

Original Article

Prevalence of and factors associated with hypertension among the hill tribe population aged 35 years and over in northern Thailand: a cross-sectional study

Kanya Somprasong^{1,2}, Tawatchai Apidechkul^{2,3}, Niwed Kullawong², Panupong Upala³, Ratipark Tamornpark³, Chalitar Chomchoei⁴, Fartima Yeemard³, Siriyaporn Khunthason^{2,3}, Vivat Keawdounglek², Chanyanut Wongfu²

¹Chiang Rai Prachanukroh Hospital, Chiang Rai, Thailand; ²School of Health Science, Mae Fah Luang University, Thailand; ³Center of Excellence for Hill Tribe Health Research, Mae Fah Luang University, Thailand; ⁴Chulabhorn Royal Academy, Bangkok, Thailand

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Abstract: Background: Hypertension (HT) is a serious noncommunicable disease that can lead to several health problems when it is not detected or is not properly diagnosed and treated in a timely manner, particularly in individuals living in poor economic and education conditions. The hill tribe population in northern Thailand is a vulnerable population with limited information available regarding HT. Methods: The study aimed to estimate the prevalence of HT and to determine the factors associated with HT among individuals from hill tribes aged 35 years and over and living in northern Thailand. A cross-sectional study was conducted to gather essential information from six main hill tribe groups: the Akha, Lahu, Karen, Hmong, Yao and Lisu tribes in Chiang Rai Province. A simple random method was used to select 30 hill tribe villages (5 villages for each tribe). People aged 35 years and over who lived in the selected villages were invited to participate in the study. A validated questionnaire and a 5-mL blood specimen were used as research instruments. A face-to-face interview was conducted to collect data after informed consent was obtained, and 5-mL blood specimens were drawn to determine the lipid profiles of the participants. Logistic regression was performed to determine the factors associated with HT at the significance level of $\alpha = 0.05$. Results: A total of 1,287 participants were recruited into the study: 60.5% were females, 30.4% were aged 35-44 years, 65.4% were illiterate, and 83.1% were married. The overall prevalence of HT was 24.3%, and the Yao tribe had the highest prevalence at 18.5%. In the multivariable analysis, three variables were found to be associated with HT: marital status, ability to read Thai, and exercise behavior. Those who were single and divorced had a 2.55 (95% CI = 1.23-5.06) and 2.69 times greater chance (95% CI = 1.10-6.59), respectively, of developing HT than those who were married. Those who could not read Thai had a 2.13 times greater chance (95% CI = 1.50-3.01) of developing HT than those who could read, and those who did not exercise and who exercised sometimes had a 1.96 (95% CI = 1.07-3.58) and 2.24 times greater chance (95% CI = 1.21-4.13), respectively, of developing HT than those who regularly exercised. Conclusion: A health screening program for the identification of new HT among the hill tribe population urgently needs to be implemented, followed by the introduction of a proper exercise program to reduce the risk of HT, particularly for those who are illiterate and for single or divorced people.

Keywords: Hypertension, hill tribe, associated factor, prevalence, noncommunicable disease

Introduction

Hypertension (HT) or high blood pressure is a serious medical condition that can lead to other severe complications, such as heart attack, stroke, heart failure, and kidney disease [1]. HT has been recognized as a major cause of premature death worldwide [1]. Moreover, the reduction of noncommunicable diseases is an urgent global agenda that has been commonly raised and discussed among the global health professional community [2].

In 2019, the World Health Organization (WHO) estimated that 1.13 billion people suffered from HT globally, and two-thirds lived in low- and middle-income countries [3]. The WHO also reported that males (25.0%) were at greater risk for HT than females (20.0%) and that 25.0% of individuals with HT could not control their blood pressure after treatment, particularly those people aged 35 years and over.

In 2018, approximately 23 million people (prevalence of 24.7%) were reported to suffer from

HT in Thailand, and more than half did not know their HT status [4]. In 2019, more than 6 million individuals with HT were registered for treatment nationally, with the total cost of all medical expenses required being 48,000 million baht per year [5]. Many factors are known to cause HT in different populations, such as high-salt diets [6], stress [7], and low physical activity [8]. Regarding public health screening programs conducted for people with no symptoms living in the community, very few people in Thailand had HT that was detected, diagnosed early and treated properly, particularly among those who were from poor families and living in remote areas [9]. Persons who are at risk for HT are not only those with high socioeconomic status but also those with poor economic and education status [10, 11], including the hill tribe people living in northern Thailand [12].

The hill tribe people have migrated from south China into the northern region of Thailand over the course of the century [13, 14]. There are six main groups: Akha, Lahu, Hmong, Yao, Karen, and Lisu [15]. In 2018, there were approximately 3.5-4 million hill tribe people living in Thailand [16]. The hill tribe people have their own languages, cultures, beliefs and lifestyle, particularly regarding daily cooking styles and preferred flavorings. Moreover, they are now living under mobilization and globalization situations, meaning that they are exposed to people outside their villages for work or other purposes. As a result of several conditions related to changes in lifestyle, including mainstream advertisements from different food and beverage companies through various channels, such as television, Facebook, and other media, hill tribe people have become vulnerable to and suffer from HT. Therefore, this study aimed to estimate the prevalence of HT and to determine factors associated with HT among the hill tribe population aged 35 years and older living in Thailand. These findings could be used for policy and public health intervention development in the future to address HT among the hill tribe people in Thailand.

Material and methods

Study design

A cross-sectional study design was applied to collect data from the participants between April 2019 and August 2019.

Study setting

The study settings were randomly selected from the lists of the six main hill tribe villages in Chiang Rai Province, Thailand: Akha, Lahu, Hmong, Yao, Karen, and Lisu [16]. In total, 30 villages (5 villages for each tribe) were selected from 15 districts: Muang, Mae Suai, Wiang Chai, Doi Luang, Wiang Pa Pao, Mae Fah Luang, Chiang Saen, Waeng Kaen, Chiang Khong, Phan, Thoeng, Khun Tant, Mae Chan, Wiang Chiang Rung, and Pha Ya Meng Rai districts.

Study population

All the hill tribe people who were living in the selected villages at the time of data collection and were 35 years of age and over comprised the study population. Those who were unable to provide essential information related to the study protocols were excluded from the study.

Study sample

The study sample was calculated based on the standard formula for a cross-sectional study design [17]. Based on $Z = 1.96$, $P = 0.15$ [4], $Q = 0.85$, and $e = 0.05$, at total of 1,106 samples were required. Allowing for 10% error throughout the study process, 1,228 individuals were needed for the analysis.

Research instruments and measurements

A questionnaire was developed based on the information found in a review of the literature; the questionnaire consisted of four (4) parts. In part one, 9 questions were used to collect the general information of the participants. In part two, 12 questions were used to collect information regarding the health behaviors of the participants. In part three, 20 questions were used to collect information on the participants' knowledge of and attitudes toward HT prevention and control. In part four, 8 items involved laboratory results.

Stress was assessed by the standard form developed by the Department of Mental Health, Thailand. This form includes five questions answered on a 4-point ranking scale (0-3), with a total possible score of 20 [18]. Those who scored from 0 to 4 were defined as having low stress, those who scored from 5 to 9 were defined as having moderate stress, and those scored from 10 or more were defined as having

high and severe stress. Body mass index (BMI) was classified into three categories: ≤ 18.5 kg/m² was underweight, 18.51-22.99 kg/m² was normal, and ≥ 23 kg/m² was overweight. Lipid profiles were detected for total cholesterol, low-density lipoprotein (LDL), high-density lipoprotein (HDL), and triglycerides. Hemoglobin A1C (HbA1c) was one biomarker detected in the laboratory.

HT was defined according to the classification of the American College of Cardiology as diastolic blood pressure ≤ 90 mmHg, systolic blood pressure ≤ 140 mmHg or both [19]. Blood pressure was measured three times in all participants at the 0-, 10-, and 15-minute points of the test.

The questionnaire's validity and reliability were improved before its use by item objective congruence (IOC) analysis and a pilot test. The IOC analysis aimed to assess the validity of the questionnaire by three experts in the field: a medical doctor, a public health expert, and an epidemiologist. Questions with scores less than 0.5 were excluded, those with scores of 0.5-0.69 were revised, and those with scores greater than 0.7 were defined as acceptable to use.

A pilot test was conducted to assess the feasibility and order of the questions for examining similar characteristics among the 15 tribes of the study population who were living in two hill tribe villages in Mae Chan District, Chiang Rai Province. Cronbach's alpha was 0.71 for part 3, knowledge of and attitudes toward HT prevention and control.

Data collection procedure

Permission to enter the villages was granted by the district officers. Afterward, all targeted village headmen were contacted and provided complete information about the study. The individuals in the study population who met the inclusion criteria were given essential information regarding the study protocols and procedures 5 days prior to data collection. An informed consent form was obtained from the individuals before data collection and blood specimen collection. Specimens were transferred to the Mae Fah Laung Medical Laboratory Center on the same day for laboratory analysis to identify biomarkers.

Data analysis

Data were double-entered into an Excel sheet before being transferred into the SPSS program (Version 24, Chicago, IL), which was used for the analysis. Both categorical and continuous data were properly analyzed to describe the characteristics of the participants. Logistic regression was used to determine the factors associated with HT among the participants with a significance level of $\alpha = 0.05$.

Ethical considerations

The complete study proposal and its protocols were approved by the Institutional Review Board and Ethics Committee of Mae Fah Laung University (No. REH-61009).

Results

A total of 1,287 participants were recruited for the analysis. More than half of the participants were female (60.5%) and were married (83.1%). The average age was 52.2 years, and the proportion of participants among the different tribes was mostly the same (15.5-20.6%). A large proportion of the participants were Buddhist (52.8%) and illiterate (65.4%), but less than one-fifth were not employed (18.7%), and the median income level was 30,000 baht per year per family. Most participants were able to speak (57.9%) and understand (55.0%) Thai; however, three-fourths could not read (60.8%) or write (51.5%) Thai.

Less than half of the participants had been examined to determine their HT status in the previous year (45.5%). Only 6.1% and 9.8% knew the HT status of their father and mother, respectively (**Table 1**).

More than half of the participants (69.6%) had high LDL, 43.8% had high total cholesterol, 40.7% had high triglycerides, and 12.3% had an abnormal level of HbA1c (**Table 2**).

Regarding the health behaviors of the participants, 22.8% had quit or were current smokers, 29.6% had ever used or currently used alcohol, and 51.9% did not exercise. Approximately one-third of the participants used a high volume of salt (35.2%), monosodium glutamate (43.1%), and oil (30.1%) for cooking.

Table 1. General characteristics of the participants

Characteristics	n	%
Total	1,287	100.0
Sex		
Male	508	39.5
Female	779	60.5
Age (years)		
35-44	391	30.4
45-54	360	28.0
55-64	336	26.1
65-74	152	11.8
≥75	48	3.7
Mean = 52.2, SD = 11.6, Min. = 35, Max. = 90		
Tribe		
Akha	265	20.6
Lahu	212	16.5
Hmong	202	15.7
Yao	200	15.5
Karen	208	16.2
Lisu	200	15.5
Religion		
Buddhist	679	52.8
Christian	608	47.2
Education		
Illiterate	842	65.4
Primary school	267	20.7
Secondary to high school	151	11.7
University degree	27	2.2
Occupation		
Unemployed	241	18.7
Agriculturalist	659	51.2
Other	387	30.1
Annual income (baht)		
≤40,000	897	69.7
40,001-79,999	239	18.6
≥80,000	151	11.7
Marital status		
Single	54	4.2
Married	1,070	83.1
Divorced	26	2.1
Widowed	137	10.6
Ability to understand Thai		
Little	542	42.1
Yes	745	57.9
Ability to speak Thai		
Little	579	45.0
Yes	708	55.0
Ability to read Thai		
No	782	60.8

A large proportion of the participants had low knowledge (70.8%) and poor attitudes (86.3%) regarding HT prevention and control (**Table 3**).

The overall prevalence of HT among the participants was 24.3%: 29.0% in the Yao tribe, 26.2% in the Hmong tribe, 25.2% in the Lisu tribe, 25.0% in the Lahu tribe, and 22.1% in the Karen tribe. Among the participants with HT, 21.2% were detected as new cases or incident cases that had never previously known their HT status. Of those who were being treated for HT control, 35.3% had uncontrolled blood pressure. There was some difference in HT prevalence according to sex: the prevalence was 25.8% in males and 23.4% in females. However, the HT prevalences according to different age categories were mostly the same (range = 22.2-25.7%).

In the univariate model, seven variables were found to be associated with HT among the participants: marital status, ability to read Thai, ability to write Thai, alcohol use, exercise, the volume of monosodium glutamate used for cooking, and the volume of oil used for cooking.

In the multivariate model, only three variables remained associated with HT: marital status, ability to read Thai, and exercise. Participants who were single and divorced had a 2.55 (95% CI = 1.23-5.06) and 2.69 times (95% CI = 1.10-6.59) greater chance, respectively, of developing HT than those who were married. Those who could not read Thai had a 2.13 times (95% CI = 1.51-3.01) greater chance of developing HT than those who could, and those who did not exercise and exercised sometimes had a 1.96 (95% CI = 1.07-3.58) and 2.24 times (95% CI = 1.21-4.13), greater chance, respectively of developing HT compared with those who exercised regularly (**Table 4**).

Discussion

The prevalence of HT among hill tribe people aged 35 years and over was 23.4%, and higher proportions of HT were in some tribes than in other tribes,

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Little	134	10.4
Yes	371	28.8
Ability to write Thai		
No	791	61.5
Little	148	11.5
Yes	348	27.0
Blood pressure examined in prior year		
No	701	54.5
Yes	586	45.5
Knowledge of father's HT history		
No	1,208	93.9
Yes	79	6.1
Knowledge of mother's HT history		
No	1,161	90.2
Yes	126	9.8

were more likely to develop HT than those who could, and those who did not exercise or exercised sometimes were more likely to develop HT than those who regularly exercised.

The Department of Disease Control, Thailand, reported that the overall prevalence of HT among the Thai population varies according to age categories and tends to increase with age [4]. The prevalence of HT among people aged 15 years and over is 24.7% [19]. However, among people aged 35 years and over, HT is more serious among the hill tribe population than among the general Thai population, with an average prevalence of 21.67% [20].

Table 2. Biomarkers of the participants

Biomarkers	n	%
Triglycerides (mg/dL)		
Normal (≤ 149)	763	59.3
High (≥ 150)	524	40.7
HDL (mg/dL)		
Low (< 40)	702	54.5
Normal (≥ 40)	585	45.5
LDL (mg/dL)		
Normal (< 100)	391	30.4
High (≥ 100)	896	69.6
Total cholesterol (mg/dL)		
Normal (≤ 199)	723	56.2
High (≥ 200)	564	43.8
HbA1c (mg%)		
Normal ($< 6.0\%$)	1129	87.7
Prediabetes (6.0-6.4%)	64	5.0
Diabetes ($\geq 6.5\%$)	94	7.3
BMI (kg/m ²)		
Underweight (≤ 18.5)	73	5.7
Normal (18.5-22.9)	393	30.5
Overweight (≥ 23.0)	821	63.8

but the difference was not significant. Among the individuals with detected HT, 21.2% had never previously known their HT status, and 35.3% had uncontrolled blood pressure after treatment. Marital status, ability to read Thai, and exercise behavior were found to be associated with HT among the hill tribe populations. Individuals who were single or divorced were more likely to develop HT than those who were married. Participants who could not read Thai

In our study, it was found that one-fifth of the study population did not know their HT status, and one-third had uncontrolled blood pressure after treatment. A study in Thailand [21] reported that 29.0% of people aged 15 years and over with HT who lived in the community were not diagnosed, which is greater than our findings for the hill tribe population. The difference in these two proportions might be due to the different ages of the study population (15 years and over versus 35 years and over).

Furthermore, Meelab et al. [22] reported that more than half (54.4%) of HT patients in Thailand could not control their blood pressure, which is greater than the proportion we found for the hill tribe population. However, this observation may be due to the large proportion of individuals with HT in the hill tribe population whose HT has not been detected and who are therefore not enrolled in a treatment process.

In our study, we also found that hill tribe people who could not use Thai fluently were more likely to develop HT than those who could read Thai. In the health care system and services in Thailand, including all messages delivered to patients, clients, and the general population, information is available only in the Thai language. Improvements in the health-related information provided to individuals could lead to improved personal attitudes and skills, especially in the prevention and control of public health problems such as HT. Without a doubt, under conditions of poor education, as is the case for the hill tribes, the understanding of

Table 3. Health behaviors and knowledge of and attitudes toward HT prevention and control among the participants

Health behaviors	n	%
Smoking		
No	993	77.2
Quit	178	13.8
Yes	116	9.0
Alcohol use		
No	906	70.4
Quit	258	20.0
Yes	123	9.6
Exercise		
No	668	51.9
Sometimes	521	40.5
Regularly	98	7.6
Salt use for cooking		
A lot	452	35.2
Moderate	727	56.5
Little	108	8.3
Monosodium glutamate use for cooking		
A lot	554	43.1
Moderate	681	52.9
Little	52	4.0
Oil use for cooking		
A lot	387	30.1
Moderate	703	54.6
Little	197	15.3
Stress (ST-5)		
Low	1,012	78.6
Moderate	222	17.2
High and severe	53	4.2
Knowledge of HT prevention and control		
Low	911	70.8
Moderate	226	17.6
High	150	11.6
Attitudes toward HT prevention and control		
Poor	1,111	86.3
Moderate	146	11.3
High	30	2.4

essential information regarding HT prevention and control that is available in Thai only is severely limited; thus, these individuals become vulnerable to developing HT. This observation is consistent with those of several studies in different settings showing that the language used to deliver health messages and health education was a serious barrier to the improvement of many chronic noncommunicable diseases [14, 23-25].

Marital status was indicated as a factor associated with HT in our study. Single and divorced individuals were more likely to develop HT than married individuals. A study conducted in Iran in 2019 [26] reported that among men, single men had a higher risk of developing HT than other groups; however, among women, married women had a higher risk of developing HT than other groups. A study in the United States [27] demonstrated that single women were at a higher risk of developing hypertension than other groups, but men who were married and men with a change in marital status had a higher risk of developing HT than other groups. In a study in Ghana [28], it was found that married women had a significantly greater risk of developing HT than other groups, while no association was found between marital status and HT development among men. The different associations between marital status and HT in different groups of people could be explained by the differences in culture and lifestyle in certain populations. In the hill tribes in Thailand, females do the majority of the cooking and preparation of food for family members [13, 16, 29, 30], while those who are single or who are not in a relationship tend to consume food that is prepared outside of the family and are more likely to eat food from restaurants, where they cannot control the volumes of salt, monosodium glutamate and oil used, which may impact their health and HT status later.

Several intervention and observation studies have clearly demonstrated the effectiveness of exercise for reducing and preventing HT in different populations. A systematic meta-analysis [31] reported that aerobic exercise could significantly reduce both systolic and diastolic blood pressure, as well as heart rate, among hypertensive patients. Lopes et al. [32] also reported that in the intervention group, exercise could reduce blood pressure and effectively help in the management of hypertension compared with the control group. Another systematic review [33] clearly showed that regular exercise could reduce blood pressure, particularly among individuals with chronic kidney disease.

There were some limitations throughout the study. First, the participants were asked about

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Table 4. Univariate and multivariate analyses for the determination of the factors associated with HT among the hill tribe population aged 35 years and above

Factors	HT				OR	95% CI	p-value	OR _{adj}	95% CI	p-value
	Yes		No							
	n	%	n	%						
Total	313	24.3	974	75.7	N/A	N/A	N/A			
Sex										
Male	131	25.8	377	74.2	1.14	0.88-1.45	0.322			
Female	182	23.4	597	76.6	1.00					
Age (years)										
35-44	98	25.1	293	74.9	1.00					
45-54	80	22.2	280	77.8	0.85	0.61-1.20	0.360			
55-64	84	25.0	252	75.0	1.00	0.71-1.40	0.984			
65-74	39	25.7	113	74.3	1.03	0.67-1.59	0.886			
≥75	12	25.0	36	75.0	1.00	0.50-2.00	0.992			
Religion										
Buddhist	172	25.3	507	74.7	0.89	0.69-1.15	0.372			
Christian and Muslim	141	23.2	467	76.8	1.00					
Tribe										
Akha	52	19.6	213	80.4	0.71	0.46-1.11	0.132			
Lahu	53	25.0	159	75.0	0.94	0.62-1.52	0.907			
Hmong	53	26.2	149	73.8	1.04	0.67-1.62	0.866			
Yao	58	29.0	142	71.0	1.20	0.77-1.86	0.432			
Karen	46	22.1	162	77.9	0.83	0.53-1.31	0.422			
Lisu	51	25.5	149	74.5	1.00					
Education										
No education	232	27.6	610	72.4	1.08	0.45-2.60	0.852			
Primary school	51	19.1	216	80.9	0.68	0.27-1.68	0.398			
Secondary to high school	23	15.2	128	84.8	0.51	0.20-1.35	0.177			
University degree	16	25.9	20	74.1	1.00					
Occupation										
Unemployed	65	27.0	176	73.0	1.00					
Agriculturalist	168	25.5	491	74.5	1.41	0.97-2.06	0.069			
Other	80	20.7	307	79.3	1.31	0.97-1.78	0.077			
Annual income (baht)										
≤40,000	218	24.5	679	75.5	1.24	0.81-1.90	0.314			
40,001-79,999	64	26.8	175	73.2	1.42	0.87-2.31	0.162			
≥80,000	31	20.5	120	79.5	1.00					
Marital status										
Single	22	40.7	32	59.3	2.34	1.34-4.10	0.003*	2.55	1.23-5.06	0.007*
Widowed	37	27.0	15	73.0	1.26	0.84-1.89	0.263	1.03	0.62-1.41	0.740
Divorced	11	42.3	100	57.7	2.50	1.13-5.51	0.023*	2.69	1.10-6.59	0.030*
Married	243	22.7	827	77.3	1.00			1.00		
Ability to understand Thai										
Little	145	26.8	397	73.2	1.25	0.97-1.62	0.083			
Yes	168	22.6	577	77.4	1.00					
Ability to speak Thai										
Little	153	26.4	426	73.6	1.23	0.95-1.59	0.112			
Yes	160	22.6	548	77.4	1.00					
Ability to read Thai										
No	220	28.1	526	71.9	1.84	1.35-2.51	<0.001*	2.13	1.51-3.01	<0.001*
Little	28	20.9	106	79.1	1.24	0.76-2.04	0.388	1.43	0.86-2.37	0.170
Yes	65	17.5	306	82.5	1.00					

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Ability to write Thai										
No	217	27.4	574	72.6	168	1.23-2.29	0.001*			
Little	32	21.6	116	78.4	1.22	0.76-1.97	0.405			
Yes	64	18.4	284	81.6	1.00					
Knowledge of father's HT history										
No	295	24.4	913	75.6	1.00					
Yes	18	22.8	61	77.2	0.91	0.53-1.57	0.743			
Knowledge of mother's HT history										
No	290	25.0	871	75.0	1.00					
Yes	23	18.3	103	81.7	0.67	0.42-1.07	0.097			
Triglycerides										
Normal	173	22.4	550	77.6	1.00					
High	140	27.1	424	72.9	1.29	1.00-1.66	0.054			
HDL										
Low	162	23.1	540	76.9	0.86	0.67-1.11	0.255			
Normal	151	25.8	434	74.2	1.00					
LDL										
Normal	101	25.8	290	74.2	1.00					
High	212	26.3	684	23.7	0.89	0.68-1.17	0.404			
Total cholesterol										
Normal	173	23.9	550	76.1	1.00					
High	140	24.8	424	75.2	1.05	0.81-1.36	0.711			
HbA1c										
Normal	279	24.7	850	75.3	1.00					
Prediabetes	10	15.6	54	84.4	0.56	0.28-1.12	0.103			
Diabetes	24	25.5	70	74.5	1.05	0.64-1.69	0.860			
BMI										
Normal	17	23.3	56	76.7	1.00					
Underweight	84	21.4	309	78.6	1.12	0.62-2.02	0.716			
Overweight	212	25.8	609	74.2	1.28	0.96-1.71	0.092			
Smoking										
No	241	24.3	752	75.7	1.00					
Quit	39	21.9	139	78.1	0.88	0.60-1.29	0.497			
Yes	33	28.4	83	71.6	1.24	0.81-1.91	0.324			
Alcohol use										
No	228	25.2	678	74.8	1.00					
Quit	49	19.0	209	81.0	0.70	0.49-0.99	0.041*			
Yes	36	29.3	87	70.7	1.23	0.81-1.87	0.329			
Exercise										
No	172	25.7	496	74.3	2.08	1.15-3.76	0.015*	1.96	1.07-3.58	0.028*
Sometimes	127	24.4	394	75.6	1.93	1.06-3.52	0.031*	2.24	1.21-4.13	0.010*
Regular	14	14.3	84	85.7	1.00			1.00		
Salt use for cooking										
A lot	111	24.6	341	75.4	1.00					
Moderate	180	24.8	547	75.2	1.01	0.77-1.33	0.938			
Little	22	20.4	86	79.6	0.79	0.47-1.32	0.359			
Monosodium glutamate use for cooking										
A lot	150	27.1	404	72.9	1.00					
Moderate	156	22.9	525	77.1	0.80	0.62-1.03	0.092			
Little	7	13.5	45	86.5	0.42	0.19-0.95	0.037*			
Oil use for cooking										
A lot	101	26.1	286	73.9	1.00					
Moderate	177	25.2	526	74.8	0.95	0.72-1.27	0.739			
Little	35	17.8	162	82.2	0.61	0.40-0.94	0.025*			

Stress (ST-5)								
Low	241	23.8	771	76.2	1.00			
Moderate	54	24.3	168	75.7	1.03	0.73-1.44	0.872	
High and severe	18	34.0	35	66.0	1.65	0.92-2.96	0.096	
Knowledge of HT prevention and control								
Low	219	24.0	692	76.0	0.84	0.57-1.24	0.358	
Moderate	53	23.5	173	76.5	0.81	0.51-1.31	0.395	
High	41	27.3	109	72.7	1.00			
Attitudes toward HT prevention and control								
Low	272	24.5	839	75.5	1.30	0.53-3.21	0.574	
Moderate	35	24.0	111	76.0	1.26	0.48-3.33	0.640	
High	6	20.0	24	80.0	1.00			

*Significant at $\alpha = 0.05$.

the volumes of salt, monosodium glutamate and oil used in their cooking. The answers provided might differ based on individual perception. Most people eat lunch from restaurants; thus, they cannot control the ingredients used. Second, some people could not clearly understand the questions, particularly those people aged 50 years and over. However, local translators who were fluent in both Thai and the local language were asked to help participants complete the questionnaire. Last, answers about the parental history of HT might not be accurate, particularly in participants older than 50 years, because in many cases, their parents had died, and no medical history was available.

Conclusion

The hill tribe people in Thailand live under poor education and economic conditions. Their understanding of health information released by health professionals is very limited due to their lack of proficiency in the Thai language, particularly in reading Thai. These conditions and the lack of understanding might make these individuals less empowered to improve their knowledge of and attitudes toward lifestyle behaviors that can protect themselves and their family from HT. Given their recent exposure to globalization and mobilization, the hill tribe people are becoming a new vulnerable population for HT, with a higher prevalence of HT among individuals aged 35 years and above than in the general Thai population of the same age. The unknown HT status of those living in the hill tribe community is a problem, and an effective public health screening program is urgently needed to identify these individuals and provide them with a proper pre-

vention and treatment program. A treatment outcome monitoring program for those who are on medications is also critical for the reduction of disease complications.

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Disclosure of conflict of interest

None.

Address correspondence to: Tawatchai Apidechkul, School of Health Science, Mae Fah Luang University, 333 Moo 1, Ta Sud Subdistrict, Muang District, Chiang Rai Province 57100, Thailand. Tel: +66-53916914; E-mail: Tawatchai.api@mfu.ac.th

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