ORIGINAL ARTICLE

The Effects of the "I see right sodium" Program for promoting health literacy regarding sodium consumption among university students in the lower northern region of Thailand

Waraporn Youngiam[1], Pajaree Abdullakasim[2], Nipa Maharachpong[2]

[1] A Doctor of Philosophy Candidate in the Health Education and Health Promotion program, Faculty of Public Health, Burapha University, Chonburi, Thailand
[2] Department of Health Education, Faculty of Public Health, Burapha University, Chonburi, Thailand

Corresponding Author*:* Waraporn Youngiam **Email:** warapornyo@nu.ac.th

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ABSTRACT

Low health literacy regarding sodium consumption has been associated with high sodium consumption behaviors among university students. This study aimed to determine and compare the effectiveness of the "I see right sodium" programs that promote health literacy concerning sodium consumption amongst first-year students. A quasi-experimental study using pre-test, post-test, and follow-up was designed to study two experimental groups and one control group. The program implementation period was September to December, 2020. Experimental group 1 (n=35) was involved in a multiple-activity program that involved both in-class workshop activities and a virtual component via the online application 'LINE'; experimental group 2 (n=34) participated in the program virtually via online applications, whereas the control group (n=34) did not participate in any of the aforementioned programs. The research instrument was a self-administered pre-test, post-test, and follow-up questionnaire. Repeated Measures ANOVA and One-way ANOVA tests were used to analyze the program's effectiveness. Results of the study revealed that the mean difference in health literacy regarding sodium consumption among the three study groups was significantly different (p-value < 0.001). The mean difference in sodium consumption behavior between experimental group 1 and experimental group 2 was significantly different (p-value = 0.005). Health literacy regarding sodium and sodium consumption behavior at the collection time (pre-test, post-test, and follow-up) was significantly different between the three different groups (p-value < 0.001, and p-value = 0.015, respectively). The researchers have concluded that the mean difference in health literacy regarding sodium consumption and its effects on sodium consumption behavior at the designated measurement points were influenced by the programs. These findings indicated that the program with multiple platforms was the most effective in promoting health literacy regarding sodium and encouraging appropriate sodium consumption behavior amongst first-year students.

Key words: health literacy, sodium consumption, university students, program

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INTRODUCTION

Consumption of sodium plays a significant role in the quality of life of individuals globally. A high sodium intake is one of the main causes of high blood pressure in children and adolescents according to recent studies.[1] Adolescents with high blood pressure are more likely to suffer from hypertension in adulthood, which increases the risk of cardiovascular [2] and kidney disease.[3]

Hypertension has become one of the main health problems in Thailand. Interestingly, the highest prevalence is found in the Northern region, with 33% of the population in 2014 suffering from hypertension.[4] The mean dietary sodium intake among the Thai population in 2019-2020 was estimated to be 3,636 mg per day[5], which is nearly twice as high as the recommended amount of 2,000 mg/day according to WHO.[6] The report indicated that people aged 18-25 years old had high sodium consumption.[5] However, Thailand has made a commitment to reduce sodium consumption to around 30% by 2025, which is one of the five strategies aimed to promote awareness and knowledge about sodium dietary intake and its impact on personal health.[7]

Factors associated with high sodium consumption among adolescents were: a limited knowledge about sodium [8-10]; easy accessibility of high sodium foods [11]; low literacy regarding sodium information [12, 13]; low to moderate communication skills along with low cognitive skills regarding sodium consumption; and a love for spicy foods.[14-16] University students tend to be the group most at risk of high sodium consumption due to the types of foods eaten in addition to the many factors mentioned above and the issues regarding the lack of health literacy.

Health literacy has been confirmed to be an important factor in disease prevention, health promotion, and quality of life improvement.[17] These elements of health literacy are related to individuals' ability to access, understand, make decisions, and practically apply health information.[18] Previous studies applied health literacy to promote and prevent health-related risk behavior in adolescents[19] and freshmen students[20], such as in areas of mental health [21], sexual behavior [22, 23], and dietary nutrition.[24] Nutrition literacy in particular, which involves the understanding of food labels and seeking of informational sources, affects dietary quality.[25, 26] However, previous studies have implemented nutrition education programs to reduce sodium intake by improving knowledge [8] among hypertension patients [27, 28] ; few studies have concentrated on the negative impact of sodium on university students' health or the applied health literacy concepts.[8] Equally important, they omit the comparison of different programs' effects.

Despite previous research applying the structures of health literacy to modify health behavior[19-24], research regarding program effectiveness on sodium health literacy promotion and sodium consumption in university students has been overlooked. Likewise, little work has been done to promote vital skills related to sodium health literacy and develop guidelines for improving sodium consumption behavior, especially regarding the effect of communication skills and cognitive skills on sodium consumption behavior among university students.[16]

The researchers were interested in promoting sodium health literacy and improving sodium consumption through the "I see right sodium" programs, which included 6 components: access skills, cognitive skills, communication skills, self-management skills, decision-making skills, and media literacy skills related to sodium. This study aimed to determine and compare the effectiveness of different "I see right sodium" programs, namely, multiple-activity programs and an online program,

amongst first-year students. The findings can help reduce the risk of hypertension or kidney diseases related to high sodium consumption and is relevant for health providers and university health sectors to improve health literacy regarding sodium and sodium consumption among university students.

METHODS

Study design and area

A quasi-experimental study using pre-test, post-test, and follow-up was designed using two experimental groups and one control group. The implementation program was conducted from September to December, 2020 at a university located in the lower northern region of Thailand.

Study population, sample size, and sampling

The study population consisted of first-year students in the 2020-2021 academic year who studied at a university located in the lower northern region.[16] The sample size was calculated by using the power analysis formula of effect size [29], which calculated the mean difference between 2 groups based on a previous study (μ_1 = the mean scores of the experimental group (4.42), μ_2 = the mean scores of the comparison group (4.10), standard deviation of the comparison group = 0.49).[21] Effect size calculation was 0.65, Alpha (α) = 0.05, Power = 0.80. Using the sample size table of Lipsey [30], researchers arranged sample sizes to include approximately 30 students per group, with a total of 3 groups. The researchers added 15% for participant loss during the implementation of the program.[31] Therefore, the final sample size was 35 students per group. Inclusion criteria for selecting the faculty areas for the intervention and control groups consisted of 1) two faculties for the experimental groups and one faculty for the control group, 2) sodium consumption behavior from the pilot study did not differ[16], 3) and each faculty are separated. Inclusion criteria for selecting the sample included 1) first-year undergraduate students, both male and female, 2) aged 18 years old or above, and 3) willingness to participate in the program. The exclusion criteria consisted of 1) students who did not participate in the entire program, and 2) students who withdrew from the program.

Research instruments

Data collection instruments

A self-administered questionnaire on sodium intake was adapted from a previous study [32,33] and applied to the health literacy program of Health Education Division, Ministry of Public Health in Thailand, which consisted of 6 components for promoting health literacy: access skills, cognitive skills, communication skills, self-management skills, decision skills, and media literacy skills.[33] The questionnaires consisted of 3 parts: **Part 1)** Personal characteristics (gender, body mass index, residence type, family history of kidney problems or hypertension, dietary habits, and social media application usage to gain knowledge about food); **Part 2)** Health literacy regarding sodium consumption (HLSC) containing 29 questions, including an assessment questionnaire regarding 1) Cognitive skills on sodium and health (10 questions with a nominal scoring of 1 and 0), and 2) Access skills, communication skills, self-management skills, decision skills, and media literacy skills regarding sodium (19 questions using a 5-point Likert scale); **Part 3)** Sodium consumption behaviors (SCB) containing 25 questions and scored using the 5-point Likert scale with (1) representing "never" and (5) signifying a daily occurrence.

The total scores for health literacy regarding sodium consumption (HLSC) ranged from 19-101. A total score of ≤ 59 indicates poor HLSC. A score from 60 to 69 indicates fair HLSC. A score from 70 to 79 indicates good HLSC, and a score ≥ 80 indicates an excellent level of HLSC.

The total scores for sodium consumption behavior (SCB) ranged from 25-125. A high SCB score indicates high sodium consumption. The 75th percentile was used to divide SCB into 2 levels, a total score of < 71 indicates low SCB, and a score ≥ 71 indicates a high level of SCB.

The validity of the questionnaires was approved by five experts in the field of Public Health, who found the Index of Item Objective Consistency (IOC) for all parts of the questionnaire to be 1.00. The Cronbach Alpha's coefficient was 0.809 for health literacy regarding sodium consumption, which indicated internal consistency reliability. The Kuder-Richardson 20 (KR-20) was 0.793, showing the reliability of cognitive skills on sodium and health, while The Cronbach Alpha's coefficient was 0.76 for sodium consumption behavior. The results were considered acceptable.[34]

Intervention instruments

The program for promoting health literacy regarding sodium consumption is called "I see right sodium" and was developed based on the literature review concerning health literacy concepts.[18] These programs consisted of 6 activities and were performed for 50 minutes once a week over a period of 6 weeks. The 6 activities for the experimental group 1, which received multiple workshops and online exercises, included the following: 1) Cognitive skills concerning sodium consumption and health; 2) Access skills about sodium consumption information; 3) Self-management skills regarding sodium consumption; 4) Decision-making skills relating to sodium consumption; 5) Communication skills regarding sodium consumption; and 6) Media and sodium information literacy critiquing skills regarding sodium consumption. Experimental group 2 received 6 activities through online applications, such as Facebook private groups and LINE groups. The control group was not involved in the activities during the 6-week class session. However, after the intervention, all the 3 groups received an online "I see right sodium" handbook for self-study, which was downloadable via QR code. During the 6-week follow-up period, no group received any extra activities for motivation to continue any part of the program. (Figure 1)

The "I see right sodium" handbook was approved by three experts in public health, health education and behavioral sciences, and nutrition. This was done to improve the contents and consistency of the objectives of this study.

Data collection

Data collection was conducted by the researcher alone throughout the whole process of the program. All participants were asked to complete self-administered questionnaires at pre-test, post-test, and follow-up. (Figure 1)

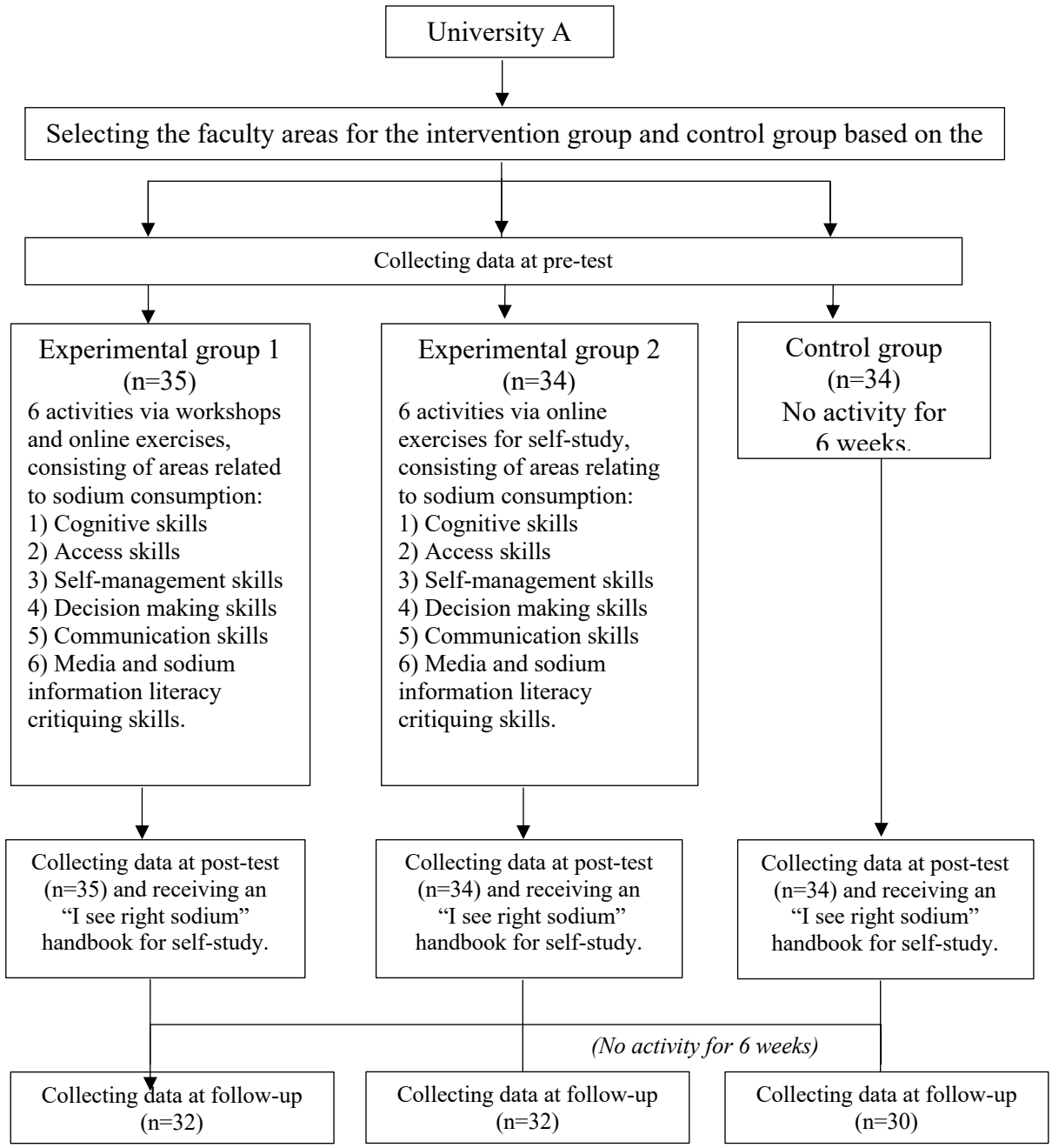

Figure 1 Sampling procedure and study implementation process.

Data analysis

The researchers analyzed data using the SPSS Statistics software, version 17, for Windows. Descriptive statistics were used to describe the information related to the participants, such as mean, standard deviation, frequency, and percentage. Normality testing was performed for health literacy concerning sodium consumption and sodium consumption behavior, measured at pre-test, post-test, and follow-up using a Shapiro-Wilk test. The normal assumption was tested before analyzing with One-way ANOVA. The results showed normal distribution and met assumptions, so One-way ANOVA test was selected to determine the differences between the 3 groups. One-way Repeated Measures ANOVA was used to analyze the program effectiveness between the 3 groups for pre-test, post-test, and follow-up within groups. A two-sided $p<0.05$ was considered statistically significant.

Ethical considerations

Ethical approval was certified by the human ethics research committee, Burapha University (No. IRB G-HS 031/2563). Participants in this study were informed of the research objectives, methods, data collection, and benefits. All participants signed the informed consent form before joining the programs.

RESULTS

At pre-test, the number of participants in experimental group 1 was 35 students, the number of participants in experimental group 2 and the control group was 34 students. At post-test, the number of participants in each group was equal to the pre-test. However, for the follow-up, experimental groups 1 and 2 had 32 students, and the control group had 30 students.

Approximately 73.5% to 88.6 % of experimental group 1, and the control group were females, whereas, half of experimental group 2 were males. Most of the three groups' participants were of normal weight and lived in a dormitory, and more than half of the three groups had no family history of kidney problems or hypertension. Regarding the three groups, ready-to-eat meals were bought by 57%-73% of the participants, and more than 70% of them loved eating spicy food. In terms of social media usage, 82.4% to 91.2% of participants used social media regarding knowledge about food content. There were no statistical differences in personal characteristics at pre-test ($p>0.05$), except for gender ($p=0.001$), among the 3 groups.

Table 1 presents main outcomes at pre-test, post-test, and follow-up. The researchers found that there was no significant difference regarding health literacy regarding sodium consumption among the 3 groups at pre-test ($p=0.06$). On average, health literacy scores increased substantially in all three groups at post-test. Experimental group 1 had higher scores than experimental group 2. There was a significant difference in the health literacy scores among the 3 groups ($p<0.001$). At follow-up, both experimental groups 1 and 2 maintained scores that were similar to post-test results, whereas the control group had slightly increased health literacy scores, and there was a significant difference among the 3 groups ($p<0.001$).

Sodium consumption behavior among the 3 groups had no significant difference at pre-test. At post-test, sodium consumption behavior scores of experimental group 1 decreased from 68 to 60, experimental group 2 had minor decreases in sodium consumption behavior scores; however, the pre-test and post-test scores of the control group showed no changes. There was a significant difference among the 3 groups ($p<0.001$). At follow-up, both experimental groups' sodium consumption behavior scores increased by

2-3 points; in contrast, the control group scores dropped by 3 points (p=0.018).

Table 1 Comparisons of main outcomes at Pre-test, Post-test, and Follow-up

Variables	Experimental group 1		Experimental group 2		Control group		p
	Mean (SD)	Min-Max	Mean (SD)	Min-Max	Mean (SD)	Min-Max	
Health literacy regarding sodium consumption (Over all) (19-101 scores)							
Pre-test	59.00 (7.27)	43-73	55.76 (10.76)	32-75	53.85 (8.50)	41-79	0.06
Post-test	76.57 (5.11)	66-86	70.97 (7.94)	56-89	58.94 (6.66)	44-72	<0.001
Follow-up	76.75 (6.73)	60-89	71.10 (8.50)	52-87	63.31 (7.58)	46-82	<0.001
Sodium consumption behavior (25-125 scores)							
Pre-test	68.03(10.40)	50-85	71.47 (7.33)	51-84	68.24 (9.05)	48-89	0.215
Post-test	60.34 (9.60)	44-78	68.35 (9.63)	51-89	68.82 (8.51)	52-87	<0.001
Follow-up	63.91 (8.33)	47-78	70.73 (10.86)	52-97	65.19(10.05)	47-83	0.018

One-way ANOVA test was applied to test.

There was a significant difference for between- and within-subjects effects regarding health literacy regarding sodium consumption, the sodium consumption behavior scores, and the interaction time per group over the period of time between the experimental groups and the control group (p<0.05). (Table 2)

Table 2 Tests of difference of Between-Subjects Effects and Within-Subjects Effects regarding Health literacy regarding sodium consumption and sodium consumption behavior among the experimental groups and the control group

	SS	df	MS	F	p-value
Health literacy regarding sodium consumption					
Tests of Between-Subjects Effects					
Group	6883.488	2	3441.744	44.031	<0.001
Error	7113.122	91	78.166		
Tests of Within-Subjects Effects					
Time	10802.989	1.955	5527.088	110.068	<0.001[a]
Time * Group	1304.981	3.909	333.831	6.648	<0.001[a]
Error (Time)	8931.494	177.864	50.215		
Sodium consumption behavior					
Tests of Between-Subjects Effects					
Group	1631.304	2	815.652	5.392	0.006
Error	13766.487	91	151.280		
Tests of Within-Subjects Effects					
Time	685.500	2	342.750	5.821	0.004[b]
Time * Group	743.454	4	185.864	3.157	0.015[b]
Error (Time)	10715.744	182	58.878		

One-way Repeated Measures ANOVA was applied to test the significant difference between the means of the three groups, [a] Huynh and Feldt correction, [b] Sphericity Assumed, SS = Sum Square; df = degree of freedom; MS = Mean Square

The mean differences of health literacy regarding sodium consumption at post-test and pre-test, and a comparison of the follow-up with pre-test results found a

significant difference between health literacy regarding sodium consumption ($p<0.05$), with a small effect size (0.291 and 0.442, respectively). However, there was no significant difference in health literacy regarding sodium consumption between follow-up and post-test. When considering the mean difference of sodium consumption behavior at post-test and pre-test, and at follow-up and pre-test, it was found that the results were significantly different concerning sodium consumption behavior ($p<0.05$) with a 'small' effect size (0.481 and 0.421, respectively). The mean difference of sodium consumption behaviors at follow-up and post-test were not significantly different.

Researchers concluded that the mean difference of health literacy relating to sodium consumption and sodium consumption behaviors at the three assessment stages was impacted by the program. At post-test, the experimental group had a higher score for health literacy regarding sodium consumption than at the pre-test. However, the score for health literacy concerning sodium consumption at post-test was not different from that measured at follow-up. The results from the study reflected that the experimental group continued to adhere to the guidelines for improving sodium literacy. Consistent with sodium consumption behaviors of the experimental group, it was found that results had improved at the post-test and continued to improve throughout the follow-up period. (Table 3)

Table 3 Comparisons of the mean differences of health literacy relating to sodium consumption and sodium consumption behavior among the experimental groups and control group during the three assessment stages were analyzed by using the Bonferroni method

(I) Time	(J) Time	Mean difference (I-J)	Std.Error	p	Effect Size (ES)
Health literacy regarding sodium consumption					
Post-test	Pre-test	12.401*	1.002	<0.001	0.291
Follow-up	Pre-test	13.764*	1.139	<0.001	0.442
Follow-up	Post-test	1.363	0.913	0.417	0.673
Sodium consumption behavior					
Post-test	Pre-test	-3.624*	1.085	0.004	0.481
Follow-up	Pre-test	-2.861*	1.143	0.042	0.421
Follow-up	Post-test	0.763	1.131	1.000	0.522

** $p<0.05$*

The mean differences of health literacy relating to sodium consumption between the control group and experimental groups 1 and 2 were significantly different ($p<0.05$). The mean differences of health literacy relating to sodium consumption between experimental groups 1 and 2 were significantly different ($p<0.05$). (Table 4).

The mean differences in sodium consumption behavior between experimental groups 1 and 2 were significantly different ($p<0.05$). (Table 4)

Table 4 Comparisons of the mean difference in health literacy regarding sodium consumption and sodium consumption behavior between groups, analyzed using the Bonferroni method.

(I) Program	(J) Program	Mean difference (I-J)	Std.Error	p
Health literacy regarding sodium consumption				
Control group	Experimental group1	-11.79*	1.276	<0.001
Control group	Experimental group 2	-7.74*	1.297	<0.001
Experimental group 1	Experimental group2	4.05*	1.297	0.007
Sodium consumption behavior				
Control group	Experimental group1	3.68	1.775	0.123
Control group	Experimental group 2	-2.17	1.805	0.700
Experimental group 1	Experimental group2	-5.84*	1.805	0.005

* $p<0.05$

DISCUSSION

The results showed that health literacy regarding sodium consumption and sodium consumption behavior among both the experimental and control groups were not significantly different at pre-test. However, after 6 weeks, the post-test results showed that experimental groups 1 and 2 had increased scores relating to sodium consumption health literacy compared to those of the control group. In addition, there were significant differences in health literacy scores of sodium consumption between and within the experimental and control groups ($p<0.05$). The interaction times regarding health literacy on sodium consumption were significantly different ($p<0.05$), which had an impact on the program. At post-test, the experimental group had a higher score for health literacy regarding sodium consumption than their pre-test scores. However, health literacy post-test scores were not different from the scores obtained at the follow-up. This reflects that the experimental group continued with sodium literacy. When considering the mean difference in health literacy relating to sodium consumption between the control group and experimental groups 1 and 2, and between experimental groups 1 and 2, it was found to be significantly different ($p<0.05$). It was found that experimental group 1, which received multiple pedagogies, workshops, and online activities improved their competency and skills of sodium health literacy. That is, those skillsets were related to health literacy intervention at the tertiary levels.[35] Moreover, there were activities to promote self-efficacy skills, such as learning from previous experiences, practicing by doing, and working with peers while encouraging their self-efficacy.[36] In addition, the researchers applied activities for practicing, reviewing, analyzing, comparing, judging, and setting goals that can impact adherence to healthy sodium intake and sodium guidelines [37], e.g. sodium test, nutrition

facts, short-films, case studies, and sodium record. Hence, the use of multiple activities not only played a role in the improvement of knowledge and sodium literacy skills, but also promoted the mentality of perceived self-efficacy and outcome expectations regarding sodium use while participating in workshops and obtaining information via the LINE application. Therefore, the scores of experimental group 1, which received multiple activities, increased more than those of experimental group 2, which only participated in the online program. Au et al. (2017) found that nutritional education programs combining clinical and online education significantly increased knowledge, self-efficacy, and salt intake reduction among participants ($p<0.05$).[38] In addition, experimental group 1 joined the group activities that aimed to promote sharing of ideas and discussion with peers. Consistent with the previous study, improved decision-making skills such as asking, sharing, and discussion-based teaching increased health literacy post-intervention and at 6-month follow-up.[39]

The aforementioned is consistent with Warren-Findlow et al. 2019, who found that a brief explanation of health literacy, nutrition education, and medication use by promoting reading and writing skills, and group activities related to analyses and critical discussion, helped to significantly improve health literacy and self-care of volunteers with low health literacy levels after 1 month ($p<0.05$).[40] Interestingly, the use of social media (Facebook and LINE) by experimental group 2 confirmed the effectiveness and suitability for the participants[27], with health literacy scores increasing and remaining at a sustainable level until follow-up. This is consistent with a previous study that found that after using a web-literacy intervention for undergraduate nursing students, 87.9% displayed confidence in using an evaluation tool. Both the ability to critique health web sites ($p = 0.005$) and confidence in finding reliable Internet-based health information ($p = 0.058$) increased.[41]

Increasing sodium health literacy scores after participation in the 6-week program had a positive effect on sodium consumption behaviors. Results confirmed that there were significant differences in the scores of sodium consumption behavior between and within the experimental groups and the control group ($p<0.05$). The interaction between time and sodium consumption behavior scores had significantly different effects ($p<0.05$).

This might be attributed to the effects experienced by experimental groups 1 and 2 relating to sodium literacy after participation in the program. The experimental group 1, received multiple workshops and online exercises. Experimental group 2 received an entirely online program. This is consistent with Keikha et al., 2021, which found a significant difference between health literacy and nutritional performance of students who participated in the intervention and control groups after the intervention ($p<0.001$). In addition, educational intervention training programs including educational posters, booklets, and PowerPoint can increase health literacy and nutritional performance of students. A significant and positive relationship was found between students' health literacy and nutritional performance ($p<0.05$).[42] In addition, this is consistent with Singtong et al., 2020, which showed that the nutrition literacy program consisted of accessing, understanding, and analysing nutritional information and dietary decision based on active learning methods and improvements in overall nutrition literacy and eating behavior among experimental groups were significantly higher than the comparison group ($p<0.001$ and 0.001, respectively).[24] This is consistent with Piaseu et al., 2020, which found that after the 4-week program promoting sodium intake reduction, knowledge was significantly higher while urinary sodium was lower than before the

program and baseline. Sodium consumption behaviors were lower after the program than baseline.[8] This could be explained by Bandura, 2012, who found that people's beliefs in their capabilities are developed in four ways: through mastering the experience, modelling social behaviors, altering social persuasions, and finally self-development through specific behaviors that adhere to beliefs about values placed on the possible outcomes. [36] This is consistent with Nutbeam, 2008, who indicated that health literacy is seen as an asset and as an outcome of health education. Once gained, the acquisition of knowledge and skills gives individuals the capacity to build a more self-efficient behavior that leads to a better understanding of sodium and health. These processes enable achievements in learning and life skills. Hence, individuals gain the power to make decisions and control the activities required to improve their health outcomes.[43] However, when comparing the differences in scores of sodium consumption behavior between the control group and the 2 experimental groups, no significant differences were found. This could have resulted from the control group reviewing the "I see right sodium" handbook after the data was collected at the post-test. Exposure to the handbook reinforced participants' interest in developing their knowledge and skills, which encouraged further practice as the handbook suggests thus, increasing sodium health literacy and changing sodium consumption behavior.

Researchers have concluded that the "I see right sodium" program based on health literacy intervention can help improve health literacy regarding sodium consumption and sodium consumption behavior scores. The multiple program scheme was the most effective learning format, whereas the online program and the "I see right sodium" handbook can be used to create positive changes in health literacy concerning sodium and sodium consumption behavior of participants.

LIMITATIONS

Some limitations are apparent. First, this study was conducted at a government university located in the lower northern region, Thailand. So, the results did not represent the private university in Thailand. Therefore, generalizing these outcomes to a private university or university located in different regions should be done with caution. The second limitation relates to duration of the follow-up period, the researchers conducted a 6-week evaluation on the effectiveness and progress of the program based on the time constraints regarding the university schedule. In order to achieve a more accurate and sustainable understanding of the program, additional time is required. Finally, all three groups lost participants for the follow-up, due to students dropping out of the university.

CONCLUSION

The "I see right sodium" program was designed to promote essential skills of health literacy regarding sodium consumption and to improve sodium consumption behaviors consistent with the WHO's recommendations. This program increased health literacy scores about sodium consumption, allowing for positive changes in the sodium consumption behaviors of the experimental group. Use of online applications, such as Facebook and LINE in conjunction with the "I see right sodium" handbook positively affected sodium health literacy and reinforced

appropriate sodium consumption behaviors among participants.

RECOMMENDATIONS

At follow-up, a short message should be established to stimulate and motivate further and broaden participation in a development program while reviewing activities among participants. Regarding future research, facilitators of these programs should use mixed methods research to achieve an in-depth understanding regarding the skills and the process required to improve health literacy concerning sodium consumption behaviors.

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