

The relationship between dietary habits and hypertension in middle-aged rural populations of Karen state, Myanmar

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ABSTRACT

Background: Hypertension, a non-communicable disease, is a leading health problem that can cause life threatening complications and a major cause of premature death. There are no previous studies on the prevalence of hypertension in rural areas, Karen State, Myanmar.

Objective: This study aimed to identify the prevalence of prehypertension/hypertension and its associated risk factors among the middle-aged population in rural areas, Karen State, Myanmar.

Method: A cross-sectional analytical study was conducted among rural areas of 3 townships (Myawaddy, Hlaing Bwe', and Kawkareik) in Karen State, Myanmar with aged 40-59 years old was chosen by multistage random and population proportion to size sampling. Factors with p-value < 0.05 were considered as statistically significant and the results were illustrated with Adjusted Odds Ratio (AOR), 95% Confidence Interval (95% CI).

Results: Among 487 participants, the prevalence of pre-hypertension/hypertension among the middle-aged population in Karen State was 51.95% (95% CI: 47.50 - 56.37). The factors significantly associated with prehypertension/hypertension were consumption of sugar sweetened ≥ 3 days per week (AOR = 4.15, 95% CI: 1.44 - 11.95), consumption of salty foods ≥ 3 days per week (AOR = 3.32, 95% CI: 1.77-7.22) and obesity (AOR = 2.26, 95% CI: 1.41-3.61).

Conclusion: About one third of people resident in rural areas in this study had high blood pressure. The characteristics that were substantially linked with prehypertension/hypertension included being obesity, consumption of sugar sweetened foods & salty foods.

Keywords: Hypertension, Karen state, Myanmar, Rural

1. Introduction

Hypertension, a leading non-communicable disease (NCD), poses a significant global health burden, increasing the risk of cardiovascular, cerebrovascular and renal diseases. It is a major contributor to premature mortality and places a considerable strain on healthcare systems particularly in low- and middle-income countries (LMICs) [1, 2]. Currently, an estimated 1.28 billion adults aged 30-79 years have hypertension, with two-thirds residing in LMICs. Alarmingly, 46% (580 million) remain undiagnosed, and only 21% have their condition under control [1].

In Myanmar, the prevalence of hypertension has been rising. The mortality rate due to NCDs increased from 46.9% in 2000 to 68% in 2017 [3]. In 2014, 7.6 million people were estimated to have hypertension, yet only 6.8 million had access to treatment [4]. Studies have identified key risk factors for hypertension including high salt intake, sugar-sweetened beverages, obesity, physical inactivity, smoking and alcohol consumption [5]. Socioeconomic status, stress, and healthcare access further influence hypertension prevalence [6]. Among Myanmar migrant workers, hypertension was

linked to unhealthy behaviours with higher prevalence among Karen (27%) than Shan (23.5%) ethnicities [7].

Despite the growing burden of hypertension in Myanmar, research on its risk factors in rural areas remains limited. Understanding the determinants of pre-hypertension and hypertension in middle-aged populations is crucial for targeted prevention strategies. This study focuses on rural Karen State, Myanmar, where hypertension is a public health concern. Karen State is divided into several zones, with rural areas referring to townships and villages outside urban centres. The study was conducted in Myawaddy, Kawkaeik and Hlaing Bwe townships where access to healthcare is limited. Identifying the prevalence and risk factors of hypertension is essential for creating effective interventions. Therefore, this study aimed to assess the prevalence and risk factors associated with pre-hypertension and hypertension among middle-aged individuals in rural Karen State, Myanmar.

2. Methods

2.1 Study Area and Design

This cross-sectional analytical study was conducted in rural areas of Karen State, Myanmar, which comprises 4 districts and 16 townships. The study aimed to classify the

prevalence of pre-hypertension and hypertension among the middle-aged population and identify associated risk factors.

2.2 Sample Size and Sampling

A sample size of 487 participants was calculated using a multiple logistic regression formula, accounting for a 10% dropout rate. The sample size was determined using the logistic regression formula developed by Hsieh, Bloch and Larsen (1998) [8] as a reference with a 95% confidence level and 80% power. The unadjusted sample size was 176.94 which was further adjusted for collinearity using variance inflation factors (VIF), resulting in a required sample size of 442. After adjusting for a 10% non-response rate, the final sample size was determined to be 487 participants.

A multistage sampling technique was employed for participant selection. First, Karen State, located in Myanmar, was selected for the study, and three districts were chosen through simple random sampling from the four districts in the state. The selected districts were Myawaddy, Kawkareik and Hlaing Bwe. In the second stage, population proportion-to-size sampling was applied to recruit participants from villages within these three townships:

Myawaddy, Kawkareik, and Hlaing Bwe. This approach was used to ensure that the sample accurately reflected the population distribution in each township. The specific sample sizes for each township were as follows: 188 participants from Kawkareik, 167 participants from Myawaddy, and 132 participants from Hlaing Bwe. For the third stage, household leaders were identified in the selected villages. Afterward, participants (middle-aged men and women) were randomly selected from each household using a simple random sampling procedure with a random start. If a household had more than one middle-aged individual, one was selected randomly. The final study sample included a total of 487 participants, ensuring that it represented the middle-aged population in the rural areas of the selected districts.

2.3 Data Collection

Data were collected via structured interviews using a pretested questionnaire covering socio-demographics, health status, behaviour, blood pressure and Body Mass Index (BMI). Blood pressure was measured per JNC7 guidelines using a mercury sphygmomanometer [9] and BMI was calculated using WHO's Asia-Pacific BMI

criteria [10]. Questionnaires were reviewed daily for completeness and adjusted as necessary.

2.4 Data Analysis

Data were entered into Microsoft Excel and analysed using Stata software, version 18.0 (College Station, Texas 77845 USA). Descriptive statistics summarized baseline characteristics with appropriate presentation for categorical and continuous variables. Inferential analysis estimated pre-hypertension and hypertension prevalence and identified risk factors using bivariate (Crude Odds Ratio (COR), 95% Confidence Interval (CI)) and multiple (Adjusted Odds Ratio (AOR), 95% CI) logistic regression. Backward elimination checked model fit with a significance level of $p < 0.05$.

3. Results

3.1 Baseline Characteristics of the Participants

The study included participants aged 40-59 years, with a mean age of 49.84 ± 5.55 years. The highest proportion of participants were aged 45-49 years (33.06%), followed by 55-59 years (25.87%). Majority were female (63.24%) and most were married (87.06%). In terms of occupational status, nearly half were farmers (48.46%), while 34.50% were housewives or unemployed. Educational

attainment was low, with 65.50% being illiterate and only 2.05% having completed high school. Regarding dietary habits, 29.98% consumed sugar-sweetened foods 1-2 days per week, and 22.80% consumed such foods 5-6 days per week. Fast food consumption was more common, with 69.40% consuming it 1-2 days per week, whereas 46.61% consumed salty foods 1-2 days per week. Additionally, 32.65% added salty sauce to their food 5-6 days per week. Only 16.84% consumed fruits and vegetables daily, and 39.84% consumed protein from meat 3-4 days per week, while 55.03% consumed protein from vegetables 1-2 days per week. About half (51.75%) consumed food cooked with sesame or peanut oil 1-2 days per week. Physical activity levels showed that 42.09% were inactive, while 38.40% were minimally active, with a mean MET score of 1779.45 ± 2216.91 . Sleep quality was predominantly good, with 91.58% scoring within the good range on the Pittsburgh Sleep Quality Index (PSQI). Acute illness within the past two weeks was reported by 7.80%, and chronic diseases were present in 28.54%. Family history of hypertension was noted in 51.54%. In terms of BMI, 41.07% had normal weight, while 21.15% were classified as Obesity Class I, with a mean BMI of 22.86 ± 3.76 (Table 1).

Table 1: Baseline characteristics among the middle-aged population (n=487)

Characteristics	Number (n)	Percentage (%)
Age (years)		
40 - 44	83	17.04
45 - 49	161	33.06
50 - 54	117	24.03
55 - 59	126	25.87
Mean (\pm SD)	49.84 (\pm 5.55)	
Median (Min: Max)	49(40:59)	
Sex		
Male	179	36.76
Female	308	63.24
Marital Status		
Single	20	4.11
Married	424	87.06
Widowed/Divorced/Separated	43	8.83
Occupational Status		
Farmer	236	48.46
Housewife/Unemployed	168	34.50
Agriculture	49	10.06
Self-employee	26	5.34
Non-government employee	2	0.41
Others	6	1.23
Educational Status		
Illiterate	319	65.50
Primary school	124	25.47
Secondary school	34	6.98
High school	10	2.05
Consumption of Sugar Sweetened per week or month (days)		
Never	25	5.13
1-2 days	146	29.98
3-4 days	105	21.56
5-6 days	111	22.80
7 days	100	20.53
Consumption of Fast Foods per week or month (days)		
Never	95	19.51
1-2 days	338	69.40
3-4 days	40	8.22
5-6 days	8	1.64
7 days	6	1.23
Consumption of Salty Foods per week or month (days)		
Never	124	25.46
1-2 days	227	46.61
3-4 days	70	14.37
5-6 days	61	12.53
7 days	5	1.03
Add salty sauce to foods per week or month (days)		
Never	4	0.82
1-2 days	92	18.89
3-4 days	102	20.94
5-6 days	159	32.65
7 days	130	26.69

Characteristics	Number (n)	Percentage (%)
Consumption of at least 1 serving of fruits and vegetables in a week or month (days)		
Never	59	12.11
1-2 days	224	46.00
3-4 days	104	21.36
5-6 days	18	3.69
7 days	82	16.84
Consumption of protein from meat in a week or month (days)		
Never	16	3.29
1-2 days	125	25.66
3-4 days	194	39.84
5-6 days	91	18.67
7 days	61	12.54
Consumption of protein from vegetables in a week or month (days)		
Never	79	16.22
1-2 days	268	55.03
3-4 days	108	22.18
5-6 days	25	5.13
7 days	7	1.44
Consumption of food cooked with sesame or peanut oil in a week or month (days)		
1-2 days	252	51.75
3-4 days	32	6.57
5-6 days	58	11.91
7 days	145	29.77
Physical activity		
Inactive (<600 MET score)	205	42.09
Minimally active (≥600 - <3000 MET score)	187	38.40
HEPA active (≥ 3000 MET score)	95	19.51
Mean MET score (±SD)	1779.45 (±2216.91)	
Median (Min: Max)	840 (0:15946)	
Pittsburgh Sleep Quality Index (PSQI)		
Good sleep quality (score 0-5)	446	91.58
Moderate sleep quality (score 6-10)	40	8.21
Poor sleep quality (score 11-21)	1	0.21
Mean (±SD)	3.67 (±1.36)	
Median (Min: Max)	3 (2:11)	
Acute illness within 2 weeks		
No	449	92.20
Yes	38	7.80
Presence of chronic disease		
No	348	71.46
Yes	139	28.54
Family history of hypertension		
No	236	48.46
Yes	251	51.54
Body Mass Index (kg/m²)		
Underweight (<18.5 kg/m ²)	48	9.86
Normal Weight (18.5 - 22.9 kg/m ²)	200	41.07
Overweight (23 - 24.9 kg/m ²)	105	21.56
Obesity class I (25 - 29.9 kg/m ²)	103	21.15
Obesity class II (≥30 kg/m ²)	31	6.36

Characteristics	Number (n)	Percentage (%)
Mean (\pm SD)		22.86 (\pm 3.76)
Median (Min: Max)		22 (15:39)

3.2 Prevalence of Pre-hypertension/ Hypertension among the Middle-aged Population

The overall prevalence of pre-hypertension and hypertension was 51.95% (95% CI: 47.50 - 56.37) with the prevalence of pre-

hypertension, stage I hypertension and stage II hypertension among the middle-aged population in rural areas, Karen State, Myanmar was 34.50 (95% CI: 30.40-38.84), 13.55 (95% CI: 10.78-16.90) and 3.90 (95% CI: 2.50-6.04) respectively (Table 2).

Table 2: Prevalence of prehypertension/hypertension among the middle-aged population (n=487)

Blood Pressure	Number (n)	Percentage (%)	95% CI
Normal	234	48.05	43.63 - 52.50
Pre-hypertension	168	34.50	30.40 - 38.84
Stage I Hypertension	66	13.55	10.78 - 16.90
Stage II Hypertension	19	3.90	2.50 - 6.04

3.3 Factors associated with prehypertension/hypertension

After controlling the confounding variables, multivariable analysis using multiple logistic regression were used to examine the associated factors of prehypertension/hypertension. Regular intake of salty foods (\geq 3 days per week) was also a significant risk

factor of pre-hypertension or hypertension (AOR: 3.32, 95% CI: 1.77-7.22). Body mass index (BMI) presented a clear dose-response relationship, with obese individuals having significantly elevated odds of pre-hypertension or hypertension (AOR: 2.26, 95% CI: 1.41-3.61) compared to those with normal BMI (Table 3).

Table 3: Bivariate and multivariable analysis of factor associated with prehypertension/hypertension among the middle-aged population using simple and multiple logistic regression (n=487)

Factors	Number of Samples	Pre-hypertension/hypertension (%)	COR	95% CI	AOR	95% CI	P-value
Age (Completed year)							0.342*
50 - 59	243	49.79	1	1	-		
40 - 49	244	54.10	1.19	0.83-1.70	-		
Gender							0.706*
Female	308	51.30	1	1	-		
Male	179	53.07	1.07	0.74-1.55	-		
Marital Status							0.736*

Factors	Number of Samples	Pre-hypertension/hypertension (%)	COR	95% CI	AOR	95% CI	P-value
Divorced/ Widow/Separated	43	53.49	1	1	-		
Single	20	60.00	1.30	0.44-3.83	-		
Married	424	51.42	0.92	0.49-1.73	-		
Occupational							0.086*
Housewife/ unemployment / Others	174	51.15	1	1	-		
Agriculture	49	65.31	1.80	0.93-3.48	-		
Farmer	236	48.31	0.89	0.60-1.32	-		
Self-employee & non- government employee	28	64.29	1.72	0.75-3.94	-		
Educational Status							0.022*
Illiterate	319	47.65	1	1	-		
Primary school	124	62.10	1.80	1.18-2.75	-		
Secondary school/High school/bachelor's degree	44	54.55	1.32	0.70-2.48	-		
Consumption of Sugar Sweetened per week (days)							<0.001* *
Never	25	28.00	1	1	1	1	
< 3 days	146	40.41	1.74	0.69-4.44	1.61	0.55-4.74	
≥ 3 days	316	59.18	3.73	1.51-9.18	3.25	1.16-9.11	
Consumption of Salty foods							<0.001* *
Never	124	41.13	1	1	1	1	
< 3 days	227	52.42	1.58	1.01-2.45	3.60	1.90-6.79	
≥ 3 days	136	61.03	2.24	1.36-3.68	3.32	1.77-7.22	
Consumption of at least 1 serving of fruits							0.754*
Never	59	47.46	1	1	-		
< 3 days	224	52.23	1.21	0.68-2.15	-		
≥ 3 days	204	52.94	1.25	0.70-2.23	-		
Add Salty Sauce to foods							0.073*
< 3 days	96	43.75	1	1	-		
≥ 3 days	391	53.96	1.51	0.96-2.36	-		
Consumption of protein from meat							0.026*
≥ 3 days	346	48.55	1	1	-		
< 3 days	125	58.40	1.49	0.98-2.25	-		
Never	16	75.00	3.18	1.01- 10.05	-		
Consumption of protein from vegetables							0.102*
≥ 3 days	140	47.14	1	1	-		
< 3 days	268	51.49	1.19	0.79-1.79	-		
Never	79	62.03	1.83	1.04-3.21	-		
Consumption of food cooked with sesame or peanut oil in a week or month (days)							0.111*
≥ 3 days	203	49.75	1	1	-		

Factors	Number of Samples	Pre-hypertension/hypertension (%)	COR	95% CI	AOR	95% CI	P-value
< 3 days	32	37.50	0.61	0.28-1.30	-		
Never	252	55.56	1.26	0.87-1.83	-		
Physical Activity							<0.001*
Inactive	205	41.95	1	1	-		
Minimally active	187	58.29	1.93	1.29-2.89	-		
HEPA active	95	61.05	2.17	1.32-3.57	-		
Pittsburgh Sleep Quality Index (PSQI)							0.160*
Moderate and poor sleep quality	41	41.46	1	1	-		
Good sleep quality	446	52.91	1.59	0.83-3.03	-		
Acute illness within 2 weeks							0.029*
No	449	50.56	1	1	-		
Yes	38	68.42	2.12	1.04-4.30	-		
Family history of chronic disease							0.114*
No	465	51.18	1	1	-		
Yes	22	68.18	2.04	0.82-5.10	-		
Body Mass Index (BMI) (kg/m²)							0.003**
Normal	248	43.55	1	1	1	1	
Overweight	105	55.24	1.60	1.01-2.53	1.43	0.88-2.33	
Obesity	134	64.93	2.40	1.55-3.71	2.26	1.41-3.61	

*COR p-value, ** AOR p-value

4. Discussion

The overall prevalence of pre-hypertension/hypertension was 51.95% (95% CI: 47.50 - 56.37). The male participants accounted for 36.76%, and females 63.24%. A study in rural Indonesia highlighted that limited access to healthcare increases the risk of hypertension [11]. The prevalence was relatively lower than the prevalence of 63.3% among Myanmar migrant workers living in Thailand likely due to the cultural and behavioural adoption [12]. Similarly, a study in Bhutan showed that the proportion of female participants (60.9%) was higher than

male (39.1%), with females having a greater prevalence of pre-hypertension/hypertension (54.1%) compared to males (45.9%) [13]. In Ghana, a higher prevalence of hypertension was found in females (57.8%) compared to males (50.12%), possibly due to socio-demographic and behavioural factors [14].

In this study, participants consuming sugar more than 3 days per week were 3.25 times more likely to have pre-hypertension/hypertension compared to those who did not consume sugar. This association can be attributed to several underlying mechanisms. High sugar intake particularly over time

contributes to excessive calorie consumption, weight gain and obesity all of which are significant risk factors for hypertension [15]. Additionally, frequent sugar consumption may promote insulin resistance leading to increased sodium retention and heightened activity of the sympathetic nervous system both of which are linked to elevated blood pressure [16]. Chronic sugar intake may also disrupt the sodium-potassium balance which is essential for maintaining healthy blood pressure levels [17]. Moreover, the inflammatory response triggered by high sugar consumption can contribute to vascular damage and impaired endothelial function reducing the blood vessels' ability to regulate blood flow effectively [18]. High sugar intake was associated with obesity and hypertension, as seen in studies from China, the USA, and Iran [19-21].

Participants who consumed salty food were 3.32 times more likely to have pre-hypertension/hypertension which aligns with findings from Italy and Peru where excessive salt intake contributed to hypertension risk [22, 23]. This result suggests that sodium intake plays a crucial role in hypertension as excessive salt causes fluid retention and increases blood volume leading to higher blood pressure. However, differences in

dietary salt sources may explain some contrasting results. For example, while Italian and Peruvian diets might heavily rely on processed foods or salty snacks, other regions may consume more natural or less processed forms of salt. Additionally, some studies have found that individuals in certain regions may have a higher tolerance to salt, potentially mitigating its hypertensive effects.

Obese participants were 2.26 times more likely to have pre-hypertension/hypertension compared to underweight and normal individuals. This finding is consistent with studies among Myanmar migrant workers, where the risk of pre-hypertension or hypertension was 2.23 times higher in overweight individuals and 5.69 times higher in obese individuals [12]. Obesity has long been recognized as a major risk factor for hypertension, likely due to its association with increased inflammation, sympathetic nervous system activation, and insulin resistance. However, variations in the methods used to assess obesity, such as differences in BMI thresholds or body composition could contribute to contrasting results in other studies [14, 24-27]. For instance, while a BMI of 30 kg/m² is commonly used to define obesity, individuals

with a lower BMI in certain populations may still exhibit high body fat percentages, which could affect hypertension risk differently than in populations with higher average BMI levels.

These findings underscore the significant role of lifestyle factors such as sugar and salt consumption, no consumption of fast foods and body weight in contributing to prehypertension/hypertension risk. The results suggested that women especially those who consume sugar and salty foods or having no consumption of fast foods faced a higher risk of developing hypertension. Additionally, maintaining a healthy body weight is crucial in managing hypertension risk.

This study is the first to examine the prevalence of prehypertension and hypertension among the middle-aged population in rural Karen State, Myanmar. It provides valuable insights that can help health care professionals and policymakers develop effective public health measures for the prevention and control of NCDs. One of the strengths of this study is its focus on a previously under-examined rural population establishing a foundation for future research and interventions targeting NCDs in this region.

However, the nature of this cross-sectional study presents several limitations that must be considered when interpreting the results. First, the cross-sectional design restricts the ability to establish causal relationships between social characteristics and the occurrence of prehypertension/hypertension. The observed associations cannot be definitively attributed to cause and effect. Furthermore, the study is subject to selection bias, as participants may not fully represent the broader population in rural Karen State. Additionally, recall bias may have occurred in self-reported data which could lead to inaccuracies in the assessment of dietary habits and medical history.

Another limitation is the data collection occurring at a single point in time, which makes it difficult to draw conclusions about long-term trends or the temporal sequence of events that might influence hypertension. The study's short-term data collection period may have also resulted in volunteer bias, where individuals who participated in the study may have different health behaviours compared to those who did not. As a result, the findings may not fully reflect the health status of all residents in rural Karen State, Myanmar.

5. Conclusion

This study highlights the strong association between pre-hypertension/hypertension and various factors, including the consumption of sugar-sweetened beverages, salty foods, fast foods and body mass index (BMI). These findings underscore the importance of addressing these factors through lifestyle changes to manage hypertension and other non-communicable diseases (NCDs). Public health strategies should focus on early promotion, prevention, detection and management of NCDs. Integrated management programs at the community level are essential and should emphasize healthier dietary habits, such as increasing the consumption of locally sourced fruits and vegetables, controlling body weight and encouraging physical activity. Furthermore, reducing unhealthy food consumption and promoting the cultivation of healthier local oilseeds can further contribute to controlling NCDs.

Acknowledgement

Firstly, I am deeply grateful to the Faculty of Public Health, Khon Kaen University, for accepting to study the Master of Public Health (International Program) and giving me the opportunity to conduct my thesis. Moreover, I would like to express their

sincere appreciation to all voluntary participants and K.P.C. HD's healthcare workers for their valuable voluntary assistance in allowing data collection and support to accomplish it. In addition, I am grateful to express special thanks to our patron, Aphu. Dr. Ed Marta (Dr. Merdin Myat Kyaw – Patron of KEHOC), Saw Jenery Htun (Senior Executive Officer, KEHOC), Saw Kyaw Hla (Chairperson, KEHOC), team leaders, and co-workers from KEHOC (Karen Ethnic Health Organization Consortium) my seniors, colleagues, my family and friends to my heartfelt thanks for support and motivation. Last, but not least, I would like to thank Dr. Aung Myint Lwin (from KEHOC), who voluntarily assisted in the study to make this possible.

Author Contribution

SSM: Conceptualization, data curation, formal analysis, methodology, writing original draft, writing review and editing.
KMH: Conceptualization, methodology, writing original draft, writing review and editing.
RKM: Conceptualization, methodology, supervision, writing original draft, writing review and editing.

Declaration**Ethical approval and consent to participate**

The research protocol of this study was approved by the Centre of Human Research Ethics, Khon Kaen University, Thailand on 13th June 2024 (Ref No: HE672067).

Competing interests

We declared that we have no competing interests.

Funding

This research received no specific grant from any funding agency

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Received 26/01/2025

Received in revised form 10/03/2025

Accepted 10/03/2025



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