

Prevalence of and Associated Factors with Uncontrolled Hypertension Among Middle-Aged Adults' Hypertensive Patients in Northeast Thailand

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ABSTRACT

Introduction: Numerous connected factors influence uncontrollable hypertension. Identifying elements influencing blood pressure regulation can provide valuable insights for addressing this issue. This study aimed to explore the prevalence of and identify the factors associated with uncontrolled hypertension among middle-aged adults living in northeast Thailand.

Methods: A cross-sectional study was conducted for data collection between January and March 2023. The study population was HT patients. Descriptive statistics and multiple logistic regression were used for data analyses with a significance level 0.05.

Results: The majority were females (67.84%), and the overall prevalence of uncontrolled hypertension was 37.76% (95% CI = 30.11-46.07). In the multivariable logistic regression, five (5) variables were found to be associated with uncontrolled hypertension: inadequate/problematic applied health information (Adjusted odds ratio (AOR) = 6.09; 95%CI=1.51-8.45), knowledge on herbs for hypertension treatment (AOR=5.33; 95%CI=2.04-13.91), education (AOR=5.06; 95%CI=1.87-13.79), household income (AOR=4.98; 95%CI=2.01-12.33), and drinking use (AOR=2.13; 95%CI=1.01-4.40). Conclusion: It is crucial to promote awareness of self-care practices among individuals with uncontrolled hypertension, especially those who engage in alcohol use, individuals with high income, and those with higher educational attainment.

Keywords: Uncontrolled, Hypertension, Prevalence, Associated factors, Middle-aged adults

Introduction

Hypertension emerged as a prominent health concern within the context of Thailand. The data reported the prevalence of hypertension among those aged 15 years and older. The numerical value experienced an upward trend, rising from 10 million in 2009 to 13 million in 2014. A significant proportion, specifically 50%, of individuals who were diagnosed with hypertension had poor awareness of their condition [1]. According to the findings of the Thai National Health Examination Survey 6th (NHES) in 2021, the prevalence of hypertension was observed to be 25.4%, with a higher prevalence among males (26.7%) than females (24.2%). The finding was slightly higher than the previous survey, the 5th survey conducted in 2014, which reported a prevalence rate of 24.7% (25.6% among males and 23.9% among females). Diagnosed, treated, and managed blood pressure prevalence was lower among males than females [2]. One significant

challenge encountered in the management of hypertension in Thailand pertained to patients' lack of awareness regarding the need to achieve and maintain normal blood pressure. According to the Thai Hypertension Society (2019) [3], patients suffering from uncontrolled hypertension are a significant contributing factor to the development of cardiovascular, renal, and cerebrovascular morbidity and mortality [4].

Middle-aged adults were found to have poor awareness of their blood pressure control and maintaining their healthy stage, particularly by taking medicine regularly. Several factors [5] related to uncontrolled HT in middle-aged adults include job situation, dietary behavior, exercise, etc. Grossman et al 2008 [6] reported that financial status was one of the important factors that contributed to uncontrolled hypertension. An unhealthy lifestyle described, including heavy alcohol consumption, tobacco consumption, sleep duration, non-adherence to dietary recommendations, and being

overweight, was associated with uncontrolled HT at the individual and combined level, particularly in men. Improvement of these health behaviors could offer effective HT management [7]. The prevalence of uncontrolled HT was detected at a higher rate among the middle-aged population, particularly those living in poverty and having a family history of hypertension [8].

Health literacy has been found to significantly impact several health outcomes, including the reduction of severe hypertension stage and hospitalizations among uncontrolled HT[9]. Health literacy is the individuals' ability to apply knowledge for themselves or for their family members to improve and maintain individual health, including utilizing health-related information to make informed decisions regarding healthcare, illness prevention, and health promotion, ultimately contributing to the enhancement and preservation of their overall quality of life over the lifespan [7]. Sorensen et al. [8] reported that individuals with higher levels of health literacy had a better health status than those with poor health literacy. Those who had limited health literacy tended to engage in risky behaviors related to disease development [9] and delayed healthcare-seeking [10, 11].

Evidence from the nationwide survey in Thailand showed a 24.6% overall prevalence of uncontrolled hypertension [16], and several factors were related to uncontrolled blood pressure among middle-aged adults. We aimed to estimate the prevalence and determine factors associated with uncontrolled HT among middle-aged adults in northeast Thailand.

Methodology

Study Area and Sample Size

A cross-sectional study was utilized. The study focused on a total of 195,692 middle-aged people with uncontrolled hypertension. The data was collected at Regional Health Centers 7, 8, 9, and 10, located in the Northeast of Thailand, between January and March 2023. The study population comprised individuals diagnosed with hypertension who had inadequate control over their blood pressure levels. The criteria for participant selection encompassed individuals aged 35 to 59 years.

A total of 143 samples were required for the analysis from the sample size calculation based on the information in a previous study [21], which achieves 80% power at a 0.05 significance level using a sample size calculation formula (Hsieh et al., 1998) [17], details as following.

$$n = \frac{P(1-P)(Z_{1-\alpha} + Z_{1-\beta})^2}{[B(1-B)(P_0 - P_1)^2]}$$

Where;

$P=0.23$, $P_0=0.62$, $P_1=0.37$, $Z_{1-\alpha}=1.96$, $Z_{1-\beta}=0.84$, $B=0.72$

$$n = \frac{0.23(1-0.23)(1.96+0.84)^2}{0.72(1-0.72)(0.62-0.37)^2}$$

Then, $n = 115.75$, rounding to 116, which meant that at least 116 samples were required. Adding up 20% for any errors, thus, 143 samples were required for the study.

The stratified sampling method was used to select the participants for the study. In the northeastern region, four (4) distinct regional health systems are classified: Regional Health 7, Regional Health 8, Regional Health 9, and Regional Health 10. The inclusion criteria were those HT patients with uncontrolled blood pressure ($\geq 140/90$ mmHg). Those who did not provide a consent form were excluded from the study.

Instruments

The questionnaires utilized in the study were designed as closed-ended and self-administered instruments which were divided into six sections: (i) information about the characteristics of a population, such as age, gender, income, and education level; (ii) the influence of environmental factors; (iii) Understanding the utilization of natural remedies for the management of hypertension; (iv) The concept of health literacy, as derived from a self-administered questionnaire known as HLS-EU-Q47; (v) Health Promoting Lifestyle Profile II (HPLP II), and (vi) PHQ-9 to assess depression.

The questionnaire was validated using the item objective congruence (IOC) method by five experts in the field. Following that, the questionnaire was modified and subsequently passed reliability testing. A pilot was used to improve the questionnaire quality: 17 questions were used to collect demographic data, environmental factors, and proficiency in applied herbal treatments for hypertension. In addition, ten questions were used to detect knowledge of herbal use for blood pressure control. Each question is provided two options; "Yes" and "No". The correct answer was scored "1", while the incorrect answer was scored "0". The total score of each participant was classified into three levels: poor (0-59% corrected answer), fair (60-79% corrected answer), and good (80-100% correct answer).

The measure of health literacy was detected by four components with 45 items: access/obtain, understand, appraise/judge/evaluate, and apply/use health information. Each question was rated using an ordinal scale that spanned from 1 to 4 (1 = very difficult, 2 = difficult, 3 = easy, 4 = very easy). The health literacy scores were classified into four distinct groups: inadequate (0-50%), problematic (51-66%), sufficient (67-84%), and excellent (85-100%). Health promotion behavior was classified into three groups using 27 question components, and each question has 4 response options. Finally, here behavior was categorized into three levels: poor (mean=1.00-2.00), moderate (mean=2.01-3.00), and good (mean=3.01-4.00).

The Patient Health Questionnaire-9 (PHQ-9) was used to evaluate the occurrence and intensity of depressive symptoms over two weeks which was employed in a 4-point Likert scale ranging from 0 (indicating no occurrence) to 3 (representing near-daily occurrence), so generating a comprehensive score that ranges from 0 to 27.

Data Analyses

Data analyses were conducted using STATA statistical version 14. Descriptive statistics of the demographic data, the environment factor, knowledge of herbal use to treat hypertension, health literacy, health promotion behavior, and depression were described using frequency and percentage for categorical data and mean, median, minimum, maximum, and standard deviation (SD) for continuous data. The estimated prevalence of uncontrolled hypertension (Uncontrolled-HT) was reported with frequency, percentage, and 95%CI. Bivariate analysis using simple logistic regression was conducted to identify crude odds and p-value for entry (P_e) <0.25 and p-value for remove (P_r) $>P_e$, which were used to select independent variables for the analytical model. Associated factors were determined with multiple logistic regression. The final model was obtained using the backward elimination method, and the research results were presented with the adjusted odds ratio and 95% CI at a significance level of 0.05 [18].

Ethical Considerations

The study was approved by the Ethics Committee of Khon Kean University's Institutional Assessment Board (HE652233). Written informed consent was obtained from each participant, ensuring their voluntary participation in the study. To preserve the privacy of the individuals, code names were assigned. Additionally, measures were taken to maintain the confidentiality of the collected data.

Results

The overall prevalence of uncontrolled hypertension was 37.76% (95% CI=30.11-46.07) (Table 1).

Table 1 Prevalence of uncontrolled HT patients (n=143)

Outcome	n (%)	95% CI
Controlled	89 (62.24)	53.93-69.89
Uncontrolled	54 (37.76)	30.11-46.07

The majority were female (67.84%), aged 55-59 years (32.87%), 81.12% were married and co-inhabiting, 55.24% were in primary school, 64.34% were farmers, and 51.75% had inadequate income. A large proportion (74.83%) had no family history of HT, 76.22% received a treatment by universal coverage, 13.29% smoked, 30.07% used alcohol, and 29.39% had diabetes mellitus as a comorbid disease. The majority had an average BMI of 24.07 kg/m² ($\pm$ 3.68), and the mean waist circumference was 88.03($\pm$ 11.60).

The mean systolic blood pressure (SBP) was 136.03 $\pm$ 16.32 mmHg, with a standard deviation of 16.32, and the mean diastolic blood pressure (DBP) was 83.88 mmHg ($\pm$ 11.87). 44.06% ever used herbal, and 40.55% reported that the major source of herbal knowledge is from healthcare providers. More than half of participants (54.55%) reported that (54.55%) had 6-7 sleeping hours. Sticky rice was the main food (67.83%), 36.22% consumed soft drinks 1-3 times per week, and consumed sugar-sweet drinks 2-4 times per week (32.17%) (Table 2).

Table 2 Demographic characteristics of middle-aged adults with HT

Characteristics	n	%
Gender		
Male	46	32.16
Female	97	67.84
Age (years)		
35-39	7	4.90
40-44	20	13.98
45-49	38	26.57
50-54	31	21.68
55-59	47	32.87
Mean ($\pm$ SD) = 50.36 $\pm$ 6.45, Median (min:max) = 51(35:59)		
Marital status		
Single	15	10.49
Married/co-inhabiting	116	81.12
	12	8.39
Separated/divorced/widowed		
Education		
Illiterate	4	2.80
Primary school	79	55.24
High school	32	22.37
Diploma	7	4.90
College	6	4.20
Master's degree or higher	15	10.49
Occupation		
Unemployed	5	3.50
Agriculturist	92	64.34
Private business	9	6.29
Officer	20	13.99
Housewife	5	3.50
Employed	12	8.38
Household income (baht)		
none	8	5.59
$\leq$ 5,000	55	38.45
5,001 – 10,000	34	23.78
10,001 – 15,000	18	12.59
$>$ 15,000	28	19.59
Adequacy of income		
No	74	51.75
Yes	69	48.25
Health insurance		
Private health insurance	4	2.80
Social security scheme	23	16.08
Universal coverage scheme	109	76.22
Government officer	7	4.90

Characteristics	n	%
Family history of hypertension		
No	107	74.83
Yes	36	25.17
Smoking		
Never	113	79.02
Ever	11	7.69
Current smoker	19	13.29
Alcohol use		
Nondrinker	83	58.04
Ever	17	11.89
Current drinker	43	30.07
Comorbidity		
None	71	49.66
Diabetes mellitus	42	29.39
Hyperlipidemia	21	14.69
Ischemic heart disease (IHD)	2	1.39
Gout	1	0.69
Kidney disease	1	0.69
Other	5	3.49
Physical activity		
Yes	102	71.33
No	41	28.67
BMI (kg/m²)		
<18.5	1	0.70
18.5-22.99	27	18.88
23-24.99	29	20.28
>25	86	60.14
Waist circumference (cm)	88.03±11.60	
Blood pressure (mmHg)		
SBP (mean ± SD)	136.03±16.32	
DBP (mean ± SD)	83.88±11.87	
Herbal use		
No	63	44.06
Few	20	13.98
Sometime	53	37.06
Frequently	2	1.40
Regular	5	3.50
Patterns of herbal use		
Tea	19	23.75
Powder	2	2.50
Extract	4	5.00
Capsule	26	32.50
Bolus	7	8.75
Decoction	22	27.50
Herbal knowledge source		
Healthcare providers	58	40.55
Friend	30	20.99
Relative	55	38.46
Sleep duration (hrs)		
< 4	9	6.29
4-5	26	18.18
6-7	78	54.55
>7	30	20.98

Characteristics	n	%
Type of rice consumption		
Sticky rice	97	67.83
Cooked rice	35	24.47
Brown rice	7	4.90
Rice Berry	4	2.80
Vegetable consumption		
Not daily	98	68.53
Daily	45	31.47
Soft drink		
No	45	35.71
< 1 time/month	29	22.83
1-3 time/week	46	36.22
4-6 time/week	1	0.65
> 6time/month	5	3.94
>1 time/day	1	0.65
Sugar sweet drink		
No	31	21.68
1 time/week	42	29.37
2-4 time/week	46	32.17
≥1 time/day	24	16.78
Duration of work (hrs/day)		
< 8	74	51.75
8-10	53	37.06
> 10	16	11.19
Communities		
Semi-urban	23	16.08
Rural	98	68.53
Urban	22	15.38
Housing		
Private house	127	88.81
Living with relatives	2	1.40
Rental	12	8.39
Welfare house	2	1.40
Place of work		
Outdoor	22	15.38
Indoor	47	32.87
Outdoor switch indoor	74	51.75
Environment pollution		
Low level	14	9.79
Moderate level	129	90.21

Table 3 Predisposing factors of HT

Factors	n	%
Knowledge of herbs for hypertension care		
Low (<60%)	26	18.18
Moderate (60-79.99)	48	33.57
High (≥80%)	69	48.25
Health literacy (total)		
Inadequate (0-50%)	30	20.98
Problematic (51-66%)	100	69.93
Sufficient (67-84%)	11	7.69
Excellent (≥85%)	2	1.40
HL finding health information (FHI)		
Inadequate (0-50%)	10	6.99
Problematic (51-66%)	32	22.38
Sufficient (67-84%)	79	55.24
Excellent (≥85%)	22	15.39

Factors	n	%
HL understanding health information (UHI)		
Inadequate (0-50%)	4	2.80
Problematic (51-66%)	4	2.80
Sufficient (67-84%)	92	64.34
Excellent (≥85%)	43	30.06
HL judging health information (JHI)		
Inadequate (0-50%)	2	1.40
Problematic (51-66%)	22	15.38
Sufficient (67-84%)	89	62.24
Excellent (≥85%)	30	20.98
HL applying health information (AHI)		
Inadequate (0-50%)	2	1.40
Problematic (51-66%)	10	6.99
Sufficient (67-84%)	94	65.73
Excellent (≥85%)	37	25.88
Health-promoting behavior		
Good (3.01-4.00)	36	25.17
Fair (2.01-3.00)	85	59.44
Poor (1.00-2.00)	22	15.39

Factors	n	%
Depression		
None (<7)	122	85.31
Mild (7-12)	18	12.59
Moderate (13-18)	3	2.10

48.25% had a high knowledge of hypertension, 55.24% had sufficient HL finding health information, 64.34% had sufficient HL understanding health information, 62.24% had sufficient HL judging health information, and 65.73% had sufficient HL applying health information.

In the univariable analysis, eight variables were found to be associated with uncontrolled hypertension among middle-aged adults with HT: Marital status, education, household income, health insurance, family history of hypertension, type of rice consumption, knowledge of herb for hypertension, HL applying health information (AHI) (Table 4).

Table 4 Univariable analysis for factors associated with uncontrolled hypertension among middle-aged adults with HT.

Factors	n	Uncontrolled HT (%)	OR	95%CI
Gender				
Female	97	32.99	1.00	
Male	46	47.83	1.86	0.90-3.81
Age (years)				
35-44	27	37.04	1.00	
45-54	69	39.13	1.09	0.43-2.73
≥55	47	36.17	0.96	0.36-2.57
Marital status				
Single	12	25.00	1.00	
Married/cohabiting	116	34.48	1.57	0.40-6.16
Separated/divorced/widowed	15	37.76	8.22	1.45-16.85*
Education				
Lower diploma	115	30.43	1.00	
Diploma or higher	28	67.86	4.82	1.98-11.71*
Occupation				
Unemployed /housewife	10	40.00	1.00	
Agriculturist	92	32.61	0.72	0.19-2.76
Private business /employed	21	23.81	0.47	0.09-2.35
Officer	20	75.00	4.5	0.89-12.74
Household income (baht)				
≤ 15,000	115	30.43	1.00	
>15,000	28	67.86	4.82	1.98-11.71*
Adequacy of income				
No	74	30.43	1.00	
Yes	69	67.86	1.42	0.72-2.80
Healthcare insurance				
Universal coverage scheme/ private health insurance	113	31.86	1.00	
Government officer /Social security scheme	30	60.00	3.20	1.39-7.36*
Family history of hypertension				
No	107	42.99	1.00	
Yes	36	22.22	0.37	0.15-0.90*

Factors	n	Uncontrolled HT (%)	OR	95%CI
Smoking				
Never	113	34.51	1.00	
Ever	11	63.64	3.32	0.91-12.04
Current smoker	19	42.11	1.38	0.51-3.71
Alcohol use				
None	83	36.14	1.00	
Ever	17	11.76	0.23	0.05-1.10
Current drinker	43	51.16	1.85	0.87-3.90
Comorbidity				
No	10	60.00	1.00	
Yes	133	36.09	0.37	0.10-1.40
Physical activity				
Yes	102	34.31	1.00	
No	41	46.34	1.65	0.79-3.45
BMI (kg/m²)				
Low/normal (<23)	28	35.71	1.00	
Over weight(23-24.99)	29	37.93	1.10	0.37-3.22
Obesity (>25)	86	38.37	1.12	0.46-2.72
Waist circumference (cm)				
Normal(<80 cm.for women, <90 cm. for men)	42	35.71	1.00	
Abnormal (≥80 cm. for women, ≥90 cm. for men)	101	38.61	1.13	0.53-2.39
Herbal use				
No	80	38.75	1.00	
Yes	63	36.51	0.90	0.45-1.79
Sleep duration per night (hrs)				
< 4	9	44.44	1.00	
4-5	26	57.69	1.70	0.36-7.85
6-7	78	35.90	0.70	0.17-2.82
>7	30	23.33	0.38	0.07-1.81
Type of rice consumption				
Sticky rice	97	29.90	1.00	
Cooked rice	35	57.14	3.12	1.40-6.94*
Brown rice/ Rice Berry	11	45.45	1.95	0.55-6.91
Vegetable consumption				
Not daily	113	38.05	1.00	
Daily	30	36.67	0.94	0.40-2.17
Soft drink				
Not drink	45	42.22	1.00	
< 1 time/month	29	34.48	0.72	0.27-1.89
1-3 time/ month	45	35.56	0.75	0.32-1.76
1-3 time/ week	17	29.41	0.57	0.17-1.89
≥4-6 time/week	7	57.14	1.82	0.36-9.12
Sugar sweet drink				
Not drink	31	48.39	1.00	
1 time/week	42	26.19	0.37	0.14-1.01
2-4 time/week	46	36.96	0.62	0.24-1.57
≥1 time/day	24	45.83	0.90	0.31-2.62
Duration of work per day (hrs)				
≥8	69	36.23	1.00	
<8	74	39.19	1.13	0.57-2.23
Communities				
Semi-urban	23	52.17	1.00	
Rural	98	32.65	0.44	0.17-1.11
Urban	22	45.45	0.76	0.23-2.46

Factors	n	Uncontrolled HT (%)	OR	95%CI
Housing				
Private house	129	35.66	1.00	
Rental	14	38.39	1.55	0.88-2.71
Place of work				
Indoor	47	38.30	1.00	
Outdoor	22	40.91	1.11	0.39-3.13
Outdoor switch indoor	74	36.49	0.92	0.43-1.96
Environment pollution				
Low level	129	36.43	1.00	
Moderate level	14	50.00	1.74	0.57-5.27
Knowledge of herbs for hypertension				
Moderate and high	117	32.48	1.00	
Low	26	61.54	3.32	1.38-8.01*
HL applying health information (AHI)				
Sufficient /Excellent	131	34.35	1.00	
Inadequate/ Problematic	12	75.00	5.73	1.47-6.23*
Health-promoting behavior				
Good / Fair	107	38.32	1.00	
Poor	36	36.11	0.90	0.41-1.92
Depression				
None (<7)	122	37.70	1.00	
Mild (7-12)	18	33.33	0.82	0.29-2.35
Moderate (13-18)	3	66.67	3.30	0.29-7.46

*Significant level at $\alpha=0.05$

After backward elimination in the final multivariable model, four variables were found to be associated with uncontrolled HT: HL applying health information (AOR = 6.09; 95% CI = 1.51-8.45), knowledge of herbs for hypertension (AOR = 5.33; 95% CI = 2.04-13.91), education (AOR = 5.06; 95% CI = 1.87-13.79), household income (AOR = 4.98; 95% CI = 2.01-12.33), and drinking use (AOR = 2.13; 95% CI = 1.01-4.40) (Table 5).

Table 5 Identifying factors associated with uncontrolled HT by multivariable logistic regression.

Factors	n	% of Uncontrolled HT	AOR (95%CI)	p-value
HL applying health information (AHI)				
Sufficient /Excellent	131	34.35	1.00	0.011*
Inadequate/ Problematic	12	75.00	6.09 (1.51-8.45)	
Knowledge of herbs for hypertension				
Moderate and High	117	32.48	1.00	0.001*
Low	26	61.54	5.33 (2.04-13.91)	
Educational Levels				
Lower diploma	115	30.43	1.00	0.001*
Diploma or higher	28	67.86	5.06 (1.87-13.79)	
Household income (baht)				
≤15,000	115	30.43	1.00	0.001*
>15,000	28	67.86	4.98 (2.01-12.33)	
Alcohol consumption				
Nondrinker/ Ex-drinker	100	32.00	1.00	0.041*
Current drinker	43	51.16	2.13 (1.01-4.40)	

*Significant level at $\alpha=0.05$

Discussion

The findings of this study have significant implications for the public health system in Thailand, as hypertension has been identified as the primary cause of death of Thais. The findings of this study indicate that there is a considerable incidence of uncontrolled hypertension among late Thai adults who already have hypertension, with a rate of 37.76% (95% CI: 30.11-46.07). The current study observed a lower prevalence of uncontrolled hypertension than in India [19]. A study conducted in Thailand in 2019 reported that the prevalence of uncontrolled hypertension was 24.6% [20], which was lower than our findings.

In the domain of health literacy about the utilization of information about hypertension, it has been shown that individuals possessing inadequate/problematic information have difficulties in effectively managing hypertension. The p-value of 0.011 obtained in this study is deemed statistically significant. These findings align with the results reported by Kevser et al. (2018) [21] in their investigation on the health conditions of individuals with uncontrolled blood pressure, reported that those individuals with low health literacy had a 2.06-fold increased risk of developing uncontrolled hypertension. Aloufi et al. [22] reported that uncontrolled HT was associated with poor knowledge of herbs. Knowledge of herbs could be one of the options for caring for HT patients.

HT patients with postgraduate diploma education who had uncontrolled hypertension were at risk of experiencing uncontrolled blood pressure levels, which coincides with a study conducted by Meesub [23], who reported that HT patients with high education were associated with uncontrolled blood pressure. This might be because those with high education tend to work office jobs with poor movement. People's occupation characteristics were related to blood pressure [24].

Household income was an associated factor with uncontrolled blood pressure among HT patients. Specifically, individuals with an average monthly household income exceeding 15,000 baht were found to have a higher risk of developing uncontrolled hypertension compared to those with an average family income below 15,000 baht. This might be because those with high incomes could buy several kinds of food for daily consumption. Eating patterns, including the quantity, could contribute to uncontrolled blood pressure [25].

The consumption of alcohol was found to be a factor that indicated an association with the presence of unmanageable high blood pressure. Abdisa et al. [26] also reported that those who consumed alcohol had a higher rate of uncontrolled HT than those who did not. It is clearly known that alcohol is one of the sources that leads to poor quality blood vessel function and

uncontrolled blood pressure. However, for those aged 60 years and lower, alcohol use had little impact on their blood pressure control [27].

Conclusion

A large proportion of middle-aged adults' population living in northeastern Thailand who are diagnosed with HT are suffering from uncontrolled blood pressure. One of the critical health promotions approaches that could support these patients in controlling their blood pressure is improving health literacy related to HT and encouraging them to use herbs for HT care in daily life. However, the interventions should focus on high-income and alcohol-use patients.

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