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Lifestyle modifications among older adults with prehypertension in primary care

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ABSTRACT

In both global and Thai contexts, unhealthy behaviors such as alcohol consumption, smoking, excessive salt intake, and sedentary lifestyles contribute to hypertension. World Health Organization (WHO) recommends lifestyle adjustments for blood pressure control. This quasi-experimental study examined the impact of an intervention on elderly individuals with prehypertension. People living in two villages were selected, matching two others demographically and geographically. The participants were allocated into two distinct groups: the intervention group and the control group, comprising 33 participants in each group. The intervention focused on a balanced diet, physical activity, stress management, and reduced tobacco/alcohol use with a low-sodium diet. The study was conducted over a period of 12 weeks. Blood pressure and heart rate were measured three times after a 10-minute rest using a calibrated sphygmomanometer. The study showed significant improvements with $p<0.001$. Systolic blood pressure decreased by 5.94 mmHg, diastolic blood pressure decreased by 3.37 mmHg, and heart rate decreased by 4.12 bpm. The findings emphasize the importance of comprehensive lifestyle modifications to manage prehypertension and reduce hypertension-related complications in older people. Further research and interventions are needed to address people with hypertension globally, including in Thailand.

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1. INTRODUCTION

High blood pressure, also called hypertension, is a serious global public health problem, even in Thailand [1]. It is characterized by high diastolic and systolic blood pressure readings of 80 to 89 mmHg and 130 to 139 mmHg, respectively [2]. High salt intake, smoking, excessive alcohol consumption, and sedentary lifestyles are unhealthy habits that contribute to the development of high blood pressure. Studies have revealed a concerning rise in the prevalence of hypertension globally, mainly brought on by dietary pattern alterations [3]. Among people aged 25 and older, the frequency of high blood pressure has increased by 40% since 2008. Additionally, from 1990 to 2019, the number of people with hypertension aged 30-79 more than quadrupled, totaling an estimated 626 million women and 652 million men worldwide [4]. Africa, where 46% of the population is affected, has the highest prevalence of hypertension [5]. In Europe, nations having epidemic prevalence rates of 37%, 32%, and 32% are Croatia, Latvia, and Hungary. Conversely, countries with rates between 12% and 16% include Ireland, Luxembourg, Romania, and the Netherlands [6]. In the

United States, hypertension impacted about 35% of the population, with men being more likely than women to have it [1]. In Asia, 38.1% of the population lives with high blood pressure, making China the country with the highest prevalence [7]. Japan comes in the second with a prevalence rate of 21.1% [8]. While in India, the prevalence was 18.10% for men and 11.40% for women [9]. According to Thailand, the prevalence rate is 25.40%, with men having a slightly greater prevalence than women (25.60% vs 23.9%) [10]. It was important to note that high blood pressure was linked to higher morbidity and mortality rates [3]. Beyond its immediate effects, hypertension has long-term consequences because it greatly raises the risk of developing several illnesses, such as dementia, diabetes mellitus, atrial fibrillation, chronic kidney disease, peripheral artery disease, valvular heart disease, hypertensive heart disease, and cerebrovascular disease [11]. It has been well established in Europe and the United States that high blood pressure increases the chance of developing ischemic heart disease and stroke. According to numerous studies, the risk of developing ischemic heart disease and stroke, which result in early mortality, doubles for every 20 mmHg increase in systolic blood pressure and ten mmHg increase in diastolic blood pressure [12]. According to projections, 7.5 million fatalities worldwide were attributed to high blood pressure in 2018, or around 12.80% of all deaths reported internationally [13]. The critical need for efficient preventive, detection, and management techniques is brought home by these worrying data.

The World Health Organization (WHO) promotes lifestyle changes as a crucial component of treatment for this health problem [14]. These interventions cover various topics, including maintaining a balanced and healthy diet, regular exercise, controlling stress, and abstaining from excessive alcohol and tobacco use [15]. It is well known that these lifestyle changes help regulate and lower blood pressure. However, it was important to note that there were few study findings, particularly addressing the impacts of lifestyle changes on senior citizens in Thai primary care settings. Although the general effectiveness of lifestyle changes has been proven, nothing is known about how they would affect Thailand's older population. Investigating the effects of lifestyle changes on this demographic was essential, given older people's unique traits and healthcare requirements.

2. METHOD

2.1. Study design

This quasi-experimental study aimed to examine the impact of lifestyle modifications on the blood pressure of prehypertensive elderly adults. The experimental and control groups are the two groups in the study, which uses a pre-test and post-test design. The study was conducted for 12 weeks between March and May 2023.

2.2. Research subjects

The approach employed in our analysis entailed the comparison of means [16], which was corroborated by statistical data obtained from prior investigations [17]. The experimental group's blood pressure and standard deviation were 115.69±11.33, while those of the control group were 127.88±16.62. Alpha was 0.05, while beta was 0.1. As a result, an initial sample size of 29 individuals was established for each group; this was subsequently increased by 5%, resulting in an adjusted sample size of 33 individuals per group. A balanced design was implemented in order to mitigate potential confusing influences stemming from geographic and demographic characteristics. This was achieved through a meticulous selection process, wherein two villages were deliberately chosen to closely resemble two other villages within the Phuphaman area. The experimental and control groups were thereafter established throughout the villages through the utilization of a simple random sampling procedure. The villages were then partitioned into distinct groups. The recruitment process for participants from each hamlet was carried out until the predetermined sample size was attained.

The inclusion criteria for the participants are as follows; i) 60 years or older, ii) Systolic blood pressure ranging from 120 to 139 mmHg or diastolic blood pressure ranging from 80 to 89 mmHg, iii) ability to communicate effectively. On the other hand, the following exclusion criteria have been established; i) individuals diagnosed by a doctor with kidney or heart disease, ii) regular consumption of alcohol or frequent smoking, iii) under treatment of cardiovascular medication.

2.3. Intervention

The study employs a two-step approach to the participants. Step 1 concentrates on implementing health promotion activities within the health center setting over four weeks. These activities encompass a range of interventions tailored to improve participants' overall health outcomes. Step 2 involves an extended period of four weeks, during which continuous sampling occurs within the volunteers' homes. This phase enables researchers to observe in a real-life context, allowing for a thorough examination of the impact of study interventions on participants' daily routines and lifestyles. To ensure diligent monitoring and assistance, a

dedicated research faculty consisting of registered nurses, public health academics, community health officials, and health volunteers conducts weekly home visits. The specifics of the following steps. Step 1. Hosts activities on Mondays, Thursdays, and Fridays, consisting of health outcomes, the impact of hypertension, and self-management for lifestyle modification. Lifestyle modification focuses on exercise, low sodium diet, and mood management.

Exercise: the arm-swing exercise (ASE). The ASE position First, stand with your feet at shoulder width, feet pointing straight ahead; the standing stance should be comfortable, and the feet firmly placed on the ground. Second, look forward, soften, and widen your visual focus; arms should be loose, relaxed, and hanging gently, and hands should remain soft and relaxed. Furthermore, gently raise both arms up in front of the body, palms facing one another, and allow the arms to gently move down and back to the sides of your hips. Finally, both arms were swung forward about 30 degrees with a smooth and even force and then backward to about 60 degrees. The speed of swinging was 30 times/min for the first weeks and then 60 times/min. Warm-up and cool down before and after the swing arm for 5 minutes. Arm swing exercise regularly frequency five days a week and duration of 30 minutes, an intensity that would maintain heart rate within the assigned training range and practicing continuously for three months. The ASE program demonstrated efficacy for improving blood pressure and heart rate among older adults.

Low sodium diet: the study recommended the reduction of salt and fish sauce in cooking practices to promote healthier habits. To further support this objective, the study provided examples of low-salt cuisine. A comprehensive list of food items with their main components was also developed for breakfast, lunch, and dinner. The selection of foods for the diet list was carefully considered, considering factors such as ingredient accessibility, affordability, and local availability. Each meal consisted of a serving of rice (80g) and three portions of maize (74g), fish (35g), or chicken (55g) in terms of calorie content. The emphasis was placed on utilizing fresh ingredients readily available within the local community. Various cooking techniques, including frying, steaming, heating, and boiling, were employed in preparing the meals. Significantly, each meal incorporated generous amounts of fresh vegetables, chicken, fish, and vegetables. The aim was to create dishes that were not excessively salty or rich in fatty flavors. By offering illustrations of low-salt cuisine and using locally available ingredients, the study aimed to encourage healthier cooking practices. The adoption of a dietary approach that prioritizes the reduction of salt intake and the avoidance of excessive fat consumption is in accordance with the goal of lowering blood pressure.

Mood management: A research study was conducted at a health center, utilizing the conference room to teach gradual breathing exercises to enhance overall health and regulate mood. The study drew upon existing academic research, which suggests that a recommended breathing technique involves inhaling through the nose and exhaling through the mouth. It is advised to practice slow and consistent inhalation while also being mindful of the frequency of breaths. Some individuals have found counting from 1 to 5 during each breath cycle helpful. Initially, participants in the study may have encountered difficulties reaching a count of 5 while maintaining a steady breath. However, if found helpful, participants were encouraged to softly allow the breath to expire while repeating the counting sequence from 1 to 5. The study's exercise routine spanned thirty consecutive days, during which participants adhered to a consistent schedule. Each day, participants dedicated fifteen minutes to the initial round of breathing exercises, followed by a five-minute session, and concluded with another fifteen-minute session. This regimen was maintained for three months, allowing continuous practice and training.

Step 2. The second step (after the first step) involves implementing an ASE exercise program at the health center, adopting a low-sodium diet, and practicing mood management techniques at home. The study includes eight weeks, during which we will conduct home visits. In order to enhance supervision and ensure compliance with the prescribed protocols, house visits are carried out on a twice-weekly schedule.

2.4. Measurement tools and materials

Blood pressure (BP) and heart rate (HR) were measured in the right arm when participants were sitting position after resting for 10 min (Digital sphygmomanometer. Omral® Japan) measurement three times (or more) about 1min apart until the last measurement did not differ 10% in both systolic and diastolic blood pressure value from the previous measurement. The average of the last three measurements was then taken as the blood pressure and heart rate value. The accuracy of the digital sphygmomanometer was ensured through calibration prior to the collection of baseline data, which occurred at six-month intervals.

2.5. Data collection

We collected data for a day in the morning in each cluster of people in the villages. All participants in each cluster arrived at the primary health care unit at 7.30 am. They were measured the baseline and outcome measurements which were physiological variables (Blood pressure, Heart rate). The assistant researchers are registry nurses trained to interview and digital sphygmomanometer measure by researchers. We make an appointment for the following data collection and measure baseline after three months.

2.6. Data analysis

We verify the normal distribution of continuous variables using the Shapiro–Wilk test. Data were analyzed using STATA Version 16 (StataCorp. 2019. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.) under the license of Praboromarajchanok Institute. Demographic data and descriptive statistics were also applied. Independent t-test was used to compare baseline characteristics and outcome variables between the experiment and control groups. Paired t-test to compare the outcome variables within the group. A difference at the level of $p<0.05$ was considered statistically significant.

2.7. Research ethics

The research board submitted a project proposal to the Institutional Review Board (IRB) at Sirindhorn College of Public Health Khon Kaen, Faculty of Public Health and Allied Health Sciences, Praboromarajchanok Institute, Thailand, to obtain approval and certification for conducting the study. The board assessed ethical considerations, study design, participant recruitment, and data collection procedures, and then granted permission. The study received certification document HE652080 on January 26, 2023.

3. RESULTS AND DISCUSSION

Sixty-six older with prehypertension (33 in each group) participated. Most participants were men, 57.58% in the lifestyle modification group (LM) and 63.64% in the control group (CON). The 75.26% and 51.52% aged 60-69 years in the lifestyle modification and control groups, respectively. Most participants graduated from primary school, 78.79% in the LM group and 90.91% in the control group. Baseline characteristics systolic, diastolic, and heart rate were comparable between the two groups, although not statistically significant $p>0.05$.

The Lifestyle modification group statistically significantly improved Blood pressure and Heart rate when compared with the control group. The lifestyle modification group substantially reduces systolic blood pressure by 5.94 mmHg, diastolic blood pressure by 3.37 mmHg, and heart rate by 4.12 beats per minute. The p-value<0.001 indicates statistical significance as shown in Table 1.

Table 1. Three-month measures between the LM group and the CON group

Variables	LM group Mean±SD.	CON group Mean±SD.	Mean difference	95% CI of mean difference lower	95% CI of mean difference upper	p-value
Systolic blood pressure	126.73±4.33	132.67±2.72	5.94	4.15	7.72	<0.001
Diastolic blood pressure	82.24±3.62	85.61±2.58	3.37	1.81	4.91	<0.001
Heart rate	80.55±3.82	84.67±3.41	4.12	2.33	5.90	<0.001

The Lifestyle Modification group demonstrated statistically significant improvements in blood pressure and heart rate compared to the baseline within the group. The lifestyle modification program resulted in a substantial reduction of 7.79 mmHg in systolic blood pressure. The statistical significance of all variables was found to be $p<0.001$. Moreover, there was a significant decrease of 4.03 mmHg in diastolic blood pressure and 2.93 beats per minute in heart rate. On the other hand, the control group did not show a significant improvement in any of the variables, with p-values>0.05 as presented in Table 2.

Table 2. Baseline and three-month measures within the LM group and the CON group

Variables	Baseline Mean±SD	After three months Mean±SD	Mean difference	95% CI of mean difference lower	95% CI of mean difference upper	p-value
LM group						
Systolic blood pressure	134.52±3.52	126.73±4.33	7.79	6.78	8.79	<0.001
Diastolic blood pressure	86.27±3.30	82.24±3.62	4.03	2.91	5.14	<0.001
Heart rate	83.48±4.23	80.55±3.82	2.93	1.97	3.90	<0.001
CON group						
Systolic blood pressure	133.30±3.72	132.67±2.72	0.63	-0.71	1.98	0.35
Diastolic blood pressure	84.88±2.67	85.61±2.58	-0.73	-1.79	0.33	0.17
Heart rate	83.18±4.26	84.67±3.41	-1.49	-3.01	0.04	0.06

3.1. Discussion

The objective of the lifestyle modification program was to examine the impact on blood pressure reduction among elderly patients with hypertension in the early stages. The program spanned three months

and encompassed crucial lifestyle changes, including regular physical exercise, reduced sodium intake, and emotional management. The study findings revealed that implementing this lifestyle modification program resulted in notable improvements. Specifically, systolic blood pressure decreased by an average of 5.94 mmHg, diastolic blood pressure reduced by 3.37 mmHg, and heart rate decreased by 4.12 beats per minute. We thoroughly discussed and analyzed the various activities of the lifestyle modification program and their impact on lowering blood pressure. It was revealed that the aforementioned activity component, which encompassed exercising, consuming less sodium, and controlling emotions, demonstrated significant efficacy in reducing blood pressure.

The ASE program, which was used with older people with prehypertension in rural regions, showed encouraging results regarding decreasing blood pressure and heart rates, similar to several studies. The results of the Chompoopan report showed that the ASE program is beneficial, emphasizing that ASE activity for 12 weeks resulted in significant decreases in blood pressure and heart rates [18]. Regular exercise has been shown to offer numerous benefits in reducing blood pressure levels [19]. The potential for lowering blood pressure through exercise can be elucidated by examining the impact on sympathetic nerve activity [20]. An important change noticed after exercise was a reduction in sympathetic nerve activity [21]. This reduction in sympathetic nerve activity also extends to the signaling pathway responsible for vasoconstriction [22]. Consequently, local vasodilator mechanisms come into play, leading to a decrease in arterial blood pressure, which is prominently observed after exercise.

In addition, the lifestyle modification program emphasized the importance of reducing sodium intake. High sodium consumption has been linked to elevated blood pressure, as excess sodium can disrupt the balance of fluids in the body and increase blood volume [23]. Educating and training patients on the importance of limiting sodium in their diet aimed to help individuals make healthier dietary choices and subsequently lower their blood pressure and heart rate, in line with the previous study. The systematic review conducted by Asri and colleagues provides valuable insights into the effects of a low-salt diet on blood pressure [24]. The review indicates that the implementation of a low-salt diet, whether through the use of salt substitutes or a low sodium intervention of 3 g or 51.3 mmol per day, had a significant impact on both systolic and diastolic blood pressure [24]. This result is the same as Wang *et al.* reports; the review's improved evidence highlights the significance of dietary salt reduction as a practical method to improve blood pressure and health outcomes [25]. The potential of hypertension could be due to the retained water diluting the sodium concentration in the bloodstream, which helps to regulate sodium levels. However, the increased fluid volume also increases the total blood volume, which can lead to increased blood flow within the arteries. Elevated blood flow can contribute to higher blood pressure [26]. The implementation of a reduced-salt diet has been shown to be a beneficial strategy for reducing blood pressure [27].

Moreover, the lifestyle change program recognized emotional regulation as a vital component. Stress and emotional factors have been recognized as contributors to increased blood pressure levels. The findings of the study state that purposeful deep breathing lowers systolic and diastolic blood pressure slows heart rate, offers a relaxing impact, and decreases stress and anxiety in prehypertensive patients. It was hypothesized that a comparable underlying process, as identified in a previous study, could potentially explain the observed results. Based on a study, evidence suggests that engaging in deep breathing exercises for a period of 10 minutes, twice per day, over a duration of four weeks, leads to favorable results in terms of reducing blood pressure and heart rate. According to the study, participants ought to attempt to maintain their breathing rates during exercises at either 6 or 10 breaths per minute [28]. The potential physiological mechanism underlying the potential blood pressure-lowering effects of deep breathing exercises can be elucidated by investigating their impact on arterial baroreflex sensitivity. The meaning of "arterial baroreflex sensitivity" describes how well the body's baroreceptors adapt to variations in arterial pressure in order to control blood pressure. Examining the effects of deep breathing exercises on arterial baroreflex sensitivity can help clarify the possible physiological mechanism by which they may decrease blood pressure. Arterial baroreflex sensitivity refers to the body's baroreceptors' ability to control blood pressure through adaptation in response to changes in arterial pressure [29]. Engaging in slow breathing techniques, such as deep breathing, resulted in an enhancement of baroreflex sensitivity [30]. This condition includes an augmented responsiveness of the human body to changes in blood pressure, leading to improved regulation and preservation of ideal blood pressure values. Futhermore, previous research has demonstrated that the practice of slow breathing techniques can potentially lead to a decrease in sympathetic activity of muscle nerves, resulting in a subsequent reduction in blood pressure [31]. Deep breathing techniques have been found to facilitate relaxation and diminish vascular resistance, resulting in a reduction in blood pressure through the modulation of sympathetic activity [32].

4. CONCLUSION

In summary, the study project's lifestyle modification program was successful in decreasing blood pressure in older adults with hypertension. The program, encompassing various components such as maintaining a regular exercise routine, reducing salt consumption, and improving emotional regulation, led to significant reductions in blood pressure and heart rate after participation. This particular form of engagement has the potential to make significant contributions to communities with a substantial population of elderly individuals, particularly in the realms of health promotion and fostering chances for social interaction. Subsequent investigations ought to incorporate interventions targeting additional demographic groups that are confronted with prehypertensive conditions.

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