

Influence of Work Environment and Health Promotion Behaviors on Pre-Hypertension in Late Adulthood

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Abstract

Pre-hypertension (Pre-HT) is a significantly risk progress factor to hypertension which contributes to the development of cardiovascular disease that led cause of death. The purpose of this research was to identify work environments, health promotion practices, and other characteristics associated with Pre-HT among adults aged 35 - 59 years. This cross-sectional research was performed from January to March of 2023 with 1,202 participants aged between 35 and 59 years chosen by a multistage random sampling. Data was through interviews utilizing a reliable structured questionnaire. The data analysis encompassed the use of descriptive statistics, and a generalized linear mixed model (GLMM) was executed to ascertain the adjusted odds ratio (Adj. OR) and 95% CI for the presented findings. The participants, 26.29% were between the ages of 40 and 41, and 66.97% were female. The overall prevalence of Pre-HT was 73.55% (95% CI: 70.98 - 75.97). Results of the multivariable analysis revealed a strong association between Pre-HT and health promotion behavior (HPB) (Adj. OR = 1.84, 95% CI: 1.31 - 2.57, P-value < 0.001) work environment (Adj. OR = 2.07, 95% CI: 1.32 - 3.26, P-value = 0.006), gender (Adj. OR = 2.60, 95% CI: 1.89 - 3.57, P-value < 0.001), Age (Adj. OR = 1.70, 95% CI: 1.08 - 2.65, P-value = 0.050), history of smoking (Adj. OR = 2.60, 95% CI: 1.89 - 3.57, P-value < 0.001), Body mass index (Adj. OR = 2.09, 95% CI: 1.54 - 2.83, P-value < 0.001). Poor health promotion increased Pre-HT risk. Relevant authorities must evaluate group context to build a suitable health promotion model.

Keywords: Pre-hypertension; Health promotion behaviors; Work environment; Generalized Linear Mixed Model; Late Adulthood

1. Introduction

Since hypertension is a major cause of death for people with cardiovascular disease, attempts have been made to lessen the severity of hypertension situations globally (WHO, 2021). The prevalence of hypertension varies greatly between regions and genders. It is predicted that by 2025 the global population of late adulthood will suffer from hypertension, accounting for approximately 1.56 million people or 60 percent of the total global population (Kearney *et al.*, 2005). The National Health and Nutrition Examination Survey (NHANES) discovered pre-hypertension (Pre-HT) in 36.30 % of the

healthy late adulthood population (Curtin *et al.*, 2012). It also revealed the prevalence of Pre-HT in 29.10 % of the late adulthood population in Southeast Asian countries. Two-thirds of people with Pre-HT will become hypertensive within 4 years after the first diagnosis (Julius *et al.*, 2006). Half of all the patients with hypertension are not properly treated as they should be. Every year approximately 8.5 million people in low-income and middle-income countries die of hypertension (Zhou *et al.*, 2021).

The Thai Hypertension Society indicates that people aged 35 and over are more likely to

encounter hypertension than other age groups. In 2020, 2021, and 2022, groups of people at risk of high blood pressure were found to be 7.13%, 7.68%, and 8.09%, respectively (Health Data Center, 2022). In the next 15 years, it is forecasted that Thailand will spend a huge budget of 1.4 trillion baht per year to tackle this problem (Thailand Development Research Institute, 2018). Health indices show that the northeastern region of Thailand tends to have a high risk of illnesses such as low HDL-C levels and high triglycerides. Death rates from hypertension in 2018, 2019, and 2020 reported by health regional medical offices 7, 8, 9, and 10 are presented as follows; Health Region 7 had death rates of 9.73, 11.70, and 12.60. Health Region 8 had death rates of 7.55, 8.47, and 9.37. Health Region 9 found death rates of 11.16, 11.74, and 12.84. Health Region 10 showed death rates of 8.93, 9.01, and 10.96.

It has been significantly found that, apart from genetic factors, major causes of hypertension include currently changing lifestyles and behavioral traits (Grossman & Messerli, 2008), lack of physical exercise, body mass index (BMI), low income, smoking, and alcohol consumption (Carey *et al.*, 2018). Promoting healthy behaviors helps achieve good health outcomes. The combination of maintaining good lifestyles, health responsibility, and good environment management is all related to hypertension prevention (Pender *et al.*, 2015).

Most previous studies on health promoting behaviors of Pre-HT are concerned with the elderly and patients with hypertension. Those studies focus on the two groups as a whole without taking a closer look at separate specific age groups. However, the late adulthood context may yield different research results. The objective of this study was examined work characteristics, health-promoting behaviors, and factors related to pre-HT among adults in late adulthood living in the northeastern region of Thailand. The significance of this study is for designing appropriate health promotion programs consistent with the context to help reduce the occurrence of new patients with hypertension. Consequently, the purpose of this study was to determine the prevalence of Pre-HT and study

the association between work environment characteristics, health-promotion, and Pre-HT among late adult people in Thailand.

2. Methodology

The study employed a cross-sectional research design. The research investigation focused on a particular group of adults (35-59 years old) who showed signs of Pre-HT. The data collection took place in Regional Health Centers 7, 8, 9, and 10, which are located in northern region of Thailand. The research sample consisted of people between the ages of 35 and 59. Between January and March 2023, a series of structured questionnaires were distributed to a sample of individuals in the working aged group, namely those aged 35 to 59, residing in northern region of Thailand. The study aims to examine the variables associated with Pre-HT in the working adult population residing in the Northeast of Thailand. Developing appropriate health promotion treatments that are customized to the individual circumstances of older adults might provide advantages in minimizing or delaying the adverse outcomes linked to hypertension.

The researchers selected northeastern Thai participants using stratified sampling. There are four regional health systems: 7, 8, 9, and 10. Using Pre-HT criteria (blood pressure readings equal to or greater than 139/89), 1,202 working age individuals were selected by using multiple regression sample size calculation formula (Hsieh *et al.*, 1998). According to previous study that focused in patients with hypertension and its associated factor: The role of low health literacy in Turkey (Selcuk *et al.*, 2018).

2.1 Questionnaires

The questionnaires utilized in the study were designed as closed-ended and self-administered instruments. In this research, a modified questionnaire was utilized, consisting of six distinct sections: 1) Information pertaining to the characteristics of a population, such as age, gender, income, and education level. 2) Influence of environmental factors 3) Understanding the utilization of

natural remedies for the management of hypertension 4) Concept of health literacy, as derived from a self-administered questionnaire known as HLS-EU-Q47. The two constructs being measured in this research are health promotion behavior, which is based on the Health Promoting Lifestyle Profile II (HPLP II), and depression, which is adapted from the Department of Mental Health. Subsequently, the questionnaire was distributed to a cohort of five persons who hold specialized knowledge in the pertinent domain, in order to enhance its validity. Professional assessments produced item objective congruence ratings of 0.92, in each case. The questionnaire was later modified, and reliability testing was conducted. A thorough examination indicates that the information had a total of 119 enquiries, which may be efficiently categorized into separate groups. There is a cumulative sum of 17 requests pertaining to demographic data. 2) The influence of environmental factors assessment of proficiency in applied herbal remedies for hypertension was conducted using Cronbach's alpha coefficient, yielding a value of 0.70. This research further examined three constructs, namely health literacy, health promoting behavior, and depression, with corresponding Cronbach's alpha coefficients of 0.94, 0.91, and 0.82, respectively.

The final element of the study focused on queries related to the comprehension of herbal treatments for hypertension. This section had a total of 10 questions. There was a singular, precise answer for every inquiry. The participants were provided with instructions to only indicate the ideal response. The accurate responses were given a score of 1, but incorrect answers and incomplete phrases were given a score of 0. The knowledge scores were categorized into three distinct groups according to their cumulative values: poor, encompassing scores below 60% (ranging from 0 to 5); fair, including scores between 60% and 80% (ranging from 6 to 7); and good, consisting of scores equal to or exceeding 80% (ranging from 8 to 10). (Bloom, 1956)

The measure of health literacy consists of four components. The test comprised a total of 45 items, designed to assess four distinct competencies: access/obtain, understand, appraise, judge, or evaluate, and apply/use health information. The rating of each question

was conducted 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, problematic, sufficient, and excellent. The inadequate group had scores ranging from 0% to 50% (with corresponding ratings between 45 and 90). The problematic group included scores between 51% and 66% (with corresponding scores between 91 and 118). The sufficient group consisted of scores ranging from 67% to 84% (with corresponding scores between 119 and 151). Lastly, the excellent group encompassed values up to 85% (with corresponding scores between 152 and 180).

This study evaluated health-promoting behavior across five key domains. The instrument consisted of a total of 27 components. The potential ratings range from 1 to 4, with higher values indicating a propensity for good health-promoting behavior. The conduct was classified into three groups based on the mean, specifically good (3.01 - 4.00), fair (2.01 - 3.00), and poor (1.00 - 2.00). The research used the six-part Patient Health Questionnaire-9 (PHQ-9) to assess the frequency and severity of depressed symptoms throughout 14-day duration, as well as to ascertain the likelihood of having depression. The Patient Health Questionnaire-9 (PHQ-9) utilizes a 4-point Likert scale that spans from 0 (identifying the absence of an event) to 3 (representing an event occurring nearly every day), so producing a total score that runs from 0 to 27. The questionnaire is well recognized and respected on an international scale.

2.2 Blood pressure measure

The utilization of Automatic Blood Pressure (ABP) was employed for the purpose of measuring blood pressure. Subsequently, the mean of the second and third measures was utilized to document the final blood pressure readings of the participants. In the JNC7 guidelines, the classification of Pre-HT was revised and redefined as increased blood pressure. An individual with a systolic blood pressure (SBP) ranging from 120 to 139 mmHg and/or a diastolic blood pressure (DBP) ranging from 80 to 89 mmHg was classified as having Pre-HT.

2.3 Data and descriptive statistics

Data analyses were conducted using STATA statistical version 14. Descriptive statistics, including the percentage, minimum, maximum, mean, standard deviation (SD), and median, were used for the analysis of demographic data, the environment factor, and knowledge of herbal use to treat hypertension, health literacy, health-promoting behavior, and depression. GLMM was used to model the random effects and correlations inside clusters. In the modeling, residential regional health was set as the random effect. A bivariate analysis was performed to define the association of each independent variable with Pre-HT. The variables that were significant in the bivariate analysis with P-value < 0.05 were proceeded with for the multivariable analysis. The results of the final model define the magnitude of the association between independent variables and Pre-HT with an adjusted OR and its 95% CI. GLMM was performed to control the clustering effects.

2.4 Ethical approval

The study has been approved by the Institutional Review Board at Khon Kean

University (HE652233). The study ensured the autonomy of the respondents, in which each participant provided written informed consent. In order to maintain the confidentiality of the persons involved, pseudonyms were allocated. Furthermore, steps were implemented to preserve the confidentiality of the gathered data.

3. Results and Discussion

This observational found that the prevalence of Pre-HT was 73.55 (95% CI: 70.98 - 75.97) (Table 1). Eight thousand and five participants (66.97%) identified as females. The average age of the respondent was 45.86 years, with a standard deviation of 6.91. The mean systolic blood pressure (SBP) was 123.84 mmHg, with a standard deviation of 13.06. The mean diastolic blood pressure (DBP) was 78.85 mmHg, with a standard deviation of 10.81 (Table 2). Bivariate analyses were performed to determine factors associated with Pre-HT. As shown in Table 4, sex, age, status, education levels, occupation, household income, health insurance, history of smoking, body mass index, alternative treatment, herbal use, soft drink, work dilation, community, work environment, and health promotion behavior.

Table 1. Prevalence of Pre-HT among late adults (n = 1,202)

Factors	Number (%)	95%CI
Normal	318(26.45)	24.03-29.02
Pre-HT	884(73.55)	70.98-75.97

Table 2. Demographic characteristics of late adult with Pre-HT

Factors	Number	%
Gender		
Female	397	33.03
male	805	66.97
Age (years) (mean ± SD)	45.86 ± 6.91	
35 - 39	241	20.05
40 - 44	316	26.29
45 - 49	257	21.38
50 - 54	220	18.30
55 - 59	168	13.98
Status		
single	219	18.22
Married/co-inhabiting	875	72.80
separated/divorced/widowed	108	8.99

Table 2. Demographic characteristics of late adult with Pre-HT (Cont.)

Factors	Number	%
Educational Levels		
Illiterate	5	0.42
Primary school	511	42.51
High school diploma	354	29.45
College	61	5.07
master's degree or higher	120	9.98
151		12.56
Occupation		
Unemployed	29	2.41
Agriculturist	621	51.66
Private business	121	10.07
Government employee	250	20.80
Officer	55	4.58
housewife	42	3.49
employed	84	6.99
Household income		
none	48	3.99
≤ 5,000 Bath	244	20.30
5,001 – 10,000 Bath	358	29.78
10,001 – 15,000 Bath	185	15.39
> 15,000 Bath	367	30.53
Adequacy of income		
No	562	46.76
Yes	640	53.24
Healthcare coverage		
private health insurance	44	3.66
Social security scheme	311	25.87
Universal coverage scheme	764	63.56
Government officer	83	6.91
Family history of hypertension		
No	455	37.85
Yes	747	62.15
Current smoking		
Never	1,013	84.28
Ex-smoker	62	5.16
Current smoker	127	10.57
Alcohol consumption		
Nondrinker	673	55.99
Ex-drinker	97	8.07
Current drinker	432	35.94
Physical activity		
Yes	703	58.49
No	499	41.51
BMI (kg/m²) (mean ± SD)		
	24.37 ± 4.19	
< 18.5	47	3.91
18.5-22.99	438	36.44
23-24.99	249	20.27
≥ 25	468	38.94
Waist circumference (cm) (mean ± SD)		
	88.88 ± 11.24	
Median (min-max)		
	82(50 - 165)	
Blood pressure (mmHg)		
SBP (mean ± SD)	123.84 ± 13.06	
DBP (mean ± SD)	78.85 ± 10.81	

Table 2. Demographic characteristics of late adult with Pre-HT (Cont.)

Factors	Number	%
Herbal Medicine Use		
Alternative treatment		
physician diagnosis	873	72.63
Use of herbal	55	4.58
Take the medicine	20	1.66
Chang Behavior	254	21.13
Herbal consumer		
No	613	51.00
few use	177	14.73
Sometime use	354	29.45
frequently used	31	2.58
regular use	27	2.25
Life style		
Type of rice consumer		
Sticky rice	831	69.13
cooked rice	298	24.79
brown rice	56	4.66
Rice Berry	17	1.41
Soft drink		
Not drink	218	18.14
< 1 time/month	194	16.14
1 - 3 time/month	426	35.44
1 - 3 time/week	209	17.39
4 - 6 time/week	81	6.74
> 6time/month	53	4.41
>1 time/day	21	1.75
Duration of work		
< 8 hr./day	462	38.44
8 - 10 hr./day	642	53.41
> 10 hr./day	98	8.15
Environment factor		
Communities		
semi-urban	186	15.47
rural	841	69.97
Urban	175	14.56
Work environment		
outdoor	187	15.56
indoor	461	38.35
outdoor switch indoor	554	46.09
Environment pollution		
low level	1086	90.35
Moderate level	116	9.65

The multivariable analysis for associated factors of Pre-HT was identified by using the Generalized Linear Mixed Model (GLMM) to control the clustering effect of the sampling selection of the participants. Factors that were significantly associated with Pre-HT in participants included: outdoor place of work (Adj. OR = 2.07, 95% CI: 1.32 - 3.26) and outdoor alternate indoor (Adj. OR = 1.12, 95%

CI: 0.84 - 1.48, P-value = 0.006), Poor HPB (Adj. OR = 1.84, 95% CI: 1.13 - 2.57, P-value < 0.001), sex (Adj. OR = 2.60, 95% CI: 1.89 - 3.57, P-value < 0.001), age (Adj. OR = 1.70, 95% CI: 1.08 - 2.65) and (Adj. OR = 1.03, 95% CI: 0.77 - 1.37) P-value = 0.050), history of smoking (Adj. OR = 2.60, 95% CI: 1.89-3.57, P-value < 0.001), Body mass index (Adj. OR = 2.09, 95% CI: 1.54-2.83, P-value < 0.001) (Table 5).

Table 3. Predisposing factors of late adult with Pre-HT among late adults

Factors	Number	%
Health-promoting behavior		
Good (3.01 - 4.00)	168	13.98
Fair (2.01 - 3.00)	724	60.23
Poor (1.00 - 2.00)	310	25.79
Knowledge on the use of herbs		
Low (< 60%)	426	35.44
Moderate (60-79.99)	566	47.09
High (≥ 80%)	210	17.47
Health literacy (total)		
Inadequate (0 - 50%)	15	1.25
Problematic (51 - 66%)	68	5.66
Sufficient (67 - 84%)	887	73.79
Excellent (≥ 85%)	232	19.30
Depression		
None (< 7)	1,068	88.85
Mild (7 - 12)	119	9.90
Moderate (13 - 18)	15	1.25

Table 4. Bivariate analysis for factors associated with Pre-HT among late adults

Factors	Number	Pre-HT (%)	Crude OR	95%CI	P-value
Gender					
Female	805	68.20	ref	ref	< 0.001
male	397	84.32	2.51	1.84 - 3.43	
Age (years)					
35 - 44	557	71.27	ref	ref	0.024
45 - 54	477	73.38	1.11	0.84 - 1.46	
≥ 55	168	81.55	1.78	1.15 - 2.74	
Status					
single	219	69.86	ref	ref	0.099
Married/co-inhabiting	875	75.20	1.30	0.94 - 1.81	
separated/divorced/widowed	108	67.59	0.89	0.54 - 1.47	
Educational Levels					
College/master's degree or higher	516	78.10	ref	ref	<0.001
High school/diploma	415	73.01	1.86	1.34 - 2.58	
Illiterate/Primary school	271	65.68	1.41	1.01 - 1.96	
Occupation					
Unemployed /housewife	71	73.24	ref	ref	0.017
Agriculturist	621	77.29	1.24	0.71 - 2.17	
Private business /employed	205	72.20	0.94	0.51 - 1.74	
Government employee	250	66.00	0.70	0.39 - 1.27	
Officer	55	70.91	0.89	0.40 - 1.95	
Household income					
> 15,000 Bath	835	75.33	ref	ref	0.035
≤ 15,000 Bath	367	69.48	1.34	1.02 - 1.76	
Healthcare coverage					
Government officer /Social security scheme	394	67.77	ref	ref	0.006
Universal coverage scheme	764	76.18	1.52	1.16 - 1.99	
private health insurance	44	79.55	1.84	0.86 - 3.96	
Family history of hypertension					
No	455	72.09	ref	ref	0.372
Yes	747	74.43	1.12	0.86 - 1.46	

Table 4. Bivariate analysis for factors associated with Pre-HT among late adults (Cont.)

Factors	Number	Pre-HT (%)	Crude OR	95%CI	P-value
Current smoking					
Never	1,013	71.47	ref	ref	
Ex-smoker	62	83.87	2.07	1.04 - 4.13	
Current smoker	127	85.04	2.26	1.36 - 3.76	0.505
Physical activity					
Yes	703	58.49	ref	ref	
No	499	41.51	1.09	0.84 - 1.41	
BMI (kg/m²)					
Low/normal (< 23)	485	67.10	ref	ref	
Over weight (23 - 24.99)	249	73.49	1.36	0.97 - 1.91	
Obesity (≥ 25)	468	80.34	2.01	1.49 - 2.70	<0.001
Waist circumference (cm)					
(< 80 cm.for women, < 90 cm. for men)	561	71.84	ref	ref	
(≥ 80 cm.for women, ≥ 90 cm. for men)	641	75.04	1.18	0.91 - 1.52	0.209
Alternative treatment					
physician diagnosis	254	66.54	ref	ref	
Use of herbal /Take the medicine	75	70.67	1.21	0.69 - 2.12	
Chang Behavior	873	75.83	1.57	1.16 - 2.13	0.012
Herbal consumer					
Yes	589	70.80	ref	ref	
No	613	76.18	1.31	1.02 - 1.70	0.034
soft drink					
Not drink	218	72.94	ref	ref	
< 1 time/month	194	65.98	0.71	0.47 - 1.09	
1 - 3 time/ month	426	77.70	1.29	0.88 - 1.88	
1 - 3 time/ week	209	74.16	1.06	0.69 - 1.63	
≥ 4 - 6 time/week	155	71.61	0.93	0.59 - 1.48	0.045
Duration of work					
≥ 8 hr./day	740	70.95	ref	ref	
< 8 hr./day	462	77.71	1.42	1.08 - 1.87	0.009
Environment factor					
Communities					
semi-urban	186	73.66	ref	ref	
rural	841	75.15	1.08	0.75 - 1.55	
Urban	175	65.71	0.68	0.43 - 1.07	0.041
Work environment					
indoor	461	69.41	ref	ref	
outdoor alternate indoor	554	73.29	1.21	0.91 - 1.58	
outdoor	187	84.49	2.40	1.54 - 3.73	<0.001
environment pollution					
low level	1,086	74.03	ref	ref	
Moderate level	116	68.97	0.77	0.51 - 1.81	0.246
Knowledge of the use of herbs					
Low	426	70.66	ref	ref	
Moderate	566	75.27	1.26	0.95 - 1.67	
High	210	74.76	1.23	0.84 - 1.78	
Health literacy					
Sufficient /Excellent	1,114	73.52	ref	ref	
Inadequate/ Problematic	88	73.86	1.01	0.62 - 1.66	0.943

Table 4. Bivariate analysis for factors associated with Pre-HT among late adults (Cont.)

Factors	Number	Pre-HT (%)	Crude OR	95%CI	P-value
health-promoting behavior					
Good / Fair	892	71.64	ref	ref	0.090
Poor	310	79.03	1.49	1.09 - 2.03	
Depression					
None (< 7)	1,068	74.53	ref	ref	0.090
Mild (7-12)	119	66.39	0.67	0.45 - 1.01	
Moderate (13 - 18)	15	60.00	0.51	0.18 - 1.45	

Table 5. Multivariable analysis of factor Associated with Pre-HT by using the GLMM

Factors	Number	% of Pre HT	Crude odds Ratio	Adj. odds Ratio	95%CI	P-value
Work environment						0.006
indoor	461	69.41	1	1		
outdoor alternate indoor outdoor	554	73.29	1.21	1.12	0.84 - 1.48	
Health-promoting behavior						< 0.001
Good / Fair	892	71.64	1	1		
Poor	310	79.03	1.49	1.84	1.31 - 2.57	< 0.001
Sex						
female	805	68.20	1	1		< 0.001
male	397	84.38	2.51	2.60	1.89 - 3.57	
Age						0.050
35 - 44	557	71.27	1	1		
45 - 54	477	73.38	1.11	1.03	0.77 - 1.37	
≥ 55	168	81.55	1.78	1.70	1.08 - 2.65	< 0.001
Current smoking						
Never	1,013	71.47	1	1		
Ex-smoker	62	83.87	2.07	2.28	1.14 - 4.59	< 0.001
Current smoker	127	85.04	2.26	2.31	1.37 - 3.90	
BMI (kg/m²)						< 0.001
Low/normal (< 23)	485	67.10	1	1		
Over weight (23 - 24.99)	249	73.49	1.36	1.34	0.95 - 1.91	
Obesity (≥ 25)	468	80.34	2.01	2.09	1.54 - 2.83	

Pre-HT is on the rise and is a problem for the public health system in Thailand. This research showed that the prevalence of Pre-HT in late adulthood in Thailand was 51.74% (95% CI, 48.91 – 54.56), and primary hypertension was 21.79 (95% CI: 19.55 – 24.22). This data lies within the prevalence of Pre-HT (43.20%) in India, 35.1% in Bangladesh and 25.2% in Nepal reported by the studies in South Asia. (Rahut *et al.*, 2023) Therefore, the current investigation revealed a higher frequency of Pre-HT compared to the survey conducted in 2004 (Aekplakorn *et al.*, 2004).

In relation to the domain of work environment, it has been shown that working outdoors and working indoors alternately outdoors were risk factors for Pre-HT

obtained in this research is deemed statistically significant. However, the data collection period was in the winter in Thailand. Extremely cold weather changes cause blood pressure levels to fluctuate. These findings align with the results reported by Hu *et al.* (2021) who found that the winter season increased BP for all participants, which makes hypertension prevalence increase if temperature reduce. It was similar to the results of Chen *et al.* (2014) found that ambient temperature in China correlates with upper and lower blood pressure levels.

The majority of the participants in this study lived in rural areas, as evidenced by our findings, which indicated that a group with HBP of poor had a risk of Pre-HT

(Chantakeeree *et al.*, 2021). There was additional information that rural people have poorer perceived self-efficacy and health-promoting behaviours than those in urban areas. Our results were similar to those of a previous study by Ho *et al.* (2012). It was found that self-awareness of the health status of hypertensive patients in Vietnam was a factor associated with the health-enhancing behaviours of hypertensive patients in Vietnam. Hosseini *et al.* (2014) found that poor health behaviours in stress management and nutrition were more common among hypertensive patients. However, the subjects were adults and still working. High responsibilities and a lot of social interactions, can be either health promotion or an obstacle to good behavior (Lee *et al.*, 2013). Pre-HT usually has no obvious symptoms and can lead a normal daily life. Therefore, the respondents thought that their current health was no different from that of people of the same age who do not have the disease (Jariyasakulwog *et al.*, 2015).

This research revealed that those with males were at risk of Pre-HT among late adults. The male had a 2.6 times higher risk of getting Pre-HT as compared to the female. The protective effect of endogenous estradiol hormone in women may account for these findings; however, some of the female participants in this study may not have reached menopause, which shields them from developing pre-HT; this could be the result of behavioural lifestyle factors and nutritional considerations. The results of this research are similar to those of Chen & Yuan (2018), who found that males are more likely to have a higher risk of Pre-HT than females. The study of Lydia *et al.*, (2021) among midlife and late-life Indonesians was significantly associated with Pre-HT.

The study demonstrated that participants who were over 45 years old were more likely to be at risk Pre-HT as compared to those 35 - 44 years old. As age increases, so does the risk of high blood pressure. The reasons for high blood pressure due to hardening of the arteries, decreased kidney function, greater body sensitivity to salt and lifestyle factors, and hormonal changes. The study report

by Jiang *et al.*, 2021 result was confirmed that the increase in blood pressure in late adult was caused by differences in social life and individual lifestyle. The risk of Pre-HT is increasing with the increase of age. A similar result was also found in another study conducted among the Pre-HT group in Vietnamese with 45 - 54 years old. However, the study population-based surveys used single visits as well, and hence our results are well comparable with our results. Apidechkul *et al.* (2023) found a similar result of an association between older age and Pre-HT among the hill tribe adults aged 30 – 59 years in Thailand.

The results of this research which found that those who currently smoking and ever smoked fold risk of getting Pre-HT are similar to the previous report Neema *et al.* (2017) Participants who were current cigarette smokers had elevated blood pressure as compared to non-smokers. A previous study by Song *et al.* (2018) illustrated that smoking was a significant risk factor for Pre-HT among China population. This may be due to the various standards of smoking. It was suggested by JNC-7 that lifestyle modifications, including quitting smoking, might be beneficial to the prevention of prehypertension. A previous study show that Smoking has interacted with obesity on NCD risk, Moreover, this research was the overweight and obese group to the most proportion.

The positive associations of Pre-HT with a BMI of 25 or more had more risk to have Pre-HT than late adult with normal BMI. observed in this survey were consistent with the results of previous studies in Soutl Asia (Rahut *et al.*, 2023) participant who were overweight and obesity had higher risk of developing Pre-HT. Jian *et al.* (2018) found that group of overweight and obese individuals had almost one to two times higher odds of being Pre-HT compared to the ones with normal weigh. The reason for the relationship between increased BMI and Pre-HT in adults was found elevated fatty tissue levels in obese individuals, may increase vascular resistance and in turn increase the workload required for the heart to pump blood throughout the body.

The current study has some limitations. Firstly, the limitation was that study cross-sectional design was not adequate to prove the real causal relationship of the disease. However, it was appropriate to estimate disease prevalence. Second, Our study was conducted in the Northeast of Thailand and not in other regions, so generalizing our results to Thailand might be uncovering, however, the characteristics of the population of the Northeast was comparable to those of all Thai, which is mixed between urban and rural population. The main strength of the present study was a large sample size from Northeast Thailand which provides new data about the prevalence of prehypertension.

4. Conclusion

This research is Thailand's first on Pre-HT in late adulthood. Work environment, HPB, sex, age, current smoking, and BMI were associated with Pre-HT. It may also be important to identify barriers to screening services for early Pre-HT and HT identification. Health promotion program development and implementation

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