21]. This is considered a meaningful result for preventing cardiovascular diseases, including hypertension. In nutrient intake results, the average sodium intake of subjects was 3,123 mg. Sodium intake after nutrition education was 2,601 mg in our study population. Participants showed a significant decrease in sodium intake after the education, indicating a positive effect of low sodium education. This result is comparable with the study of Nsiah-Asamoah *et al.,* [25]. However, continuing education to reduce sodium intake is still necessary since it exceeds the intake goal. Meanwhile, potassium intake reduces the risk of hypertension [27-29]. Other studies on hypertension patients also recommended increasing potassium intake in low sodium nutrition education; there was only a decrease in sodium intake after education but no significant change in potassium intake [13,26]. Nsiah-Asamoah *et al.*, also showed the importance of increased potassium intake [25]. In this study, subjects were taught to eat raw vegetables or salads instead of herbs to reduce sodium intake and increase potassium intake. However, it is assumed that subjects reduced their vegetable intake due to difficulties changing their eating habits [30]. Thus, nutrition education that recommends the consumption of potassium needs to suggest recipes and diets that maintain the taste of traditional foods while reducing sodium and reducing the loss of potassium. In addition, the energy intake of subjects decreased from 1,603 kcal before education to 1,526 kcal after

education. The lower energy intake of subjects might be an effect of the nutrition education informing subjects that being overweight might be a risk factor for elevated blood pressure. Although a decrease in food intake due to nutrition education has a positive effect on weight loss, a decrease in energy intake and a decrease in nutrients such as potassium may negatively affect eating habits. Thus, it is necessary to add education emphasizing the importance of energy and micronutrient intake. However, there were no significant changes in the intake of other macronutrients. Lee *et al.*, demonstrated the changes in different micronutrients before and after education and found similar results [14]. The participants exhibited significantly decreased intake frequency only for fish items. The decrease in fish items intake frequency is consistent with a significant decrease in dietary behavior related to salt intake. In Bangladesh, fish is consumed in salted plaques, a high part of meat. High-sodium fish should be consumed fresh, cooked without seasoning, and eaten. Many studies have reported that soup intake is associated with increased sodium intake, suggesting that excessive sodium-induced behaviors such as eating noodles or soups can increase sodium intake [31,32]. In future studies, introducing a variety of educational content, such as a one-time adequate meal and specific meal guidelines, is necessary to prevent a decrease in the quality of meals by reducing the number of meals for weight loss to reduce blood pressure. Also, developing education programs that can increase the intake of calcium, potassium, and dietary fiber for hypertension patients and implementing surveys related to the intake of potassium and dietary fiber, along with a questionnaire on salt intake, are needed to analyze the effects of nutritional education accurately.

Limitations of the study: A fundamental limitation of this study is its small sample size of 350 participants, which may not comprehensively represent the broader hypertensive population. Additionally, the study's six months may not capture the long-term effectiveness of nutritional education on hypertension management. The demographic homogeneity, with a predominantly female and higher-income cohort, may limit the generalizability of the findings. Furthermore, the reliance on self-reported dietary adherence introduces the potential for reporting bias. The absence of a control group also limits the ability to attribute observed changes solely to the nutritional education intervention.

CONCLUSION AND RECOMMENDATIONS

In conclusion, our study demonstrates the effectiveness of nutritional education programs in managing hypertension among adults. The intervention significantly reduced systolic blood pressure and sodium intake, highlighting the importance of dietary modifications in hypertension management. Although no significant changes were observed in diastolic blood pressure, biochemical markers, and other nutrient intakes, the positive trend in blood pressure reduction underscores the potential of sustained nutritional education. Future programs should emphasize balanced nutrient intake, including increased potassium consumption, to enhance overall dietary quality and improve hypertension outcomes. Continued education and tailored interventions are essential for long-term hypertension management.

Funding: No funding sources.

Conflict of interest: None declared.

REFERENCES

1. Carey, R. M., Muntner, P., Bosworth, H. B., & Whelton, P. K. (2018). Prevention and control of hypertension: JACC health promotion series. *Journal of the American College of Cardiology*, *72*(11), 1278-1293.
2. Whelton, P. K., Carey, R. M., & Aronow, W. S. (2018). Acc/aha/aapa/abc/acpm/ags/APhA/ASH/ASPC/nma/pcna guideline for the prevention, Detection, evaluation, and management of high blood pressure in adults: a Report of the American College of Cardiology/American heart Association. Task force on clinical practice guidelines//J. Am. Coll. Cardiol.-2017.-Nov 13. *Почки*, *7*(1), 68-74.
3. Caprioli, J., & Coleman, A. L. (2010). Blood pressure, perfusion pressure, and glaucoma. *American journal of ophthalmology*, *149*(5), 704-712.
4. Wang, J., Zhang, L., Wang, F., Liu, L., & Wang, H. (2014). Prevalence, awareness, treatment, and control of hypertension in China: results from a national survey. *American journal of hypertension*, *27*(11), 1355-1361.
5. Mohsen Ibrahim, M. (2018). Hypertension in developing countries: a major challenge for the future. *Current hypertension reports*, *20*, 1-10.
6. Collaboration NR. Worldwide trends in blood pressure from 1975 to 2015: a pooled analysis of 1479 population-based measurement studies with 19· 1 million participants.
7. WHO W. A global brief on hypertension: silent killer, global public health crisis.
8. Mills, K. T., Bundy, J. D., Kelly, T. N., Reed, J. E., Kearney, P. M., Reynolds, K., ... & He, J. (2016). Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries. *Circulation*, *134*(6), 441-450.
9. Singh, R. B., Suh, I. L., Singh, V. P., Chaithiraphan, S., Laothavorn, P., Sy, R. G., ... & Sarraf-Zadigan, N. (2000). Hypertension and stroke in Asia: prevalence, control and strategies in developing countries for prevention. *Journal of human hypertension*, *14*(10), 749-763.

10. Gajewska, D., Kucharska, A., Kozak, M., Wunderlich, S., & Niegowska, J. (2019). Effectiveness of individual nutrition education compared to group education, in improving anthropometric and biochemical indices among hypertensive adults with excessive body weight: a randomized controlled trial. *Nutrients*, *11*(12), 2921.
11. Ettehad, D., Emdin, C. A., Kiran, A., Anderson, S. G., Callender, T., Emberson, J., ... & Rahimi, K. (2016). Blood pressure lowering for prevention of cardiovascular disease and death: a systematic review and meta-analysis. *The Lancet*, *387*(10022), 957-967.
12. Pallazola, V. A., Davis, D. M., Whelton, S. P., Cardoso, R., Latina, J. M., Michos, E. D., ... & Welty, F. K. (2019). A clinician's guide to healthy eating for cardiovascular disease prevention. *Mayo Clinic Proceedings: Innovations, Quality & Outcomes*, *3*(3), 251-267.
13. Son, S. M., Park, Y. S., Lim, H. J., Kim, S. B., & Jeong, Y. S. (2006). Pilot study for low salt consumption projects for Korean people. *Ministry of Health and Welfare Research Report*, p98-389.
14. Lee, Y. S., Rhee, M. Y., & Lee, S. Y. (2020). Effect of nutrition education in reducing sodium intake and increasing potassium intake in hypertensive adults. *Nutrition Research and Practice*, *14*(5), 540-552.
15. World Health Organization. Obesity: preventing and managing the global epidemic: report of a WHO consultation.
16. Whelton, P. K., Carey, R. M., & Aronow, W. S. (2018). Acc/aha/aapa/abc/acpm/ags/APhA/ASH/ASPC/nma/pcna guideline for the prevention, Detection, evaluation, and management of high blood pressure in adults: a Report of the American College of Cardiology/American heart Association. Task force on clinical practice guidelines//J. Am. Coll. Cardiol.-2017.-Nov 13. *Почки*, *7*(1), 68-74.
17. Williams, B., Mancia, G., Spiering, W., Agabiti Rosei, E., Azizi, M., Burnier, M., ... & Desormais, I. (2018). 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). *European heart journal*, *39*(33), 3021-3104.
18. Silva, P., Araújo, R., Lopes, F., & Ray, S. (2023). Nutrition and food literacy: framing the challenges to health communication. *Nutrients*, *15*(22), 4708.
19. Ard, J. D., & Svetkey, L. P. (2005). Diet and blood pressure: applying the evidence to clinical practice.
20. Mattes, R. D. (1997). The taste for salt in humans. *The American journal of clinical nutrition*, *65*(2), 692S-697S.
21. Moon, E. H., & Kim, K. W. (2011). Evaluation of nutrition education for hypertension patients aged 50 years and over. *Korean Journal of Community Nutrition*, *16*(1), 62-74.
22. Son, S. M., & Kim, M. J. (2001). The effect of nutrition education program for various chronic disease in elderly visiting public health center. *Korean Journal of Community Nutrition*, *6*(4), 668-677.
23. Rhee, M. Y. (2011). Sodium Intake: Research for the Improvement in Measurement Methods and the Effect of Sodium Intake on Cardiovascular Health. *Seoul: Dongguk University Industry-Academic Cooperation Foundation*.
24. Park SeoYun, P. S., Kwon JongSook, K. J., & Kim HyeKyeong, K. H. (2018). Effect of a public health center-based nutrition education program for hypertension in women older than 50 years of age.
25. Nsiah-Asamoah, C., Setorglo, J., & Mie, J. B. (2017). Nutritional Counseling for Hypertensive Patients: Have Final- Year Nursing Students Learnt Enough to Be Able to Offer Advice to Such Patients?. *Journal of Biomedical Education*, *2017*(1), 6865704.
26. Jung, E. J., Kwon, J. S., Ahn, S. H., & Son, S. M. (2013). Blood pressure, sodium intake and dietary behavior changes by session attendance on salt reduction education program for pre-hypertensive adults in a public health center. *Korean Journal of Community Nutrition*, *18*(6), 626-643.
27. Houston, M. C. (2011). The importance of potassium in managing hypertension. *Current hypertension reports*, *13*(4), 309-317.
28. Suter, P. M., Sierro, C., & Vetter, W. (2002). Nutritional factors in the control of blood pressure and hypertension. *Nutrition in Clinical Care*, *5*(1), 9-19.
29. Aburto, N. J., Hanson, S., Gutierrez, H., Hooper, L., Elliott, P., & Cappuccio, F. P. (2013). Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses. *Bmj*, *346*.
30. Yim, K. S. (2008). The effects of a nutrition education program for hypertensive female elderly at the public health center. *Korean Journal of Community Nutrition*, *13*(5), 640-652.
31. Kim, H. H., & Lee, Y. K. (2013). Analysis of presumed sodium intake of office workers using 24-hour urine analysis and correlation matrix between variables. *Korean Journal of Nutrition*, *46*(1), 26-33.
32. Park, Y. H., & Chung, S. J. (2016). A comparison of sources of sodium and potassium intake by gender, age and regions in Koreans: Korea National Health and Nutrition Examination Survey (KNHANES) 2010-2012. *Korean Journal of Community Nutrition*, *21*(6), 558-573.