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The Effects of a Plant-Forward Cooking Workshop Program on Dietary Behaviors in Adults with Hypertension: A Feasibility Study

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Abstract

Identifying effective nutrition education strategies to alleviate the prevalence of hypertension within the United States is critical. The purpose of this study was to determine the feasibility of an online six-week cooking and nutrition educational program for adults with hypertension. A pre/post feasibility study was conducted in which participants (n=9) met online weekly. Each one-hour class highlighted a different plant-forward recipe and discussed nutrition information. A group chat was implemented for building community and sharing nutrition and recipe knowledge. Participants completed 3-day 24-hour recalls, knowledge and attitude surveys, and a 24-hour urine sample for analysis of potassium and sodium. Results demonstrated a significant increase in nutrition knowledge ($p=0.003$) for managing fruit, vegetable, sodium, and potassium consumption for hypertension. No increase in fruit and vegetable consumption nor changes in urinary sodium and potassium were observed. Autonomous motivation and perceived social support were positively associated with attitudes towards fruit and vegetable consumption, and qualitative findings suggested dietary quality improvements. This study achieved its primary feasibility objectives and provided valuable insights for refining further culinary-based interventions. Future studies should expand with larger sample sizes and lengthier interventions.

Keywords: cooking workshops, hypertension, fruit and vegetable consumption, nutrition knowledge, social support

Introduction

Hypertension affects approximately 49.1% of adults ages 20 and older in the United States (CDC, 2017) and is a leading modifiable risk factor for cardiovascular disease (CVD), stroke, and chronic kidney disease (CKD) (WHO, 2023). It often develops asymptomatically, causing damage to the cardiovascular system and vital organs over time. Contributions to hypertension include comorbidities such as diabetes, obesity, and pregnancy, as well as modifiable risk factors such as inadequate diet, physical inactivity, and excess alcohol and tobacco use (CDC, 2017).

Diet plays a pivotal role in the prevention and management of hypertension. Dietary patterns like the DASH (Dietary Approaches to Stop Hypertension) and Mediterranean that emphasize consuming at least five servings of fruits and vegetables daily reduce blood pressure by improving endothelium function due to the elevated ratio of potassium to sodium (Altwali et al., 2023; Filippou et al., 2021). Excess sodium increases fluid retention and blood volume, raising vascular resistance and exacerbating hypertension. Studies showed that reducing sodium intake to less than 2.3g daily, or ideally to 1.5g daily for high-risk individuals, significantly lowers systolic and diastolic blood pressure (Grillo et al., 2019). Rivera et al. reported that U.S. adults with a greater intake of high-sodium processed foods exhibited up to a 15% greater risk of developing hypertension compared with those consuming minimally processed foods, such as dairy, or unprocessed, whole foods. Additionally, studies have shown that individuals who consume 3.5-5g daily of potassium promote sodium excretion and support vascular health (Ekmekciolgu et al., 2016). A systematic review of 22 randomized controlled trials investigating the effects of potassium on hypertension supports that increasing consumption of fruits, vegetables, and legumes reduced both systolic and diastolic blood pressure by 3.49 and 1.96 mm Hg, respectively (Aburto et al., 2013). However, the challenge remains that adults do not consume adequate servings of fruits and vegetables daily.

Cooking interventions can be an effective strategy in alleviating health issues by demonstrating ways to incorporate nutritious foods into daily diets (Kalantar-Zadeh et al., 2021). The prominent well-being model, PERMA (Positive emotion, Engagement, Relationships, Meaning, and Accomplishment), supports the positive connection between group cooking and one's well-being (Farmer & Cotter, 2021). The positive mental health aspects of cooking, such as a sense of community, can help complement and reinforce the content and changes being taught (Farmer & Cotter, 2021). Despite cooking interventions being conducted among adults with hypertension, these tend to be in-person, where barriers exist, such as transportation and limited enforcement of skills within their homes (Rohela et al., 2021). Therefore, this study examined the feasibility of a virtual cooking program that incorporated nutrition education, healthcare professional involvement, and group chat support for adults with hypertension.

Methods

Study Design

A six-week pre/post feasibility study was conducted at the University of Florida from February 2025 to April 2025. All participants provided an informed consent prior to initiation of the study. UF IRB #202401549 approved this study as expedited.

Participants

Participants were recruited through flyer advertisements in the UF at work newsletter, ResearchMatch, and local cardiac and lifestyle medicine clinics. General practitioners assisted with recruitment in their respective clinics by recommending the study to adults meeting the inclusion criteria. Interested participants were screened via telephone to determine eligibility. Adults (>18 years old) who were diagnosed with hypertension were eligible to participate. Other inclusion criteria included no problems with swallowing and the absence of dietary restrictions. Exclusion criteria included not meeting the above criteria and self-reported pregnancy/lactation.

Study Procedure

Participants who met the inclusion criteria completed their baseline visit at pre-assigned times, scheduled using the online platform Calendly, in the clinical lab of the Food Science and Human Nutrition (FSHN) Department. After providing informed consent, participants were weighed with a digital scale (Omron HBF-514C). Weight was taken to the tenth in kg. Height was self-reported to calculate body mass index (BMI). Participants' blood pressures were taken using an electronic machine (Omron 3 Series Upper Arm Blood Pressure Monitor, BP7150), three times during the visit, 5 minutes apart from each other, and averaged.

Participants completed a 24-hour food recall with the study coordinator, using a multiple-pass technique (Blanton, et al. 2006), and were instructed to complete 2 additional 24-hour food recalls over the next 2 days. These spreadsheets included columns for the time of meal, the ingredients of the meal, condiments used, and amounts consumed. Reminders were sent each morning to complete and return these recalls. Once recalls were obtained, the study coordinator entered each day into the Automated Self-Administered 24 hour (ASA24) to reduce participant burden. The ASA24 is a method to estimate average total energy, macronutrients, micronutrients, and dietary supplement intakes through providing images of foods and beverages for participants to better estimate their portion sizes.

Participants responded to a validated 48-item questionnaire regarding their demographics, dietary habits, fruit and vegetable knowledge and attitudes, and cooking confidence and attitudes through QualtricsTM. The full questionnaire was adapted using validated Food Frequency Questionnaires according to the methodology by Huang and colleagues for gathering information on sodium, potassium, fruit, and vegetable intake, as well as a validated workshop skills evaluation form (Huang et al., 2022, Prizzia & Andrade, 2020). For the determination of participants' dietary habits and knowledge, a multiple-choice format was used. For the determination of attitudes about fruits and vegetables and cooking confidence, a 5-point Likert scale of 1 (strongly disagree) to 5 (strongly agree) was used. Finally, participants were given materials for a 24-hour urine collection and were provided with verbal and printed instructions. Participants returned their 24-hour urine sample the morning after completing their test at a pre-arranged date.

Workshop Development and Format

During Fall 2024 (October-November), recipes were developed in a food-grade laboratory. Recipes were created with a plant-forward emphasis and focused on a different color of the rainbow. Nutrient analysis was performed using the Food Processor Nutrition Analysis Software by Elizabeth Stewart Hands and Associates (ESHA). Each recipe had less than 400 mg of sodium per serving and at least 600 mg of potassium per serving. A taste-testing of these recipes with experts in FSHN (n=9) was conducted. Panelists provided feedback for improvement, including flavor profile, texture, and vegetable additions, which were subsequently modified prior to the initiation of the study. The cost of each dish was calculated at less than $5 per serving.

Once recruitment was finished, for the feasibility portion of the virtual cooking program, participants were added to a WhatsApp group chat to provide a source of communication for the weekly recipes and workshop links in addition to fostering a sense of community amongst the group. Participants were encouraged to ask questions, share their experiences and thoughts after each class, and post photos of their completed meals. The weekly cooking workshop time occurred on Mondays at 7 pm Eastern Standard Time, based on the availability of each participant.

Each workshop lasted 60 minutes and was recorded for those unable to attend live. The workshops were split into a nutrition education component and a cooking demonstration. Each

week focused on a specific nutrition education topic and theme while promoting the consumption of fruits and vegetables, ensuring adherence with recommendations for sodium and potassium intake for those with hypertension. Workshops began with a 15-minute nutrition education component in which the study coordinator explained the benefits of the recipe and tailoring it to the needs of those with hypertension. For example, in the breakfast workshop, the discussion focused on the importance of a high-protein breakfast and on ways to incorporate fruits and vegetables into recipes. Table 1 illustrates the structure of each workshop. A lifestyle medicine physician co-led five workshops, and a registered nurse practitioner co-led one workshop, both providing their professional expertise and answering questions that arose throughout the lesson. For the next 45 minutes, participants prepared the dishes as they followed along with the study coordinator. Each class was expected to take a total of 60 minutes; however, some classes were 10 minutes shorter or longer, depending on cooking times and questions asked.

Table 1. Structure of Cooking Program

Week	Color	Topic of Focus	Recipe
1	Red	Introduction to cooking with produce	Veggie Skillet Lasagna
2	Orange	Plant-based proteins	Chickpea Coconut Curry
3	Yellow	Importance of breakfast	Egg Bites and Banana Protein Muffins
4	Green	Various dietary patterns (ie. Mediterranean)	Mediterranean Bowl
5	Purple	Enjoyment of cooking	Spring Rolls
6	Brown	Sweets and Snacks	Sweet Potato Brownies and Carrot Cake Energy Bites

Compliance was encouraged on WhatsApp through weekly reminders and tips to stay motivated to cook with fruits and vegetables. Participants were encouraged to send photographs after each cooking workshop to share their meals with other individuals and the study coordinator. Compliance was further encouraged through a lifestyle medicine physician's involvement, who assisted with recruitment and co-led five of the six workshops with the study coordinator.

Following the six weeks of cooking workshops, participants were invited back to the lab for a post-study visit. Participants completed the same information as baseline and were interviewed

about their experiences with this workshop. The interview consisted of six open-ended questions about their thoughts on the recipes, the style of cooking classes, and areas for improvement. Responses were analyzed for recurring themes.

Data Analysis Methods

Preliminary urine analysis was conducted on the sample, including volume, creatinine to albumin (ACR), and stick tests. Four 15 mL centrifuge tubes were filled with urine and frozen at –20°C for mineral analyses. Upon receiving each urine sample, the total volume was recorded. Urine was transferred into 4 15 mL centrifuge tubes, and the remaining urine was discarded. Preliminary urine analysis was conducted using two strips: Multistix 10SG and Clinitek Microalbumin 2. ACR was measured with the Clinitek Status + Analyzer and dip strips, while other markers, including protein and glucose, were measured with the Clinitek Advantus analyzer and dip strips.

For mineral analysis, the vials were thawed in an ice bath for 30 minutes. From each sample, 2 aliquots of 0.5 mL were transferred into 2 separate, pre-labeled centrifuge tubes. Twelve mL of mineral-free water was added to each tube to complete the 25x dilution. For a second dilution factor, 0.3 mL was taken from each of the 25x dilution tubes and placed into pre-labeled centrifuge tubes, and 14 mL of mineral-free water was added to these tubes to finalize the 47.6x dilution. Each of these tubes (2 replicates of each dilution per participant) was injected into an Atomic Emission Spectrometry (AES) to analyze the mineral output in the urine. Due to the sensitivity of the AES machine, sodium and potassium were measured using a 47.6x dilution. Mineral output was averaged among replicates for each participant. Using the total 24-hour urine volume, a ug/24h was calculated.

Upon entering 24-hour recalls into the ASA24 system, the average intake of nutrients and the determination of diet quality by the Healthy Eating Index (HEI) were produced. The HEI-2020 was used to evaluate the diet quality of pre- and post-data based on person-level ASA24 intake for each record day. Data from the ASA24 were converted to HEI-2020 scores in *SAS*, version 9.4, using the simple HEI-2020 scoring algorithm. The HEI-2020 is a reliable and valid tool that measures the alignment of foods and beverages consumed to the 2015-2020 Dietary Guidelines for Americans (Shams-White et al., 2023). A higher score indicates higher diet quality for that component based on the 2015-2020 Dietary Guidelines for Americans (Shams-White et al., 2023).

Statistical analysis

Frequency and counts were reported for demographics. Descriptive statistics in questionnaire results were used to summarize continuous variables, presented as mean ± standard deviation (SD). A Wilcoxon Signed Rank Test was used to assess changes in the primary outcome, fruit and vegetable consumption, and for the secondary outcomes, changes in blood pressure, HEI scores, and urinary minerals. Statistical significance was determined at $p < 0.05$ with a critical value of W=5. Spearman correlation tests were used to measure the associations between knowledge, attitudes, motivation, and cooking scores. Excel v9 was used to perform the statistics. Statistical significance was determined at $p<0.05$.

Results

Participant Characteristics

A total of 9 adults, 78% female (n=7), an average of 42.8 years, with a nearly equal distribution of races/ethnicities, and who had an average BMI of 34.5 kg/m^2, completed the entirety of the study. At baseline, the average systolic blood pressure was 138.1 mmHg±15.6. The average diastolic pressure was 85.0 mmHg ±8.3. Sixty-seven percent of participants had ACRs within normal range (<30mg/g). All other aspects of the urine were considered within normal ranges (Table 2).

Table 2. Participant Demographics (n=9)

Characteristics	N
Age (y in ranges)	42.8 (27-69)
Sex	
Female	7
Male	2
Race/Ethnicity	
Black/African American	3
White/Caucasian	2
Hispanic	4
Average total household income	$75,000
BMI Pre Study (kg/m2 range)	34.5 (21.9-58.0)
BMI Post Study (kg/m2 range)	34.2 (21.7-57.6)
Average BP Pre-Study (mmHg)	138.1/84.0
Average BP Post-Study (mmHg)	135.1/84.7
uACR (<30 mg/g reference value)	6
<30	3
30-300	

Results from participant recruitment

Recruitment for this study was for a total of two months (January-February 2025) with participant enrollment occurring on an ongoing basis. A total of 52 prospective participants expressed interest, with 27 responding to an initial email and agreeing to be screened, and 14 meeting the inclusion criteria and joining the study. Physician referrals and the UF at Work Newsletter were the most successful forms of recruitment. Participation was not feasible for any ResearchMatch-screened prospective participants due to distance from the laboratory. Throughout the intervention, five participants dropped out because of the inability to provide the first 24-hour urine sample (n=1), language barrier (n=1), or inability to attend the online sessions (n=3) (Table 3).

Table 3. Participant recruitment methods

Method of Recruitment	Expressed Interest	Screened	Accepted into Study	Dropped
Physician Referral	19	7	7	2
UF at Work Newsletter	15	15	7	3
UF Research Studies	9	0	0	N/A
Instagram				
Research Match	9	5	0	N/A
Total	52	27	14	5

Participant compliance

Despite scheduling the workshops based on participant availability, only a few (n=3) consistently attended every online workshop. All participants (n=9) watched each of the 6 workshops, either live or recorded, as measured by direct messaging on WhatsApp. All participants completed each 24-hour dietary recall, questionnaire, and urine test for both baseline and post-study.

Sample collection

The process for collecting the urine samples and the self-assessment of dietary and fruit and vegetable habits was appropriate for obtaining the data. Each visit to the clinical lab lasted 30 minutes, which was sufficient to collect the data from surveys, weights, and blood pressure, and for participants to share their experiences (post-study). For urine sample drop-off, providing the

option for the study coordinator to pick up samples instead of requiring participants to return to the lab reduced participant burden.

Diet intake and Quality, Knowledge, Attitudes, and Cooking Motivation

Average fruit and vegetable intake results are illustrated in Figure 1, and Wilcoxon signed rank test results are summarized in Table 4.

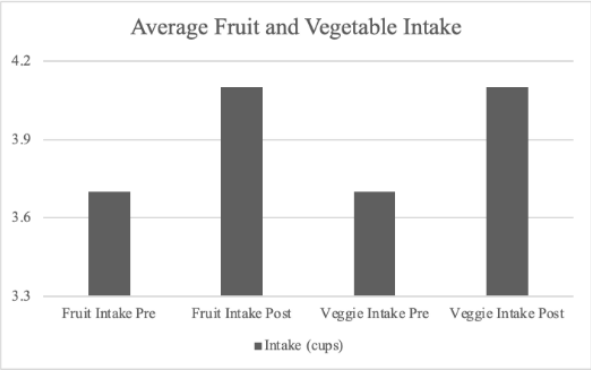

Figure 1. Average Fruit and Vegetable Intake

Table 4. Wilcoxon signed rank test for differences in pre/post variables (n=9)

Variable	Media Pre	Median Post	W-value	P value
Fruit Intake	4	5	9.5	0.43
Vegetable Intake	4	4	0	0.08
Knowledge of F,V, Na, K	2	4	0	0.00
HEI	60.63	50.01	5	0.04

No significant differences were observed in urinary minerals (Table 5).

Table 5. Mineral output values (ug/24hours)

Mineral	Mean (pre)	SD (pre)	Mean (post)	SD (post)
Sodium	85.69	70.93	152.88	120.94
Potassium	71.63	29.96	85.37	21.39

Table 6. Descriptive statistics for questionnaire domains.

Domain	Mean (pre)	Mean (post)	Mean Change
Knowledge	1.33±1.12	3.44±0.88	2.11±1.54
Sodium Attitudes	2.89±0.75	4.08±0.79	1.19±0.74
Potassium Attitudes	1.33±0.91	1.64±1.19	0.31±0.67
F/V Motivation (Internal)	4.43±0.52	4.48±0.48	0.05±0.31
F/V Motivation (External)	2.72±0.57	2.83±0.43	0.11±0.55

Cooking Enjoyment	4.16±0.38	4.29±0.64	0.13±0.49
Barriers	3.53±0.58	3.75±0.63	0.22±0.80
Eating Habit Influences	2.63±0.74	3.02±0.68	0.39±0.51
Motivations for Cooking	4.36±0.50	4.44±0.37	0.08±0.78

Associations of Diet Intake, Knowledge, Motivation, and Cooking

Based on the Spearman correlation tests, there was a strong, negative correlation between barriers to eating fruits and vegetables and motivation to eat more fruits and vegetables (ρ = -0.92, p = 0.03). No additional associations were observed (Table 7).

Table 7. Spearman correlation tests (in terms of change in pre to post data)

Variable 1	Variable 2	ρ	p-value
Knowledge	Na Intake	0.67	0.22
Knowledge	K Intake	0.78	0.12
Cooking Enjoyment	FV Motivation	0.15	0.81
Barriers	FV Motivation	-0.92*	0.03*
HEI	Na Intake	-0.52	0.15
HEI	K Intake	-0.15	0.70
Sodium Attitudes	Na Intake	0.21	0.74
Sodium Attitudes	HEI	0.67	0.22
Potassium Attitudes	K Intake	0.11	0.86
Potassium Attitudes	HEI	0.45	0.45

FV Motivation refers to the motivation to consume fruits and vegetables.
*indicates $p<0.05$ and is considered statistically significant.

Perceptions of Cooking Sessions

Participants described learning how to incorporate different fruits and vegetables into meals. Participants increased home cooking while gaining more creativity when cooking.

The recipes were well received, with participants describing them as “flavorful,” “easy,” and “veggie-forward.” Suggestions included adjusting the portion sizes for those who live alone as well as giving more ideas for vegetable substitutions for future meals.

Participants appreciated the weekly online format, stating that this frequency and style were easy to fit into their schedule. Participants mentioned that in-person cooking classes would be more interactive and valuable; however, the difficulty of coordinating with people’s differing work and life schedules was noted.

When asked about their experience with WhatsApp, many participants expressed their enjoyment of the platform, describing it as “interactive,” “community-building,” and a “source

of valuable information". Participants enjoyed seeing others' photos of completed meals after each workshop and appreciated advice sent from others when questions arose. Some would have liked to see all the recipes being used for the program at once to plan.

Discussion

This study explored the effect of a 6-week online cooking and nutrition education intervention on dietary behaviors in adults with hypertension. Results showed nutrition knowledge and attitudes increased, whereas there was no increase in fruit and vegetable consumption.

Despite no changes in fruit and vegetable consumption, participants indicated consuming at least 4 servings daily at baseline. According to the Dietary Guidelines for Americans 2025, adults are advised to consume at least 2-3 servings of fruits and vegetables, indicating that participants were exceeding this recommendation. However, these self-reported values were higher than those estimated from the HEI scores. This discrepancy suggests baseline overestimation due to social desirability bias. Previous studies have shown that 24-hour dietary recalls are susceptible to social desirability and stigma around eating behaviors (Hebert et al., 1995, Barros et al., 2003). As the recruitment for this study was focused on plant-forward and incorporating more fruits and vegetables into a diet, it may have contributed to self-selection of participants who already were consuming enough fruits and vegetables. Moreover, recalls were conducted in person with the study coordinator rather than on the ASA24 website to reduce participant burden and ensure timely completion (Zarah et al., 2021). While this approach has advantages, participants may have discomfort in disclosing all foods consumed or consumed in limited amounts due to a lack of rapport and trust built. Similar findings have been reported in studies of overweight adults, where conversation analysis revealed under-reporting of socially sensitive foods such as take-out meals, butter, and alcohol (Tapsell et al., 2000). Through their study, they found that building a non-judgmental rapport throughout visits helped alleviate these issues. Once the post-study recalls were recorded in this study, the participants may have been more open and likely to share their dietary choices freely as they had built trust and rapport.

As determined through the post-study interviews, participants indicated that they increased the diversity of fruits and vegetables consumed and prepared them in new ways, despite not increasing the numerical quantities consumed. This may reflect the program's emphasis of "eating with the rainbow," in which recipes incorporated a specific color. Even though no differences were observed with blood pressure or urinary sodium and potassium, this

underscores the importance of future culinary studies to focus on the quality and richness of nutritional compositions over the quantity of the produce consumed.

At the end of the intervention, participants reported fewer barriers to consuming fruits and vegetables and a greater motivation to do so. These results may have been attributed to the facilitation of a welcoming environment and the attempt to build rapport throughout the workshops. The WhatsApp group chat encouraged a community amongst participants that enhanced engagement, accountability, and social support. This is similar to a virtual cooking program for adults with CKD, which included an asynchronous toolkit that enhanced participant engagement, community formation, and learning (Macias-Navarro et al., 2024). Additionally, the study coordinator focused on accessible recipes during the cooking classes to encourage compliance with incorporating fruits and vegetables into meals post-intervention. This was confirmed during post-study interviews when participants commented on the simplicity of the recipes, the ease of obtaining and affording the ingredients, and the comfort of following along with the instructor. The heightened sense of community and recipes completed together with the study coordinator both likely reinforced participants' confidence by making cooking appear achievable. This may have reduced perceived obstacles towards cooking and making improvements in their diets, thus strengthening motivation.

Furthermore, the increase in knowledge and attitude scores post-intervention suggests that participants gained insight and knowledge from the cooking workshops. Similar to this study, Moreau et al. demonstrated the significant association between cooking confidence and dietary habits, and between knowledge of healthy eating and confidence in dietary choices post an 8-week cooking program for older adults. Similarly, researchers investigated the effects of a 24-week active cooking intervention paired with a behavioral weight management intervention on overweight and obese adults using self-management and self-motivation techniques (n=50), resulting in significant weight loss (Alpaugh et al., 2020). For the present study, although the study coordinator provided motivational texts and reminders, and encouraged, alongside a physician, home-cooking with fruits and vegetables, it was ultimately the participant's choice to change and set goals for themselves. This study may have been the first step for individuals to acknowledge that a dietary change could be helpful in their lives, from seeing firsthand how healthy, nourishing meals make their bodies feel. Future studies may benefit from including a

behavioral management component to provide participants with tools rooted in psychology to help them actively change their eating habits.

Conclusion

In conclusion, results from this feasibility study demonstrated that a 6-week online cooking workshop for adults with hypertension was associated with increases in nutrition knowledge, attitudes, confidence, and perceived barriers related to fruit and vegetable consumption, despite no measurable increase in intake. Qualitative findings suggest that this intervention positively influenced dietary quality rather than quantity. These findings support emerging evidence that culinary interventions may exert meaningful health benefits through improvements in the quality of diet, confidence, and motivation, despite an absence of changes in overall intake volume. This study highlighted the importance of community-building strategies and social support for autonomous motivation in dietary interventions. Several limitations provide important context for these findings and inform directions for future research. Participant recruitment and retention proved more complex than anticipated, requiring an extended recruitment period and the inclusion of additional providers due to limited initial interest. Compliance was also variable, as only 33% of participants consistently attended live sessions despite 89% reporting that the workshop timing fit their schedules. These challenges underscore the need for more flexible program structures, such as rolling admissions, multiple start dates, or a hybrid delivery model that combines live and pre-recorded sessions. Implementing a cyclical workshop format or continuous session delivery may improve accessibility, consistency, and engagement while preserving the community-oriented aspects of the intervention.

Future interventions should continue to explore behavioral support components to enhance adherence and long-term impact. While this study was limited by a small sample size, the statistical findings should be considered exploratory. Despite recruitment challenges, and variability in participation, it achieved its primary feasibility objectives and provides valuable insights for refining future culinary-based interventions. Online cooking workshop programs are a feasible and promising approach for improving nutrition and psychosocial outcomes among adults with hypertension, ultimately serving as a foundation for behavior changes that improve cardiometabolic health.

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