Original Article

The Effect of Prevent-U Application on Hypertension Prevention among Elderly with Risk of Hypertension in Phrae Province, Thailand: A Quasi-Experimental Design

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Abstract

OBJECTIVES: Investigating the effect of prevention of hypertension (HT) among elderly people at risk of HT in Phrae province, Thailand.

MATERIALS AND METHODS: This quasi-experimental study focused on 52 elderlies at risk of HT. Twenty-six elderly people were randomized into an intervention group and received standard care and were given access to the Prevent-U application for 12 weeks. Meanwhile, the remaining twenty-six received only standard care. As a baseline, demographic data and blood pressure (BP) levels were collected for all the elderly, and at the end of the study BP levels were measured once again. All data were analyzed by Chi-square test, paired *t*-test, and independent *t*-test.

RESULTS: After 12 weeks' BP levels of intervention group were lower than the baseline whether systolic blood pressure (SBP) (baseline:136.08 ± 1.54, 12th week: 127.00 ± 1.78, $p < 0.001$) and diastolic blood pressure (DBP) (baseline: 85.77 ± 1.36, 12th week: 82.73 ± 1.28, $p < 0.001$). In addition, the results when comparing BP levels between the intervention group and comparison group after the end of the study, the BP levels of the intervention group were lower than the comparison group as well, SBP (Intervention group: 127.00 ± 1.78, Comparison group: 137.65 ± 1.26, $p < 0.001$) and DBP (Intervention group: 82.73 ± 1.28, Comparison group: mean = 87.88 ± 1.24, $p < 0.001$)

CONCLUSION: The findings of this study presented users' decline in BP levels after using the Prevent-U application. Thus, Prevent-U application may helpful in preventing high BP in the elderly at risk of HT.

Keywords: application, hypertension, elderly, people with risk of hypertension, hypertension prevention

Nowadays, Thailand's population structure is shifting from a young population to an ageing population. Thailand faces a serious situation with the number of elderly citizens growing rapidly and the proportion of the elderly population has increased to 10.0%. Therefore, Thailand has fully become an ageing society.

One significant factor that the Thai government will face is higher expenses, especially medical expenses. This is because the elderly is at an advanced age bodily, the organs deteriorate and a lower autoimmune response leads to disease, so this demographic has many more health problems and are susceptible to a variety of diseases more so than other age groups. The most common health concern for elderly people is chronic disease, such as cardiopathy, stroke, cancer, diabetes and HT. According to a Department of Health survey[1] in 2013, the most common disease of elderly people was HT (41.1%) and the results of a screening of elderly health status data from the Ministry of Public Health[2] in 2015 showed HT was a major health problem in elderly people (31.7%). There are many reasons for HT, including unmodifiable risk factors (age, family history) and also unhealthy lifestyles like physical inactivity, using tobacco, and alcohol consumption. Furthermore, an essential unhealthy lifestyle that can lead to having high BP is a poor dietary habit that includes eating high sodium and high cholesterol foods.[3] The result of a sodium intake assessment measured by a 24-hour Urine collection and analysis in Thailand among a population of 1,599, aged 18 years old and

above, showed an average sodium daily consumption of 3,636 milligrams about 1.8 teaspoons of salt.[4]

HT is often called a "silent killer" because most people who have HT have no obvious warning symptoms until it has done damage to the arteries reported when high BP is noted. Also, HT is still considered one of the major public health issues due to the fact that it can lead to serious medical conditions and even untimely deaths.[5] Moreover, not only does HT affect health outcomes but it also becomes a family burden. Hence, the prevention of HT is essential, furthermore everybody should be aware of the risks and pay attention to their behaviour and lifestyle choices.

People with a risk of HT are defined as having an SBP between 120 to 139 mmHg and/or DBP between 80 to 89 mmHg and they seem to have a greater risk of developing HT later on, especially elderly people. A review of literature on the prevention of HT presented ways to lower HT risk without medication, these include regular physical activity, a healthy diet, and better stress management.[6] So far, the Thai government and Thai public health agencies have been implementing projects and activities for HT prevention in people with risk of HT, e.g., HT screening in the health care center, conducting interventions to inform people of the risk of HT. However, these activities were not as successful as expected and the trend of incidental HT has increased, particularly among the elderly. According to elderly health status survey in 2013, two in five elderlies who tested for diabetes and HT screening were found to be unaware that they had high BP.[7] Moreover, there were many national studies about HT prevention by changing behaviors in people with risk of HT such as a study of Samnak N et al[8], Singkharothi A,[9] and Songwatthanayut P et al,[10] but those studies focused on the general population with risk of HT. So, there has been limited study of the elderly with a risk of HT as a group and the challenges of developing interventions or innovations for elderly with a risk of HT in Thailand.

Phrae is a province in Northern Thailand, and a survey of the Foundation of Thai Gerontology Research and Development Institute and Institute for Population and Social Research in 2017 found that Phrae has the highest elderly rate in Thailand (24.7%).[11] Also, from a survey of the elderly health status, most of them had chronic diseases, in particular HT. In addition, a survey on the number of inpatients department to classify 75 diseases in 2003, 2007 and 2012 showed HT was the most likely disease in elderly people and the number of new patients has risen every year (4,112 patients, 6,338 patients and 9,375 patients, respectively).[12] In accordance with Phrae Provincial Health Office data in 2007-2009, the prevalence of HT per 100,000 population was 6,420.71, 7.461.21 and 7,589.69, respectively.[13] Also, the Health data center reported HT mortality rate of Phrae province was the highest and ranked 1st in Thailand in 2015 (16.31 per 100 population) and in 2018, the HT mortality rate of Phrae province was ranked 2nd in Thailand (4.00 per 100 population). Apart from the high rate of HT mortality, the number of new patients of people at risk of HT in Phrae placed second in rank in Northern Thailand in 2017 and 2018.[14]

Regardless of the HT situation in Phrae province, this study focused on and conducted the Prevent-U application, applied Health Belief Model for developing application, to investigate the effect of prevention of HT among elderly people at risk of HT in Phrae province. The expected outcome of this application may be useful to help change behavior among the elderly at risk of HT and to reduce the chances of developing HT as a patient later.

Materials and Methods

This study was a quasi-experimental study (two groups pre- and post- test experimental) aimed to study the effect of Prevent-U application on HT prevention among elderly with risk of HT in Phrae province, Thailand.

The study focused on elderly with risk of HT in Phrae province. A sample size of this study was calculated through a James J. Schlesselman formula which using the confidence level of 95% (Type I error = 0.05), the power (1-α) 80%. Based on the study of Singkharothi A[9]; effect size = 0.87, 19 cases were calculated, but the researcher increased the sample size by 35% to avoid and to prevent discrepancies due to data collection, and loss of follow-up. In conclusion, the total sample size for this study was 26 cases per group (Intervention group = 26 cases, comparison group = 26 cases).

Study duration

The total study duration was 4 months; intervention period (3 months) and followed-up (1 month). From July to October 2021, the elderly was screened and recruited for eligibility.

All eligible Thai elderly, both male and female, were required to be aged between 60 to 69 years old, with ability to perform routine activities by themselves, able to read and communicate in Thai language, have their own smartphone and can access the internet and SBP at 130-139 mmHg and/or DBP at 85-90 mmHg. While the elderly is on anti-hypertensive medication, those who were considered hospitalized patients for kidney disease or renal artery disease treatment and participant in intervention group who open and used an application less than 20% per week were excluded from this study.

Procedure

After the researcher had recruited participants who met the eligibility criteria, 26 elderlies were randomly assigned to the intervention group and the other 26 elderlies assigned to the comparison group.

The intervention group received standard care from a health-promoting hospital and was allowed to install and use Prevent-U application on their own smartphone for 12 weeks.

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Prevent-U application

Prevent-U application is a type of mobile phone technology and download from Google play store, based on a Health Belief Model.

Prevent-U application consists of 5 systems namely personal system, data system, collecting system, reporting system and consulting system. The details of each system of Prevent-U application are as follows (Table 1).

Table 1: Detail of Prevent-U application

Prevent-U application system				
Personal system	Data system	Collecting system	Reporting system	Consulting system
• Display user personal data about age, height, weight, mean score of food Consumption Behavior, an average time of physical activity and level of BP, summarizes data by number, graph and color. In addition, all data were concluded and updated on this system every week. • P.S. Users fill out the data about age, height, and weight for 1st log in.	• Display content covers HT and how to prevent and avoid high BP in the elderly with a risk of HT which is presented in Thai language and in an infographic. • All content in this system is updated every day and continued for 12 weeks and users are able to read and re-read all content anytime. • P.S. Each time users opened and read the infographic, the system recorded users' participation.	• Users recorded food consumption behavior, time of physical activity and level of BP each week themselves. • After users completed filling out all the data, the system evaluated the data and sent feedback to the personal system to show results in terms of number, graph and color to users. • P.S. Collection data worked simultaneously with the personal and report system.	• In case users recorded data that was irregular or exceeding the standard score more than twice, the user was notified through the personal screen to alert them to change their behavior.	• When users found problems or obstacles or frequently asked questions related to changing behavior or raising BP, this system sent suggestions to users via automated one-way communication.

For 12 weeks, an intervention group had to open and use Prevent-U application every day. The intervention group were given tasks on how to use the application:

1. Fill out the data about age, height, and weight for 1st log in and fill out and update data about weight for each week.
2. Open and read infographic data every day.
3. Record food consumption behavior, time of physical activity, and BP each week themselves.

In addition, the intervention group received regular standard care from health-promoting hospital.

On the other hand, the comparison group received only standard care from health-promoting hospital for 12 weeks.

Standard care from health-promoting hospital

Participants in both groups received a home visit and their BP was measured by a health worker, and a village health volunteer once a week.

Prevention of contamination

This study design was a quasi-experimental study, so there were no blinding or masking participants therefore bias and contamination might occur in this study. So, the researchers considered these points and try to avoid bias and contamination between the intervention group and comparison group as follows:

Avoiding selection bias:

1. Researcher matched age and income of participants.
2. Researcher selected health-promoting hospital that used same standard service for prevention HT.

Avoiding contamination: To avoiding contamination between participants, the researcher randomly assigned participants to 2 health-promoting hospitals within a distance of 10 kilometers.

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Measurement

The primary outcome was BP level. Collection data was separated into 2 periods at baseline and end of the intervention (week 12th). Measurements of this study were the following:

1. Demographic characteristics: At baseline, researcher collected demographic data (12 items) in both groups through a structured interview.
2. BP level: At the baseline and end of the intervention, participants in both groups had SBP and DBP measured by Omron automatic BP monitor Hem 7121.

Statistical analysis

Descriptive Statistics

Demographic data of participants are analyzed by descriptor including frequency, percentage, mean, and standard deviation

Analytical Statistics

1. Independent t-test used to determine the mean of BP between the intervention group and the comparison group over time (at baseline, and 12th week). The significance level of this study is defined at 0.05.
2. Chi-square test use to compare characteristics between the intervention group and the comparison group at baseline.

Ethical consideration

This study was approved by The Human Research Ethics Committee of Thammasat University (Medicine) (MTU-EC-CF-0-251/63).

Results

Demographic characteristics

For the intervention group, more than half (69.2%) were female. 57.7% of them had their age in the range of 60-63 years old. Most of them (88.5%) were married. 38.5% of elderly had an education level equivalent to the level of vocational certificate. 65.4% of them have been working and had income in the range of 5,001- 10,000 bath per month. For health status, 77.0% of them went to health promoting hospital when they had illness or sickness; received health data from health promoting hospital (80.8%). For health behavior, 73.1% did not drink alcohol and 88.5% did not smoke. For the comparison group, half of them (50.0%) were male. 53.8% of them had their age in the range of 60-63 years old. 80.8% were married. Elderly had an education level equivalent to the level of secondary school (61.5%). Most of them (80.8%) have been working and had income in the range of 5,001- 10,000 bath per month. For health status, 80.8% of them went to health promoting hospital when they had illness or sickness; received health data from health promoting hospital (80.8%). For health behavior, 46.2% did not drink alcohol and 76.9% did not smoke (Table 2).

For those using the application, results showed that 69.3% of the intervention group had completely followed the instructions to use the Prevent-U application and 19.2% of intervention group often followed the instructions to use the Prevent-U application (Table 3).

Table 2: Characteristics of elderly with risk of Hypertension (HT) (n = 52)

Characteristics	Intervention group (n = 26) n (%)	Comparison group (n = 26) n (%)	x^2	*p*
Gender			1.997	0.158
Female	18 (69.2)	13 (50.0)		
Male	8 (30.8)	13 (50.0)		
Age (years)			0.094	0.760
60 - 64	18 (69.2)	19 (73.1)		
65 - 69	8 (30.8)	7 (26.9)		
Mean ± SD	63.23 ± 2.215	63.19 ± 1.85		
Min, Max	61, 68	61, 67		
Marital status			0.591	0.442
Single	3 (11.5)	5 (19.2)		
Married	23 (88.5)	21 (80.8)		
Family type			0.693	0.405
Nuclear family	11 (42.3)	14 (53.8)		
Extended family	15 (57.7)	12 (46.2)		
Educational level			2.769	0.096
Secondary school	10 (38.5)	16 (61.5)		
Vocational certificate or above	16 (61.5)	10 (38.5)		
Work status			1.564	0.211
Work	17 (65.4)	21 (80.8)		
Did not work	9 (34.6)	5 (19.2)		
Income (per month)			0.115	0.734
< 10,000 baths	21 (80.8)	20 (76.9)		
≥ 10,000 baths	5 (19.2)	6 (23.1)		
Family history of hypertension			0.843	0.358
Having a family member with hypertension	20 (76.9)	17 (65.4)		
Did not have a family member with hypertension	6 (23.1)	9 (34.6)		
Family history of hypertension			0.843	0.358
Having a family member with hypertension	20 (76.9)	17 (65.4)		
Did not have a family member with hypertension	6 (23.1)	9 (34.6)		
Receiving health data			1.667	0.435
Got from health promoting hospital	21 (80.8)	21 (80.8)		
Got from internet	2 (7.7)	4 (15.4)		
Did not get from any platform	3 (11.5)	1 (3.8)		
Alcohol consumption			0.787	0.375
Did not drink	19 (73.1)	16 (61.5)		
Drank	7 (26.9)	10 (38.5)		
Smoking			1.209	0.271
Did not smoke	23 (88.5)	20 (76.9)		
Smoked	3 (11.5)	6 (23.1)		

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Table 3: Percentage of participants who followed the instructions to use the Prevent-U application (n = 26)

Activities on Prevent-U application	Always (100% using application)	Often (60% using application)	Occasionally (40% using application)	Seldom (20% using application)
Open and read infographic data Recorded food consumption behavior Recorded time of physical activity Recorded level of BP	18 (69.3%)	5 (19.2%)	3 (11.5%)	0 (0.0%)

Comparing BP level between intervention group and comparison group

Comparing BP level **by Independent *t*-test** (at baseline)

At baseline, SBP level of intervention group were at risk level (136.08 ± 1.54) and the SBP of the comparison group were at risk level (137.54 ± 1.33). In addition, results on those comparing SBP between the intervention group and comparison group showed there was no difference between the groups in terms of difference in SBP.

For DBP, at baseline the intervention group were at risk level (85.77 ± 1.36) and DBP of the comparison group were at risk level (86.12 ± 1.70). Results from comparing DBP between the intervention group and the comparison group presented there was no difference between the groups in terms of difference in DBP (Table 4).

Comparing BP level by **Independent *t*-test** (at ending of the study)

After 12 weeks, SBP level of the intervention group was lower than baseline (baseline: 136.08 ± 1.54, week 12th: 127.00 ± 1.78, $p < 0.001$). Also, DBP of the intervention group was lower than baseline (baseline: 85.77 ± 1.36, week 12th: 82.73 ± 1.28, $p < 0.001$).

In addition, the result of comparing BP levels between the intervention group and the comparison group after ending the study found BP levels of the intervention group to be lower than the comparison group whether in SBP (Intervention group: 127.00 ± 1.78, Comparison group: 137.65 ± 1.26, $p < 0.001$) or DBP (Intervention group: mean= 82.73, S.D.=1.28, Comparison group: 87.88 ± 1.24, $p < 0.001$) (Table 5).

Table 4: Comparing BP level between the intervention group and the comparison group by Independent *t*-test (at baseline) (n = 52)

	Intervention group (n = 26)		Comparison group (n = 26)		*t*-test	Df	*p*- value
	Mean ± SD	Level	Mean ± SD	Level			
Systolic blood pressure	136.08 ± 1.54	Risk	137.54 ± 1.33	Risk	3.64	50	0.351
Diastolic blood pressure	85.77 ± 1.36	Risk	86.12 ± 1.70	Risk	0.80	50	0.423

Table 5: Comparing BP level between the intervention group and the comparison group by Independent *t*-test (at the end of the study) (n = 52)

	Intervention group (n = 26)		Comparison group (n = 26)		*t*-test	Df	*p*- value
	Mean ± SD	Level	Mean ± SD	Level			
Systolic blood pressure	127.00 ± 1.78	Normal	137.65 ± 1.26	Risk	24.80	50	< 0.001*
Diastolic blood pressure	82.73 ± 1.28	Normal	87.88 ± 1.24	Risk	14.71	50	< 0.001*

*Statistically significant < 0.05

Discussion

Study results showed after 12 weeks that the BP levels of the intervention group were lower than the baseline whether SBP or DBP. This is because the Prevent-U application can encourage users to be aware of the dangers of HT and can lead them to change their risk behaviors. The results may be interpreted as follows: after the intervention group used the Prevent-U application continuously, it helped them to be aware of themselves. Also, they received data about self-care which is related to food, physical activity and stress management. For data about food, after users read all the data they were able to choose food that is appropriate to their health status. The major change in consumption behavior was to reduce sodium intake (fish sauce, shrimp paste and salt) and this is great for the heart health. Moreover, the intervention group had more time spent on physical activity using the application. During physical activity, the body heats up and loses sweat. Sweating has salt, so some of the excess sodium was excreted from the body. This study's results were in line with the study of Fadilah SZ,[16] and Kaplan AL et al[17] that found that participants who used the application had a significant improvement in BP levels ($p < 0.001$).

In addition, at the end of the study, BP levels of the intervention group were lower than the comparison group, both in SBP and DBP. The results may be interpreted as follows: The Prevent-U application was designed based on the Health Belief Model. This application may help the intervention group to perceive the risk and severity of HT and via the data system, it may change their attitude, awareness and lead to change their behavior later. Next, the system is a collecting system, it helps users to record their food consumption behavior, physical activity and BP level. After users completed filling out all data, this was evaluated and feedback was sent to users via statistics and graphs. Hence, users were encouraged by feedback and made an effort to change behavior and were interested in reducing their BP level. This study result was in in line with the study of Bengtsson U et al[18] that found that HT patients who used an interactive mobile phone support system had significant reductions in BP levels ($p < 0.05$).

Conclusion

From the results of this study Prevent-U application has been shown to have had a positive effect on the prevention of HT. For those participants who continuously used it, their BP levels were lower than the baseline and were lower than the comparison group.

Strength and limitation points

The strength of this application is showing the participant's health status, encouraging more awareness of the harmful effects of HT and it lead users to increase more interaction and self-care. So, users change their health behavior and reduce their BP levels after using the Prevent-U application.

However, we founded limitations of this study when it came to characteristics. Some of the characteristics data of participants might be a cofounding factor such as their educational level. Indeed, the researcher used the Chi-square test to compare characteristics between the intervention group and the comparison group at the baseline and the characteristics between the two groups did not differ significantly. The researchers tried to allow for these confounding factors by statistics. In any case, some of the participants in the intervention group had an educational level higher than a diploma, so participants in this group may have an advantage in terms of reading skills and in summarizing over the comparison group.

Recommendation

Recommendation for agencies

We recommend that agencies authorized to be responsible for the prevention of HT may implement standard health care or suggest for people at risk of HT to download and use this application for self-management.

Recommendation for future study

In addition, the recommendation for future study at this point is that researchers should consider confounders, and may design study methods by variable restrictions i.g. age, educational level, or other factors related to or that may affect the outcome.

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