ORIGINAL ARTICLE

Applying the transtheoretical model of health behavior change: using calendars for hypertension management in elderly individuals during the COVID-19 pandemic in Phrae Province, Thailand

Apichet Jumneansuk[1], Phitchasuda Dechboon[1], Rattanaporn Arsa[1], Anongnat Pansathin[1], Tanatas Pudpong[2]

[1]Public Health Department, Faculty of Public Health, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani, Thailand
[2]Environmental Health Department, Faculty of Public Health, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathum Thani, Thailand

Corresponding Author: Rattanaporn Arsa **Email:** Rattanaporn.ar@vru.ac.th

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ABSTRACT

Hypertension is a persistent global public health concern, particularly affecting elderly individuals and is further compounded by the challenges posed by the COVID-19 pandemic. Innovative interventions are essential to effectively manage blood pressure in this vulnerable demographic group. This quasi-experimental study implemented a calendar-based intervention among 84 elderly individuals in Phrae Province, Thailand. The intervention integrated dietary recommendations, physical activity guidelines, and hypertension education. Over eight weeks, the intervention group exhibited a significant reduction in systolic blood pressure (6.59 mmHg) and diastolic blood pressure (2.52 mmHg) levels (p-value<0.05), contrasting with the comparison group's increase. The calendar-based program effectively enhanced hypertension knowledge, empowering participants to make informed health decisions. The study's holistic approach, grounded in health behavior change models, effectively promoted hypertension awareness and facilitated healthier lifestyles. Results suggest the calendar-based program's suitability for elderly individuals at high risk of hypertension, especially during the COVID-19 pandemic, due to its cost-effectiveness and accessibility. This research underscores the potential of calendar-based interventions in supporting blood pressure management among elderly populations, with broader implications for public health strategies, especially during challenging circumstances such as pandemics.

Key words:
hypertension management; elderly; calendar-based intervention; dietary recommendations

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INTRODUCTION

Hypertension presents an ongoing and significant global public health challenge due to its chronic nature and the absence of a definitive cure. Inadequate management of blood pressure levels can lead to severe complications, posing a threat to vital organs. The prevalence of hypertension in Thailand has shown a consistent upward trajectory, as indicated by epidemiological data. For instance, a report by the Health Data Center reveals that hypertension incidence among individuals aged 15 and older increased from 16.4% in 2016 to 18.0% in 2019.[1] Furthermore, the Thailand National Health Examination Survey from 2019 to 2020 demonstrates a rise in hypertension prevalence among those aged 15 and above, reaching 16.5% in 2018 compared to 15.3% in 2015.[2] These trends underscore the persistent and pressing nature of hypertension as a critical health concern, necessitating comprehensive attention from governmental entities and healthcare providers.

Effective prevention and management strategies for hypertension must be at the forefront of public health initiatives. These strategies should focus on a range of factors that influence blood pressure, including age, lifestyle habits, diet, physical activity, genetics, stress levels, and medication usage.[3] Neglecting this imperative could significantly disrupt patient quality of life, family routines, and the broader healthcare infrastructure.

Phrae Province, nestled in Northern Thailand, presents a distinctive hypertension landscape. Ministry of Public Health data highlights Phrae as ranking second in the northern region for the highest incidence of hypertension among previously identified high-risk individuals in 2017 (4.27%) and 2018 (5.39%).[4] From 2019 to 2021, surveillance data for chronic non-communicable diseases in Phrae Province reveals hypertension incidences of 2,238.13, 1,583.18, and 1,832.68 per 100,000 population, respectively.[5] Responding to this challenge, public health institutions in Phrae have initiated comprehensive projects and activities to enhance susceptible groups' well-being and manage blood pressure effectively.[6,7] However, the rapid global spread of the COVID-19 pandemic, which began in 2019, has had far-reaching effects in Phrae Province and beyond. Its consequences have extended beyond daily routine modifications, affecting social activities and impacting public health services. The crucial guideline of avoiding social gatherings to curb COVID-19 transmission has significantly disrupted healthcare services in the Phrae region, further affecting patients and individuals at risk of hypertension.

Amid the persistent backdrop of the COVID-19 pandemic, this research seeks to amplify visual care tailored to high blood pressure risk groups, with a particular emphasis on the elderly demographic. The rationale for focusing on this high-risk group stems from the observation that hypertension patients presently receive blood pressure management medications through the assistance of health volunteers, while those at elevated risk of hypertension are currently devoid of comprehensive health promotion and preventive interventions typically delivered by healthcare facility personnel.

Furthermore, the focus on the elderly population, particularly those at high risk for hypertension, is underscored by their unique susceptibility to adverse outcomes during the pandemic. The convergence of age-related vulnerabilities, coexisting health conditions, diminished mobility, social isolation, medication management challenges, and restricted access to preventive services collectively renders elderly individuals with a high risk of hypertension notably vulnerable in the context of COVID-19. Consequently, directing attention toward their prevention

and care becomes an imperative step in mitigating the potential health ramifications of the virus.[8,9]

Nevertheless, the stringent practice of social distancing, necessitated by the ongoing COVID-19 situation, precludes conventional group activities and in-person interventions aimed at blood pressure management among study participants. Faced with this predicament, the research team embarked on an exploratory endeavor to identify an alternative strategy that harmonizes with the daily routines of elderly individuals. This quest led to the identification of calendars as a pragmatic and pertinent solution. Ultimately, the decision was made to revert to a fundamental intervention approach, wherein a calendar-based intervention would be implemented and evaluated. This intervention specifically targets the prevention of high blood pressure among elderly individuals who possess a predisposition to hypertension. In conjunction with this calendar-based strategy, the application of the transtheoretical model of health behavior change[10] is proposed. The theory is chosen for its capacity to engender motivation and behavior change, aligning with the objectives of blood pressure control as facilitated through the calendar intervention.

Although there is a limited body of direct research pertaining to the use of calendars for blood pressure control, it is worth noting that health organizations, including hospitals and health promotion facilities in Thailand, have successfully applied calendar-based programs to promote behavior change among elderly populations.[11,12] Building on this premise, we anticipate that the implementation of a calendar program will similarly yield favorable results in the context of blood pressure management among the elderly.

METHODS

Research Design

This study used a quasi-experimental design and aimed to assess the impact of implementing a calendar package for blood pressure management among elderly individuals predisposed to hypertension during the COVID-19 pandemic.

Population and Sample Size

The study was conducted with a participant pool consisting of elderly individuals aged 60 years or above who were identified as having a predisposition to hypertension and actively seeking healthcare services within Phrae Province. The sample size was determined using the G-power program, with an effect size 0.12, a confidence level of 95% (Type I error = 0.05) and a test power of 80% (1- β) to ensure statistical robustness. Subsequently, a total of 84 individuals aged 60 years or above, meeting the predisposition to hypertension criteria, were thoughtfully selected from the pool of individuals receiving healthcare services at Chohae Health Promoting Hospital in Phrae Province, taking into consideration the unique circumstances posed by the COVID-19 outbreak.

The selection of Chohae Health Promoting Hospital in Phrae Province as the study setting was a deliberate choice made due to several pertinent factors. Firstly, this healthcare facility is strategically located to serve the elderly population in the region, making it a relevant choice for our study. Moreover, the decision was influenced by the unique circumstances created by the COVID-19 pandemic. The hospital had already implemented stringent safety measures to protect its patients, ensuring a secure environment for our research. Therefore, the choice of this setting was based on its

suitability, accessibility, and the safety it provided to our participants, which were crucial considerations during the ongoing pandemic.

The participants were selected based on specific criteria, which included systolic blood pressure readings ranging from 130 to 139 mmHg and diastolic blood pressure readings ranging from 80 to 89 mmHg, observed on two separate occasions within a two-month timeframe. This deliberate selection aimed to identify individuals with a predisposition to hypertension. The choice of these blood pressure ranges adheres to widely recognized blood pressure guidelines. It is essential to emphasize that the focus of this study is on individuals at an elevated risk of developing hypertension. The selected blood pressure ranges fall within the prehypertensive category, signifying an increased likelihood of progressing to hypertension. Participants also had to reside in the Chohae sub-district for at least six months and had no reported issues with vision, hearing, physical mobility, or literacy. While, participants who have received the COVID-19 vaccine, and who takes medication for blood vessel dilation were excluded from this study. Once participants who met these criteria were identified, a computer-based random sampling method was employed to assign them to either the intervention group or the control group.

Procedure

Participant Allocation and Intervention: From a total of 84 participants, 42 were assigned to the intervention group. Over the course of eight weeks, this group received a calendar package in addition to regular healthcare services from the health promotion hospital. Simultaneously, the remaining 42 participants were designated as the comparison group. Like the intervention group, they received regular healthcare from the health promotion hospital for the same eight-week duration.

1. Calendar package

A customized calendar package, designed in accordance with the Transtheoretical Model of Health Behavior Change,[10] was developed to enhance awareness and facilitate the effective management of high blood pressure. The calendar package was thoughtfully crafted to provide participants with targeted educational materials, visual aids for tracking blood pressure readings, evidence-based dietary guidelines, and personalized exercise recommendations. Here's an overview of the calendar package:

1.1 Dietary Recommendation: The intervention strategy elucidated in this study encompasses a diligently curated daily menu plan meticulously formatted to ensure its accessibility and usability for participants. This dietary regimen has been meticulously tailored to decisively target issues germane to sodium and processed food consumption—pivotal contributors to elevated blood pressure levels. Moreover, a distinct facet of this intervention is the pronounced emphasis on integrating indigenous dietary elements. This notably encompasses incorporating locally sourced food menus, endemic Thai fruits, and native vegetables, all of which remain exceptionally attainable even within the constraints imposed by the prevailing COVID-19 circumstances.

The dietary information is presented in both textual and visual formats within designated date boxes on the calendar. The layout follows a systematic checklist pattern, providing clear instructions for all three daily meals. Participants can actively engage with this information by marking the relevant boxes on the daily checklist. Furthermore, each calendar page is structured to cover a full week, ensuring a comprehensive approach to dietary guidance.

1.2 Physical Activity Guidelines: Throughout the eight-week duration, each

weekly page is accompanied by a set of guidelines for stick exercises. Each page features a single-stick exercise pose specifically tailored for the elderly, ensuring appropriateness and safety. The eight stick exercise poses are set out below:

1.2.1 Stick-Seated Pedal
1.2.2 Stick Arm Elevation
1.2.3 Stick Deltoid Extension
1.2.4 Stick Calf Raises
1.2.5 Stick Leg Oscillation
1.2.6 Stick Lateral Leg Ascension
1.2.7 Stick Forward Bend
1.2.8 Stick Torso Twist

1.3 Hypertension knowledge: Comprehending hypertension is crucial for elderly individuals at risk. For those predisposed to hypertension, it is imperative that they assimilate essential elements, including its definition, associated risk factors, potential complications, blood pressure thresholds, and the technique for performing manual blood pressure measurements. The comprehensive content encompassing these critical facets is meticulously incorporated into each calendar page, presented through a combination of textual explanations and succinct infographics.

Before implementation, the research team met the intervention group at Chohae Health Promotion Hospital. They explained how to use the calendar, demonstrated stick exercises, and scheduled exercise dates. Furthermore, the research team provided participants with regular healthcare practice during COVID-19. It is noteworthy that this meeting was conducted in strict adherence to COVID-19 protocols, entailing mask usage, hand sanitation with alcohol, and the practice of social distancing.

2. Regular healthcare under the COVID-19 scenario for the elderly prone to hypertension.

In the context of the COVID-19 scenario, standard healthcare for elderly individuals susceptible to hypertension entails furnishing them with fundamental information about hypertension, along with guidance on modifying health behaviors encompassing dietary choices and physical activity. The research team offered all participants with consistent healthcare practices.

Data Collection

This study spanned eight weeks, comprising two distinct phases of data collection: baseline and at the conclusion of the eight-week intervention period. All data collection points were administered at Chohae Health Promoting Hospital, with strict adherence to the prescribed guidelines for preventing the spread of COVID-19.

Research Instruments

The research employed a set of data collection instruments, each requiring approximately 30 minutes per interview session. The following sections outline the instruments utilized within this study:

Part 1. Elderly Characteristics: Participants were required to answer interview questions consisting of 11 items, covering demographic information such as gender, age, weight, height, marital status, educational attainment, income, alcohol consumption, smoking habits, having a medical benefits scheme, and underlying diseases.

Part 2. Hypertension Knowledge: The interview methodology drew upon previous research assessing patients' health knowledge with diabetes and hypertension[13]. The assessment included a set of 20 items, categorized into three distinct sections: foundational understanding of hypertension, behaviors associated with hypertension risk, and practices aimed at preventing hypertension.

A scoring mechanism ranging from 0 to 20 points was employed. Scores between 0 and 14 indicated that individuals had a "knowledgeable" grasp of the fundamental aspects of hypertension, while scores exceeding 15 denoted individuals with a heightened level of cognitive acuity or "enlightenment."

Part 3. Hypertension Prevention Recordkeeping: Participants were instructed to document their preventative behaviors relating to dietary intake and physical activity. All participants recorded their food consumption and physical activity on the calendar provided.

Part 4. Blood Pressure Measurement: Blood pressure readings were obtained from participants using an automated monitor at two specific time points – the baseline and the conclusion of the eight-week intervention period. These measurements were conducted in accordance with established guidelines and by trained healthcare personnel at the study site, Chohae Health Promoting Hospital in Phrae Province, Thailand.

Statistical Analysis

After collecting the interview responses, the data underwent a rigorous analysis using both descriptive and analytical statistics to derive meaningful insights.

1. Descriptive Statistics

The collected interview responses underwent comprehensive analysis, incorporating descriptive statistics (frequencies, percentages, means, and standard deviations) for participant demographics.

2. Analytical Statistics

Analytical statistics, including the Chi-square test, paired sample t-test, and independent t-test, were applied to evaluate the impact of the calendar-based intervention on preventing high blood pressure among elderly individuals predisposed to hypertension during the COVID-19 pandemic in Phrae Province, Thailand, with a significance level of 0.05.

Ethical Consideration

This study was approved by Phrae Province Public Health Office. Project number: PPH.018/2564. Date of approval: December 20, 2021.

RESULTS

Elderly Characteristics

In the intervention group, 66.7% were females, with an average 63.19 years of age, approximately 51.12 kilograms in weight, and roughly 159.07 centimeters in height. Most were married (88.1%), with an average monthly income of THB 5,316.67, primarily from farming, pensions, and state welfare funds. The majority (83.3%) were under the universal coverage scheme for medical benefits. Regarding behaviors, 40.5% reported alcohol consumption, while 16.7% were smokers. Additionally, 78.6% had underlying medical conditions, with diabetes being the most common, followed by high cholesterol.

In the comparison group, 52.4% were females, with an average 63.10 years of age, about 49.64 kilograms in weight, and approximately 157.71 centimeters in height. A significant portion (83.3%) were married, with an average monthly income of THB 5,478.57, mainly from agriculture, pensions, and state welfare. The universal coverage scheme was predominant (81.0%) for medical benefits. In terms of behavior, 31.0% reported alcohol consumption, while 23.8% were smokers. Additionally, 76.2% had preexisting medical conditions, with diabetes and high cholesterol being the most prevalent.

Baseline analysis found no statistically significant differences between the two groups ($p > 0.05$).

Table 1. Elderly characteristics (n = 84)

Factors	Intervention group (n = 42)	Comparison group (n = 42)	p-value
Gender			0.182
- Female	28 (66.7%)	22 (52.4%)	
- Male	14 (33.3%)	20 (47.6%)	
Age (years)			0.953
Mean± SD	63.19±2.03	63.10±2.05	
Min, Max	61, 68	60, 68	
Weight (kilograms)			0.902
Mean±SD	51.12±9.45	49.64±9.58	
Min, Max	38, 69	37, 70	
Height (centimeters)			0.689
Mean±SD	159.07±4.25	157.71±4.28	
Min, Max	150, 169	150, 168	
Marital status			0.533
- Married	37 (88.1%)	35 (83.3%)	
- Single	5 (11.9%)	7 (16.7%)	
Educational attainment			0.611
- Beyond the junior high school level	22 (52.4%)	24 (57.1%)	
- Equivalent to or below the junior high school level	20 (47.6%)	18 (42.9%)	
Income (THB per month)			0.811
Mean±SD	5316.67±6903.65	5478.57±6753.26	
Min, Max	600, 30000	600, 23000	
Medical benefit scheme			0.776
- Universal Coverage Scheme	35 (83.3%)	34 (81.0%)	
- Government	7 (16.7%)	8 (19.0%)	
Alcohol consumption			0.362
- No	25 (59.5%)	29 (69.0%)	
- Yes	17 (40.5%)	13 (31.0%)	
Smoking habits			0.415
- No	35 (83.3%)	32 (76.2%)	
- Yes	7 (16.7%)	10 (23.8%)	
Underlying disease			0.874
- Presence of an underlying disease	33 (78.6%)	32 (76.2%)	
- Absence of any underlying disease	9 (21.4%)	10 (23.8%)	

** p-value <0.05*

Hypertension Knowledge

At the study's onset, both the intervention and comparison groups exhibited a knowledgeable level of hypertension, with mean scores of 6.83. After the eight-week intervention, the intervention group's mean score significantly increased to 11.38 ($p < 0.05$), while the comparison group showed a modest increase to 7.45.

Comparison of hypertension knowledge mean scores between the two

groups at baseline indicated similar values (intervention group mean = 6.83, S.D = 1.24; comparison group mean = 6.90, S.D = 1.03). However, following the eight-week intervention, a statistically significant difference in mean scores emerged between the groups ($p < 0.05$) (Table 2).

Table 2 Hypertension knowledge (n = 84)

Hypertension knowledge	Intervention group (n = 42)	Comparison group (n = 42)	p-value
Baseline			
- Knowledgeable (scores from 0–14)	42 (100.0%)	42 (100.0%)	
- Enlightenment (scores of 15 or above)	0 (0.0%)	0 (0.0%)	
Mean±S.D	6.83±1.24	6.90±1.03	0.776
Min, Max	5, 10	5, 10	
Conclusion of the eight-week intervention period			
- Knowledgeable (0–14 scores)	36 (85.8%)	42 (100.0%)	
- Enlightenment (scores of 15 or above)	6 (14.2%)	0 (0.0%)	
Mean±S.D	11.38±2.33	7.45±1.02	<0.001*
Min, Max	7, 16	6, 10	
p-value	<0.001*	0.052	

** p-value <0.05*

Hypertension Prevention Recordkeeping

In Table 3, we present a comprehensive overview of the primary local Thai food group consumption by participants of both the intervention and comparison groups at two key time points: the study's outset and its conclusion after eight weeks. These food groups encompass grains and cereals, protein sources, vegetables, fruits, herbs and spices, local specialties, flavorings, and snacks/desserts.

At the commencement of the study, participants in both groups showcased similar dietary preferences within each food group. Notably, in the "Grains and cereals" category, common staples included sticky rice, rice, and rice noodles, which were widely consumed by individuals in both groups. Similarly, within the "Protein" category, the dietary staples were consistent across both groups, featuring pork, chicken, and fish.

Upon the study's culmination, it becomes evident that there was a high degree of stability in food choices within the grains, cereals, and local specialties categories, influenced by the strong adherence to traditional dietary practices in Thai culture. However, significant variations emerged in the selection of flavorings, protein sources, and fruit consumption, notably within both the intervention and comparison groups:

Protein Sources: Our findings indicate distinct changes in protein preferences between the intervention and comparison groups. The intervention group notably shifted towards lean, low-sodium protein sources, with a particular emphasis on chicken and fish. Chicken, being a lean protein, offers advantages in terms of lower saturated fat content when compared to pork. This choice aligns with the heart-healthy benefits of fish, known for its richness in omega-3 fatty acids, which have a positive impact on blood pressure. Meanwhile, the comparison group exhibited no significant deviations from their baseline protein choices, maintaining a diverse selection of protein sources.

Fruits: Significant alterations were observed in fruit consumption patterns. The intervention group exhibited an increased consumption of fruits, with a notable focus

on those recognized for their potential to lower blood pressure. This shift led to the prominent inclusion of fruits such as papaya, watermelon, and mango in their dietary choices. In contrast, the comparison group adhered to their baseline fruit consumption patterns, which encompassed a wide array of fruits without specific emphasis on those known for their blood pressure-reducing properties.

Flavorings: The intervention group underwent a significant transition in their choice of flavorings. They adopted a dietary calendar that underscored lower sodium and lipid content, which was particularly evident in their choice of flavorings. The intervention group displayed a reduced reliance on high-sodium options like fish sauce and soy sauce.

Table 3. Summary of the essential local Thai food group consumption (n = 84)

Food group consumption	Intervention group (n = 42)		Comparison group (n = 42)	
	Baseline	Eight weeks	Baseline	Eight weeks
Grains and cereals	1. Sticky rice 2. Rice 3. Rice noodles	1. Sticky rice 2. Rice 3. Rice noodles	1. Sticky rice 2. Rice 3. Rice noodles	1. Sticky rice 2. Rice 3. Rice noodles
Protein	1. Pork 2. Chicken 3. Fish	1. Chicken 2. Fish 3. Pork	1. Pork 2. Chicken 3. Fish	1. Pork 2. Chicken 3. Fish
Vegetables	1. Morning glory 2. Bok choy 3. Cucumber	1. Bok choy 2. Morning glory 3. Eggplant	1. Cucumber 2. Bok choy 3. Pumpkin	1. Cilantro 2. Cucumber 3. Bok choy
Fruits	1. Mango 2. Banana 3. Apple	1. Papaya 2. Watermelon 3. Mango	1. Banana 2. Mango 3. Orange	1. Mango 2. Banana 3. Orange
Herbs and spices	1. Garlic 2. Chili 3. Shallots	1. Garlic 2. Thai basil 3. Ginger	1. Garlic 2. Shallots 3. Chili	1. Garlic 2. Shallots 3. Lemongrass
Local specialties	1. Larb 2. Kaeng hang le 3. Khanom jeen Nam ngiao	1. Larb 2. Kaeng hang le 3. Khanom jeen Nam ngiao	1. Larb 2. Khanom jeen Nam ngiao 3. Kaeng hang le	1. Larb 2. Kaeng hang le 3. Nam prik num
Flavoring	1. Fish sauce 2. Soy sauce 3. Shrimp paste	1. Salt 2. Curry paste 3. Fish sauce	1. Fish sauce 2. Soy sauce 3. Oyster sauce	1. Fish sauce 2. Soy sauce 3. Shrimp paste
Snack and dessert	1. Mango with sticky rice 2. Kluay buat chi 3. Bua loi	1. Kluay buat chi 2. Bua loi 3. Khanom krok	1. Khanom Krok 2. Kluay buat chi 3. Tub tim grob	1. Khanom krok 2. Kluay buat chi 3. Bua loi

Blood Pressure Level

A paired t-test revealed a significant reduction in systolic blood pressure within the intervention group from baseline to eight weeks (baseline mean = 136.42, S.D = 1.53; eight-week mean = 129.83, S.D = 1.55). However, there were no statistically significant changes in systolic blood pressure levels within the comparison group over the same period (baseline mean = 136.92, S.D = 1.86; eight-week mean = 137.45, S.D = 1.19) (see Table 4).

Additionally, independent t-tests comparing systolic blood pressure levels between the intervention and comparison groups indicated no significant differences at baseline (intervention group mean = 136.42, S.D = 1.53; comparison group mean = 136.92, S.D). However, after eight weeks, statistically significant disparities emerged between the two groups (intervention group mean = 129.83, S.D = 1.55; comparison group mean = 137.45, S.D = 1.19) (see Table 4).

Table 4. Comparison of systolic blood pressure levels (SBP) (n = 84)

Systolic blood pressure (mm/Hg)	Intervention group (n = 42)	Comparison group (n = 42)	p-value
Baseline			
Mean ±S.D	136.42±1.53	136.92±1.86	0.183[b]
Min, Max	132, 139	132, 139	
Eight weeks			
Mean ±S.D	129.83±1.55	137.45±1.19	<0.001[b]
Min, Max	124, 138	135, 139	
p-value	<0.001[a]	0.153 [a]	

[a] *A paired t-test conducted at the significant level of 0.05*
[b] *Independent t-test conducted at the significant level of 0.05*

Using paired t-tests to assess diastolic blood pressure levels in participants, we found a significant reduction in diastolic blood pressure within the intervention group from baseline to eight weeks (baseline mean = 86.14, S.D = 1.55; eight-week mean = 83.62, S.D = 1.97). Conversely, the comparison group exhibited a significant increase in diastolic blood pressure over the same period (baseline mean = 86.26, S.D = 1.53; eight-week mean = 87.17, S.D = 1.57) (see Table 5).

Furthermore, independent t-tests comparing diastolic blood pressure levels between the intervention and comparison groups revealed no significant differences at baseline (intervention group mean = 86.14, S.D = 1.55; comparison group mean = 86.26, S.D = 1.53). However, after eight weeks, statistically significant disparities emerged between the two groups (intervention group mean = 83.62, S.D = 1.97; comparison group mean = 87.17, S.D = 1.57) (Table 5).

Table 5 Comparison of diastolic blood pressure levels (n = 84)

Diastolic blood pressure (mm/Hg)	Intervention group (n =42)	Comparison group (n =42)	p-value
Baseline			
Mean ±S.D	86.14±1.55	86.26±1.53	0.725 [b]
Min, Max	84, 89	84, 89	
Eight weeks			
Mean±S.D	83.62±1.97	87.17±1.57	<0.001 [b]
Min, Max	81, 89	84, 89	
p-value	<0.001[a]	0.011 [a]	

[a] *A paired t-test conducted at the significant level of 0.05*
[b] *Independent t-test conducted at the significant level of 0.05*

DISCUSSION

Hypertension remains a global public health challenge due to its well-established association with severe health complications. Managing blood pressure levels effectively is considered paramount, particularly among elderly individuals who may be predisposed to hypertension. Innovative interventions are deemed essential, especially in the context of the COVID-19 pandemic. In this discussion, we cautiously examine the significance of the observed changes in systolic and diastolic blood pressure levels within both the intervention and comparison groups.

Effectiveness of the Calendar-Based Intervention:

In this study, a calendar-based intervention was implemented, tailored specifically for elderly individuals at risk of hypertension. The results reveal what appears to be a noteworthy reduction in systolic blood pressure levels within the intervention group over the span of eight weeks, amounting to a substantial decrease of approximately 6.59 mmHg. Concurrently, diastolic blood pressure levels exhibited a commendable decrease of approximately 2.52 mmHg within the intervention group, in stark contrast to the increase observed in the comparison group.

It is noteworthy that prior research endeavors focusing on dietary programs,[14, 15, 16] physical activity interventions,[17, 18] and hypertension education interventions[19,20] have consistently demonstrated significant improvements in blood pressure management. Thus, this study meticulously analyzed the primary determinants contributing to elevated blood pressure within the region. These findings were thoughtfully integrated with the outcomes of prior investigations, forming a cohesive foundation for our research endeavor.

The calendar-based intervention, which included dietary recommendations, physical activity guidelines, and hypertension knowledge dissemination, appears to have played a substantial role in positively impacting blood pressure management among elderly individuals at risk of hypertension. The calendar, functioning as a practical and integrated tool, effectively incorporated dietary recommendations, exercise routines, and hypertension knowledge into the daily lives of our elderly participants.

Researchers applied the Transtheoretical Model of health behavior change[10] during the implementation of the calendar program. In its initial phases, fundamental components related to hypertension knowledge were thoughtfully incorporated into the calendar. This holistic approach appears to have considerable

potential in augmenting hypertension awareness within the intervention group, motivating participants to engage actively with information on hypertension and make well-informed decisions regarding their health.

The substantial improvement in hypertension knowledge within the intervention group strongly suggests the potential effectiveness of the calendar-based intervention in motivating behavioral change. This educational approach seamlessly integrated crucial information about hypertension, which appears to have contributed to notable changes in the participants' behavior. The well-established concept emphasizing the role of enhancing awareness and knowledge in facilitating behavior change is evident in our study, as the intervention successfully empowered participants to comprehend the significance of hypertension, its associated health risks, and strategies for effective management. This enhanced understanding likely acted as a compelling motivator, encouraging participants to make well-informed decisions regarding their dietary choices, levels of physical activity, and overall health. Furthermore, the calendar's holistic approach, firmly grounded in the Transtheoretical Model, appeared to provide a structured pathway from knowledge acquisition to the implementation of actionable steps. As participants progressed through the calendar, they not only gained awareness but also acquired the practical tools and insights necessary to effectively embrace healthier behaviors. Our findings seem to align with previous studies by Ozoemena EL et al. (2019)[21]and Prestigiacomo C et al. (2020),[22] which also underscored the significance of knowledge enhancement in motivating behavioral change among individuals dealing with hypertension.

In summary, the substantial increase in hypertension knowledge within the intervention group acted as a powerful catalyst, effectively bridging the gap between awareness and actual behavior change. This enriched knowledge base likely played a pivotal role in motivating participants to embrace healthier lifestyle choices, ultimately contributing to the positive outcomes observed in this study.

Moving forward, the subsequent pages of the calendar incorporated a diet menu, supporting participants in their journey toward behavioral change as they progressed through the Transtheoretical Model's stages of action. A diet emphasizing low sodium intake plays a pivotal role in blood pressure management. Excess sodium in the diet can lead to fluid retention and increased blood volume, exerting undue strain on the heart and blood vessels, a particularly relevant consideration for elderly individuals who may be more sensitive to the effects of sodium.[23] After engaging with the calendar-based program, the intervention group demonstrated increased consumption of fruits and vegetables, with particular emphasis on those rich in potassium and antioxidants like vitamins A and C. These minerals facilitate the relaxation of blood vessel walls, thereby reducing blood pressure and counteracting the effects of sodium. Specifically, increased potassium intake has been associated with lower blood pressure levels, making it an indispensable dietary component for elderly individuals.[23] Furthermore, physical activity, especially aerobic exercise, has been shown to enhance the functioning of blood vessels. It stimulates the release of nitric oxide, a molecule that induces vasodilation, reducing resistance to blood flow and lowering blood pressure.

In summary, the calendar-based program exhibits the potential to be a highly suitable intervention for elderly individuals at high risk of hypertension, especially amidst the challenging backdrop of the COVID-19 pandemic. Its effectiveness is rooted in its ability to provide a visual and tangible reminder, establish healthy routines, promote self-

care, disseminate essential hypertension knowledge, and remain both cost-effective and accessible. The combined influence of these factors is likely to contribute significantly to its success in supporting blood pressure management and overall well-being within this vulnerable demographic group, especially when traditional healthcare services may be limited or less accessible due to the challenges posed by the pandemic.

Practical Implications

The implications of our study extend beyond mere reductions in blood pressure. The calendar-based intervention has demonstrated its potential as an accessible and cost-effective strategy for public health institutions, especially in regions grappling with challenges such as the COVID-19 pandemic. The calendar, functioning as a visual and tangible tool, particularly resonates with elderly individuals who may encounter barriers when attempting to access traditional healthcare services. It empowers them to actively manage their health, which assumes exceptional significance during a pandemic where healthcare resources are strained.

RECOMMENDATION

Nonetheless, it is essential to acknowledge the limitations inherent in this study. The relatively small sample size and the short duration of the eight-week intervention may not entirely capture the long-term effects of the calendar-based approach. Furthermore, the study's geographical specificity necessitates caution in generalizing the results to other populations. Future research endeavors, encompassing larger and more diverse samples and extended follow-up periods, are warranted to validate and expand upon these promising results.

CONCLUSION

In conclusion, the significant reductions in systolic and diastolic blood pressure levels observed within the intervention group underscore the potential of calendar-based interventions in hypertension management. These findings highlight the importance of innovative and accessible approaches, particularly during extraordinary circumstances such as the COVID-19 pandemic. Further research with larger sample sizes and longer intervention periods is warranted to confirm and expand upon these encouraging results. Nonetheless, this study provides a promising avenue for public health initiatives seeking to enhance hypertension management and reduce cardiovascular risks among elderly populations.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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