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Improving DASH Diet Behaviors, Knowledge and Clinical Outcomes in Uncontrolled Hypertension through a Self-Management DASH Diet Intervention: A Quasi-Experimental Study

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Abstract

The Dietary Approaches to Stop Hypertension (DASH) diet is recognized as one of the most effective dietary interventions for reducing blood pressure. Self-management interventions based on the DASH diet have been developed to enhance dietary adherence and promote sustained blood pressure control among patients with hypertension. This study evaluated the self-management DASH diet intervention on DASH diet behaviors, knowledge and clinical outcomes in patients with uncontrolled hypertension. A quasi-experimental, one-group pretest-posttest study was conducted at the internal medicine outpatient department of a tertiary hospital in Maha Sarakham province, Thailand. Forty-eight participants with uncontrolled hypertension were recruited through purposive sampling. The 12-week intervention integrated DASH diet education, behavior modification, self-management skills, knowledge enhancement, and telephone-based follow-up. Data on knowledge, DASH diet behaviors, systolic and diastolic blood pressure (SBP/DBP), and urine sodium were collected at baseline and post-intervention. Descriptive statistics and paired t-tests were applied for statistical analysis. After 12 weeks, participants' knowledge scores improved from 8.75 to 10.00 and DASH diet behaviors improved significantly from 41.18 to 51.97 ($p<0.001$). Moreover, SBP decreased by 12.68 mmHg and DBP by 10.27 mmHg ($p<0.001$). In addition, urine sodium levels also decreased significantly ($p<0.001$). The findings suggest that a self-management DASH diet intervention can improve patients' knowledge and promote healthier dietary behaviors, as well as reduce SBP, DBP, and urine sodium levels.

Introduction

Hypertension remains a major global public health challenge and one of the most important modifiable risk factors for cardiovascular disease (CVD) (Murray et al., 2020). According to the Global Burden of Disease Study 2019, elevated systolic blood pressure was responsible for 10.8 million deaths worldwide

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(Murray et al., 2020). In 2023, the World Health Organization (WHO) released its first global report on hypertension, highlighting that an estimated 1.28 billion adults live with the condition, yet approximately 46% are unaware of it, and only one in five have it under control (World Health Organization, 2023). This silent killer often presents no early symptoms but gradually progresses, leading to severe complications such as myocardial infarction, stroke, heart failure, and chronic kidney disease particularly among individuals with uncontrolled hypertension.

Uncontrolled hypertension remains a major challenge in the management of patients with hypertension. It is defined as systolic blood pressure (BP)≥140 mmHg and/or diastolic BP≥90 mmHg in patients receiving anti-hypertensive treatment (Adeniyi et al., 2016; Kunanon et al., 2021). A systematic review and meta-analysis reported the prevalence of uncontrolled hypertension in people with comorbidities in sub-Saharan Africa to be 78.6% (95% CI 71.1–85.3%) (Mohamed et al., 2021). In Thailand, the prevalence of uncontrolled hypertension is 24.6%, indicating that approximately one in four Thai adults with hypertension had suboptimal blood pressure control (Chalisarapong, 2022). Previous studies found various key factors associated with uncontrolled hypertension including salty habits (Trong et al., 2024), non-adherence to a low-salt diet and dietary approaches to stop hypertension (Cherfane et al., 2024; Worku & Gessese, 2024), use of three or more antihypertensive medications (Worku & Gessese, 2024), consumption of processed food (Trong et al., 2024), non-adherence to medication (Habtegiorgis et al., 2024; Worku & Gessese, 2024), poor knowledge (Habtegiorgis et al., 2024; Horvat et al., 2022), and poor self-management (Habtegiorgis et al., 2024; Kumalasari et al., 2024). Furthermore, knowledge regarding hypertension and the DASH diet is a critical precursor to behavior change, as patients must understand the rationale behind dietary restrictions to maintain long-term adherence. These findings underscore that uncontrolled hypertension remains a significant public health problem influenced by behavioral, dietary, and self-care factors.

Lifestyle modification is a cornerstone of hypertension management, as emphasized by all major international and national clinical practice guidelines (Kunanon et al., 2021; Whelton et al., 2018). Among various lifestyle strategies, dietary intervention is one of the most impactful. The Dietary Approaches to Stop Hypertension (DASH) diet is a non-pharmacological intervention with robust, strong evidence for its efficacy in lowering blood pressure (Filippou et al., 2020; Guo et al., 2021; Theodoridis et al., 2023). Compared with a control diet, the DASH diet reduced both SBP and DBP (difference in means: –3.2 mm Hg; 95% CI: –4.2, –2.3 mm Hg; P<0.001, and –2.5 mm Hg; 95% CI: –3.5, –1.5 mm Hg; P<0.001, respectively) (Filippou et al., 2020). The DASH eating plan emphasizes the consumption of fruits, vegetables, whole grains, and low-fat dairy products, while limiting saturated fat, cholesterol, and, most importantly, sodium. Its effectiveness stems from the synergistic combination of high potassium, magnesium, and calcium intake with low sodium consumption (Filippou et al., 2020; Ilori et al., 2023). However, the translation of dietary knowledge into sustained, real-world behaviors remains challenging. Adherence often declines over time due to a lack of practical skills, knowledge, and self-monitoring capabilities.

This challenge highlights the need to move beyond simple education towards patient empowerment through a structured self-management approach. Self-management is a process by which individuals with chronic illnesses gain the skills, confidence, and motivation to actively participate in managing their own health (Grady & Gough, 2014). Effective self-management interventions typically incorporate core components such as collaborative goal setting, action planning, self-monitoring (e.g., of diet and blood pressure), and problem-solving to overcome barriers (Bumrungsuk, 2022; Kurt & Gurdogan, 2022). By building a patient's confidence, these programs can foster long-term adherence to complex regimens such as the DASH diet. From the literature review, various studies have demonstrated the benefits of integrating self-management behaviors with adherence to DASH diet among persons with hypertension and uncontrolled hypertension (Alnooh et al., 2022; Ayu et al., 2024; Susanti et al., 2021). Despite evidence supporting both self-management interventions and the DASH diet, these approaches are often implemented separately, lack standardized structure, and are rarely integrated into routine outpatient clinical care. Furthermore, few studies have focused specifically on patients with previously uncontrolled hypertension, who represent a high-risk group requiring intensive, skill-based support. Therefore, this study was developed to bridge this gap by implementing a structured self-management program. The primary objective was to evaluate the effectiveness of this 12-week intervention

on knowledge, DASH diet behaviors, and clinical outcomes (SBP, DBP, and urine sodium levels) in patients with uncontrolled hypertension. The use of SBP and DBP as primary clinical outcomes is justified by their roles as the gold standard for assessing hypertension control. Additionally, random urine sodium levels were utilized as an objective biomarker to provide a more accurate assessment of dietary sodium intake compared to self-reported tools, thereby strengthening the empirical evidence of behavioral adherence to the DASH diet.

Materials and methods

1. Study design

A quasi-experimental, one-group pretest–posttest design was used to evaluate the effects of a self-management DASH diet intervention. The study was conducted in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guidelines. Data collection took place from March to December 2024 at the internal medicine outpatient department of a tertiary hospital in Maha Sarakham Province, Thailand. Outcomes were assessed among participants before and after the 12-week intervention period.

2. Sample

Sample size determination was calculated using G*Power version 3.1.9.2. The parameters were set at a significance level of 0.05 and a power of 0.80. Although prior studies on dietary interventions in hypertensive patients observed a large effect size (d=2.14) (Kongkeaw et al., 2022), this study employed a medium effect size (d=0.5). Furthermore, the final sample size was increased by 10% to compensate for possible dropouts. Thus, the minimum required sample size was calculated to be 48 participants. Forty-eight participants with uncontrolled hypertension were recruited through purposive sampling based on inclusion criteria: 1) aged 18 years or older; 2) having a documented diagnosis of uncontrolled hypertension (SBP>140 mmHg or DBP>90 mmHg on repeated measurements) despite receiving antihypertensive treatment, 3) being able to understand and communicate in Thai, 4) having access to a telephone for follow-ups, and 5) providing voluntary informed consent to participate. Patients were excluded if they had a secondary cause of hypertension, or were diagnosed with a terminal illness.

3. Ethical considerations

The study protocol received full ethical approval from the Institutional Review Board of the studied hospital (Reference: MSKH_REC 66-01-032, dated November 6, 2023). All participants provided written informed consent before any data collection or intervention activities. All data were anonymized and stored securely to ensure participant confidentiality.

4. Measurement tools

4.1 Demographic and clinical data form

This form collected baseline information on age, gender, education level, occupation, and duration of hypertension diagnosis.

4.2 Hypertension and DASH diet knowledge questionnaire

This was developed by the researcher and consisted of 10 dichotomous (true/false) items. Each correct response was scored as 1, with total scores ranging from 0 to 10. Higher scores indicate greater knowledge of hypertension and the DASH diet, with scores greater than 8 reflecting a high level of knowledge. The instrument's content validity was examined by a panel of three experts, yielding a Content Validity Index (CVI) of 0.96. Its reliability, tested on a pilot sample (n=30), was acceptable with a Kuder-Richardson 20 (KR-20) coefficient of 0.60.

4.3 DASH diet behaviors assessment questionnaire

Developed by the researcher, this instrument consisted of a 20-item questionnaire, assessing DASH diet behaviors over the previous week with a 5-point Likert scale (e.g., from 'never (1)' to 'always (5)'). The possible score ranges from 20 to 100, with a score of 50 or above indicating high DASH diet adherence, and a score below 50 indicating low DASH diet adherence. The CVI for this instrument was 0.93, and its reliability was high, with a Cronbach's alpha coefficient of 0.87 (n=30).

4.4 Clinical outcomes

SBP and DBP were measured by the researcher using a calibrated automated sphygmomanometer. Measurements were taken in a quiet room after the participant had rested for at least 5 min, with their back supported and feet flat on the floor. Three readings were taken one minute apart, and the average of the last two readings was recorded. Urine sodium levels were measured via urine electrolyte collection; participants were provided with a container and detailed oral and written instructions to ensure complete collection for laboratory analysis.

4.5 Intervention

The self-management DASH (SM-DASH)

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intervention was designed following self-management principles and an extensive literature review for a total duration of 12 weeks. The intervention included clearly defined steps, with each week focusing on specific activities and goals to facilitate patient engagement and learning.

Week 1 (In-person session)

The program began with a 60-min in-person session. First, baseline data were collected. Next, the researcher conducted a motivational interview to assess each participant's readiness to change. Personalized goals related to diet and blood pressure were set collaboratively. Educational materials including a comprehensive manual on hypertension and the DASH diet were distributed, which featured practical tips, food lists, and meal plans. Participants also received a logbook to record their daily food intake, physical activity, and home blood pressure readings.

Week 2 (Group-based learning)

This 45-min session focused on building practical skills. The session covered skills training for home blood pressure monitoring, ensuring proper technique and understanding of the readings. The session also covered skills for selecting and preparing food consistent with the DASH diet, including guidance on reading food labels, choosing appropriate ingredients, and cooking according to DASH principles.

Week 3 (Group-based learning)

This session focused on self-awareness and mental well-being for 45 min, including self-assessment to guide participants in evaluating their progress against initial goals. Stress relaxation involved introducing and discussing simple techniques for managing stress, which can significantly affect blood pressure.

Weeks 4–11 (Telephone follow-up)

The core of the intervention's support system was the weekly telephone call. These 15–20-min structured calls were designed to provide ongoing guidance and reinforcement. During each call, the researcher would review the participant's self-monitoring log from the previous week, provide positive reinforcement for achievements and progress toward goals, engage in collaborative problem-solving to identify and address any barriers encountered, reinforce key educational concepts from the manual, and answer any questions and adjust the action plan for the upcoming week as needed. This continuous contact was crucial for maintaining self-confidence.

Week 12 (Final In-person session)

Participants returned to the clinic for a final 30-min session. Post-intervention data were collected using the same instruments as at baseline. Participants received a summary of their progress, and the researcher discussed strategies for maintaining their new long-term health behaviors.

In addition, this SM-DASH intervention, manual, logbook was examined for content validity by a panel of three experts, yielding a CVI of 0.96, 0.90 and 0.93. Moreover, home BP monitor was calibrated by a technician before data collection.

5. Statistical analysis

All data were entered and analyzed using SPSS for Windows. The analysis proceeded in two stages. First, descriptive statistics (frequencies, percentages, means, and standard deviations [SD]) were used to summarize the demographic characteristics of the participants and the baseline and post-intervention values for all outcome variables. Second, to evaluate the effectiveness of the intervention, paired-samples t-tests were conducted to compare the mean scores of knowledges, health behaviors, SBP, DBP, and urine sodium levels before and after the 12-week program. The data for each variable were tested for normality by Kolmogorov–Smirnov statistics. It indicated normality for all variable ($p>0.05$) and met assumptions for using paired-samples t-tests.

Results and discussion

Forty-eight participants were enrolled and completed the 12-week study, resulting in a 100% retention rate. Most participants were female (68.75%), and the sample included adults, with 66.70% being under the age of 60. Nearly half of the participants (45.80%) had completed primary education, and the most common occupation was agriculture (56.30%). The most common monthly income range was 10,000 to 14,999 baht/month (39.60%). The average duration of living with a hypertension diagnosis was 3.73 years (SD=3.67) (Table 1).

The intervention had a profound impact on both knowledge and DASH diet behaviors (Table 2). At baseline, participants had a relatively good understanding of their condition, with a mean knowledge score of 8.75 (SD=1.60). Following the intervention, the mean score increased significantly to 10.00 (SD=0.00) ($p<0.001$). More importantly, this knowledge translated into action. The mean DASH diet behaviors score, reflecting

Table 1 Number and percentage of demographic data among persons with uncontrolled hypertension (n=48)

Demographic data	n(%)
Gender	
Female	33 (68.75%)
Male	15 (31.25%)
Age (Mean=53.08, SD=14.84, Min=20, Max=85)	
Less than 40 years	9 (18.80%)
40–59 years	23 (47.90%)
60 years or older	16 (33.30%)
Marital status	
Single	7 (14.60%)
Married	27 (56.30%)
Widowed/Divorced/Separated	14 (29.20%)
Education level	
Primary education	22 (45.80%)
Secondary education	15 (31.30%)
Diploma or equivalent	3 (6.30%)
Bachelor's Degree	8 (16.70%)
Occupation	
Unemployed	11 (22.90 %)
Agriculture	27 (56.30 %)
General employee	8 (16.70 %)
Government/State enterprise	2 (4.20 %)
Monthly income	
≤5,000 baht/month	10 (20.80%)
5,001–9,999 baht/month	15 (31.30%)
10,000–14,999 baht/month	19 (39.60%)
15,000–19,999 baht/month	3 (6.30%)
≥20,000 baht/month	1 (2.10%)
Health insurance	
Civil servant medical benefit	3 (6.30%)
Scheme local government officer	2 (4.20%)
Medical benefit scheme social security	7 (14.60%)
National health security office	36 (75.00%)
Duration of disease (Mean=3.73, SD=3.67, Min=1, Max 17)	
1–5 years	39 (81.25%)
6–10 years	7 (14.58%)
More than 10 years	10 (4.17%)
Use of antihypertensive drugs	
Taking 1–2 types of drugs	32 (66.70%)
Taking 3–4 types of drugs	16 (33.30%)

compliance with the DASH diet, increased significantly from a baseline of 41.18 (SD=5.77) to 51.97 (SD=7.96) post-intervention ($p<0.001$). This represents a shift from a low level of DASH diet behaviors to a high level, suggesting participants consistently and continually incorporated the dietary recommendations into their daily lives.

This program resulted in clinically meaningful and statistically significant improvements in SBP, DBP, and urine sodium levels (Table 2). The primary outcome, SBP, decreased by an average of 12.68 mmHg, from a mean of 157.69 (SD=14.68) at baseline to 145.00 (SD=19.14) after 12 weeks ($p<0.001$). Similarly, DBP decreased by an average of 10.27 mmHg, from a mean of 97.58 (SD=7.29) to 87.31 (SD=13.13) ($p<0.001$). The objective measure of dietary sodium intake confirmed the self-reported behavioral changes. The mean 24-h urine sodium levels decreased significantly from a standard criterion of 69.94 (SD=35.79) post-intervention ($p<0.001$). This significant decrease shows a substantial change in dietary sodium consumption among the participants.

The findings of this study suggest that the 12-week SM-DASH intervention, integrated with the DASH diet, is associated with meaningful improvements in patients with uncontrolled hypertension in Thailand. The improvement in clinical outcomes can be attributed to the structured skills training in Weeks 2 and 3, which moved beyond simple education to active problem-solving, allowing patients to navigate real-world barriers like eating out or managing stress. Participants showed substantial improvements not only in their knowledge and DASH diet behaviors but also in key clinical outcomes. Specifically, there were statistically significant reductions in both SBP and DBP, as well as in urine sodium levels, indicating better dietary control. This

Table 2 Comparison of mean scores for knowledge, DASH diet behaviors, SBP, DBP, and Urine sodium levels before and after the program (n=48)

Variables		Mean	SD	Interpretation	Mean difference	t	*p*-value
Knowledge	Before	8.75	1.60	High	–1.25	–5.397	<0.001
	After	10.00	0.00	High			
DASH diet behavior	Before	41.18	5.77	Poor	10.79	–8.707	<0.001
	After	51.97	7.96	Good			
SBP	Before	157.69	14.68	–	12.68	4.740	<0.001
	After	145.00	19.14	–			
DBP	Before	97.58	7.29	–	10.27	5.477	<0.001
	After	87.31	13.13	–			
Urine sodium levels	Standard criteria	<200 mmol/day	–	–	–150.06	–29.047	<0.001
	After	69.94	35.79	–			

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outcome underscores the effectiveness of a comprehensive intervention that combines education, behavior modification, and ongoing follow-up to empower and encourage patients in managing their chronic condition.

These findings are consistent with those of Kurt and Gurdogan (2022), who reported improvements in knowledge, treatment adherence, and self-care following a self-management support program that included face-to-face counseling, hypertension education, medication management guidance, and home blood pressure monitoring training. However, notable differences exist between the studies. Kurt and Gurdogan's program addressed a broader range of lifestyle factors, such as physical activity and stress management, whereas the SM-DASH intervention concentrated primarily on DASH dietary adherence and sodium reduction. This targeted approach, combined with the use of urine sodium levels as an objective indicator of dietary compliance, may account for the more specific changes in dietary behavior and clinical outcomes observed in the present study. Similarly, Bumrungsuk (2022) demonstrated that a 13-week Self-Management Training Program, delivered through small-group education, a patient manual, and peer discussion groups, resulted in significantly lower SBP and DBP ($p<0.005$) and higher self-management behavior scores in the experimental group compared to the control group ($p<0.01$). Both Bumrungsuk's program and the SM-DASH intervention utilized group-based education and blood pressure measurement; however, a distinguishing feature of the present study is the explicit use of the DASH dietary framework in conjunction with urine sodium levels monitoring.

The reduction in urine sodium levels represents another key finding, as it reflects an objective and reliable biomarker of actual sodium intake, which is superior to dietary self-reports. The statistically significant reduction in urine sodium levels after the program completion provides strong empirical evidence that patients successfully applied DASH diet knowledge to their daily lives, particularly by reducing their consumption of salty and processed foods and by choosing low-sodium condiments. This change may have resulted from education emphasizing the role of sodium in raising blood pressure, consistent with the core principles of the DASH diet. As emphasized by Susanti et al. (2021), adherence to the DASH diet is essential to prevent complications in hypertensive patients. Therefore, these results confirm that the program can produce measurable behavioral changes and tangible health benefits.

Regarding blood pressure reduction, which is the primary goal of treatment, statistically significant decreases in both systolic and diastolic blood pressure were observed following participation in the DASH diet self-management program. These findings suggest a potential beneficial role of the program in supporting blood pressure control. These findings are consistent not only with international research but also with relevant data. For example, Polsook and Aungsuroch (2024) conducted a pilot study in Thailand and found that an app-based self-management program effectively reduced blood pressure levels. Likewise, Ayu et al. (2024) in Indonesia demonstrated that even education about the DASH diet alone resulted in a reduction in blood pressure. The consistent findings across these studies reinforce and strengthen the conclusion that structured lifestyle interventions, including education, skills building, and follow-up, are highly effective non-drug treatment strategies and should be promoted as part of the standard of care for hypertensive patients in healthcare settings.

Conclusion

In conclusion, the 12-week SM-DASH intervention was associated with improvements in participants' hypertension-related knowledge, adoption of healthier behaviors, and reductions in blood pressure and sodium intake among patients with uncontrolled hypertension. These findings suggest that a structured, self-management–focused dietary program may support behavioral change and blood pressure control when delivered within routine clinical care.

Several limitations should be considered when interpreting these results. The primary limitation is the quasi-experimental, one-group design without a control group, a small sample from a single hospital, and a short 12-week follow-up period, which may affect the generalizability of the results. In addition, the assessment of health behaviors relied on a self-report questionnaire, which may be subject to recall bias or social desirability bias, although this was mitigated by the inclusion of the objective urine sodium levels measure. The study was conducted at a single tertiary care hospital with a specific patient population, which may limit the generalizability of the findings to other settings, such as primary care or different regions of the country. Finally, the 12-week follow-up period was relatively short, and the long-term sustainability of the observed changes is unknown.

This study provides a practical, nurse-led model that can be feasibly implemented in busy outpatient departments to manage high-risk patients with uncontrolled hypertension. The SM-DASH intervention demonstrates that transitioning from brief advice to a structured, supportive program can yield significant clinical benefits. Healthcare systems should consider investing in training nurses and other healthcare professionals in behavioral coaching and self-management support techniques. Moreover, adapting and testing this intervention in various populations and settings will advance understanding and drive progress in hypertension care.

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Conflicts of interest

The authors declare no conflicts of interest.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used Gemini to enhance language clarity and grammar. The final content was reviewed and edited by the authors.

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Journal of Food Health and Bioenvironmental Science (September – December 2026), 19(3), e269881
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