**The Open Public Health Journal**
*DOI: 10.2174/0118749445748226102806051 8, 2026, 19, e187494457482*

**ISSN: 1874-9445**
***1***

**CROSS SECTIONAL STUDY** **OPEN ACCESS**

# Factors Associated with Adequate Health Literacy among At-Risk Groups in Sam Sung District, Khon Kaen Province

Chaimongkol Srilom[1] and Krittiyanee Thammasarn[1,*]

[1]*Faculty of Public Health, Khon Kaen University, Khon Kaen, 40002, Thailand*

**Abstract:**

***Introduction/Objective:*** Hypertension is a major global public health issue and a major cause of death globally. It is a major risk factor for heart failure, myocardial infarction, stroke, coronary heart disease, and renal failure. Accordingly, this study aimed to investigate the factors associated with adequate health literacy among an at-risk group for hypertension in Sam Sung District, Khon Kaen Province.

***Methods:*** A Cross-sectional study was conducted between July and December 2025. The study selected a purposive sample of 1,215 high-risk individuals. Data were collected via a structured questionnaire and analyzed using STATA version 15. Multiple logistic regression was employed to determine the direction and magnitude of associations, reported as Adjusted Odds Ratios (AOR) with 95% confidence intervals (95% CI) and *p*-values.

***Results:*** After adjusting for covariates, six factors were significantly associated with adequate health literacy regarding hypertension. Females were significantly less likely to have adequate health literacy compared to males. (AOR = 0.53; 95% CI: 0.38-0.71). Individuals engaged in agriculture and wage labor demonstrated a significantly lower likelihood of adequate health literacy compared to the unemployed. (AOR = 0.27; 95% CI: 0.13-0.60) and wage laborers (AOR = 0.40; 95% CI: 0.17-0.95). Conversely, those with an average income of average income of 5,001-10,000 Baht were 1.45 times more likely to have sufficient health literacy than those earning less than 5,000 Baht (AOR = 1.45; 95% CI: 1.07-1.96) Regarding health status, individuals with diabetes had lower health literacy than those without comorbidities (AOR = 0.31; 95% CI: 0.17-0.58). Meanwhile, for hypertension preventive behaviors, participants with high levels of preventive practices had a significantly higher proportion of adequate health literacy compared to those with low levels (AOR = 5.05; 95% CI: 2.82-9.06). Lastly, participants with high levels of hypertension knowledge were significantly less likely to demonstrate adequate health literacy compared to those with low knowledge levels (AOR = 0.15; 95% CI: 0.05-0.33)

***Discussion:*** Health literacy among high-risk hypertensive individuals is significantly influenced by sociodemographic factors (sex, occupation, income), diabetic comorbidity, disease knowledge, and preventive behaviors. These findings underscore the necessity of assessing health literacy to identify vulnerable groups, particularly females and socioeconomically disadvantaged individuals. Healthcare providers should leverage these insights to design targeted educational programs and personalized interventions, ultimately improving self-care practices, encouraging healthy behaviors, and reducing cardiovascular disease risks in chronic disease management.

***Conclusion:*** Our findings demonstrate that the majority of individuals at risk for hypertension still exhibit inadequate health literacy. This underscores an urgent need to educate and empower these high-risk groups to enhance their health literacy and promote healthier lifestyles, serving as a core component of community health promotion.

**Keywords:** Hypertension, Health literacy, Risk factors, Preventive behaviors, Chronic diseases, community health.

© 2026 The Author(s). Published by Bentham Open.
This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Public License (CC-BY 4.0), a copy of which is available at: https://creativecommons.org/licenses/by/4.0/legalcode. This license permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

[*] Address correspondence to this author at the Faculty of Public Health, Khon Kaen University, Khon Kaen, 40002, Thailand; E-mail: krittiyanee@kku.ac.th

*Cite as:* Srilom C, Thammasarn K. Factors Associated with Adequate Health Literacy among At-Risk Groups in Sam Sung District, Khon Kaen Province. Open Public Health J, 2026; 19: e187494457482.
http://dx.doi.org/10.2174/0118749445748226102806051 8

Received: July 14, 2026
Revised: September 28, 2026
Accepted: October 16, 2026
Published: November 10, 2026

***Send Orders for Reprints to reprints@benthamscience.net***

## 1. BACKGROUND

With 1.3 billion adults affected, hypertension is a major global public health issue and a major cause of death globally, giving it the moniker “the silent killer.” Moreover, it is a major risk factor for heart failure, myocardial infarction, stroke, coronary heart disease, and renal failure. Only one in five hypertensive individuals are able to effectively control their disease, although hypertension therapies are reasonably priced [1]. In addition, people have been forced to modify their daily routines and lives due to rapid changes in today's social, economic, political, and cultural contexts as well as information technology developments. This is especially noticeable when it comes to adopting high-paced work schedules that prioritize the ease of fast food or prepared meals. Thais are more likely to have Non-Communicable Diseases (NCDs), such as hypertension, as a result of these diets, which are mostly heavy in calories [2].

The Thai National Health Examination Survey 2019-2020 found that 25.4% of people over the age of 15 have hypertension. The rate of change increased by 18.69% during the 2008-2009 and 2019-2020 surveys [2]. Additionally, the incidence rates of newly diagnosed hypertension patients from 2022 to 2024 were 1,160.44, 1,243.07, and 1,362.03 per 100,000 population, respectively, according to statistics from the Ministry of Public Health's Health Statistics Center, indicating a consistent increasing trend [3]. The at-risk group had a 42.9 per 1,000 chance of becoming the ill group, while the prevalence of hypertension in the Northeastern region was 841.32 per 100,000 people [2, 3]. Concurrently, in Khon Kaen Province, the new incidence rates of hypertension from 2022 to 2024 were 1,090.74, 1,085.49, and 1,211.82 per 100,000 people, respectively. In Khon Kaen, screening data for those 35 years of age and older who were at risk for hypertension from 2022 to 2024 revealed rates of 4.97%, 5.52%, and 8.65%, respectively, indicating a steady rise [3]. One of the districts in Khon Kaen Province is Sam Sung District, which has 23,196 residents and consists of 35 villages and 5 subdistricts. Between 2022 and 2024, the district's incidence rates of new instances of hypertension were 2,102.93, 1,965.91, and 1,944.80 per 100,000 people, respectively [3]. The fact that these rates exceed the provincial incidence as a whole is noteworthy. Similarly, from 2022 to 2024, the district's screening results for those 35 years of age and older who were at risk for hypertension showed rates of 3.18%, 2.04%, and 6.83%, respectively. The “3E 2S” health promotion principles—Eating, Exercise, Emotion, Non-Smoking, and Alcohol Abstinence—are being used to prevent disease, although new cases are still occurring [3]. Cultural upheavals, living conditions, and dietary patterns marked by imbalanced consumption—excessively sugary, fatty, and salty foods—are all directly and indirectly impacted by socioeconomic changes. These factors are the main causes of Non-Communicable Diseases (NCDs). There is a linear relationship between the risk of hypertension and cardiovascular mortality and a persistently high intake of salt and sodium that exceeds physiological requirements. The WHO recommends a daily sodium intake of no more than 2,000 milligrams, which is comparable to less than 5 grams, or just under one teaspoon, of salt [3]. Global data shows an average daily salt consumption of 8-10 grams [4].

The ability of a person to meet health-related demands in contemporary culture is referred to as health literacy. According to a review of the literature, health literacy is related to general literacy and includes public knowledge, motivation, and the ability to obtain, comprehend, evaluate, and use health information [5]. In order to preserve or enhance quality of life, this ability is used to make decisions about healthcare, disease prevention, and health promotion in daily life [5]. Due to its strong correlation with socioeconomic determinants of health, health behaviors, healthcare utilization, the quality of the health system, and professional capacity building, this idea has drawn more and more attention in both research and practice [6]. A prior study used social support and the 3E-2S principles to lower the incidence of diabetes and hypertension in newly identified at-risk populations [7]. According to the findings, participants' mean scores for social support and health behaviors were considerably higher following the training ($p$-value $< 0.001$) [7]. Furthermore, Village Health Volunteers' (VHVs) mean post-experimental skill score for home blood pressure measuring was significantly higher than the pre-experimental score ($p$-value $< 0.001$) in a study assessing the effects of a phone follow-up program combined with home blood pressure measuring on health behaviors and blood pressure levels of hypertensive patients [8]. The patients' post-experiment mean health behavior score was significantly higher than their pre-experiment score ($p$-value $< 0.001$) [8]. Blood pressure levels were lowered by 83.55% when food consumption was modified in accordance with the Buddhist Medicine method. 90.91% of hypertension patient groups were able to control their blood pressure, and 27.50% [9]of them were able to reduce their salt intake adequately. Additionally, ongoing communication can generate incentive to sustainably modify attitudes and behaviors, according to an assessment of the second year of the Thai salt reduction program conducted by Mahidol University's Institute of Nutrition [10].

Goal 1 of the 13th National Health Development Plan (2023-2027) shows that the Thai Ministry of Public Health now prioritizes public health literacy (HL): “Citizens display proper health practices and possess health literacy for self-care.” [11] As a result, improving health literacy has emerged as a crucial issue that calls for more tangible mobilization. The World Health Organization (WHO), which defines public health literacy as the cognitive and social skills that determine people's motivation and ability to obtain, comprehend, and use information in ways that promote and maintain good health, has called on member nations to give public health literacy top priority [12]. Inadequate health literacy also contributes to riskier behaviors, fewer preventive behaviors, more frequent hospitalizations, and a lack of knowledge about proper

adherence to medical advice [13], according to American studies. Increased healthcare costs are a result of all these variables, both on a personal and national level. Consequently, considering the large number of people who are at risk for hypertension, increasing health literacy is an essential way to treat the underlying cause of the issue.

A survey of the literature shows that several theories have been used to modify behavior, but there has been little work done on developing a health behavior promotion model that incorporates Sorensen *et al.*'s health literacy concept [5]. To stop new cases from occurring and postpone the morbidity from NCDs, the researcher must raise awareness.

## 2. METHODS

### 2.1. Study Design

This descriptive-analytical, cross-sectional study was conducted between July and December 2025. The study population comprised a high-risk group for hypertension in Sam Sung District, Khon Kaen Province. This study was reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) [14] guidelines for cross-sectional studies. A total of 1,215 participants were selected using purposive sampling. To be eligible for inclusion, individuals were required to meet the following criteria: (1) aged between 35 and 60 years; (2) identified by healthcare providers as being at risk for hypertension, characterized by a Systolic Blood Pressure (SBP) of 120-139 mmHg or a Diastolic Blood Pressure (DBP) of 80-89 mmHg, with no prior diagnosis of hypertension; and (3) willing to voluntarily participate in the study until its completion. Conversely, individuals were excluded if they met any of the following criteria: (1) an inability to perform self-care, defined as an Activities of Daily Living (ADL) score of less than 12; or (2) the presence of severe infectious diseases, such as tuberculosis or COVID-19. Then, the data were analyzed using Stata 15 software, with descriptive and inferential statistics. A *p*-value below 0.05 was considered significant.

**Data Collection Procedure**: The research instrument used for data collection was a structured questionnaire developed by the researchers based on a comprehensive literature review and the health literacy framework by Sorensen *et al*. [5]. The questionnaire was divided into two main sections:

(1) **Socio-demographic Characteristics:** Including age, gender, education level, occupation, and underlying health conditions.

(2) **Health Literacy Scale for Hypertension:** This section assessed four domains of health literacy: hypertension-related information accessing skills, comprehension skills, making and evaluation skills, and application skills, which were adapted from the HLS-EU-Q47 framework. Participants rated perceived difficulty on a 4-point Likert scale (1 = very difficult, 4 = very easy). The health literacy index was calculated as: Index = (mean - 1) × (50/3). Scores were converted to a 0-50 scale. Four levels were defined: inadequate (1-25), problematic (26-33), sufficient (34-42), and excellent (43-50). For analysis, adequate health literacy (sufficient/excellent) was compared with inadequate health literacy (problematic/inadequate). Instrument Validation: Content validity was assessed by three experts using the Index of Item-Objective Congruence (IOC). Items with IOC ≥0.50 were retained. The overall mean IOC was 0.87 (range: 0.67-1.00 across sections). Reliability was assessed by testing the questionnaire with 30 samples from a non-study group. Cronbach's alpha coefficients exceeded 0.96 for all multi-item scales.

### 2.2. Statistical Analysis

Data were analyzed using STATA version 15. Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize general information about the sample and to identify predictors of health literacy outcomes at two levels. Following the crude analysis, variables demonstrating a potential association were selected to construct the initial model. Multivariate analysis using multiple logistic regression was then performed to identify the independent predictors of the outcome while adjusting for confounding factors. The direction and magnitude of these associations were reported as Adjusted Odds Ratios (AOR) with corresponding 95% confidence intervals (95% CI) and *p*-values. Model selection was executed using a backward-elimination procedure based on the Likelihood Ratio test. Variables were sequentially removed if their exclusion did not significantly alter the model; *p*-values of less than 0.05 were retained as the threshold for statistical significance. This process was repeated until all remaining variables contributed significantly to the final model.

## 3. RESULTS

According to Table **1**, among the 1,215 participants, the majority were female (71.85%) with an average age of 50.83 years (Standard Deviation = 6.61 years). Most had a Body Mass Index (BMI) within the normal range (52.10%) and had completed primary education (51.11%). The primary occupation was agriculture (84.20%), with a median monthly income of 3,000 THB (min = 0 THB, max = 80,000 THB). The majority had no underlying diseases (83.87%), though 62.72% had a family history of hypertension. Most were non-smokers (86.42%) and non-drinkers of alcohol (70.21%). Regarding disease-specific baseline measures, half of the participants demonstrated a moderate level of hypertension preventive practices (65.68%). Furthermore, the assessment of baseline hypertension knowledge revealed that a substantial majority possessed a low level of knowledge (76.13%).

According to Table **2**, after adjusting for other covariates, six factors were significantly associated with sufficient health literacy regarding hypertension. Females were less likely to have sufficient health literacy compared to males (AOR = 0.51; 95% CI: 0.35-0.75). Individuals engaged in agriculture were less likely to have sufficient health literacy than those who were unemployed (AOR =

**Table 1. General Information of the Participants (n = 1,215).**

| General Information | Count | Percentage |
|---|---|---|
| **Gender** | | |
| Female | 873 | 71.85 |
| Male | 342 | 28.15 |
| **Age** | Average age of 50.83 years (Standard Deviation = 6.61 years) | |
| 35- 39 years | 123 | 10.12 |
| 40 - 49 years | 258 | 21.23 |
| 50- 59 years | 800 | 65.84 |
| 60 years | 34 | 2.80 |
| **Body Mass Index** | | |
| Underweight | 22 | 1.81 |
| Normal | 633 | 52.10 |
| Overweight | 458 | 37.70 |
| Obese Class 1 | 77 | 6.34 |
| Obese Class 2 | 21 | 1.73 |
| Obese Class 3 | 4 | 0.33 |
| **Education Level** | | |
| No formal education | 5 | 0.41 |
| Primary school | 621 | 51.11 |
| Lower secondary school | 276 | 22.72 |
| Upper secondary school | 268 | 22.06 |
| Diploma/Associate degree | 15 | 1.23 |
| Bachelor’s degree | 30 | 2.47 |
| **Occupation** | | |
| Agriculture | 1,023 | 84.20 |
| Laborer | 114 | 9.38 |
| Unemployed | 35 | 2.88 |
| Self-employed | 18 | 1.48 |
| Business | 14 | 1.15 |
| Government Official | 11 | 0.91 |
| **Monthly Income** | Median = 3,000 THB (min = 0, max = 80,000) | |
| Less than 5,000 THB | 820 | 67.49 |
| 5,001 - 10,000 THB | 335 | 27.57 |
| 10,001 - 15,000 THB | 31 | 2.55 |
| 15,000 THB and above | 29 | 2.39 |
| **Underlying Diseases** | | |
| None | 1,019 | 83.87 |
| Diabetes | 86 | 7.08 |
| Gout | 73 | 6.01 |
| Coronary Heart Disease | 25 | 2.06 |
| Kidney Disease | 12 | 0.99 |
| **Family History of Hypertension** | | |
| Yes | 762 | 62.72 |
| No | 453 | 37.28 |
| **Smoking Status** | | |
| Non-smoker | 1,050 | 86.42 |

| General Information | Count | Percentage |
|---|---|---|
| Ex-smoker | 44 | 3.62 |
| Current smoker | 121 | 9.96 |
| **Alcohol Consumption** | | |
| Non-drinker | 853 | 70.21 |
| Drinker | 362 | 29.79 |
| **Hypertension Preventive Practices level** | | |
| Low | 106 | 8.72 |
| moderate | 798 | 65.68 |
| high | 311 | 25.60 |
| **Knowledge of hypertension level** | | |
| Low | 925 | 76.13 |
| moderate | 217 | 17.86 |
| high | 73 | 6.01 |

**Table 2. Factors associated with adequate health literacy. (n = 476).**

| Factors | Adequate Health Literacy | | Crude OR | Adjusted OR | 95% CI | *P*-Value |
|---|---|---|---|---|---|---|
| | n | % | | | | |
| **Gender** | | | | | | |
| Male | 156 | 32.77 | 1 | 1 | | |
| Female | 320 | 67.23 | 0.6 | 0.51 | 0.35 to 0.75 | 0.001* |
| **Age** | | | | | | |
| 35 - 39 years | 48 | 10.08 | 1 | 1 | | |
| 40 - 49 years | 104 | 21.85 | 1.05 | 1.21 | 0.68 to 2.15 | 0.52 |
| 50 - 59 years | 310 | 65.13 | 0.98 | 0.90 | 0.52 to 1.55 | 0.71 |
| 60 years | 14 | 2.94 | 1.09 | 0.96 | 0.36 to 2.38 | 0.89 |
| **Body Mass Index** | | | | | | |
| Underweight | 12 | 2.52 | 1 | 1 | | |
| Normal | 231 | 48.53 | 0.49 | 0.64 | 0.23 to 1.75 | 0.38 |
| Overweight | 196 | 41.18 | 0.62 | 1.01 | 0.36 to 2.81 | 0.98 |
| Obese Class 1 | 26 | 5.46 | 0.42 | 0.35 | 0.11 to 1.11 | 0.07 |
| Obese Class 2 | 7 | 1.47 | 0.41 | 1.73 | 0.36 to 8.40 | 0.50 |
| **Education Level** | | | | | | |
| No formal education | 0 | 0 | 1 | 1 | | |
| Primary school | 230 | 48.32 | 0.77 | 1.23 | 0.44 to 3.39 | 0.69 |
| Lower secondary school | 117 | 24.58 | 0.96 | 1.12 | 0.39 to 3.27 | 0.83 |
| Upper secondary school | 114 | 23.95 | 0.97 | 1.30 | 0.46 to 3.69 | 0.62 |
| Diploma/Associate degree | 2 | 0.42 | 0.20 | 0.41 | 0.06 to 2.74 | 0.36 |
| **Occupation** | | | | | | |
| Unemployed | 21 | 4.41 | 1 | 1 | | |
| Agriculture | 384 | 80.67 | 0.4 | 0.29 | 0.13 to 0.65 | 0.003* |
| Business | 10 | 2.10 | 1.6 | 1.28 | 0.30 to 5.50 | 0.74 |
| Laborer | 44 | 9.24 | 0.4 | 0.45 | 0.18 to 1.10 | 0.08 |
| Self-employed | 6 | 1.26 | 0.3 | 0.27 | 0.06 to 1.12 | 0.07 |
| **Monthly Income** | | | | | | |
| Less than 5,000 THB | 296 | 62.18 | 1 | 1 | | |

| Factors | Adequate Health Literacy | | Crude OR | Adjusted OR | 95% CI | *P*-Value |
|---|---|---|---|---|---|---|
| | n | % | | | | |
| 5,001 - 10,000 THB | 149 | 31.30 | 1.42 | 1.44 | 1.03 to 2.00 | 0.03* |
| 10,001 - 15,000 THB | 17 | 3.57 | 2.15 | 0.92 | 0.33 to 2.58 | 0.88 |
| 15,000 THB and above | 14 | 2.94 | 1.65 | 2.22 | 0.79 to 6.20 | 0.13 |
| **Underlying Diseases** | | | | | | |
| None | 413 | 86.76 | 1 | 1 | | |
| Diabetes | 19 | 3.99 | 0.42 | 0.24 | 0.12 to 0.47 | <0.001* |
| Coronary Heart Disease | 10 | 2.10 | 0.98 | 0.59 | 0.00 to 1.59 | 0.30 |
| Gout | 34 | 7.14 | 1.28 | 0.99 | 0.53 to 1.87 | 0.99 |
| **Family History of Hypertension** | | | | | | |
| No | 189 | 39.71 | 1 | 1 | | |
| Yes | 287 | 60.29 | 0.84 | 0.77 | 0.57 to 1.05 | 0.1 |
| **Smoking Status** | | | | | | |
| Non-smoker | 412 | 86.55 | 1 | 1 | | |
| Ex-smoker | 17 | 3.57 | 0.98 | 1.22 | 0.51 to 2.93 | 0.65 |
| Current smoker | 47 | 9.87 | 0.98 | 1.04 | 0.62 to 1.77 | 0.86 |
| **Alcohol Consumption** | | | | | | |
| Non-drinker | 335 | 70.38 | 1 | 1 | | |
| Drinker | 141 | 29.62 | 0.99 | 0.89 | 0.63 to 1.26 | 0.51 |
| **Hypertension Preventive Practices level** | | | | | | |
| Low | 35 | 7.35 | 1 | 1 | | |
| moderate | 211 | 44.33 | 0.73 | 0.53 | 0.30 to 0.92 | 0.03* |
| high | 230 | 48.32 | 5.76 | 4.21 | 2.27 to 7.81 | <0.001* |
| **Knowledge of hypertension level** | | | | | | |
| Low | 401 | 84.24 | 1 | 1 | | |
| moderate | 69 | 14.50 | 0.61 | 0.63 | 0.42 to 0.95 | 0.03* |
| high | 6 | 1.26 | 0.12 | 0.13 | 0.05 to 0.33 | <0.001* |

0.29; 95% CI: 0.13-0.65). Conversely, those with an average income of 5,001-10,000 Baht were 1.44 times more likely to have sufficient health literacy than those earning less than 5,000 Baht (AOR = 1.44; 95% CI: 1.03-2.00). Regarding health status, individuals with diabetes had lower health literacy than those without comorbidities (AOR = 0.24; 95% CI: 0.12-0.47). Meanwhile, individuals with a high level of hypertension prevention behaviors were 4.21 times more likely to achieve sufficient health literacy than those with a low level (AOR = 4.21; 95% CI: 2.27-7.81). Lastly, individuals with a high level of hypertension knowledge showed a lower likelihood of sufficient health literacy compared to those with a low knowledge level (AOR = 0.13; 95% CI: 0.05-0.33).

According to Table **3**, after adjusting for other covariates, six factors were significantly associated with sufficient health literacy regarding hypertension. Females were less likely to have sufficient health literacy compared to males (AOR = 0.53; 95% CI: 0.38-0.71). Regarding occupation, individuals engaged in agriculture (AOR = 0.27; 95% CI: 0.13-0.60) and those employed as laborers (AOR = 0.40; 95% CI: 0.17-0.95) were less likely to have sufficient health literacy than those who were unemployed. Conversely, individuals with an average income of 5,001-10,000 Baht were 1.45 times more likely to have sufficient health literacy than those earning less than 5,000 Baht (AOR = 1.45; 95% CI: 1.07-1.96). For health status, individuals with diabetes had lower health literacy than those without comorbidities (AOR = 0.31; 95% CI: 0.17-0.58). Meanwhile, individuals with a high level of hypertension prevention behaviors were 5.05 times more likely to achieve sufficient health literacy than those with a low level (AOR = 5.05; 95% CI: 2.82-9.06). Lastly, individuals with a high level of hypertension knowledge showed a lower likelihood of sufficient health literacy compared to those with a low knowledge level (AOR = 0.15; 95% CI: 0.06-0.36). Model selection was performed using a backward elimination procedure based on the Likelihood Ratio test. Variables such as age, BMI, education level, family history of hypertension, smoking status, and alcohol consumption were removed as they did not significantly contribute to the final model ($p > 0.05$).

**Table 3. Factors associated with adequate health literacy final model. (n = 476).**

| Factors | Adequate Health Literacy | | Crude OR | Adjusted OR | 95% CI | *P*-Value |
|---|---|---|---|---|---|---|
| | n | % | | | | |
| **Gender** | | | | | | |
| Male | 156 | 32.77 | 1 | 1 | | |
| Female | 320 | 67.23 | 0.6 | 0.53 | 0.38 to 0.71 | <0.001* |
| **Occupation** | | | | | | |
| Unemployed | 21 | 4.41 | 1 | 1 | | |
| Agriculture | 384 | 80.67 | 0.4 | 0.27 | 0.13 to 0.60 | 0.001* |
| Business | 10 | 2.10 | 1.6 | 1.38 | 0.33 to 5.77 | 0.66 |
| Laborer | 44 | 9.24 | 0.4 | 0.40 | 0.17 to 0.95 | 0.04* |
| Self-employed | 6 | 1.26 | 0.3 | 0.34 | 0.09 to 1.29 | 0.11 |
| **Monthly Income** | | | | | | |
| Less than 5,000 THB | 296 | 62.18 | 1 | 1 | | |
| 5,001 - 10,000 THB | 149 | 31.30 | 1.42 | 1.45 | 1.07 to 1.96 | 0.01* |
| 10,001 - 15,000 THB | 17 | 3.57 | 2.15 | 0.96 | 0.36 to 2.56 | 0.94 |
| 15,000 THB and above | 14 | 2.94 | 1.65 | 1.98 | 0.79 to 4.98 | 0.15 |
| **Underlying Diseases** | | | | | | |
| None | 413 | 86.76 | 1 | 1 | | |
| Diabetes | 19 | 3.99 | 0.42 | 0.31 | 0.17 to 0.58 | <0.001* |
| Coronary Heart Disease | 10 | 2.10 | 0.98 | 0.65 | 0.25 to 1.63 | 0.35 |
| Gout | 34 | 7.14 | 1.28 | 1.04 | 0.59 to 1.87 | 0.88 |
| **Hypertension Preventive Practices level** | | | | | | |
| Low | 35 | 7.35 | 1 | 1 | | |
| moderate | 211 | 44.33 | 0.73 | 0.65 | 0.38 to 1.10 | 0.11 |
| high | 230 | 48.32 | 5.76 | 5.05 | 2.82 to 9.06 | <0.001* |
| **Knowledge of hypertension level** | | | | | | |
| Low | 401 | 84.24 | 1 | 1 | | |
| moderate | 69 | 14.50 | 0.61 | 0.75 | 0.51 to 1.09 | 0.13 |
| high | 6 | 1.26 | 0.12 | 0.15 | 0.06 to 0.36 | <0.001* |

## 4. DISCUSSION

This study revealed that Females were significantly less likely to have adequate health literacy compared to males. (AOR = 0.53; 95% CI: 0.38-0.71). This finding contrasts with some conventional literature but aligns with recent community-based studies highlighting gender disparities in rural developing regions [15, 16]. In rural agricultural contexts, women frequently bear a double burden of domestic caregiving and agricultural labor, leading to time constraints that impede their active participation in health education programs and information seeking [15]. Furthermore, structural socioeconomic disadvantages, including lower formal educational attainment among older rural women, further diminish their functional and critical health literacy capacities [16, 17]. Recent evidence from Xie, Y. *et al*. [15] and Acquah, I. *et al.* [16] confirms that lower health literacy among women in rural settings is heavily driven by limited access to health information and cognitive overload from managing household wellness alongside chronic disease risks [16, 18]. Therefore, health promotion strategies in primary care must prioritize women as a vulnerable subgroup by deploying tailored, simplified, and accessible educational interventions within community networks. Regarding occupation, individuals engaged in agriculture (AOR = 0.27; 95% CI: 0.13-0.60) and wage laborers (AOR = 0.40; 95% CI: 0.17-0.95) demonstrated a significantly lower likelihood of adequate health literacy compared to the unemployed. In line with a study by Bawornthip *et al.* [18], educational level, occupation, family medical history, and access to health information from healthcare personnel significantly influenced participants' health literacy. Moreover, this study found that individuals with a monthly income of 5,001-10,000 THB had a higher proportion of adequate health literacy than those earning less than 5,000 THB (AOR = 1.45; 95% CI: 1.07-1.96). Consistent with Singh *et al*. [19], low literacy levels and excessive wealth were correlated with hypertension, whereas higher educational attainment was inversely associated with hypertension.

Interestingly, regarding health status, participants in the high-risk group with diabetes as a comorbidity were significantly less likely to achieve adequate health literacy compared to those without comorbidities (AOR = 0.31; 95% CI: 0.17-0.58) [20]. This finding contradicts the assumption that living with a chronic condition automatically improves health literacy; instead, it indicates that diabetic comorbidities pose additional challenges. This result is consistent with recent studies by Bekele F and Feyisa I [21]. and Vågenes ST *et al.* [22], which observed high rates of limited health literacy among chronic and diabetic patients. Managing diabetes involves multiple self-care protocols—such as dietary restrictions, blood glucose monitoring, and medication adherence—which can create information overload and cognitive fatigue for high-risk individuals [23]. Consequently, healthcare providers should design simplified, continuous, and tailored educational programs to better support individuals managing comorbid chronic conditions. In terms of hypertension preventive behaviors, participants with high levels of preventive practices had a significantly higher proportion of adequate health literacy compared to those with low levels (AOR = 5.05; 95% CI: 2.82-9.06). Interestingly, participants with high levels of hypertension knowledge were significantly less likely to demonstrate adequate health literacy compared to those with low knowledge levels (AOR = 0.15; 95% CI: 0.05-0.33) [24]. This inverse relationship highlights the well-documented 'knowledge-behavior gap' in chronic disease management [23, 24]. Possessing factual knowledge about hypertension—such as identifying cut-off blood pressure numbers—does not inherently guarantee functional skills for accessing, appraising, or applying health advice in daily routines [22, 24]. Recent findings by Ozyuncu and Erol [25] confirm that despite population awareness and theoretical disease knowledge, non-adherence and health literacy gaps often stem from the inability to translate information into practical self-management and lifestyle modifications [25]. Furthermore, individuals with higher disease knowledge may possess greater awareness of the complexities and barriers associated with lifestyle modifications, leading them to perceive health-seeking tasks as more challenging on health literacy assessment scales [24]. Therefore, healthcare providers must transition from passive health information dissemination toward interactive, skill-based interventions that empower patients to apply their knowledge effectively.

## 5. STUDY LIMITATIONS

This study has certain limitations. First, the cross-sectional design precludes causal inferences between variables; therefore, future prospective longitudinal studies are warranted to establish causal relationships regarding factors associated with adequate health literacy among high-risk hypertensive individuals. Another limitation is the use of purposive sampling, as the high-risk hypertensive group was selected from a single district, potentially limiting the generalizability of the findings to the broader population. Consequently, more comprehensive sampling strategies should be employed in future research.

## CONCLUSION

Our findings demonstrate that the majority of individuals at risk for hypertension still exhibit inadequate health literacy. This underscores an urgent need to educate and empower these high-risk groups to enhance their health literacy and promote healthier lifestyles, which serves as a core component of community health promotion. Furthermore, appropriate follow-up strategies should be implemented to modify the health behaviors of at-risk individuals. Such measures are vital for preventing new cases within the community and ultimately reducing the financial burden associated with hypertension treatment.

## AUTHORS' CONTRIBUTIONS

The authors confirm their contributions to the paper as follows: C.S. and K.T. designed the study, performed data collection, and analyzed the data. All authors contributed to the writing of the manuscript and approved the final version for submission.

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| ADL | = | Activities of Daily Living |
| AOR | = | Adjusted Odds Ratio |
| BMI | = | Body Mass Index |
| CI | = | Confidence Interval |
| DBP | = | Diastolic Blood Pressure |
| HL | = | Health Literacy |
| HLS-EU-Q47 | = | Health Literacy Survey-European Union 47-item Questionnaire |
| IOC | = | Index of Item-Objective Congruence |
| NCDs | = | Non-Communicable Diseases |
| OR | = | Odds Ratio |
| SBP | = | Systolic Blood Pressure |
| SMBG | = | Self-Monitoring of Blood Glucose |
| THB | = | Thai Baht |
| VHV / VHVs | = | Village Health Volunteers |
| WHO | = | World Health Organization |

## ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study utilized primary data. The research protocol and data collection instruments were reviewed and approved by the Ethics Committee in Human Research of Khon Kaen University (Approval No. HE682046). Prior to the main data collection, the questionnaire was pilot-tested with 30 participants possessing similar characteristics to the target sample in Kranuan District, Khon Kaen Province. Ethical principles were strictly upheld throughout the data collection process.

## HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committees and with the 1975 Declaration of Helsinki, as revised in 2013.

## CONSENT FOR PUBLICATION

Participants were thoroughly informed about the study's objectives, procedures, potential risks, and benefits before providing written informed consent. They were explicitly notified of their right to make independent decisions regarding participation, as well as their right to withdraw from the study at any time without penalty. To ensure confidentiality and anonymity, no personally identifiable information was collected, and all data were kept strictly confidential and presented only in aggregate form.

## STANDARDS OF REPORTING

STROBE guidelines were followed.

## AVAILABILITY OF DATA AND MATERIALS

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## FUNDING

None.

## CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

## ACKNOWLEDGEMENTS

The authors would like to thank all participants and health officers in the Sam Sung District, Khon Kaen Province, for their cooperation in this research.

## REFERENCES

[1] World Health Organization. Hypertension. 2024. Available from: https://www.who.int/health-topics/hypertension#tab=tab_3

[2] Patanavanich R, Vityananan P, Neelapaichit N, *et al*. Association between electronic cigarette use and depression among Thai adolescents: The Thailand National Health Examination Survey 2019–2020. Tob Induc Dis 2022; 20(November): 1-8. http://dx.doi.org/10.18332/tid/155333 PMID: 36447457

[3] Pokpermdee P, Sukpatthanakul K, Phimla S, *et al*. Assessment of Thailand's Health System Performance in 2022-2023. J Health Syst Res 2024; 18(3): 291-313.

[4] He FJ, Brown M, Tan M, MacGregor GA. Reducing population salt intake—An update on latest evidence and global action. J Clin Hypertens (Greenwich) 2019; 21(10): 1596-601. http://dx.doi.org/10.1111/jch.13664 PMID: 31448517

[5] Sørensen K, Van den Broucke S, Fullam J, *et al*. Health literacy and public health: A systematic review and integration of definitions and models. BMC Public Health 2012; 12(1): 80. http://dx.doi.org/10.1186/1471-2458-12-80 PMID: 22276600

[6] Nutbeam D. The evolving concept of health literacy. Soc Sci Med 2008; 67(12): 2072-8. http://dx.doi.org/10.1016/j.socscimed.2008.09.050 PMID: 18952344

[7] Tanhui N, Sangthong P, Thohman M, Nowsuwan K, Singweratham N. The effect of health literacy program according to the 3e 2s principle on health literacy, preventive behaviors, and blood pressure levels among people in hypertensive risk Group. J Nurs Public Health Res (Southampt) 2023; 3(2): 96-111. https://he02.tci-thaijo.org/index.php/jnphr/article/view/260356 [internet].

[8] Sornlorm K, Thi WM. Health literacy and high blood pressure among Myanmar migrant workers in Northeastern Thailand. PLoS One 2024; 19(4): e0302057. http://dx.doi.org/10.1371/journal.pone.0302057 PMID: 38662714

[9] Visanuyothin S, Plianbangchang S, Somrongthong R. An integrated program with home blood-pressure monitoring and village health volunteers for treating poorly controlled hypertension at the primary care level in an urban community of Thailand. Integr Blood Press Control 2018; 11: 25-35. http://dx.doi.org/10.2147/IBPC.S160548 PMID: 29713195

[10] Sonuch P, Aekplakorn W, Pomsanthia N, *et al*. Community-based intervention for monitoring of salt intake in hypertensive patients: A cluster randomized controlled trial. PLoS One 2024; 19(11): e0311908. http://dx.doi.org/10.1371/journal.pone.0311908 PMID: 39576798

[11] National Economic and Social Development Council. Preparation of (Draft) The Thirteenth National Health Development Plan. 2022. Available from: https://kb.hsri.or.th/dspace/handle/11228/6222

[12] World Health Organization. Health literacy: the solid facts. 2013. Available from: https://iris.who.int/handle/10665/326432

[13] Berkman ND, Sheridan SL, Donahue KE, Halpern DJ, Crotty K. Low health literacy and health outcomes: An updated systematic review. Ann Intern Med 2011; 155(2): 97-107. http://dx.doi.org/10.7326/0003-4819-155-2-201107190-00005 PMID: 21768583

[14] Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ 2007; 335(7624): 806-8. http://dx.doi.org/10.1136/bmj.39335.541782.AD PMID: 17947786

[15] Xie Y, Ma M, Zhang Y, Tan X. Factors associated with health literacy in rural areas of Central China: structural equation model. BMC Health Serv Res 2019; 19(1): 300. http://dx.doi.org/10.1186/s12913-019-4094-1 PMID: 31077197

[16] Acquah I, Hagan K, Javed Z, *et al*. Social Determinants of Cardiovascular Risk, Subclinical Cardiovascular Disease, and Cardiovascular Events. J Am Heart Assoc 2023; 12(6): e025581. http://dx.doi.org/10.1161/JAHA.122.025581 PMID: 36926956

[17] Lee EH, Lee YW, Chae D, *et al*. Pathways linking health literacy to self-management in people with type 2 diabetes. Healthcare (Basel) 2021; 9(12): 1734. https://www.mdpi.com/2227-9032/9/12/1734 http://dx.doi.org/10.3390/healthcare9121734 PMID: 34946460

[18] Bawornthip P, McDonall J, Tamdee D, Driscoll A, Hutchinson A. Health literacy and uptake of healthy diet and exercise amongst individuals with prehypertension in Thailand. Health Promot Int 2025; 40(3): daaf089. http://dx.doi.org/10.1093/heapro/daaf089 PMID: 40531173

[19] Singh S, Shankar R, Singh GP. Prevalence and associated risk factors of hypertension: A cross-sectional study in urban Varanasi. Int J Hypertens 2017; 2017(1): 5491838. http://dx.doi.org/10.1155/2017/5491838 PMID: 29348933

[20] Levic M, Bogavac-Stanojevic N, Lakic D, Krajnovic D, Krajnovic D. Predictors of inadequate health literacy among patients with type 2 diabetes mellitus: Assessment with different self-reported instruments. Int J Environ Res Public Health 2023; 20(6): 5190. http://dx.doi.org/10.3390/ijerph20065190 PMID: 36982101

[21] Mogessie HM, Gebeyehu MA, Kenbaw MG, Tadesse TA. Diabetic health literacy and associated factors among diabetes mellitus patients on follow up at public hospitals, Bale Zone, South East Ethiopia, 2021. PLoS One 2022; 17(7): e0270161. http://dx.doi.org/10.1371/journal.pone.0270161 PMID: 35797276

[22] Vågenes ST, Graue M, Igland J, Kolltveit BCH, Riise HKR. Health

literacy among people at risk or with type 2 diabetes in Norwegian primary care—A cross sectional study. PLoS One 2024; 19(10): e0312485. http://dx.doi.org/10.1371/journal.pone.0312485 PMID: 39446869

[23] Zeng J, Tao P, Lai L, *et al*. The knowledge-behavior gap in nutritional literacy and its associations with chronic disease in older adults: a mediation analysis. Front Nutr 2026; 13: 1782729. http://dx.doi.org/10.3389/fnut.2026.1782729 PMID: 42039902

[24] Beiranvandi A, Beiranvand A, Karami K, Mohammadi R. Association of health literacy, medication beliefs, and illness perception among older adults with hypertension: a community-based study. BMC Public Health 2026; 26(1): 854. http://dx.doi.org/10.1186/s12889-025-26123-4 PMID: 41654774

[25] Ozyuncu N, Erol C. How can we increase the efficacy of antihypertensive treatment? Kardiol Pol 2024; 82(1): 19-28. http://dx.doi.org/10.33963/v.kp.98705 PMID: 38230498

**DISCLAIMER:** Please note that this article is currently in the 'Early view' stage and is not the final 'Version of Record'. While it has been accepted, copy-edited, and formatted, however, it is still undergoing proofreading and corrections by the authors. Therefore, the text may still change before the final publication. Although 'Early view' may not have all bibliographic details available, the DOI and the year of online publication can still be used to cite them. The article title, DOI, publication year, and author(s) should all be included in the citation format. Once the 'Final Version of Record' becomes available the 'Early view' will be replaced by that.