ORIGINAL ARTICLE

Prevalence and risk factors associated with hypertension among the Hmong people in Phayao Province, Thailand

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ABSTRACT

Hypertension is a significant global public health issue, including in Thailand. Research findings are still lacking among vulnerable populations in remote areas, with particular emphasis on the Hmong ethnic group. The data obtained from the research can be utilized to plan and develop tailored and effective health policies for specific ethnic groups, thereby enhancing the efficiency of hypertension management. This cross-sectional study aimed to investigate the prevalence and risk factors of hypertension among the Hmong tribe in Phayao province. The study sample comprised 380 individuals using a multi-stage sampling method from the Hmong ethnic group aged 20 years and older. This study was a face-to-face interview. Data were analyzed using descriptive statistics, Chi-square test, and multiple logistic regression. The results showed that 32.9% of the respondents had hypertension based on home blood pressure measurements (135/85 mmHg). The average systolic blood pressure (SBP) was 125.69 mmHg and diastolic blood pressure (DBP) was 78.61 mmHg. In the multiple logistic regression analysis, the significant factors associated with hypertension were stress (Adj.OR:0.26; 95%CI 0.12-0.57; p=0.001), sugar consumption (Adj.OR:4.21; 95%CI 2.44-7.28; p<0.001), and salt consumption (Adj.OR:2.00; 95%CI 1.15-3.42; p=0.014). Health centers should conduct regular screening for hypertension and develop innovations in promoting appropriate dietary behavior modifications (specifically sugar and salt intake) with culturally tailored communication materials for the Hmong tribe to address the problem effectively and sustainably.

Key words:
hypertension, prevalence, associated factor, hmong tribe

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INTRODUCTION

Hypertension is a global burden and a chronic disease.[1] It can lead to severe heart disease, stroke, and end-stage renal disease if it is left untreated.[2-5] According to the World Health Organization, hypertension impacts approximately 1.28 billion adults aged 30 to 79 years around the globe.[6] When looking at Thailand, the prevalence of hypertension reported by the Sixth National Health Examination Survey in 2020 was 25.4% in total (26.7% in men vs 24.2% in Women.[7]

While the risk of hypertension can occur in every Thai person, Phayao (the northern province of the first health region of Thailand) is located at 300 to 1,500 meters above sea level[8] and features diverse landscapes, including mountains and plains. As it is known that the high altitude is associated with an increase in blood pressure, people living in this area might be at risk of hypertension in addition to other contributing factors including advanced age[10-12], sex[10-12], educational level[12], obesity[10-11], the lack of exercise[10-11], an unhealthy lifestyle.[11]

According to the health data center of the Public Health Office of Phayao Province (from 2017 to 2020), the incidence rates of newly diagnosed cases of high blood pressure were 1,552, 1,466. 78, 1,453. 56, and 1,860. 88 per one hundred thousand population, respectively. The rates of new cases of high blood pressure from the high- risk group were 4. 05% , 3. 79%, 4. 07%, and 5. 55%, while the rates of blood pressure control were 39. 22% , 38.46%, 37.23%, and 35.38%, respectively (with a target of 50%).[13] It is noted that the blood pressure control in patients with high blood pressure has not yet reached the set target.[14]

According to the diverse landscape of Phayao province, there are various types of ethnic groups, especially the Hmong tribe (the largest group of ethnic groups). They have occupations including farming, gardening, and plantation work, with a significant shift towards rubber plantations recently. The population mainly consists of working-age individuals, while the number of children has decreased, and the elderly population has been on the rise. The top five causes of illness and death in Phayao province include aging, cancer, accidents, heart disease, and hypertension.[15] A previous study reported that the Hmong tribe lacked awareness regarding blood pressure screening[16], had a lower quality of life than indigenous lowland groups[17], accessed healthcare facilities, and used specific language communication for the working-age group who could communicate in Thai. Lifestyle patterns have changed, affecting behaviors, occupations, and consumption habits. Traditional practices, like home-cooked meals and herbal remedies, have shifted to align with the current economic situation. There is limited research in Thailand. Furthermore, there is an absence of research outcomes concerning factors correlated with hypertension, specifically within the Hmong ethnic group.

Given the aforementioned issues and circumstances, the study aimed to estimate the prevalence of hypertension and determine the factors associated with hypertension among the Hmong tribe in Phayao Province. The research findings would be the foundation for planning appropriate strategies to prevent and control hypertension in the Hmong tribe in the future.

METHODS

Study design and population

This cross-sectional study was conducted in Thung Kluai Sub-district, Phu Sang District, Phayao Province, following a systematic methodology. Initially, the

regions inhabited by the Hmong population within Phayao Province, namely Pong District, Mueang District, Chiang Kham District, and Phu Sang District, were identified. Subsequently, simple random sampling was employed, resulting in the selection of Phu Sang District. Following this, the subdistricts within Phu Sang District where the Hmong population resides, including Thung Kluai Subdistrict, Pa Sak Subdistrict, and Phu Sang Subdistrict, were considered. Simple random sampling was again utilized, leading to the selection of the Thung Kluai Subdistrict. Data collection was conducted efficiently and accurately from May to July 2022.

Sample size and sampling procedure

The sample size was calculated using the formula developed by Daniel WW [18] and the eligible sample size required for this study was at least 320 people. The researcher collected data using a multi-stage sampling method, with the assistance of village healthcare volunteers who were responsible for communication with each household. The study received good cooperation and voluntary participation from 380 eligible participants. The inclusion criteria of the Hmong tribe were that they were at the age of 20 and over, living in the Thung Kluai Sub-district, Phu Sang District, and Phayao Province, and they agreed to participate in this study. The exclusion criteria included participants who were ill or suffering from complications at the time of the study and/or those who were not present at the study site at the time of data collection.

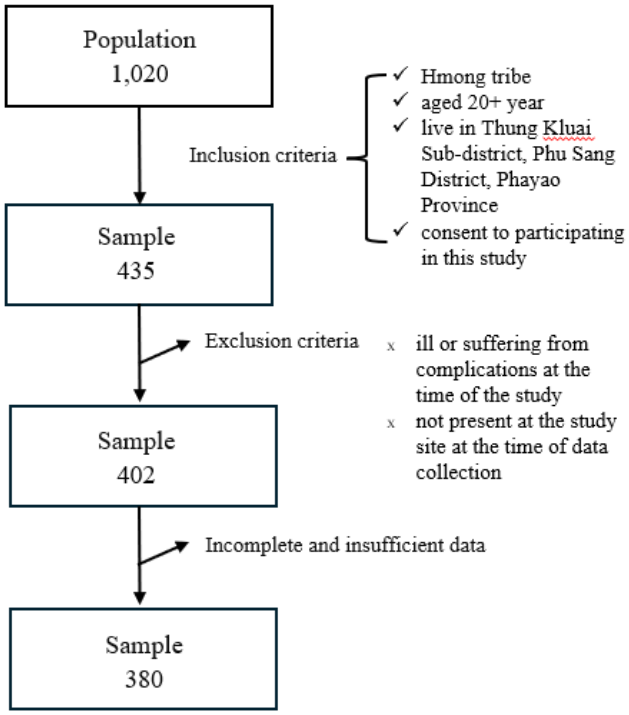

Figure 1. The flow of participants at the enrollment of the study.

Measurement instruments

An automatic blood pressure measurement device was used to measure blood pressure[19] and calibrated by the researcher before the study. The researcher compared the automatic blood pressure monitor with a manual sphygmomanometer; a standard device

verified for its accuracy. Due to various definitions of high blood pressure guidelines, (2018 European Society of Hypertension/European Society of Cardiology Guidelines for the Management of Arterial Hypertension)[20] this study used the cut-off point of 135/85 mmHg for self-measurement with a Home Blood Pressure Monitor (HBPM) recommended by Thai Hypertension Society Guidelines. [2 1] Diagnostic threshold for HBPM was ≥135/85 mm Hg. For diagnostic evaluation of blood pressure, HBPM was measured preferably for 7 consecutive days: in the mornings as well as in the evenings. The subject was in the seated position, with their back and arm supported, and after 5 min of rest, two measurements per occasion were taken 1–2 min apart. HBPM was the average of these readings.

This study used interviews and self-recorded blood pressure forms for data collection. This interview form was developed based on a review of relevant literature. It consisted of four parts: (1) general characteristics of participants (age, gender, educational level, occupation, income, weight (kg), height (cm), waist circumference (cm), medical history, family history of hypertension/ diabetes, smoking habits, and alcohol consumption); (2) hypertension knowledge assessment form consisting of 15 questions (The correct answer was given one point, and the wrong answer was given a zero point). For example, " individuals with hypertension were those with blood pressure readings of 140/90 mmHg or higher" ; (3) attitude assessment towards hypertension that consists of 15 questions, rated as follows: stronglyagree=4 / agree=3 / disagree=2 / strongly disagree= 1) for instance, "you believe that hypertension is a preventable disease" ; (4) practice assessment of healthy lifestyle had eight questions with the frequency of practice categorized (not at all=0; rarely=1/3 days per week; 2/5 days per week= 3;every day= 4). For example "you chose to eat a diet rich in vegetables and fruits", "you prepared food that was not overly salty", and "you did not smoke". Parts 2 to 4 were assessed using Bloom's cut- off point. However, the researcher simplified it into two groups, resulting in the categorization of good (80–100%) and not good (<80%). Part 5 involved the EQ-5D-5L and visual analog scale, a standardized health-related quality-of-life assessment tool developed by the EuroQol Group, and permission to use the tools had been obtained successfully. The responses are composed of a series of five numbers representing different health dimensions. A score of 1 indicates no problems, 2 indicates slight problems, 3 indicates moderate problems, 4 indicates severe problems, and 5 indicates extreme problems or an inability to perform the activity. The transformation of health status into utility scores reflects an individual's satisfaction with their own health condition, ranging from -1 to 1. A score of 1 indicates perfect health, while a score of 0 indicates the worst possible health.[22]

The researcher conducted a quality check of the interview protocol in this study. This interview, consisting of a 30-sample group with characteristics similar to those of the eligible participants of the main study, has been tested for content validity and reliability. Each part of the interview showed acceptable Cronbach's alpha values ranging from 0.75 to 0.86.

Data collection

The ethics of this study complied with the Declaration of Helsinki. Approval and ethical clearance were obtained from the Phayao Human Ethics Committee at the University of Phayao, with the assigned Institutional Review Board (IRB) approval reference number UP-HEC 1.3/007/65.

After the IRB approval, all participants were informed of the purposes

of this survey study. There was no obligation if the participants wanted to withdraw from the study at any time and there were no negative impacts for them. All information was kept in a secure place and would be confidential and anonymous. Eligible participants who agreed to participate in this program would read and sign an informed consent form with a semi-structural questionnaire before starting an interview. The data was collected by collaborating with local public health agencies and village healthcare volunteers (VHVs). VHVs functioned as interpreters if participants could not communicate in the Thai language effectively.

Data analysis

The statistical software was used to analyze the data, using descriptive statistics and inferential analyses, including the correlational analysis and Chi-square test at the significance level of 0.05. Before running the data analysis, the assumptions of multivariate logistic regression were tested for independence of errors, linearity in the logit for continuous variables, absence of multicollinearity, and no strong influential outliers. They all met the assumptions. In the multiple logistic regression analyses conducted stepwise on blood pressure levels, the researchers identified factors statistically significantly related at the significant level of 0.05 and variables with p- values less than 0. 3[23] because the researchers intend to perform a comprehensive selection of variables during the initial stage to ensure that potentially significant variables are not excluded prematurely. The variables included age, education, occupation, waist circumference, health score, stress, sugar consumption, salt consumption, fat consumption, and exercise.

RESULTS

This research study showed most participants had normal blood pressure levels, were males, had no hypertension and no history of hypertension and diabetes, had age less than 40 years, were Buddhists, had middle education (elementary education), worked in labor sectors, earned income less than 10,000 baht, were obese, had a medical history, and had visual analog scale equal to or higher than a score of 90. Most males had normal waist circumference, while most females had large waist circumference (Table 1).

Table 1. General characteristics of Hmong tribe in Phayao province. (n=380)

Characteristics		Number	%
Blood pressure levels			
	Normal	255	67.1
	High (≥135/85 mmHg.)	125	32.9
	SBP($\bar{x}$=125.69, *SD*=13.95, Min=96.71, Max=160*)*		
	DBP ($\bar{x}$=78.61, *SD*=11.74, Min=58.46, Max=110)		
Gender			
	Male	191	50.3
	Female	189	49.7
Age	$\bar{x}$=39.63, *SD*=13.736, Min=20, Max=70		
	< 40 years	226	59.5
	≥ 40 years	154	40.5
Religion			
	Buddhist	254	66.8
	Christian	126	32.2

Characteristics	Number	%
Education		
Low	93	24.5
Middle	166	43.6
High	125	31.9
Occupation		
Agriculture	155	40.8
Commerce	31	8.2
Labor	183	48.2
Other	11	2.9
Income (per month $\bar{x}$=6,102.63, *SD*=5,450.467, Min=0, Max=50,000		
< 10,000 Baht	295	77.6
≥10,001 Baht	85	22.4
Body Mass Index (BMI) $\bar{x}$=24.05, *SD*=4.20, Min=16.81, Max=41.26		
Normal	166	43.7
≥ overweight	214	56.3
Waist circumference (WC) of male $\bar{x}$=85.82, *SD*=10.977, Min=65, Max=130; n= 191		
Normal	142	74.3
Exceeding the standard of	49	25.7
Waist circumference (WC) of female $\bar{x}$=82.80, *SD*=11.307, Min=63, Max=125; n= 189		
Normal	90	47.6
Exceeding the standard	99	52.4
Medical history		
Yes	49	12.9
No	331	87.1
Family history of hypertension		
Yes	74	19.5
No	306	80.5
Family history of diabetes		
Yes	49	12.9
No	331	87.1
Visual analog scale $\bar{x}$=89.29, *SD*=11.266, Min=45, Max=100		
Low (< 90 score)	133	35.0
High (≥ 90 score)	247	65.0

The healthy lifestyle in this study showed most participants reported no alcohol consumption, no smoking, no stress, no fat consumption, no sugar consumption, no salt consumption, and a lack of exercise (Figure 2).

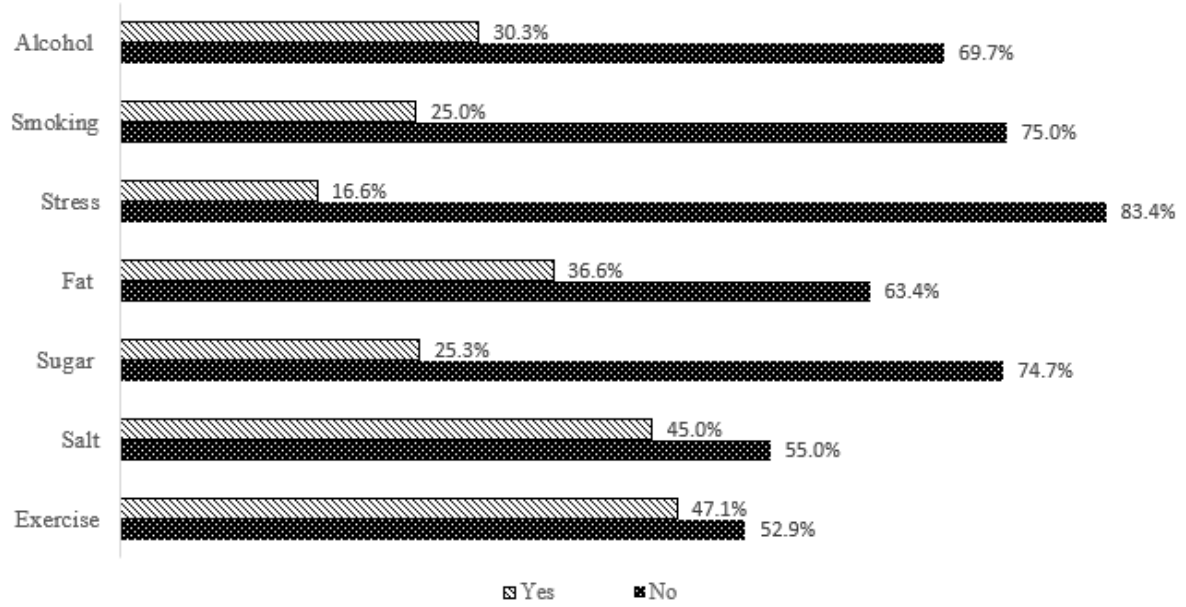

Figure 2. The healthy lifestyle of Hmong tribe in Phayao province. (n=380)

The quality of life in the health dimension showed that most participants reported having no mobility, no self-care, no regular activities, no pain/discomfort, and no anxiety/ depression (Figure 3).

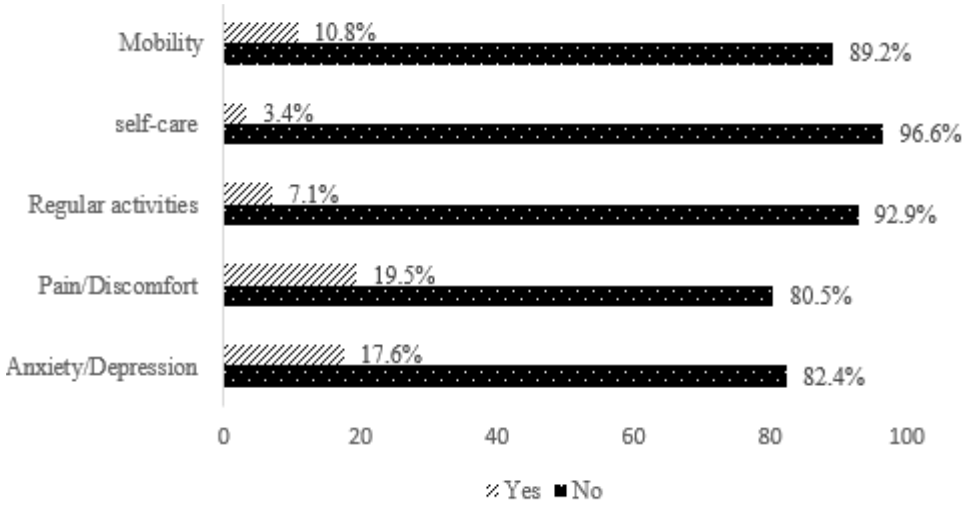

Figure 3. Quality of life in the health dimension of Hmong tribe in Phayao province. (n=380)

In the Chi-square analysis, there was a significant difference in the relationship between age, occupation, weight circumference, stress, sugar consumption, salt consumption, and fat consumption (Table 2).

Table 2. The Chi- square test assesses the relationship between the independent variables and hypertension within the Hmong tribe in Phayao province. (n=380)

Variables	Hypertension		p-value	Crude OR (95%CI)
	No	Yes		
Gender			0.259	0.781(0.509-1.200)
Male	123(64.4)	68(35.6)		
Female	132(69.8)	57(30.2)		
Age			0.021*	1.660 (1.076-2.562)
< 40 years	162(71.7)	64(28.3)		
≥ 40 years	93(60.4)	61(39.6)		
Religion			0.570	1.142 (0.722-1.806)
Christian	87(69.0)	39(31.0)		
Buddha	168(66.1)	86(33.9)		
Education			0.060	1.588 (0.979-2.577)
Uneducated	55(59.1)	38(40.9)		
Educated	200(69.7)	87(30.3)		
Occupation			0.026*	1.632 (1.058-2.518)
Agriculture	94(60.6)	61(39.4)		
Other	161(71.6)	64(28.4)		
Income			0.593	1.148 (0.691-1.907)
< 10,000 Baht	200(67.8)	95(32.2)		
≥10,001 Baht	55(64.7)	30(35.3)		
BMI			0.566	1.135 (0.736-1.750)
Normal	114(68.7)	52(31.3)		
≥ overweight	141(65.9)	73(34.1)		
Waist circumference			0.003*	1.934 (1.250-2.992)
Normal	169(72.8)	63(27.2)		
Exceeding the standard	86(58.1)	62(41.9)		
Family history of hypertension			0.119	1.514 (0.897-2.556)
Without	211(69.0)	95(31.0)		
Have	44(59.5)	30(40.5)		
Family history of diabetes			0.348	1.344 (0.724-2.497)
Without	225(68.0)	106(32.0)		
Have	30(61.2)	19(38.8)		
Knowledge towards hypertension			0.774	0.937 (0.600-1.462)
Not good	90(66.2)	46(33.8)		
Good	165(67.6)	79(32.4)		
Attitude towards hypertension			0.610	1.120 (0.725-1.731)
Not good	109(68.6)	50(31.4)		
Good	146(66.1)	75(33.9)		
Healthy lifestyle			0.539	1.169 (0.711-1.921)
Inappropriate	197(67.9)	93(32.1)		
Appropriate	58(64.4)	32(35.6)		
Quality of life			0.994	0.998 (0.593-1.679)
Not good	55(67.1)	27(32.9)		
Good	200(67.1)	98(32.9)		

Variables	Hypertension		p-value	Crude OR (95%CI)
	No	Yes		
Visual analog scale			0.277	1.287 (0.816-2.031)
Low	94(70.7)	39(29.3)		
High	161(65.2)	86(34.8)		
Stress			0.001*	0.289 (0.138-0.606)
Low	201(63.4)	116(36.6)		
High	54(85.7)	9(14.3)		
Sugar consumption			<0.001*	4.101(2.522-6.669)
Low	214(75.4)	70(24.6)		
High	41(42.7)	55(57.3)		
Salt consumption			0.003*	1.941 (1.258-2.993)
Low	154(73.7)	55(26.3)		
High	101(59.1)	70(40.9)		
Fat consumption			0.005*	1.860 (1.198-2.886)
Low	174(72.2)	67(27.8)		
High	81(58.3)	58(41.7)		
Exercise			0.286	1.264 (0.822-1.945)
No	125(69.8)	54(30.2)		
Yes	130(64.7)	71(35.3)		
Smoking			0.659	1.117 (0.684-1.822)
No	193(67.7)	92(32.3)		
Yes	62(65.3)	33(34.7)		
Alcohol consumption			0.501	0.851(0.531-1.363)
No	175(66.0)	90(34.0)		
Yes	80(69.6)	35(30.4)		

* Significance level ($\alpha<0.05$)

In multiple logistic regression analysis, factors associated with hypertension showed that there was a significant association between stress and hypertension in the Hmong tribe (Adj. OR: 0. 26; 95% CI 0. 12– 0. 57; p=0.001). The Hmong tribe who had high stress were 74% less likely to have hypertension compared to those with low stress. There was a significant association between sugar consumption and hypertension in the Hmong tribe (Adj. OR: 4. 21; 95% CI 2. 44– 7. 28; p<0. 001) . Hmong tribal people who consumed high levels of sugar exhibited a significantly elevated risk of hypertension, with an odds ratio of 4.21 compared to their counterparts with lower sugar intake within the Hmong tribe. There was a significant association between salt consumption and hypertension in the Hmong tribe (Adj.OR:2.00; 95%CI 1.15-3.42; p=0.014). Hmong individuals who exhibited elevated salt consumption were associated with a two-fold higher likelihood of developing hypertension in comparison to their counterparts with lower salt intake within the Hmong community (Table 3).

Table 3. Multiple logistic regression analysis showing factors associated with hypertension of the Hmong tribe in Phayao province. (n=380)

Variables	B	SE	Adj.OR	95% CI	p-value
Stress					
High	-1.368	0.407	0.255	0.115-0.566	0.001
Low*					
Sugar consumption					
High	1.438	0.279	4.212	2.439-7.275	<0.001
Low*					
Salt consumption					
High	0.683	0.279	1.979	1.146-3.419	0.014
Low*					
Constant	-1.480	0.256	0.228		<0.001

*Reference group

DISCUSSION

This study conducted in a single location might be biased and limited in its ability to generalize the findings to other populations or locations. However, the researcher used a multi-stage sampling method, starting with sampling villages or communities and then sampling individuals within those villages or communities. This approach helped increase the diversity of the sample and reduce bias. Additionally, the research tools were pre-tested on a smaller sample to ensure their suitability and comprehensibility. Therefore, the findings of this study were reliable. The results of this study indicated that the prevalence of hypertension among the Hmong tribe in Phayao province was 32.9% (blood pressure of 135/85 mmHg or more).[21] It is similar to the findings of studies conducted among other ethnic groups.[24-28] However, the results of the Thai National Health Examination Survey conducted during 2019–2020 found a prevalence of only 25.4%.[7] Another study on the prevalence of hypertension among hill tribe populations in Chiang Rai province, Thailand found a rate of 24.3%.[16] In contrast, a study in India found that the prevalence of hypertension was 48%.[29] Another study reported that the overall prevalence of hypertension was 16.7%, with 41% being pre-hypertensive.[30] The prevalence of hypertension is 34.0% and 28.3% among men and women of the Indian indigenous (tribal) population.[31] Furthermore, a study conducted in high-altitude populations in Nepal indicated that the prevalence of hypertension (or individuals on anti-hypertensive medication) was 46.1%, 40.9%, and 54.5% at altitudes of 2800, 3270, and 3620 meters, respectively.[32] Consequently, it is evident that the prevalence of hypertension varies by region in different countries. However, it was observed that the higher the altitude above sea level, the greater the prevalence of hypertension. There was evidence showing that hypertension prevalence among the tribal population was higher than that of the general population. The average SBP and DBP were 125.69 mmHg and 78.61 mmHg, respectively. The average SBP among the tribes was observed to be much higher than the national average,[33] which was correlated with the Cardio-ankle Vascular Index (CAVI).[34] Consequently, it is imperative for public health institutions to deliver healthcare services that are intricately attuned to the unique needs of the Hmong community. This may entail employing specialized linguistic approaches in crafting health communication materials and implementing hypertension screening initiatives facilitated by VHVs who possess localized knowledge and expertise.

Individuals aged over 40 years have a 39.6% proportion of hypertension, which is consistent with other research indicating that increasing age correlates with higher hypertension rates.[33-36] Hmong women tend to have a BMI indicating overweight and a waist circumference exceeding the standard values. Consistent with research findings, patients with hypertension had a BMI of overweight and a mini- risk of increased waist circumference,[24,37] particularly among women. Blood pressure tends to increase in women after menopause.[35] The condition of being overweight significantly predisposes individuals to the onset of diseases such as diabetes mellitus and various cardiovascular disorders. This is primarily attributed to the deposition of adipose tissue along the vascular walls, leading to atherosclerosis and subsequent hypertension.

In this study, we found that stress, sugar consumption, and salt intake were associated with hypertension. From this study, it is observed that individuals of the Hmong ethnicity exhibiting low stress levels are susceptible to developing hypertension. It may seem contradictory because, generally, stress is considered a factor that contributes to high blood pressure. However, in this case, it was observed that despite low stress levels, high blood pressure was still present. This could be attributed to other factors such as high sodium intake, lack of physical activity, or genetic predisposition. However, in the Indian context, it was reported that mental stress is a risk factor for hypertension prevalence among the tribal population.[33] Persistent low stress levels coupled with chronic stress accumulation could lead to physiological alterations within the body, potentially perturbing vascular functionality and thereby predisposing individuals to hypertension. Furthermore, stress also influences unhealthy behaviors regarding health, such as imbalanced dietary habits and inadequate rest, both of which are risk factors for hypertension. This is compounded by the circumstances of the COVID- 19 pandemic, which have led to alterations in healthcare- seeking behaviors and overall health management practices.[38]

In addition, high sugar consumption increases the risk of hypertension by 4. 2 times. This study aligns with prior research indicating that elevated sugar intake can contribute to the onset of hypertension by influencing blood glucose levels. Sugar serves as a significant determinant affecting blood pressure homeostasis. Elevated blood glucose levels may cause arterial rigidity and heighten blood pressure, thus constituting etiological factors for hypertension. Moreover, heightened sugar consumption may cause weight gain, further exacerbating the risk of hypertension.[39-40] High sugar consumption has been associated with weight gain and obesity, which are significant risk factors for hypertension. This is consistent with research conducted in India that identified obesity as a risk factor for hypertension.[41] Thai people have a continuous increase in sugar consumption every year, which is associated with higher incidences of non-communicable diseases in the country.[42] The Hmong tribe tends to consume high levels of sugar due to their livelihood, which involves engaging in high- energy activities such as agricultural practices and manual labor. Moreover, the cultural significance of sugar consumption, often embedded within their traditions and teachings, further contributes to their elevated sugar intake.[43-44] The deleterious effects of high sugar intake extend across various dimensions of health, with hypertension representing a prominent manifestation. Thus, strategic management of sugar consumption emerges as a pivotal preventive measure for attenuating the long-term susceptibility to this pathology.

From this study, it was found that the Hmong ethnic group consuming high salt intake is at double the risk of developing hypertension compared to those

consuming lower amounts, which aligns with other studies,[36,45] and among the Chiru tribe of Northeast India, high salt intake (OR = 7.81 and 3.36) was a risk factor associated with hypertension.[46] Foods rich in salt and fat are often served with rice in Thai culture,[25] especially among people in rural northern Thailand. Those who frequently bought ready-to-eat food or used bouillon cubes/ monosodium glutamate during food preparation were likely to have hypertension.[47] In line with the findings of the study, it was observed that individuals from the hill tribes use a substantial amount of salt in food preparation, by utilizing seasoning powder extensively.[24] Regular consumption of salty- flavored dishes leads to increased water retention in the body upon salt intake, thereby contributing to the development of hypertension. Based on the findings of previous studies, knowledge and attitudes have been identified as significant predictors of salt- related practices.[48] As a result, the Hmong tribe should be concerned about their diet' s excessive salt and sugar. Maintaining low sodium and low sugar intake are crucial steps in controlling blood pressure. The dietary behaviors of the Hmong people, who consumed salty and sweet foods, differed from those of Thai individuals with hypertension. With changes in lifestyles, these tribal groups have been inflicted with various cardiovascular and metabolic disorders in different proportions.[49] The Hmong tribe typically had a culture of consuming simple and fresh food sourced from their own agricultural activities and livestock.[50] They predominantly used seasonings such as salt and sugar in their cooking.[51] The foods they consumed often had salty and sweet flavors to enhance palatability and extend shelf life. Health awareness among the Hmong people regarding the adverse effects of consuming high levels of salt and sugar was likely limited due to restricted access to health information, making it challenging for them to alter their dietary habits.[50] Future research should be done to expand the study to multiple areas to increase generalizability. Additionally, employing qualitative research methods alongside quantitative approaches is advised to provide more comprehensive and in-depth data. Utilizing a variety of research methods would have enhanced the reliability of the findings and ensured that the information obtained could be practically applied within the context of the Hmong ethnic group. Investigating the health behaviors and perceptions of the Hmong tribe regarding hypertension, as well as developing appropriate strategies for the prevention and management of health issues in this group, would have been highly beneficial for improving the long-term health of this population.

This study defined blood pressure according to the 2018 European Society of Hypertension/European Society of Cardiology Guidelines for the Management of Arterial Hypertension[20] and the 2022 Thai Hypertension Society guidelines on home blood pressure monitoring[21], which set the HBPM cut-off point at 135/85 mmHg. Consequently, the prevalence of hypertension may have differed from other studies, such as JNC8, which used a cut-off point of 140/90 mmHg. The impact of changing the HBPM cutoff was associated with increases in masked (from 10% to 22%) and sustained (from 27% to 35%) hypertension among untreated participants.[52] In this research, blood pressure was measured at home by village health volunteers responsible for daily monitoring. These measurements were reliable in terms of both the instruments and the measurement environment, unlike clinical settings where the cut-off point of 140/90 mmHg is used. Measurements in clinical settings can sometimes be affected

by errors or the excitement of the patients themselves.

LIMITATIONS OF THE STUDY

The study conducted in one location may not encompass the diversity of the population in other areas, thereby limiting its ability to reflect the broader population. Language and communication in this research interview require the use of interpreters. Therefore, we need to provide training and instructions on the interview format to the interpreters before data collection. Hypertension in this research is considered solely on screening criteria and has not been diagnosed by a physician. This study employed the definition of blood pressure using HBPM with a cut-off point of 135/85 mmHg, which may impact its applicability for reference in contexts where different criteria are utilized.

CONCLUSION

The prevalence of hypertension among the Hmong tribe in Phayao province persists at an elevated rate. Factors such as stress, sugar consumption, and salt intake were significantly associated with hypertension. Health centers should conduct regular screenings for hypertension and develop innovations to promote appropriate dietary behavior modifications (specifically concerning sugar and salt intake) with culturally tailored communication materials for the Hmong tribe to address the problem effectively and sustainably.

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