

Burden and Factors Associated with Hypertension Among the Adult Population of the Lisu Hill Tribe, Northern Thailand

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ABSTRACT

Introduction: Hypertension (HT) is a serious silent disease that can lead to difficult complications, particularly in individuals living with unhealthy behaviors and those with poor socioeconomic status. The Lisu hill tribe in Thailand is vulnerable to HT due to their poor socioeconomic status. **Objective:** This study aimed to estimate the magnitude of HT and identify the factors associated with HT among the Lahu hill tribe population aged 30 years and over in Thailand. **Methods:** A cross-sectional study was conducted with the aim of assessing several factors relevant to the sociodemographic and health behaviors of participants, including the assessment of HT using a validated questionnaire and a manual sphygmomanometer. Five of the 35 Lisu hill tribe villages in the Chiang Rai province were randomly selected. All the individuals in selected villages aged 30 years and over were invited to provide the information after obtaining a written informed consent on voluntary basis. A 5 mL blood specimen was collected for testing lipid profiles. Logistic regression was used to detect the associations at a significance level of $\alpha=0.05$. **Results:** A total of 282 participants were recruited in the study; 61.3% were women and 69.5% were aged between 40 and 69 years. Most participants were married (78.4%), and never attended a school (74.0%), and Buddhist (72.7%). A large proportion of participants was working as farmers (57.4%); 70.9% had an income of less than 50,000 baht (1,515 USD) per year per family, and 22.0% reported having family debt. The overall prevalence of HT was 31.6%. After controlling for age, sex, marital status, and religion in the multivariable model, two factors were found to be associated with HT among the Lisu adult population in Thailand. Participants who reported using a low volume of monosodium glutamate were more likely to have HT than those who reported a high volume (AOR=2.87; 95% CI=1.35–6.12) and those who had normal levels of triglycerides were more likely to have HT than those who had high triglycerides (AOR=2.05; 95% CI=1.18–3.54). **Conclusion:** The Lisu people in Thailand are living in a poor economic situation, have low education level, and mainly work in the agricultural sector. A large proportion of people suffer from HT; therefore, an effective public health program to improve health behaviors and adjusting their cooking practices could lead to a reduction in the burden of HT particularly in providing them a valid medical advice to use appropriate volume of monosodium glutamate and cooking oil in their daily life.

Keywords: Burden; Factors associated; Hypertension; Lisu; Hill tribe

Introduction

Hypertension (HT) is one of the greatest health problems and is considered as a major threat for non-communicable diseases (NCD) for people worldwide. It could lead to several health problems, such as heart, brain, and kidney diseases [1]. The major critical points of HT effective care and treatment are early detection among people who are in the asymptomatic stage and

maintaining the blood pressure at an acceptable level after treatment [2]. These points will directly support the reduction of complications from the disease [3], which could reduce the quality of life among people with severe complications from the pathogenesis [4]. Therefore, early detection and treatment would be a better recommendation, particularly for people who belong to a vulnerable or risk population, such as those

aged 30 years and over [5]. However, identifying the risk factors or influencing factors of HT in a certain population and designing a proper public health intervention should be the advanced measures to minimize utilizing resources including live and economic loss, and to improve well-being eventually [6].

In 2019, the World Health Organization (WHO) estimated that 1.13 billion people worldwide had HT, and two-thirds lived in low-and middle-income countries [1]. HT has been recognized as a major cause of premature death worldwide and is attributed to 25.0% of all NCDs among the adult population [1]. In 2019, the Ministry of Public Health Thailand reported that a population of approximately 6 million Thai developed HT, and only half of them were properly diagnosed [7]. Thailand needs all medication expenses of 80,000 baht for 10 million individuals with HT, which is a large burden for the national health system [8]. The definition of HT is clearly defined by the WHO, as a measure of blood pressure in individuals for 2 days and having a systolic blood pressure reading on both days equal to or greater than 140 mmHg, and/or the diastolic blood pressure reading on both days equal to or more than 90 mmHg [1]. Several risk factors have been clearly identified in different populations, such as older age [9], high BMI [10], salty dietary intake including monosodium glutamate [11], serum lipid [12], smoking [13], and living in a rural area [14]. People who are living in poor socioeconomic status are much more vulnerable to HT [15].

Lisu is one of the hill tribes in Thailand with a population of approximately 30,000 living in 35 villages in the Chiang Rai province, Thailand [16]. The Lisu have their own language and practices according to their culture, including cooking practices. The majority of the Lisu in Thailand are living in low socioeconomic status and working in the agricultural sector. More than half of the Lisu are unable to use Thai fluently, which is the main barrier to receiving essential health information from government agencies in Thailand, which uses Thai for all communications. Moreover, a large proportion of the Lisu people are living in a very rural area of northern Thailand, particularly in the border areas of Thailand and Myanmar.

Therefore, this study aimed to estimate the magnitude and determine the factors associated with HT among the Lisu adult population aged 30 years and over living in Thailand.

Methods

A cross-sectional study design was used to collect essential information from participants from the Lisu hill tribe living in the Chiang Rai province, Thailand. The study settings were the Lisu villages which were randomly selected for five of 35 Lisu villages in the Chiang Rai province. Individuals living in five Lisu villages and aged 30 years and over were invited to

participate in the study between November 2018 and June 2019.

The sample size was calculated using the standard method [17] for a cross-sectional design, with $p=0.22$ [18], $q=0.78$, and $e=0.05$; therefore, 265 participants were required for the analysis.

A questionnaire was developed by reviewing the literature on different sources of information. All questions developed detected its validity and reliability in a small group of people (20 people) who had similar characteristics with the targeted population of the study in Mae Fah Laung District, Chiang Rai province, Thailand, with the overall Cronbach's alpha of 0.73. Eventually, a set of questions was ready for data collection, which consisted of four sections. In Section No.1, seven questions were used to collect the demographic characteristics of the participants. In Section No.2, sixteen questions were used to analyze the daily health behaviors that were relevant to HT. In Section No.3, 20 questions were used to assess the knowledge and attitude toward HT prevention and control. In Section No.4, four blank open questions were provided for filling laboratory information, such as lipid profiles, HbA1c levels, and blood pressure.

In this study, stress was assessed by the standard tool, the stress test-5 questions. It was developed by the Department of Mental Health, Thailand, composed of five questions, with four ranked response options for each item (0–3) [19]. The body mass index (BMI) was classified into three categories: underweight (≤ 18.5 kg/m²), normal (18.51–22.99 kg/m²), and overweight (≥ 23.0 kg/m²) [20]. The waistline for men was classified into two groups; normal (< 90 cm) and over standard (≥ 90 cm); and two groups were classified in women, normal (< 80 cm) and over standard (≥ 80 cm) [21]. With respect to the male-waist-to-hip ratio, two groups were categorized as: normal (≤ 0.90) and obese (> 0.90), while in among the women, two groups were classified: normal (≤ 0.85) and obese (> 0.85) [21]. Two groups were categorized for values of total cholesterol: normal (≤ 199 mg/dL) and high (≥ 200 mg/dL) [22]. With respect to high-density lipoprotein (HDL) cholesterol, two groups were categorized for men: low (< 40 mg/dL) and normal (≥ 40 mg/dL). Additionally, two groups were categorized for females: low (< 50 mg/dL) and normal (≥ 50 mg/dL) [22]. With respect to the low-density lipoprotein (LDL) cholesterol, two groups were categorized: normal (< 100 mg/dL) and high (≥ 100 mg/dL) [22]. Two groups for triglycerides level were classified: normal (≤ 149 mg/dL) and high (≥ 150 mg/dL) [22]. Glycated hemoglobin (HbA1c) values were classified into three categories: normal (< 6.0), prediabetes (6.0–6.4), and diabetes (≥ 6.5) [23]. The identification of HT followed the definition of the WHO guideline, as mentioned earlier [1].

All selected village headmen were contacted after obtaining permission from the local government. They were informed of all essential information regarding

the study and the inclusion and exclusion criteria for the eligible population for the study. Those who met the eligibility criteria for the study were requested to not consume food and drink for at least 12 h before the collection of the 5 mL blood specimen. On the day of data collection, all participants were double-checked to ensure that everyone was eligible for the study. Written informed consent was obtained after given the details regarding the study. The interview lasted for 20 min each.

The questionnaires were converted into a code and entered into an Excel sheet before being transferred into the R program for analysis. A descriptive analysis was performed to present the characteristics of participants in terms of mean and SD for continuous data, while percentages were presented for categorical data. Logistic regression was used to identify the factors associated with HT with different levels of

significance for the univariable ($\alpha=0.20$) and multivariable ($\alpha=0.05$) analyses.

Ethical consideration

All the study protocols were by the Mae Fah Luang University Research Ethic Committee on Human Research (No. REH-6100). Before starting interview, all participants were provided all relevant and essential information, and a written informed consent form was obtained in all participants before starting interview.

Results

A total of 282 participants were recruited in the study; 61.3% were women, 78.4% were married, and 69.5% were aged between 40 and 69 years. Most participants were uneducated (74.0%), Buddhist (72.7%), and farmers (57.4%) and had a family income

Table 1 Univariable and multivariable analyses in identifying factors associated with HT among Lisu adult populations

Factor	Total (%)	HT		OR	95%CI	P-value	AOR	95%CI	p-value
		Yes (%)	No (%)						
Total	282 (100.0)	89 (31.6)	193 (68.4)	N/A	N/A	N/A	N/A	N/A	N/A
Sex									
Male	109 (38.7)	33 (30.3)	76 (69.7)	1.00					
Female	173 (61.3)	56 (32.4)	117 (67.6)	1.10	0.66-1.85	0.712			
Age (years)									
30-39	46 (16.3)	14 (30.4)	32 (69.6)	1.00					
40-49	61 (21.6)	21 (34.4)	40 (65.6)	1.20	0.53-2.73	0.663			
50-59	69 (24.5)	22 (31.9)	47 (68.1)	1.07	0.48-2.40	0.870			
60-69	66 (23.4)	21 (31.8)	45 (68.2)	1.07	0.47-2.41	0.877			
70-79	33 (11.7)	9 (27.3)	24 (72.7)	0.86	0.32-2.31	0.760			
≥ 80	7 (2.5)	2 (28.6)	5 (71.4)	0.91	0.16-5.29	0.920			
Marital status									
Single	9 (3.2)	2 (22.2)	7 (77.8)	1.00					
Married	221 (78.4)	68 (30.8)	153 (69.2)	1.56	0.32-7.68	0.588			
Other	52 (18.4)	19 (36.5)	33 (63.5)	2.02	0.38-10.70	0.411			
Education									
No	209 (74.0)	66 (31.6)	143 (68.4)	1.00	0.57-1.78	0.991			
Yes	73 (26.0)	23 (31.5)	50 (68.5)	1.00					
Religion									
Buddhism	205 (72.7)	61 (29.8)	144 (70.2)	1.00					
Other (Christianity and Islam)	77 (27.3)	28 (36.4)	49 (63.6)	1.35	0.78-2.34	0.288			
Occupation									
Unemployed	70 (24.8)	19 (27.1)	51 (72.9)	1.00					
Agriculturalist	162 (57.4)	57 (35.2)	105 (64.8)	1.46	0.79-2.70	0.232			
Other	50 (17.7)	13 (26.0)	37 (74.0)	0.94	0.41-2.15	0.889			
Income per family per year (baht)									
≤ 50,000	200 (70.9)	60 (30.0)	140 (70.0)	1.00					
50,001-100,000	68 (24.1)	24 (35.3)	44 (64.7)	1.27	0.71-2.28	0.417			
≥ 100,001	14 (5.0)	5 (35.7)	9 (64.3)	1.30	0.42-4.03	0.654			
Family debt									
No	220 (78.0)	72 (32.7)	148 (67.3)	1.29	0.69-2.41	0.428			
Yes	62 (22.0)	17 (27.4)	45 (72.6)	1.00					
Family member (person)									
0-4	149 (52.8)	53 (35.6)	96 (64.4)	4.97	1.11-22.24	0.036*			
5-8	113 (40.1)	34 (30.1)	79 (69.9)	3.87	0.85-17.63	0.080*			
≤ 9	20 (7.1)	2 (10.0)	18 (90.0)	1.00					

Table 1 Univariable and multivariable analyses in identifying factors associated with HT among Lisu adult populations (cont.)

Factor	Total (%)	HT		OR	95%CI	P-value	AOR	95%CI	p-value
		Yes (%)	No (%)						
Father's history of HT									
No	161 (59.2)	55 (34.2)	106 (65.8)	1.32	0.77-2.26	0.306			
Yes	14 (5.0)	3 (21.4)	11 (78.6)	0.71	0.22-2.35	0.579			
Unknown	107 (37.9)	31 (29.0)	76 (71.0)	1.00					
Mother's history of HT									
No	167 (59.2)	56 (33.5)	111 (66.5)	1.18	0.69-2.04	0.549			
Yes	12 (4.3)	3 (25.0)	9 (75.0)	2.32	0.89-6.05	0.085*			
Unknown	103 (36.5)	30 (29.1)	73 (70.9)	1.00					
Stress (ST-5)									
Low	238 (84.4)	72 (30.3)	166 (68.7)	1.00					
Moderate	38 (13.5)	13 (34.2)	25 (65.8)	1.20	0.58-2.48	0.624			
High	6 (2.1)	4 (66.7)	2 (33.3)	4.61	0.83-25.75	0.082*			
Exercise									
No	152 (53.9)	47 (30.9)	105 (69.1)	0.97	0.45-2.09	0.938			
Sometimes	92 (32.6)	30 (32.6)	62 (67.4)	1.05	0.47-2.36	0.909			
Everyday	38 (13.5)	12 (31.6)	26 (68.4)	1.00					
Smoking									
No	195 (69.1)	66 (33.8)	129 (66.2)	1.00					
Yes	87 (30.9)	23 (26.4)	64 (73.6)	0.70	0.40-1.23	0.217			
Alcohol use									
No	208 (73.8)	68 (32.7)	140 (67.3)	1.00					
Yes	74 (26.2)	21 (28.4)	53 (71.6)	0.82	0.46-1.46	0.493			
Salt in daily cooking									
Low	40 (14.2)	18 (45.0)	22 (55.0)	2.16	1.00-4.69	0.051*			
Moderate	151 (53.5)	46 (30.5)	105 (69.5)	1.16	0.65-2.06	0.621			
High	91 (32.3)	25 (27.5)	66 (72.5)	1.00					
Monosodium glutamate in daily cooking									
Low	44 (15.6)	24 (54.5)	20 (45.5)	3.10	1.49-6.45	0.002*	2.87	1.35-6.12	0.006**
Moderate	134 (47.5)	36 (26.9)	98 (73.1)	0.95	0.54-1.69	0.861	0.86	0.47-1.58	0.631
High	104 (36.9)	29 (27.9)	75 (72.1)	1.00			1.00		
Cooking oil									
Low	49 (17.4)	24 (49.0)	25 (51.0)	2.45	1.14-5.25	0.021*			
Moderate	162 (57.4)	45 (27.8)	117 (72.2)	0.98	0.53-1.83	0.951			
High	71 (25.2)	20 (28.2)	15 (71.8)	1.00					
Knowledge of HT prevention and control									
Low	154 (54.6)	42 (27.3)	112 (72.7)	1.00					
Moderate	61 (21.6)	21 (34.4)	40 (65.6)	1.40	0.74-2.65	0.300			
High	67 (23.8)	26 (38.8)	41 (61.2)	1.69	0.92-3.10	0.089*			
Attitudes toward HT prevention and control									
Negative	210 (74.5)	65 (31.0)	145 (69.0)	1.00					
Neutral	56 (19.9)	19 (33.9)	37 (66.1)	1.15	0.62-2.14	0.670			
Positive	16 (5.7)	5 (31.3)	11 (68.8)	1.01	0.34-3.04	0.980			
Body mass index (BMI)									
Normal	94 (33.3)	31 (33.0)	63 (67.0)	1.00					
Underweight	20 (7.1)	3 (15.0)	17 (85.0)	0.36	0.10-1.32	0.122*			
Overweight	168 (59.7)	55 (32.7)	113 (67.3)	0.99	0.58-1.69	0.968			
Waistline									
Normal	138 (48.9)	41 (29.7)	97 (70.3)	1.00					
Risk for metabolic complication	144 (51.1)	48 (33.3)	96 (66.7)	1.18	0.72-1.96	0.513			
Waist-to-hip ratio									
Normal	157 (55.7)	47 (29.9)	110 (70.1)	1.00					
Risk	125 (44.3)	42 (33.6)	83 (66.4)	1.18	0.72-1.96	0.511			
Total cholesterol									
Normal	176 (62.4)	58 (33.0)	118 (67.0)	1.00					
High	106 (37.6)	31 (29.2)	75 (70.8)	0.84	0.50-1.42	0.516			
Triglycerides									
Normal	162 (57.4)	61 (37.7)	101 (62.3)	1.98	1.17-3.37	0.011*	2.05	1.18-3.54	0.010**
High	120 (42.6)	28 (23.3)	92 (76.7)	1.00			1.00		
HDL cholesterol									
Low	154 (54.6)	47 (30.5)	107 (69.5)	0.90	0.54-1.49	0.680			
Normal	128 (45.4)	42 (32.8)	86 (67.2)	1.00					
LDL cholesterol									
Normal	92 (32.6)	27 (29.3)	65 (70.7)	1.00					
High	190 (67.4)	62 (32.6)	128 (67.4)	1.17	0.68-2.00	0.578			

*Significant level at $\alpha=0.20$, and **Significant level at $\alpha=0.05$

equal to or less than 50,000 baht per year (70.9%) (Table 1).

The prevalence of HT among the participants was 31.6% (89 of 282). Among 89 HT cases, 82 (92.1%) were on treatment at the date of data collection, and 7 (7.9%) cases were newly identified. Women (32.4%) had a higher prevalence than males (30.3%). The prevalence was observed to decrease with the increase of age; however, it was not different between those who had attended a school and those did not (Table 1).

A large proportion reported alcohol use (26.2%), smoking (30.9%), moderate to high salt use in their daily cooking practice (85.8%), moderate-to-high monosodium glutamate use in their daily cooking practice (84.4%), and moderate-to-high use of cooking oil in their daily cooking practice (82.6%) (Table 1).

Using ST-5 to assess the stress, 15.6% participants had moderate to high stress, 54.6% participants had a low level of knowledge of HT prevention and control, and 74.5% participants had negative attitude on HT prevention and control (Table 1).

More than half of the participants were overweight based on BMI assessment (59.7%), 44.3% participants were categorized into the risk group based on the waist-to-hip ratio, and 51.1% participants were observed to be at risk for metabolic complications based on the waistline assessment (Table 1).

High total cholesterol was detected in 106 participants (37.6%); 42.6% had high triglycerides, and 67.4% had high LDL cholesterol (Table 1).

In the univariable analysis, eight factors were found to be associated with HT: number of family members, mother's history of HT, BMI, salt use in daily cooking practice, monosodium use in daily cooking practice, stress, knowledge of HT prevention and control, and triglyceride level (Table 1). However, after controlling for age, sex, marital status, and religion in the multivariable model, two factors were found to be associated with HT among the Lisu adult population in Thailand. Those who reported using a low volume of monosodium glutamate were more likely to have HT than those who reported a high volume (AOR=2.87; 95%CI=1.35–6.12), and those who had normal levels of triglycerides were more likely to have HT than those who had high triglycerides (AOR=2.05; 95%CI=1.18–3.54).

Discussion

Under the living circumstances of the Lisu hill tribe people in Thailand, a large proportion of individuals were suffering from HT. More than half of the people aged 30 years and over never attended a school and worked on traditional farms with low incomes. Smoking and alcohol use were common, particularly in men. The heavy use of salt, monosodium glutamate, and cooking oil for their daily cooking practice, including having low knowledge and negative attitude toward HT prevention and control were observed. More than half of the participants had

overweight and high lipid levels. However, it was notable that those who reported using low levels of monosodium glutamate and normal triglyceride levels were more likely to have HT than those who reported using a high volume of monosodium glutamate and high triglyceride, respectively.

In our study, it was found that the prevalence of HT was 31.6% (89 of 282 participants); 82 (92.1%) cases were on treatment at the date of data collection, and 7 (7.9%) cases were newly identified. The prevalence of HT between sex and different age groups was not statistically different. The prevalence among the adult multi-ethnic population in China was also closely reported as in this study, which was 29.5 [24]. However, the report of the prevalence of HT among the people aged 35 years and over in Nepal from the national survey reported it to be between 20.8–41.7%; additionally, the prevalence increased with an increase in age [15], in contrast to our study where the prevalence decreased with an increase in age. A study among the hill tribe elderly aged 60 years and over in Thailand reported that the prevalence of HT was 45.5% [25], while in our study, 27.3–31.8% were found among the Lisu aged 60 years and above. This might be the impact of a large proportion of the Lisu people who intended to check their HT status from health professionals and know their HT status. However, the prevalence among Thai adult populations has been reported to be 22.1% [18], which is significantly lower than the hill tribe adult population.

Some factors were found to be associated with HT among the Lisu hill tribe adult population in the univariable analysis at a significance level of $\alpha=0.20$, such as number of family members, mother's history of HT, BMI, salt use in daily cooking practice, monosodium use in daily cooking practice, stress, knowledge of HT prevention and control, and triglyceride level. However, these factors were not found to be significantly associated with HT in the multivariable analysis. It may be necessary to increase the sample size and also requires stronger study design to assess the associations such as case-control or cohort study.

In our study, it was found that those people who reported using a low volume of monosodium glutamate for cooking were more likely to have HT than those who reported use of a high volume of monosodium glutamate. This might be the negative impact of conducting a cross-sectional study, in which most of the HT among the Lisu had been diagnosed and treated. Subsequently, the association could be found in the opposite relationship because the majority of HT patients used a low volume of monosodium glutamate after receiving medical advice for reducing the risk factor from health professionals. However, the relationships between using a high volume of monosodium glutamate and HT development has been reported in several studies [26–28].

Only triglycerides among serum lipids were found to be associated with HT among the hill tribe adult population in Thailand. However, the association was found in the opposite association; those who had normal triglyceride levels were more likely to have HT than those with high TG levels. This might be the negative impact of a cross-sectional study, particularly among the Lisu people in Thailand. The majority of Lisu adults who have HT have known their HT status and treatment. Therefore, it is highly possible that those who know their HT statuses are under control of their dietary habits and are having normal levels of triglycerides. Normally, several studies have reported the association between high serum triglyceride levels and HT in different populations and countries [29–31].

There are several limitations in this study. First, some questions, particularly asking about the volume use of sodium, monosodium glutamate, and cooking oil, were impractical because most of the participants' responses were based on their perception. This might have interfered with the analysis in the final step. Second, it was difficult to make the participants understand the questions with respect to knowledge and attitude in a clear manner and obtain valid responses due to the poor education level of the participants. However, in this study, researchers optimized the way to obtain the most validated answers by repeating their understanding on the certain question before providing the answer. A few people reported that they did not clearly follow the instructions of no food and drink 12 h before collecting blood specimens. However, during the analysis, those specimens showed inappropriate for laboratory work and were excluded from the analysis. Finally, with the limitations of a cross-sectional study, some associations did not follow expectations, such as a low use of monosodium glutamate was found to be associated with HT, which might be because participants who obtained a diagnosis of HT previously (92.1%) were using low monosodium glutamate after receiving advice from health professionals.

Conclusions

The population of the Lisu hill tribe in Thailand lives in an illiterate manner and in a poor economic status. Substance use is common. A large proportion of them use high volumes of salt, monosodium glutamate, and cooking oil in their daily cooking practices. The majority of the Lisu people have BMI above the normal range and high serum lipid levels. One-third of the population was observed to have HT, and high levels of monosodium glutamate and triglycerides are factors associated with HT among the adult Lisu population in Thailand. However, further strong study design is suggested to perform to confirm the associations such as a case-control study.

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