ORIGINAL ARTICLE

Factors Influencing Food Literacy for Sodium Reduction among Prehypertensive Adults in Roi Et Province, Thailand: A Cross-Sectional Study

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Background: Sodium intake directly affects the development of non-communicable diseases, particularly hypertension. Promoting sodium-reduction dietary literacy offers a viable approach to reducing risk factors associated with hypertension.

Objective: To determine the level of food literacy for sodium reduction (FLS) and to investigate the factors associated with FLS among prehypertensive adults receiving primary care services in Roi Et Province, Thailand.

Materials and Methods: The present study was a cross-sectional study explored the factors influencing FLS among 674 prehypertensive adults attending primary care in Roi Et Province, Thailand. The participants, aged over 35 years, were selected through multistage sampling. FLS was assessed using a validated 32-item questionnaire, and sodium intake was measured via 24-hour urine collection.

Results: Of the 674 participants, 63.5% showed inadequate FLS. Multiple logistic regression showed that regular exercise (AOR 1.88), strong family support (AOR 2.87), greater knowledge of food and sodium (AOR 1.50), and positive sodium consumption behaviors (AOR 2.58) were significantly associated with better FLS (all $p<0.05$).

Conclusion: These findings highlight the urgent need for targeted interventions that enhance food literacy (FL), encourage family involvement, and promote healthy lifestyle habits to reduce sodium intake and prevent hypertension.

Keywords: Food literacy; Sodium reduction; Prehypertensive adults

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Hypertension is a major public health concern globally and in Thailand, with excessive sodium intake recognized as a key modifiable risk factor for elevated blood pressure and cardiovascular disease (CVD)[1]. High sodium consumption promotes water retention, increasing blood volume and vascular resistance, which elevates blood pressure[2]. Evidence indicates that reducing daily sodium intake by 700 to 800 mg can lower the incidence of CVD by up to 20% and reduce mortality from hypertension and stroke[1,3]. Despite national efforts to curb sodium consumption, Thailand continues to face challenges, especially in rural provinces such as Roi Et, where mortality rates from hypertension, which is 2.45% and CVD, at 7.79%, exceed national averages[4].

A critical barrier to sodium reduction is the low level of FL among the population. FL refers to the knowledge, skills, and behaviors required to plan, select, prepare, and consume food that supports good health[5,6]. Individuals with greater FL are more likely to follow healthier dietary patterns, including reduced sodium intake, which supports better blood pressure control and cardiovascular outcomes[7]. However, data on FL specifically related to sodium reduction remain limited in high-risk, rural Thai communities.

In Roi Et Province, where salt and sodium literacy is notably low[8], understanding the factors influencing FLS is essential for designing effective interventions. The present study aimed to identify determinants of FLS among prehypertensive adults receiving primary care in Roi Et to inform programs that promote healthier dietary behaviors and reduce the burden of hypertension. Improving

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FLS could lead to sustainable behavioral changes in sodium consumption, lowering cardiovascular risk and reducing healthcare costs for this high-risk population.

Materials and Methods

Study design

The present study was a cross-sectional study conducted between May and October 2024 in Roi Et Province in northeast Thailand. This region has a notably high burden of hypertension and cardiovascular mortality[9]. The study targeted adults aged over 35 years, aligning with national hypertension screening guidelines[10]. Participants were recruited from 229 primary care units (PCUs) across seven districts, reflecting the primary care context where preventive interventions are most impactful.

A multistage random sampling approach was applied. In stage 1, Roi Et Province was chosen from Health Region 7 due to its high hypertension rates. All 20 districts were stratified by population size, and two subdistricts were randomly selected from each, totaling 40 subdistricts. In stage 2, within each subdistrict, lists of registered prehypertensive adults, which were 35 years or older, were obtained from PCUs. A systematic random sampling method was used to select individuals in proportion to each subdistrict's population. In stage 3, the final sample size per subdistrict was based on probability-proportional-to-size allocation, and participants were randomly chosen until the required number was reached. In total, data were collected from 229 PCUs across 40 subdistricts and 20 districts, ensuring representative coverage of the provincial population.

Study population and sample

The sample size was calculated using Daniel's proportion formula and power analysis for multiple logistic regression, resulting in a minimum of 546 participants[11]. Accounting for a 10% attrition rate, 674 participants were recruited. The inclusion criteria were age 35 years or older, prehypertensive blood pressure levels at systolic 130 to 139 mmHg or diastolic 85 to 89 mmHg[12], residency in Roi Et, and the ability to communicate in Thai. The exclusion criteria were stage 3 or higher chronic kidney disease, severe health conditions, and incomplete data submission. A multistage sampling technique was applied, consisting of purposive selection of Roi Et Province, random selection of PCUs within districts, and systematic random sampling of eligible individuals within units. This approach ensured representative coverage of the target population.

Research tools

Data collection instruments:

Data was collected using a self-administered questionnaire developed from validated tools and a literature review. All instruments were translated into Thai following a standard forward and backward translation process to ensure linguistic equivalence. Content validity was reviewed by three experts in nutrition and behavioral science, and the index of item-objective congruence (IOC) method resulted in a mean IOC value of 0.80. The Thai versions were pilot tested with 30 adults in a non-study area to assess clarity, cultural relevance, and internal consistency. The questionnaire comprised six sections as follows.

Demographics and health information: Included age, gender, occupation, income, anthropometrics such as weight, height, body mass index (BMI), and waist circumference, blood pressure, smoking, alcohol use, exercise, and chronic illnesses.

Family support: Assessed via a modified family Apgar scale tailored to sodium reduction behaviors, with an eight-item, 5-point Likert scale (Cronbach's α=0.73)[13-15]. A total score below 30 was categorized as an inappropriate level, and scores of 30 or greater were classified as appropriate.

Knowledge of food and sodium: A 25-item section adapted from Grimes et al.[16], measuring understanding of low-sodium food choices (Kuder-Richardson 20=0.72). Scores of less than 30 were considered inappropriate, while scores of 30 or greater indicated appropriate knowledge.

Sodium consumption behavior: A 20-item scale adapted from Chan et al.[17], assessing the frequency of sodium-related behaviors (Cronbach's α=0.93). Scores below the sample mean of 43.45 indicated inappropriate behavior, and those of 43.45 or greater were classified as appropriate.

Food literacy for sodium reduction (FLS-32): A 32-item instrument based on Vidgen's FL model[5], covering planning, selection, preparation, and eating practices related to sodium reduction (Cronbach's α=0.96). Cut-off points for each domain were determined using the sample mean as the norm-referenced threshold with plan and manage: less than 18.57 as inappropriate and 18.57 or above as appropriate, select: less than 19.16 as inappropriate and 19.16 or above as appropriate, prepare: less

than 18.58 as inappropriate and 18.58 or above as appropriate, eat: less than 16.30 as inappropriate and 16.30 or above as appropriate, and overall FLS: less than 84.87 as inappropriate and 84.87 or above as appropriate.

The cut-off points for all scales were determined using norm-referenced methods based on sample means.

Anthropometric and biochemical measurements

Trained research staff measured participants' weight and height using calibrated digital and Detecto scales, respectively, and calculated BMI to assess nutritional status. Sodium intake was objectively estimated via a single 24-hour urine collection, which is considered the gold standard for population sodium assessment[18,19]. Participants received detailed instructions to ensure accurate collection. A sodium excretion level greater than 1,800 mg/day was considered excessive.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics, including demographic and health-related variables. The normality of continuous data distributions was assessed using the Kolmogorov-Smirnov test.

Means and standard deviations (SDs) were reported for normally distributed continuous variables, whereas frequencies and percentages were used to describe categorical variables. FLS levels were analyzed both overall and across their four dimensions, which are planning and management, selection, preparation, and eating practices, using descriptive analyses to determine the proportion of participants with appropriate versus inappropriate FLS levels. To identify factors associated with FLS, multiple logistic regression analysis was conducted. The dependent variable, FLS, was dichotomized as appropriate (coded 1) or inappropriate (coded 0) based on a norm-referenced cut-off derived from the mean score. The independent variables comprised demographic factors that include age, gender, occupation, and income, health behaviors that include exercise, smoking, and alcohol consumption, family support, knowledge of food and sodium, and sodium consumption behaviors.

Model assumptions, including multicollinearity and interaction effects, were assessed before the model was finalized. No significant multicollinearity was detected, with all variance inflation factors (VIF) values below 2.0, and no significant interaction terms were observed. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated to quantify the strength and direction of associations. An AOR greater than 1 indicated an increased likelihood of appropriate FLS, whereas an AOR less than 1 indicated a decreased likelihood. Statistical significance was set at two-tailed p-value less than 0.05.

All analyses were performed using IBM SPSS Statistics, version 25.0 (IBM Corp., Armonk, NY, USA).

Ethical approval

The present study was approved by the Ethics Committee of the Mahasarakham University Faculty of Public Health (28032024/ECMSU191052; Kham Riang, Thailand). The Ethics Committee of the Roi Et Provincial Public Health Office approved the conduct of the research in primary healthcare facilities. All participants completed the study voluntarily and gave informed consent, as required for ethics approval.

Results

Participant characteristics

Six hundred seventy-four prehypertensive adults participated in the present study, comprising 441 women (65.43%) and 233 men (34.57%). Nearly half of the participants (47.78%) were aged 60 years or older. Most worked in agriculture, with 53.41%, and reported a monthly income between 5,000 and 9,999 Baht at 67.66%. Most participants were non-smokers at 59.60%, abstained from alcohol at 74.62%, and engaged in regular exercise at 85.60%. Regarding family support related to sodium reduction, 55.50% of participants reported an appropriate level, with a mean score of 29.87±6.34. Knowledge of food and sodium was adequate in 61.50% of participants, with a mean score of 18.46±1.64, and 50.60% demonstrated appropriate sodium consumption behaviors, with a mean score of 43.45±5.24. Despite this, excessive sodium intake was prevalent in 88.28% of participants, with an average intake of 2,504±696 mg/day (Table 1).

FLS levels

The FLS-32 instrument assessed four key dimensions, which were planning and management, food selection, food preparation, and eating practices. Approximately half of the participants achieved appropriate scores in each dimension with 47.3% in planning and management, 47.5% in food selection, 45.4% in food preparation, and 48.2% in eating

Table 1. Participant demographic characteristics

Characteristic	Frequency (n=674); n (%)
Sex	
Female	441 (65.43)
Male	233 (34.57)
Age (years)	
<40	13 (1.92)
40 to 49	130 (19.30)
50 to 59	209 (31.00)
≥60	322 (47.78)
Occupation	
Unemployed	71 (10.53)
Civil servant	31 (4.60)
Private employee	26 (3.87)
Personal business	59 (8.75)
Agriculture	360 (53.41)
General employee	127 (18.84)
Monthly income (Baht)	
<5,000	59 (8.75)
5,000 to 9,999	456 (67.66)
10,000 to 14,999	110 (16.32)
15,000 to 19,999	24 (3.56)
≥20,000	25 (3.71)
Smoking	
No	402 (59.60)
Yes/previous	272 (40.40)
Alcohol consumption	
No	503 (74.62)
Yes/previous	171 (25.38)
Exercise	
No	97 (14.40)
Yes	577 (85.60)
Family support	
Inappropriate level (score <30)	300 (44.50)
Appropriate level (score ≥30)	374 (55.50)
Mean±SD	29.87±6.34
Knowledge of food and sodium	
Inappropriate level (score <30)	246 (36.50)
Appropriate level (score ≥30)	428 (61.50)
Mean±SD	18.46±1.64
Sodium consumption behavior	
Inappropriate level	333 (49.40)
Appropriate level	341 (50.60)
Mean±SD	43.45±5.24
Sodium intake	
Normal	79 (11.72)
Excessive	595 (88.28)
Mean±SD	2,504±696

SD=standard deviation

Table 2. Food literacy for sodium reduction levels

Dimension	Frequency (n=674); n (%)
Plan and manage	
Inappropriate level (score <18.57)	355 (52.70)
Appropriate level (score ≥18.57)	319 (47.30)
Mean±SD	18.57±8.33
Select	
Inappropriate level (score <19.16)	354 (52.50)
Appropriate level (score ≥19.16)	320 (47.50)
Mean±SD	19.16±8.17
Prepare	
Inappropriate level (score <18.58)	368 (54.60)
Appropriate level (score ≥18.58)	306 (45.40)
Mean±SD	18.58±5.64
Eat	
Inappropriate level (score <16.30)	349 (51.80)
Appropriate level (score ≥16.30)	325 (48.20)
Mean±SD	16.30±6.41
Overall	
Inappropriate level (score <84.87)	428 (63.50)
Appropriate level (score ≥84.87)	246 (36.50)
Mean±SD	84.87±24.11

SD=standard deviation

practices. Only 36.5% of participants showed adequate FLS, thus a score of 84.87 or greater, indicating that nearly two-thirds lacked sufficient skills and knowledge to effectively manage sodium intake (Table 2).

Factors associated with FLS

Multivariable logistic regression analysis identified significant predictors of appropriate FLS levels after adjustment for confounders, including gender, age, occupation, income, chronic disease status, smoking, BMI, and alcohol consumption. Participants who engaged in regular exercise were nearly twice as likely to have adequate FLS (AOR 1.88, 95% CI 1.16 to 3.04, p=0.01). Strong family support emerged as the most influential factor, with those reporting appropriate family support nearly three times more likely to demonstrate adequate FLS (AOR 2.87, 95% CI 2.07 to 4.00, p<0.001). Greater knowledge of food and sodium also significantly increased the likelihood of adequate FLS (AOR 1.50, 95% CI 1.07 to 2.10, p=0.02). Furthermore, participants exhibiting appropriate sodium consumption behaviors had a 2.6-fold greater chance of adequate FLS (AOR 2.58, 95% CI 1.86 to 2.59, p<0.001) (Table 3).

Table 3. Multiple logistic regression analysis investigating the association between FLS and independent variables (n=674)

Independent variable	n	%FLS (appropriate)	Crude OR	Adjusted OR	95% CI	p-value
Exercise						0.010
No	97	32.9	1	1		
Yes	577	53.9	2.37	1.88	1.16 to 3.04	
Family support						<0.001
Inappropriate level	300	35.3	1	1		
Appropriate level	374	63.4	3.17	2.87	2.07 to 4.00	
Knowledge of food and sodium						0.020
Inappropriate level	246	45.1	1	1		
Appropriate level	428	54.2	1.44	1.50	1.07 to 2.10	
Sodium intake behavior						<0.001
Inappropriate level	333	38.4	1	1		
Appropriate level	341	63.1	2.73	2.58	1.86 to 3.59	

FLS=food literacy for sodium reduction; OR=odds ratio; CI=confidence interval

%FLS (appropriate) refers to the percentage of participants who demonstrated an appropriate FLS level as determined using a norm-referenced approach based on the mean score.

Discussion

Participant characteristics

The present study involved 674 prehypertensive adults in Roi Et Province, a region with a high burden of hypertension and CVD[9]. The gap between knowledge and behavior in sodium reduction reflects contextual factors within rural Thai communities, such as dietary traditions and limited access to low-sodium food options. Most participants were women, older adults, and agricultural workers, reflecting the demographic profile of rural northeast Thailand, and most reported low-to-moderate income, high rates of regular exercise, and low rates of smoking and alcohol consumption. These characteristics are consistent with previous population-based studies in rural Thai settings, where older adults and women are more likely to participate in community health programs[20,21]. Cultural practices, limited availability of low-sodium foods, economic constraints, and strong preferences for traditional high-sodium ingredients may hinder individuals from translating their knowledge into action, despite awareness of healthy eating practices. Despite high rates of exercise and family support, a striking 88% of participants had excessive sodium intake, with mean daily urinary excretion well above the World Health Organization (WHO) recommended maximum of 1,800 mg/day[18]. This highlights the ongoing challenge of dietary sodium reduction in rural communities, even among those engaged in health-promoting behaviors.

FLS levels

Only 36.5% of participants demonstrated adequate FLS. This finding raises concern, because FLS encompasses not only knowledge but also practical competencies in planning, selecting, preparing, and consuming low-sodium foods[5]. The low proportion of individuals with appropriate FLS mirrors trends observed in other Thai and international studies, where knowledge and awareness about sodium do not always translate into healthy dietary behaviors[16,22]. Most participants struggled particularly with food preparation and selection, areas critical for reducing sodium intake in daily life. The high average sodium excretion with 2,504 mg/day, observed in the present study further underscores the gap between knowledge and practice, as well as the need for more effective, skill-based interventions[18].

The data also revealed that participants showed low scores across all FLS dimensions, especially in planning, selection, and preparation. This is consistent with recent research showing that food preparation and management skills are key weaknesses among vulnerable populations[23]. Low FLS is also linked to a limited ability to interpret nutrition information and make appropriate food choices, resulting in persistent high sodium consumption[24]. Socio-demographic factors, particularly income, play a significant role in shaping FLS, as individuals with less education often lack both the knowledge and skills needed for healthy food selection[25,26]. These findings highlight the importance of designing FLS improvement programs that focus on practical training and use family and community support to drive sustainable behavior change[27]. Furthermore, population-level FLS assessments should consider not only knowledge and skills but also the broader social context that supports effective sodium reduction[28].

Factors associated with FLS

Multivariate analysis identified four key factors associated with higher FLS, which are regular exercise, strong family support, greater knowledge of food and sodium, and positive sodium consumption behaviors. These findings are consistent with previous research demonstrating that food literacy is shaped by both individual and social determinants[5,7,16]. Regular exercise was positively associated with FLS, supporting evidence that health-promoting behaviors often cluster and reinforce each other[8,29]. Family support emerged as the strongest predictor, highlighting the central role of shared meals, food preparation, and nutrition communication in Thai households[30]. Knowledge of food and sodium was also a significant factor, but as previous studies have shown, knowledge alone is insufficient without practical skills and supportive environments[6,31]. Finally, appropriate sodium consumption behaviors were linked to higher FLS, emphasizing the importance of empowering individuals to act on their knowledge through practical skills and motivation[16].

These results indicate that interventions to improve FLS should adopt an integrated approach, combining physical activity promotion, family engagement, and practical food skills training. Recent studies have demonstrated that family-based and community-driven interventions are particularly effective in enhancing food literacy and promoting sustainable dietary changes[27,28]. Moreover, the strong association between family support and FLS shows the importance of using cultural and familial structures in rural Thai communities to facilitate health behavior change[23]. While knowledge is essential, its influence is stronger when combined with behavioral strategies and supportive environments[32]. Designing interventions to address these complex determinants could bridge the gap between awareness and actual dietary practice, leading to more effective sodium reduction at the population level[33]. Finally, future research should explore the potential of digital health tools and peer-led models to further strengthen FLS and related health outcomes in diverse settings[34].

The strengths of the present study include a large, representative sample and the use of 24-hour urinary sodium excretion, the gold standard for sodium intake assessment[35].

Recommendation

The present study found that factors significantly associated with FLS were exercise, family support, knowledge of food and sodium, and sodium consumption behavior. Further, some participants demonstrated low FLS, which may explain why sodium intake was higher than recommended levels. Therefore, the four identified factors should be integrated into an FLS program to enhance FLS levels, leading to dietary sodium-reduction behaviors. The program's effectiveness can be assessed by measuring urinary sodium excretion, ensuring that it does not exceed the recommended standard levels.

Limitation

The limitations of the present study include its cross-sectional design, which limits causal inference, and the use of self-reported data, which may be subject to recall bias. Additionally, the focus on Roi Et Province may limit the generalizability of the findings to other regions.

Conclusion

Most pre-hypertensive adults in Roi Et Province exhibited limited FLS, despite moderate levels of knowledge and family support. Interventions that combine nutrition education, practical skill-building, and family engagement are urgently needed to support healthier eating habits and reduce sodium intake among at-risk rural populations.

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What is already known about this topics?

High sodium intake is a key contributor to hypertension. FL supports sodium reduction, yet remains low in many rural Thai communities, including Roi Et Province.

What does this study add?

This study provides new insights into the determinants of FLS among pre-hypertensive adults in rural Thailand, a population at high risk of CVD. It highlights the low prevalence of adequate FLS despite high levels of health-promoting behaviors such as exercise and family support. The study identifies key individual and social factors, regular physical activity, family support, food and sodium knowledge, and positive sodium consumption behaviors, as significant predictors of FLS.

Conflicts of interest

The authors have no conflicts of interest

associated with the material presented in this paper.

References

1. Visseren FLJ, Mach F, Smulders YM, Carballo D, Koskinas KC, Bäck M, et al. 2021 ESC Guidelines on cardiovascular disease prevention in clinical practice. Eur Heart J 2021;42:3227-337.
2. Bureau of Non-Communicable, Department of Disease Control, Ministry of Public Health, Thailand. Strategies to reduce salt and sodium consumption in Thailand 2016-2025. Nonthaburi: Bureau of Non-Communicable; 2016.
3. Razavi AC, Dyer A, Jones M, Sapin A, Caraballo G, Nace H, et al. Achieving dietary sodium recommendations and atherosclerotic cardiovascular disease prevention through culinary medicine education. Nutrients 2020;12:3632. doi: 10.390/nu12123632.
4. Health Data Center. Data to support the service plan for non-communicable diseases (NCD DM, HT, CVD) [Internet]. 2023[cited 2023 Aug 18]. Available from: https://hdc.moph.go.th/ret/public/standard-subcatalog/b2b59e64c4e6c92d4b1ec16a599d882b.
5. Vidgen H, editor. Food literacy: key concepts for health and education. London: Routledge; 2016.
6. Chongmontri K, Malarat A, Chankhaw S. Food literacy among Thai elderly. Thai Red Cross Nurs J 2020;13:159-80.
7. Prompunjai P, Thammakun T, Singthong T. Model development for reducing sodium consumption at the district level using a district health board mechanism. OSIR 2023;16: 22-30.
8. Buja A, Rabensteiner A, Sperotto M, Grotto G, Bertoncello C, Cocchio S, et al. Health literacy and physical activity: A systematic review. J Phys Act Health 2020;17:1259-74.
9. National Statistical Office. Statistical yearbook Thailand 2024 [Internet]. Ministry of Digital Economy and Society; 2024 [cited 2025 Apr 27]. Available from: https://www.nso.go.th/public/e-book/Statistical-Yearbook/SYB-2024/.
10. Department of Disease Control, Ministry of Public Health, Thailand. Forecast of communicable diseases and health hazards [Internet]. 2024 [cited 2025 Apr 27]. Available from: https://www.ddc.moph.go.th/dncd/forecast_detail.php?publish=15231&deptcode=dncd.
11. Daniel WW. Biostatistics: a foundation for analysis in the health sciences. 7th ed. New York: John Wiley & Sons; 1999.
12. The Hypertension Society of Thailand. Hypertension treatment guidelines for general practice [Internet]. 2019 [cited 2023 Aug 18]. Available from: http://www.thaincd.com/good-stories-view.ph.
13. Smilkstein G, Ashworth C, Montano D. Validity and reliability of the family APGAR as a test of family function. J Fam Pract 1982;15:303-11.
14. DeVellis RF. Scale development: theory and applications. 4th ed. Thousand Oaks, CA: Sage Publications; 2017.
15. Polit DF, Beck CT. Nursing research: generating and assessing evidence for nursing practice. 11th ed. Philadelphia: Wolters Kluwer; 2021.
16. Grimes CA, Khokhar D, Bolton KA, Trieu K, Potter J, Davidson C, et al. Salt-related knowledge, attitudes and behaviors (KABs) among victorian adults following 22-months of a consumer awareness campaign. Nutrients 2020;12:1216. doi: 10.3390/nu12051216.
17. Chan A, Kinsman L, Chan SW. Psychometric testing of the Determinants of Salt-Restriction Behaviour Questionnaire in people of Chinese ancestry: a methodological study. BMC Nurs 2022;21:339. doi: 10.1186/s12912-022-01124-5.
18. Chailimpamontree W, Kantachuvesiri S, Aekplakorn W, Lappichetpaiboon R, Sripaiboonkij Thokanit N, Vathesatogkit P, et al. Estimated dietary sodium intake in Thailand: A nationwide population survey with 24-hour urine collections. J Clin Hypertens (Greenwich) 2021;23:744-54.
19. Lucko AM, Doktorchik C, Woodward M, Cogswell M, Neal B, Rabi D, et al. Percentage of ingested sodium excreted in 24-hour urine collections: A systematic review and meta-analysis. J Clin Hypertens (Greenwich) 2018;20:1220-9.
20. Suwanna K, Sittibun W, Kaewdam J, Innupaph L, Homprasit J, Dumthong S, et al. Effect of reducing salt consumption program towards dietary consumption behavior among with hypertensive risk group: A case study in Nakhon Si Thammarat. Health Sci J Thai 2021;3:1-13.
21. Webster J, Su'a SA, Ieremia M, Bompoint S, Johnson C, Faeamani G, et al. Salt intakes, knowledge, and behavior in Samoa: Monitoring salt-consumption patterns through the World Health Organization's surveillance of noncommunicable disease risk factors (STEPS). J Clin Hypertens (Greenwich) 2016;18:884-91.
22. Yiga P, Van Lippevelde W, Seghers J, Ogwok P, Tafiire H, Muluuta SN, et al. The conceptual framework for a combined food literacy and physical activity intervention to optimize metabolic health among women of reproductive age in urban Uganda. BMC Public Health 2022;22:351. doi: 10.1186/s12889-022-740-w.
23. Moshtagh M, Daneshvar M, Ghaedamini Harouni G. Social determinants of food literacy in Iranian adult population: A cross-sectional study. Food Sci Nutr 2025;13:e70044.
24. Forray AI, Coman MA, Cherecheș RM, Borzan CM. Exploring the impact of sociodemographic characteristics and health literacy on adherence to dietary recommendations and food literacy. Nutrients 2023;15:2853. doi: 10.3390/nu15132853.
25. Begley A, Paynter E, Dhaliwal SS. Evaluation tool development for food literacy programs. Nutrients

2018;10:1617. doi: 10.3390/nu10111617.
26. Shim JS, Oh K, Kim HC. Dietary assessment methods in epidemiologic studies. Epidemiol Health 2014;36:e2014009.
27. Li N, Yan LL, Niu W, Yao C, Feng X, Zhang J, et al. The effects of a community-based sodium reduction program in rural china - a cluster-randomized trial. PLoS One 2016;11:e0166620.
28. Isa DM, Shahar S, He FJ, Majid HA. Associations of health literacy with blood pressure and dietary salt intake among adults: a systematic review. Nutrients. 2021;13(12):4534. doi: 10.3390/nu13124534
29. Auntilikun K, Putthong W, Jaitim K, Mongkhonpan K, Saita S, Vittaporn S, et al. Factors affecting food consumption among older adults in a rural community in northern Thailand. Am J Health Behav 2024;48:146070. doi: https://doi.org/10.5993/AJHB.48.5.24.
30. Cheikh Ismail L, Hashim M, Jarrar AH, Mohamad MN, Al Daour R, Al Rajaby R, et al. Impact of a nutrition education intervention on salt/sodium related knowledge, attitude, and practice of university students. Front Nutr 2022;9:830262. doi: 10.3389/fnut.2022.830262.
31. Alhazmi A, Hawash MM, Ali H, Narapureddy BR, Aziz F. Knowledge, attitudes, and practices related to dietary salt among older adults in Abha, Saudi Arabia. J Health Popul Nutr 2024;43:53. doi: 10.1186/s41043-024-00545-z.
32. Vidgen HA, Gallegos D. Defining food literacy and its components. Appetite 2014;76:50-9.
33. Xun R, Gao Y, Zhen S, Mao T, Xia H, Zhang H, et al. Effects of behavioral interventions for salt reduction on blood pressure and urinary sodium excretion: A systematic review and meta-analysis of randomized controlled trials. Glob Heart 2023;18:65. doi: 10.5334/gh.1281.
34. Yan YY, Chan LML, Wang MP, Kwok JYY, Anderson CS, Lee JJ. Technology-supported behavior change interventions for reducing sodium intake in adults: a systematic review and meta-analysis. NPJ Digit Med 2024;7:72. doi: 10.1038/s41746-024-01067-y.
35. Lucko AM, Doktorchik C, Woodward M, Cogswell M, Neal B, Rabi D, et al. Percentage of ingested sodium excreted in 24-hour urine collections: A systematic review and meta-analysis. J Clin Hypertens (Greenwich) 2018;20:1220-9.