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ORIGINAL STUDY

Factors Influencing Sodium Consumption Behaviors among University Employees in Phitsanulok Province, Thailand: A Cross-Sectional Study

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Abstract

Background: **Excessive sodium intake is the most widely recognized dietary risk factor among adults, as it leads to an increase in noncommunicable diseases (NCDs). This study aimed to identify factors that influence sodium consumption behaviors (SCBs) among university employees.**

Methods: **A cross-sectional study with a stratified multistage probability sampling design was conducted to collect data from 430 public university employees in the lower northern region of Thailand aged 20−69 years from October to November 2022. The data were collected through a self-administered questionnaire, analyzed using binary logistic regression, and presented using adjusted odds ratio (AOR) with 95% confidence interval (CI).**

Results: **Among all 430 participants, 74.7% were women, and the average age was 40.46 ± 8.04 years old. Factors influencing high SCBs were preferences for processed food (AOR 2.41, 95% CI: 1.52−3.89) followed by ordering food delivery (AOR 2.33, 95% CI: 1.51−3.61), a fondness for salty food (AOR 1.70, 95% CI: 1.04−2.80), working in non-health science departments (AOR 1.67, 95% CI: 1.06−2.63), eating out (AOR 1.63, 95% CI: 1.05−2.54), having a low level of applying to sodium information (AOR 2.11, 95% CI: 1.16−3.86), and having a low level of understanding of sodium information (AOR 2.04, 95% CI: 1.02−4.05).**

Conclusions: **Interventions to improve health literacy on sodium consumption of university employees are essential to improve understanding and application of sodium information. These interventions should especially focus on people who prefer processed food, order food delivery, are fond of salty food, and enjoy eating out.**

Keywords: Adults, Health literacy on sodium consumption, Sodium consumption behavior, Thailand, University employees

1. Introduction

Mortality and morbidity from non-communicable diseases (NCDs) constitute one of the major challenges for economic development and an aging population in the 21st century [1]. There is significant evidence suggesting that a high sodium intake causes increased blood pressure, which is conducive to hypertension (HT) and other complications, such as cardiovascular disease (CVD), chronic kidney disease, obesity, and gastric cancer [2−5].

NCDs are the number one cause of death in Thailand, claiming the lives of 400,000 people annually, and are responsible for 74% of deaths in the country. Of Thai citizens, 14% are at risk of dying prematurely from NCDs, one of which is CVD [6]. Although there are many determinants of NCDs, excessive sodium intake is a recognized behavioral risk factor for NCDs [7].

The World Health Organization (WHO) has committed to achieving a 30% global reduction in salt/sodium intake by 2025, setting an individual sodium intake goal of <2000 mg/day [8]. These goals are based on evidence showing that the sodium intake for the general adult population in many countries remains high [9−11]. This is consistent with the policy for reducing NCDs in Thailand,

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which aims to reduce sodium intake among people over 18 years old by 30% by 2025 [6]. A recent survey study of the Thai population between 2019 and 2020 showed that the mean dietary sodium intake was 3636 mg per day, which is nearly twice the recommended WHO goal [12].

During the COVID-19 pandemic, Thai consumer behaviors were shaped by the so-called "new normal" lifestyle. This lifestyle change resulted in more online food purchases and a greater use of food delivery services. Tellingly, instant noodles, which is a high-sodium food, was the product with the greatest increase in purchases [13]. A previous study looking at expected use of food delivery application in during COVID-19 and the future found that the prediction study cloud kitchen business plan in Phitsanulok Province reflected this increasing trend; the expected predicting use of food delivery applications by university employees and students increased from 28.48% to 50.93%, or 500 times per day [14].

Health literacy has been shown to be a significant, independent, and modifiable social determinant of health [15]. It is considered one of the most important processes that allows individuals to access, understand, appraise, and apply health information for disease prevention and health promotion. Thus, greater health literacy is linked to improving health outcomes and quality of life [16]. Higher health literacy has a significant relationship with nutritional behavior [17]. Salt intake tends to decrease in people who have higher literacy and awareness [18]. Regarding Thai health literacy, it was found that 58.9% of individuals have a fair level of health literacy, while 25% of adults aged 25–59 have a low level of health literacy [19]. In previous research, factors related to a high sodium intake among adults were perceived behavioral control, habit [20], male gender, a large waist circumference, obesity [21], being 20–29 years old, higher fruit and vegetable intake [22], and low levels of knowledge about reducing high sodium dietary consumption [23]. In contrast, higher health literacy was associated with lower consumption of sodium. However, there are few studies focusing about sodium consumption and health literacy among adults in Phitsanulok Province.

The Thai National Health Examination Survey VI, conducted in 2019, revealed an HT prevalence rate of 25.4% in adults aged 15 years or older, which was higher than the rate in the NHES V conducted in 2014 [24]. Similarly, the health status annual report 2021 in Phitsanulok Province identified an HT prevalence rate of 24.74%, which was an increase from the previous year. Furthermore, the HT risk among those aged 35 years or older was 11%. A majority of food (88.2%) from the market had a high level of salt, followed by over three-quarters (77.8%) of food from restaurants [25]. These findings correspond to a trend of high NCDs and high sodium consumption among Thais.

Due to the high prevalence of high blood pressure and excessive sodium consumption among people in Thailand, the Department of Disease Control of the Ministry of Public Health set the strategy for the year 2016–2025. Their goal is to reduce salt and sodium consumption 30% by the year 2025 through 5 strategies is called "SALTS" including S (stakeholder network), A (awareness), L (legislation and environmental reform), T (technology and innovation), and S (surveillance, monitoring and evaluation) [26]. This strategy is an essential investment to prevent and control of NCDs in Thailand [6].

University employees are individuals employed by the university in any capacity. They include both academic and supportive staff, all of whom are an important part of a productive economy. Most university employees buy food daily [23], and their workplaces are surrounded with many convenience stores and food delivery platforms. Hence, they are at risk of high sodium intake. This study was conducted to identify factors influencing sodium consumption behaviors among university employees in Phitsanulok Province, Thailand.

2. Methodology

2.1. Study design and population sampling

This cross-sectional study was carried out among public university employees in Phitsanulok Province, which is a central city in the lower northern region of Thailand and has three public universities. Simple random sampling was used to select one of three public universities to recruit participants. The calculation of the sample size was based on the N4studies application, where a finite population was used for testing the proportion formula [27]:

$$n = \frac{Np(1-p)z^2_{1-\frac{\alpha}{2}}}{d^2(N-1)+p(1-p)z^2_{1-\frac{\alpha}{2}}}$$

where n is the sample size. The target population (N) was 4935 university employees [28]. The desired level of confidence was 95%, Z = 1.96 ($\propto = 0.05$), the proportion of sodium consumption among university employees from the previous research (p) was 0.58 [23], and the margin of error (d) was 0.05. The sample size calculated from the formula was 348. The estimated sample size was increased by 10%

due to the non-response rate as the formula of sample size adjusted for non-response [29]:

$$n_{adj} = \frac{n}{(1-R)^2}$$

where n is the sample size calculated (348), R is the rate of non-response (0.1). Therefore, the necessary sample size (n) was 430. The inclusion criteria selected male or female university employees both in academic and supportive staff positions, aged 20−69 years who agreed to participate in the study. Foreign employees and university students were excluded from the study. The data collection occurred from October to November 2022. The details of the study were provided to participants. Informed consent was obtained before collecting the data. A stratified sampling technique was used to select the participants. The participants were divided into three groups based on their affiliations [28]:

1) "Faculty" affiliation consisted of 3 clusters: A (health science cluster), B (science and technology cluster), and C (humanities and social sciences cluster)
2) "College" affiliation consisted of 4 colleges: graduate school, school of renewable energy and smart grid technology, the institute for fundamental study, and international college
3) Office workers were organized into 3 divisions: division of administration, office of the library, and office of the university council

Simple random sampling was used to select participants in each affiliation type. Based on the proportional allocation, quota sampling was used to select the participants in each subgroup until enough were recruited (Fig. 1).

2.2. Research instruments

A self-administered structured questionnaire was used to collect the data. The 70-item questionnaire consisted of the following three parts: (1) general characteristics (17 questions, such as sex, age, body mass index (BMI), marital status, income, education level, employment status, family history of hypertension, and eating habits); (2) health literacy on sodium consumption. Items were developed by author based on four health literacy components identified in a review by Sorensen and colleagues [16]. This section consisted of 28 questions and the three following parts:

Part 1 consisted of 18 questions about accessing, appraising, and applying information about sodium. Part 1 included 5 items about accessing, 5 items about appraising, and 8 items about applying sodium information. All items were scored using a modified Likert scale and were positive questions. The response categories used a five-point Likert scale, ranging from 5 (strongly agree) to 1 (strongly disagree).

Part 2 consisted of 10 questions for understanding of sodium information with 4 choices. For scoring, 1 point was given for each correct answer and 0 point for each incorrect answer. The four components of health literacy on sodium consumption were divided into three levels (low, moderate, and high). The three levels determined by categorizing scores that were below the 25th percentiles for low, the scores between at the 25th and below the 75th percentiles for moderate, and the scores at greater or equal to the 75th percentiles for high. The category assigned to each number of points were as follows:

1) The total number of points for access to sodium information score ranged from 5 to 25. The level of access to sodium information was categorized as low (score: 5−17), moderate (score: 18−21), and high (score: 22−25).
2) The total number of points for understanding of sodium information score ranged from 0 to 10. The level of understanding sodium information was categorized as low (score: 0−3), moderate (score: 4−6), and high (score: 7−10).
3) The total number of points for appraisal of sodium information score ranged from 5 to 25. The level of appraisal of sodium information was categorized as low (score: 5−15), moderate (score: 16−19), and high (score: 20−25).
4) The total number of points for application of sodium information score ranged from 8 to 40. The level of application of sodium information was categorized as low (score: 8−19), moderate (score: 20−28), and high (score: 29−40).

Part 3 included 25 items regarding sodium consumption behaviors (SCBs). Respondents provided information about their high sodium consumption frequency. The response options were "Never," "Seldom," "Sometimes," "Almost always," and "Always." The response categories used a five-point Likert scale, ranging from 5 (always) to 1 (never). The negative questions consisted of 7 items including 1,2,3,4,5,22 and 25 which the score ranged from 1 (always) to 5 (never). Total SCB scores ranged from 25 to 125. The scores for SCBs were divided into two levels at the 50th percentile using total scores of <68 and 68 or over, indicating low and high levels of SCBs.

The content validity of the questionnaire was examined by three experts in the fields of public health and nutrition. The Item Objective Congruence

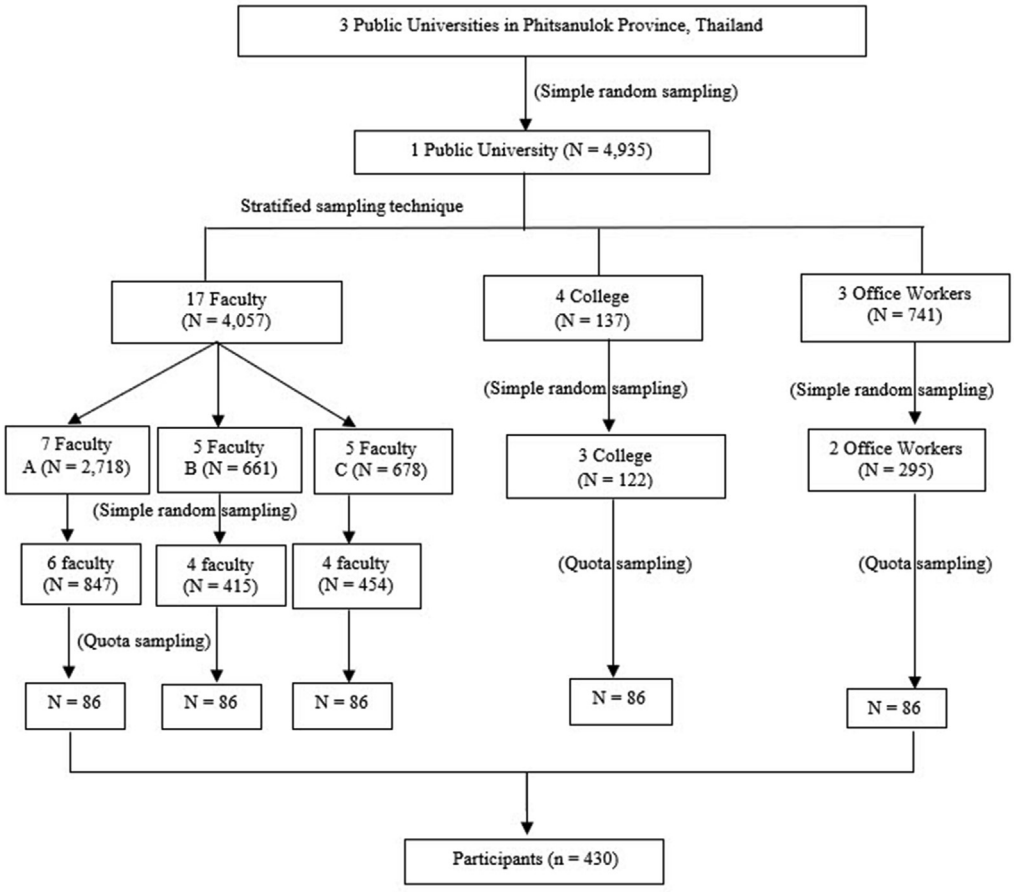

Fig. 1. Flow diagram of participants in the study.

(IOC) index value was between 0.67 and 1.00. The reliability of this questionnaire was tested with 30 university employees who had characteristics similar to those of the sample population. The Cronbach's alpha coefficient was 0.87 for accessing to sodium information, 0.86 for appraisal of sodium information, 0.89 for application of sodium information, and the SCBs. The Kuder-Richardson 20 (KR-20) was 0.71 for understanding sodium information.

Data collection was conducted through voluntary participants of each affiliation attending an appointment to complete the questionnaire. The researcher and trained assistant researcher explained the research study's objectives. Informed consent was obtained from each participant before data collection. Then, participants took approximately 20−25 min to complete the questionnaire.

2.3. Data analysis

Statistical analyses were performed using Statistical Package for Social Sciences version 17.0 for Windows. The descriptive statistics included the variables' number, percentage, minimum, maximum, mean, and standard deviation (SD). Simple logistic regression was used to identify the association of each independent variable with dependent variable. The independent factors that had p-value <0.25 were included in the multivariable analysis. Binary logistic regression with the backward Wald method was used to identify the factors that influenced high sodium consumption behaviors. The results are presented as adjusted odds ratio (AOR), crude odds ratio (COR), and 95% CI. A *p*-value of less than 0.05 was considered statistically significant.

2.4. Ethical considerations

This study was approved by the Ethics Committee in Human Research at Naresuan University, Project Number: COA No. 206/2022, IRB No. P2-0378/2564.

3. Results

3.1. General characteristics

Among a total of 430 participants, 74.7% were female, and the average age was 40.46 ± 8.04 years old. The proportions of those who had normal weights and obesity were similar (39.1%, and 37.7%). Almost half of respondents (48.8%) were single. About half

of participants (50.9%) had an average monthly income of approximately 30,000 Thai baht or more. Of the participants, 54.7% had master's degrees, 84.9% were supporting staff, and 65.6% worked at a non-health science department. More than half had a family history of hypertension (58.8%), 57.0% knew their blood pressure value, and 15.1% had been previously diagnosed with hypertension. Most participants (58.6%) cooked at home; 30.7% were fond of salty food; 41.4% preferred processed food; 60.0% enjoyed snacks or baked goods; and 49.1% ordered food by delivery (Table 1).

Table 1. General characteristics of university employees in Phitsanulok Province (n = 430).

General characteristics	n	Percentage
Sex		
Male	109	25.3
Female	321	74.7
Age group (years)		
20−29	45	10.5
30−39	141	32.8
40−49	195	45.3
50−59	46	10.7
60−69	3	0.7
Mean = 40.46, SD = 8.04, Min = 20, Max = 65		
Body Mass Index (kg/m^2)		
Underweight (<18.5)	18	4.2
Normal (18.5−22.9)	168	39.1
Overweight (23−24.9)	82	19.1
Obesity (≥25)	162	37.6
Mean = 24.39, SD = 4.55, Min = 15.62, Max = 48.89		
Marital status		
Single	210	48.8
Married	186	43.3
Separated/Divorced	34	7.9
Income (Thai baht per month)		
<30,000	211	49.1
≥30,000	219	50.9
Education level		
Bachelor's degree or less	195	45.3
Master's degree or more	235	54.7
Employment status		
Academic position	65	15.1
Supporting staff	365	84.9
Department		
Health science	148	34.4
Non-health science	282	65.6
Family history of hypertension		
Yes	253	58.8
No	177	41.2
Know their own blood pressure value		
No	185	43.0
Yes	245	57.0
Hypertension (previous diagnosis)		
Yes	65	15.1
No	365	84.9
Eating habits		
Home cooking	252	58.6
Eating out	178	41.4
Fondness for salty food		
Yes	132	30.7
No	298	69.3
Preference for processed food		
Yes	178	41.4
No	252	58.6
Enjoy snacks or baked goods		
Yes	258	60.0
No	172	40.0
Order food delivery		
Yes	211	49.1
No	219	50.9

3.2. Level of health literacy on sodium consumption among participants

Health literacy on sodium consumption involved access to, understanding, appraisal, and application of sodium information. The findings revealed that most participants had moderate levels of access to, understanding of, and application of sodium information (49.3%, 49.5%, and 46.3%, respectively). Only 42.3% had high levels of appraising sodium information (Table 2).

3.3. Level of sodium consumption behavior among participants

Among a total of 430 participants, 52.1% and 47.9% had low and high levels of sodium consumption behavior. The average score for sodium consumption behavior was 68.4 (Table 3).

3.4. Factors influencing SCBs among participants

To identify factors producing high SCBs, binary logistic regression analysis with the backward Wald method was used. Factors that significantly led to high SCBs consisted of a preference for processed food (AOR 2.41, 95% CI: 1.52−3.89), followed by ordering food delivery (AOR 2.33, 95% CI: 1.51−3.61), a fondness for salty food (AOR 1.70, 95% CI: 1.04−2.79), working in a non-health science department (AOR 1.67, 95% CI: 1.06−2.63), and eating out (AOR 1.63, 95% CI: 1.05−2.54). Among the four components of health literacy, a low level of application of sodium information had the greatest impact on high sodium consumption (AOR 2.11, 95% CI: 1.16−3.86), followed by a low level of understanding of sodium information (AOR 2.04, 95% CI: 1.02−4.05) (Table 4).

4. Discussion

The results indicated that most of the participants had a moderate level of access to, understanding of, and application of sodium information, at 49.3%, 49.5%, and 46.3%, respectively. Only 42.3% had a high level of appraising sodium information. In

Table 2. Levels of health literacy on sodium consumption among university employees in Phitsanulok Province (n = 430).

The components of health literacy on sodium consumption	Mean ± SD	Levels of health literacy on sodium consumption, n (%)		
		Low	Moderate	High
Access to sodium information (score of 5−25)	19.71 ± 3.49	92 (21.4)	212 (49.3)	126 (29.3)
Understanding of sodium information (score of 0−10)	5.80 ± 2.05	58 (13.5)	213 (49.5)	159 (37.0)
Appraisal of sodium information (score of 5−25)	18.20 ± 3.65	96 (22.3)	152 (35.3)	182 (42.3)
Application of sodium information (score of 8−40)	24.68 ± 6.37	101 (23.5)	199 (46.3)	130 (30.2)

addition, around 20% of participants had low levels of access to, appraisal of, and application of health literacy on sodium consumption. One explanation for these results is that most participants (54.7%) had education level at a master's degree or more. Higher education can help an individual develop a broad range of cognitive and non-cognitive skills, health information seeking, decision making, and self-efficacy; these skills can be utilized to improve better health. Therefore, health literacy affects a person's ability to accurately search for and use health information, and to adopt healthier behaviors [16]. The results of this study are similar to those of a previous study [30] that found that the majority (63.1%) of all employees scored low on self-perceived food literacy and that 34.5% had inadequate or problematic scores on health promotion literacy. However, these findings contrasted those of a previous study of Chiang Mai University personnel [31]; this study revealed that half of participants (54.2%) and almost half of participants (45.8%) had a good and moderate level of food literacy.

The prevalence of high sodium consumption behavior among university employees was 47.9% with an average score of 68.4 (minimum = 33; maximum = 113). When examining individual items for sodium consumption behavior, only 8.4% of participants always tasted their food before adding and limiting seasoning. Larger proportions of participants almost always ate soup in food and ready to eat foods from restaurants (40.9%) or street food vendors (39.5%). Most participants (51.4%) ate buffet or fast food approximately 1−2 days per week. These findings are consistent with a previous study [24] that found that working age people (aged 30 years or over) mostly ate out. A different study [25] found that a majority of ready to eat food in markets (88.2%) and restaurants (77.8%) in Phitsanulok province had high salt levels. These results show that university employees are at high risk for excessive sodium consumption that is greater than recommended levels.

Table 3. Levels of sodium consumption behavior among university employees in Phitsanulok Province (n = 430).

Levels of sodium consumption behaviors	n	Percentage
Low (<68 scores)	224	52.1
High (≥68 scores)	206	47.9
Mean = 68.40, Median = 68.00, SD = 11.91, Min = 33, Max = 113		

Our study showed that among the factors influencing high sodium consumption among university employees, those who preferred processed food were 2.41 times (95% CI: 1.52−3.89) more likely to have high sodium consumption than those who did not eat processed food. Participants who ordered food delivery were 2.33 times (95% CI: 1.51−3.61) more likely to have high sodium consumption than those who did not use a food delivery platform. One possible reason was that the COVID-19 pandemic impacted individual consumption behavior. This finding is consistent with a previous study [32] that revealed that respondents in Singapore reported unhealthier eating habits during lockdown. The study found that there was an 11% increase (95% CI, 8%−14%) in ordering in barbecue/fried foods and a 4% increase (95% CI, 2%−6%) in ordering beverages category ($p < 0.001$); whereas, vegetables ordering decreased by 15% (95% CI, 12%−19%). However, these findings are different from those of a previous study [33] that found that around 10.2% of Japanese adults aged 20−69 years improved their dietary quality consciousness during COVID-19 through behaviors such as cooking almost everything from their own ingredients and increasing their frequency of eating balanced meals.

University employees who were fond of salty food were 1.70 times (95% CI: 1.04−2.79) more likely to have a high sodium consumption than those who did not. This result is consistent with a previous study [34] that reported that affinity for salt is a driver of salt intake in young and healthy adults. This is because one's preferred level of salt largely influences one's dietary salt intake; individuals have a higher salt intake because they like eating salt. University employees who worked in non-health

Table 4. Results of binary logistic regression analysis to identify factors influencing sodium consumption behaviors (SCBs) among university employees in Phitsanulok Province (n = 430).

Variables	n	Level of sodium consumption behavior (%)		Crude odds ratio (COR)		Adjusted odds ratio[b] (AOR)	
		Low	High	OR (95% CI)	*p*-value	OR (95% CI)	*p*-value
Sex							
Female	321	51.1	48.9	1		1	
Male	109	55.0	45.0	0.85 (0.55−1.32)	0.475	1.05 (0.61−1.79)	0.867
Age group (years)							
>40	211	53.6	46.4	1		1	
≤ 40	219	50.7	49.3	1.12 (0.77−1.64)	0.552	1.23 (0.07−2.14)	0.748
Body Mass Index level							
Underweight /Normal	186	52.7	47.3	1		1	
Overweight/Obesity	244	51.6	48.4	1.04 (0.71−1.53)	0.829	0.85 (0.53−1.36)	0.501
Marital status							
Single	244	52.0	48.0	1		1	
Married	186	52.2	47.8	1.00 (0.69−1.47)	0.983	1.01 (0.63−1.60)	0.982
Income (Thai baht per month)							
<30,000	211	49.3	50.7	1		1	
≥30,000	219	54.8	45.2	0.80 (0.55−1.17)	0.254	0.81 (0.44−1.48)	0.491
Education level							
Master's degree or more	235	54.5	45.5	1		1	
Bachelor's degree or less	195	49.2	50.8	1.23 (0.84−1.80)	0.279	0.74 (0.41−1.33)	0.312
Employment status							
Academic position	65	49.2	50.8	1		1	
Supporting staff	365	52.6	47.4	0.87 (0.51−1.48)	0.616	0.50 (0.25−1.02)	0.067
Department							
Health science	148	58.8	41.2	1		1	
Non-health science	282	48.6	51.4	1.51 (1.01−2.26)	0.045[a]	1.67 (1.06−2.63)	0.026[a]
Family history of hypertension							
Yes	253	51.0	49.0	1		1	
No	177	53.7	46.3	0.90 (0.61−1.32)	0.584	1.06 (0.67−1.68)	0.805
Know their own blood pressure value							
Yes	245	54.3	45.7	1		1	
No	185	49.2	50.8	1.23 (0.84−1.80)	0.295	1.06 (0.65−1.72)	0.814
Hypertension (previous diagnosis)							
Yes	65	50.8	49.2	1		1	
No	365	52.3	47.7	0.94 (0.55−1.59)	0.817	1.09 (0.55−2.16)	0.795
Eating habits							
Home cooking	252	59.5	40.5	1		1	
Eating out	178	41.6	58.4	2.07 (1.40−3.05)	<0.001[a]	1.63 (1.05−2.54)	0.029[a]
Fondness for salty food							
No	298	60.1	39.9	1		1	
Yes	132	34.1	65.9	2.91 (1.90−4.46)	<0.001[a]	1.70 (1.04−2.79)	0.035[a]
Preference for processed food							
No	252	65.1	34.9	1		1	
Yes	178	33.7	66.3	3.67 (2.45−5.49)	<0.001[a]	2.41 (1.52−3.89)	<0.001[a]
Enjoy snacks or baked goods							
No	172	65.7	34.3	1		1	
Yes	258	43.0	57.0	2.54 (1.70−3.78)	<0.001[a]	0.69 (0.42−1.14)	0.151

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Order food delivery							
No	219	65.3	34.7	1		1	
Yes	211	38.4	61.6	3.02 (2.04–4.47)	<0.001[a]	2.33 (1.51–3.61)	<0.001[a]
Accessing of sodium information							
High	126	54.0	46.0	1		1	
Moderate	212	54.2	45.8	0.99 (0.63–1.54)	0.961	0.86 (0.50–1.48)	0.581
Low	92	44.6	55.4	1.46 (0.85–2.50)	0.171	1.18 (0.55–2.54)	0.673
Understanding of sodium information							
High	159	55.3	44.7	1		1	
Moderate	213	53.1	46.9	1.10 (0.73–1.66)	0.661	0.85 (0.96–0.60)	0.874
Low	58	39.7	60.3	1.87 (1.02–3.48)	0.042[a]	2.04 (1.02–4.05)	0.043[a]
Appraisal of sodium information							
High	182	58.5	41.2	1		1	
Moderate	152	46.7	53.3	1.63 (1.05–2.51)	0.028	0.58 (0.66–2.09)	1.17
Low	96	47.9	52.1	1.51 (0.94–2.56)	0.084	0.68 (0.41–1.78)	0.85
Application of sodium information							
High	130	60.8	39.2	1		1	
Moderate	199	55.3	44.7	1.25 (0.80–1.97)	0.325	1.28 (0.78–2.11)	0.328
Low	101	37.4	65.3	2.92 (1.70–5.01)	<0.001[a]	2.11 (1.16–3.86)	0.015[a]

[a] Statistically significant (p-value <0.05), Constant value = −1.935, Hosmer and Lemeshow test; Step 14, Chi-square = 8.57, df = 8, p-value = 0.38.
[b] Multivariate model: Adjusted for all covariates.

science departments had a 1.67 times higher sodium consumption (95% CI: 1.06–2.63) than those who worked in a health science department. This result is consistent with a previous study [35] that found that non-health care workers had significantly higher urine sodium excretion than health care workers, at 4442 ± 1865 versus 3617 ± 1406 mg per day (p < 0.001). University employees who ate out had a 1.63 times higher sodium consumption (95% CI: 1.05–2.54) than those who cooked at home. This result is consistent with a previous study [36] that found that having more than 1 meal outside the home per day was associated with greater sodium intake among adolescents and adults. It is also similar to the result from another study [37], which showed that 43.6% of adults in Malaysia consumed at least one to two meals away from home per day. However, having three meals away from home per day was not associated with high dietary sodium intake; yet this association was significant (COR 1.67, 95% CI: 1.19–2.35) in the simple logistic regression. This is in line with a previous study [22] that revealed that buying food and cooking were not related to excess salt and sodium consumption among those aged 20–69 years.

Regarding health literacy on sodium consumption, the results showed that only two components of health literacy influenced high sodium consumption behavior. Individuals with a low level of applying sodium information were 2.11 times (95% CI: 1.16–3.86) more likely to have high sodium consumption compared to those with a high level of application. This is because the ability to make informed decisions about sodium is important to consumption and healthy eating behavior. This is consistent with a previous study [38] that identified a positive association between health literacy and the 2015 healthy eating index; in this study, high health literacy levels played an important role in adherence to the Iranian Dietary Guidelines. In the present study, we found that participants with a low level of understanding sodium information were 2.04 times (95% CI: 1.02–4.05) more likely to have high sodium consumption than those with a high level of understanding. This is likely due to the link between understanding sodium information and nutrition knowledge, such as nutrition facts and nutrition label use. This is consistent with a previous study [30] that found a significant association between self-perceived food literacy and health promotion literacy in employees with low and medium levels of education (B = 0.31, 95% CI = 0.15–0.48). Another study [39] found that food literacy components, including food and nutrition knowledge, food skills, and resilience (control ability), were positively

associated with healthy eating habits among young adults in Korea.

Our findings show that university employees who enjoyed snacks or baked goods and had a moderate level of appraising sodium information were not associated with high sodium intake; However, these associations were significant association in the simple logistic regression (COR 2.54, 95% CI: 1.70−3.78 and COR 1.63, 95% CI: 1.05−2.51). This contrasts with a previous study [40] that found that there was an increase in sodium per capita per day from snack food sources between 1977−1978 and 2011−2014 in all race-ethnicity groups for both adults and children in the United States ($p < 0.01$). Moreover, food literacy, such as knowing essential nutrition information, reading nutrition facts, and processing food and nutrition knowledge represent a fundamental component of food literacy. These factors reflect individuals' healthy eating practices [41].

Finally, general characteristics, such as sex ($p = 0.867$), age ($p = 0.748$), BMI ($p = 0.501$), marital status ($p = 0.982$), income ($p = 0.491$), education level (0.312), and family history of hypertension ($p = 0.805$), were not associated with high SCBs. This result is inconsistent with previous research carried out in Thailand [22], Korea [42], and Malaysia [43].

Therefore, the effective interventions to reduce sodium consumption should consist of label reading, choosing lower-sodium options, and reducing added seasoning sauce. Also, strategies to promote sodium reduction through online interventions, governance policy, innovation [44], providing healthy lunch and nutrition education in workplace [45] are significantly intervention.

4.1. Limitations

This study was conducted only among public university employees in Phitsanulok Province. Therefore, the generalizability of the study's findings is limited.

5. Conclusion

This study confirmed that factors influencing high SCBs among university employees were preferences for processed food, ordering food delivery, a fondness for salty food, working in non-health science departments, eating out, and low levels of application, and understanding of sodium information. This finding may encourage interventions designed to improve health literacy on sodium consumption and sodium reduction to focus on risk factors for high sodium intake among university employees.

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Conflict of interest

None.

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