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Impact of a Food Sanitation Literacy Program on Food Handlers' Behavior: A Quasi-Experimental Evaluation in the Upper Tapi Basin, Thailand

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ABSTRACT

Introduction: The upper Tapi River area has been developed into a tourist attraction with more accommodations and restaurants. Food sanitation surveillance is therefore necessary to reduce the risk of foodborne diseases. This study addresses the need to evaluate the effectiveness of a Food Sanitation Literacy Development Program (FSLDP) on food handlers' behavior.

Methods: This research is quasi-experimental with a one-group pretest-posttest design to study the effect of the food sanitation literacy development program (FSLDP) on the behavior of food handlers. A sample of entrepreneurs at 135 food and beverage restaurants will be obtained between May and October 2024. The Food Sanitation Literacy Development Program (FSLDP) was used in the experimental group for a total of 4 weeks, which consisted of organizing group activities with activities to enhance food sanitation knowledge, lectures, discussions, playing games, and practicing.

Results: Results showed a significant increase in food sanitation literacy, with mean scores rising from 99.89 (SD = 17.75) before the program to 125.38 (SD = 17.12) immediately after, and further to 126.82 (SD = 19.88) at the one-month follow-up. All six dimensions—access to information, knowledge and understanding, communication skills, self-management, media literacy, and decision-making—demonstrated consistent and sustained improvements. Food sanitation behavior scores similarly increased from 46.74 (SD = 9.20) at baseline to 62.50 (SD = 7.80) immediately post-program and 64.50 (SD = 5.85) at one month, indicating both immediate and maintained behavioral gains. Personal hygiene behaviors, particularly handwashing habits and correct handwashing steps, improved significantly, whereas appearance when handling food and behavior during work showed minimal change. Repeated-measures ANOVA confirmed that these improvements were statistically significant ($p < 0.001$) and largely maintained over time.

Conclusion: These findings suggest that structured educational interventions, supported by practical exercises and access to digital resources, can effectively enhance food safety literacy, foster proper hygiene practices, and contribute to the long-term implementation of safe food handling behaviors among food handlers in tourism-intensive areas.

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INTRODUCTION

Food sanitation involves a range of practices aimed at improving, maintaining, and correcting food safety to protect consumer health (1). Even if food appears appetizing, contamination can lead to adverse health effects, such as stomach pain, diarrhea, vomiting, dizziness, or even chronic illness. These health issues, referred to as foodborne diseases, are significant public health concerns (2). Health literacy plays a vital role in disease prevention, encompassing an individual's ability to access, understand, and apply essential health knowledge. This includes adopting behaviors related to hygiene, nutrition, and sanitation (3). Begley (2019a) emphasize that active participant engagement is key to the effectiveness of adult food literacy programs (4). Participants involved in hands-on activities and discussions showed greater improvements in knowledge and behavior, suggesting that interactive and experiential learning enhances the translation of literacy into practice**.** This highlights the importance of incorporating engagement-focused strategies in public health education programs. Butcher (5), emphasized that food literacy interventions should address all four key domains - knowledge, skills, behavior, and attitudes - to empower individuals in managing diet and health. Several studies (6,7,8,9), also link food literacy aspects, such as cooking skills and food conceptualization, with better diet quality. Furthermore, advocated for more health promotion initiatives to improve health literacy and practical application. Mushota et al (10) reported that a school-based WASH education program implemented in a resource-limited area of Ujjain, India produced a marked increase in students' knowledge, with scores rising from 15.17 before the intervention to 34.13 afterward ($p < 0.001$).

The initiative strengthened students' understanding of key issues such as water safety, sanitation practices, and appropriate responses to diarrheal illness. Health Promotion provides a critical commentary on how digital technologies—such as social media, mobile apps, and data-driven platforms—are reshaping the delivery of health promotion (11). Many studies explored how smartphone applications can support health behavior change, based on in-depth interviews with users. Participants reported key opportunities, including convenience, real-time self-monitoring, personalized feedback, and increased motivation (11,12,13). Sibanyoni *et al*, reported from Mpumalanga, South Africa, that food handlers often have positive attitudes but limited food safety knowledge, especially regarding hygiene and cross-contamination (15). These results reinforce the need for interventions that build both sanitation literacy and practical skills. They also support the rationale for structured training programs in the present study. The Tapi River, flowing 232 kilometers from the Nakhon Si Thammarat mountains to Bandon Bay in Surat Thani Province, is a vital natural and economic resource in southern Thailand.

The Upper Tapi River Basin has seen development as a tourist destination, leading to the growth of restaurants and accommodations. However, assessments have shown that many food restaurants in the region struggle with maintaining proper sanitation standards, including food safety, hygiene, and infrastructure management. These issues suggest a gap in food sanitation literacy among food handlers. To address this, a study was conducted to assess the impact of a Food Sanitation Literacy Development Program (FSLDP) aimed at improving food safety practices among workers in food and beverage outlets in the Upper Tapi Basin. The objectives were to evaluate the effects of the FSLDP and to compare food sanitation literacy and behavior before and after the program. The study aims to offer insights and guidelines for enhancing food sanitation literacy, contributing to improved public health, and supporting sustainable tourism in the region.

METHOD

This study employed a quasi-experimental design using a one-group pretest-posttest approach to examine the effects of the Food Sanitation Literacy Development Program (FSLDP) on the behaviors of food contact personnel in restaurants located in tourist areas within the Upper Tapi Basin and surrounding regions. The research was conducted between May and October 2024.

Population and sample

The population is the food handlers who handle food in restaurants and beverages in tourist attractions in the Upper Tapi Basin and related areas. Selective samples in this study were carried out with multi-step sampling. The study area was divided into districts through which the Tapi River flows and which are geographically connected, including all seven districts of Nakhon Si Thammarat Province and one district of Surat Thani Province. A survey of restaurants identified a total of 208 restaurants. The sample size was calculated using the Krejcie and Morgan formula, resulting in 135 restaurants with a margin of error not exceeding 0.05. Simple random sampling was then employed,

using a lottery method, to select the sample in accordance with the specified inclusion criteria. Therefore, the sample group is food handlers in the restaurants in the tourist area of the Upper Tapi Basin and the linked areas with 135 restaurants. The discrepancy occurred by 5%, and a sample of entrepreneurs at 135 restaurants will be obtained. The selection criteria for the sample are as follows: The inclusion criteria include (1) being in contact with food in a restaurant and having worked in a restaurant for not less than 6 months; (2) agreeing to participate in the study; and (3) being able to learn, speak, read, write, and communicate in Thai. Exclusion Criteria**:** (1) Transfer, resignation, or failure to work in a restaurant during the study; (2) lack of participation in at least one activity; (3) did not consent and did not cooperate in participating throughout the study.

Research Location

The sample group is food handlers in the restaurants in the tourist area of the Upper Tapi Basin and the linked areas that cover areas including Phipun district, Chawang district, Tham Phannara district, Thung Yai district, Lan Saka district, Chang Klang district, Nabon district, Nakhon Si Thammarat province, and Wiang Sa district, Surat Thani Province, with 135 restaurants.

Instrumentation or Tools

The tools used in the experiment include a Food Sanitation Literacy Development Program (FSLDP), which consists of organizing group activities with activities to enhance food sanitation knowledge, lectures, discussions, playing games, and practicing in the experimental group for a total of 4 weeks. The research processes include:

Prepare a research team and coordinate with relevant government agencies, including local public health agencies and local government organizations in the area, to coordinate with food and beverage restaurant owners to determine the date and time of the event.

The research team collected data on a sample of food and beverage restaurants using a survey of the general environment to measure the knowledge and practice of food sanitation management among food handlers in food and beverage restaurants before the participatory workshop (pretest).

Trial of the FSLDP for food sanitation management in food handlers who work in food and beverage restaurants in the sample group by repeating the test 3 times, namely pretest, posttest, and follow-up test. The details are as follows:

The 1st was to lecture on activity with the use of accompanying videos and content on the food sanitation literacy component: Supporting access to food sanitation information and food sanitation media literacy. Duration approximated 6 hours.

The 2nd time was to conduct lecture activities with the use of accompanying videos, content on the elements of food sanitation literacy: knowledge and understanding of food sanitation standards and laws related to food contact persons, and brainstorming activities on how to make "food distribution places" meet the food sanitation standards in food restaurantss and comply with relevant laws. Duration approximated 6 hours.

The 3rd time was to demonstrate and practice food sanitation skills for food handlers and the food contact person to bring a self-assessment form to analyze the areas that need to be improved and developed using the principles of food sanitation. The duration is 6 hours, and the exam form is completed after the education. Then, participants of the workshop adopted the activities that promote the implementation of food sanitation management in food and beverage restaurants to be carried out in their stores or their respective areas. The researcher went to the area to observe the practice of food sanitation management and took a test after a 1-month trial of the program.

The tools used to collect data and evaluate the FSKDP of food contact persons in food and beverage restaurants consist of 3 parts as follows:

Part 1: Personal characteristics consist of 7 items, including gender, age, education level, income, experience working in a restaurant, food hygiene training history, and history of certification for clean food good taste.

Part 2: The 30-item Food Sanitation Literacy Questionnaire is a 5-level rating scale questionnaire, following the Likert scale. Perception Levels (Five-point Scale and Three-level Interpretation) (9). Perception was measured on a five-point Likert scale (1–5), where 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly agree. For interpretation, the scores were further classified into three levels, including low level of perception, moderate level of perception, and high level of perception.

Part 3**:** Food Sanitation Behavior Questionnaire of 15 items, a 5-level rating scale questionnaire according to the Likert scale. It is equal to 5 frequent practices (9). It is equal to 4 practices from time to time. It is equal to 3, practiced repeatedly, is equal to 2, and does not practice at all. The value is equal to 1, as respondents have only one option. interpret the results in 3 levels (low–moderate, high), can divide the total score into three equal intervals, like this: a score between 15.00 – 35.00 indicates that the practice is at a low level of appropriateness. A score between 35.01 and 55.00 suggests that the practice is at a moderate level of appropriateness, and a score between 55.01 and 75.00 indicates that the practice is at a high level of appropriateness.

Part 4: Personal Hygiene Behaviors Questionnaire of 20 items: Personal hygiene behaviors were assessed in four dimensions: 1) Appearance when handling food (5 items), 2) Behavior during work (5 items), 3) Handwashing habits (5 items), and 4) Correct handwashing procedures (5 items). The results were interpreted into three levels: a mean score of ≤1.33 indicates inappropriate behavior, a mean score of 1.34–2.67 indicates moderately appropriate behavior, and a mean score of ≥2.68 indicates highly appropriate behavior.

Part 5: Food Sanitation Standard Assessment – "Food Distribution Location". The Food Sanitation Standard Assessment Form consisted of three components: food distribution location, food processing, assembly, or cooking, and hygiene of containers, equipment, and other utensils. The assessment included a total of 68 items, scored as 1 = Proper management and 0 = Improper handling.

The interpretation of food sanitation management levels was classified into three categories: 46–68 points = extreme good, 23–45 points = good, and 0–22 points = moderate. Instrument validity was assessed using the point-biserial correlation method, appropriate for dichotomous scoring (0 = incorrect, 1 = correct). Validity was tested using the point-biserial correlation, with coefficients above 0.70 considered acceptable. Reliability, assessed by KR-20, yielded an overall reliability coefficient of 0.85, which indicates a high level of internal consistency for questionnaires or tests with dichotomous items.

Instrument Quality Inspection

Content validity of the FSLDP and the food sanitation literacy and behavior questionnaire by 3 experts. Results of the conformance index of the FSLDP. The food, sanitation literacy, and behavior questionnaire had a conformity index of 0.95 and 0.97, respectively. The test was then conducted on 30 people with similar characteristics. Then, find Cronbach's Alpha Coefficient, which has the following alpha coefficients: The value equals 0.85, and the food sanitation behavior questionnaire is 0.95.

Data Analysis

Data analysis using ready-made computer programs. Initially, the distribution of the main variable data of the sample was tested. Therefore, the data were analyzed with descriptive statistics, and the difference in the mean was compared with statistics. Repeated measures, ANOVA, and paired-samples t-test at a statistically significant level, $p < 0.05$.

Ethical Approval

This study was approved by the Health Research Ethical approval for the study was granted by the Research and Development Ethics Committee of Thaksin University, COA No. TSU 2023_035/REC No.0058. All participants, including parents or guardians for participants under 18, provided informed consent prior to participating in the study. The confidentiality of all participants was strictly maintained throughout the research process.

RESULTS

Personal Information

Most of the food handlers were females, 87 persons (64.44%). Seventy-two (53.33%) food handlers were younger than or equal to 28 years old, and 63 (46.67%) were over 28 years old (mean ± SD; 28.21±7.65 years). Food handlers' education level was found to be either secondary school (35 persons, 25.93%) or above secondary school (64 persons, 47.40%). Food handlers' income level was less than or equal to 18,000 Baht (5.00%), and 95% had more than 18,000 Baht. Thirty-nine restaurants (28.89%) had less than or equal to five years of experience, and 96 (71.11%)

had more than. Forty-seven (34.81%) employees had passed the Clean Food Good test, 88 persons (65.19%) had not passed the Clean Food Good test training.

Comparison of the scores of food sanitation literacy and food sanitation behavior of food handlers immediately and after 1 month

This study demonstrated that the food sanitation promotion program effectively enhanced participants' knowledge and behavior regarding food sanitation. All six dimensions—access to information, knowledge and understanding, communication skills, self-management, media literacy, and decision-making—showed consistent and sustained improvements. The Food Sanitation Literacy Development Program (FSLDP) significantly improved all domains of food sanitation literacy among food handlers. For access to food sanitation information, scores increased from 17.15 ± 2.50 before the program to 20.20 ± 2.75 immediately after, and 19.58 ± 3.52 at one-month follow-up. Knowledge and understanding improved from 16.20 ± 2.85 to 21.5 ± 2.50 and 22.6 ± 3.70, while communication skills increased from 15.41 ± 3.24 to 21.40 ± 2.78 and 21.50 ± 3.21. Self-management rose from 16.54 ± 2.95 to 20.30 ± 3.20 and 20.74 ± 2.95, media literacy from 16.90 ± 3.20 to 21.40 ± 2.65 and 21.60 ± 3.40, and decision-making from 17.69 ± 3.01 to 20.58 ± 3.24 and 20.80 ± 3.10, respectively. These results indicate that improvements were both immediate and largely sustained one month after the program *(*Fig. 1). Additionally, the mean score of food sanitation literacy increased from 99.89 (SD = 17.75) before the intervention to 125.38 (SD = 17.12) immediately after, and further to 126.82 (SD = 19.88), one month post-intervention. Meanwhile, food sanitation behavior scores increased from 46.74 (SD = 9.20) at baseline to 62.50 (SD = 7.80) immediately after the program, and to 64.50 (SD = 5.85) at the one-month follow-up *(Fig. 2)*.

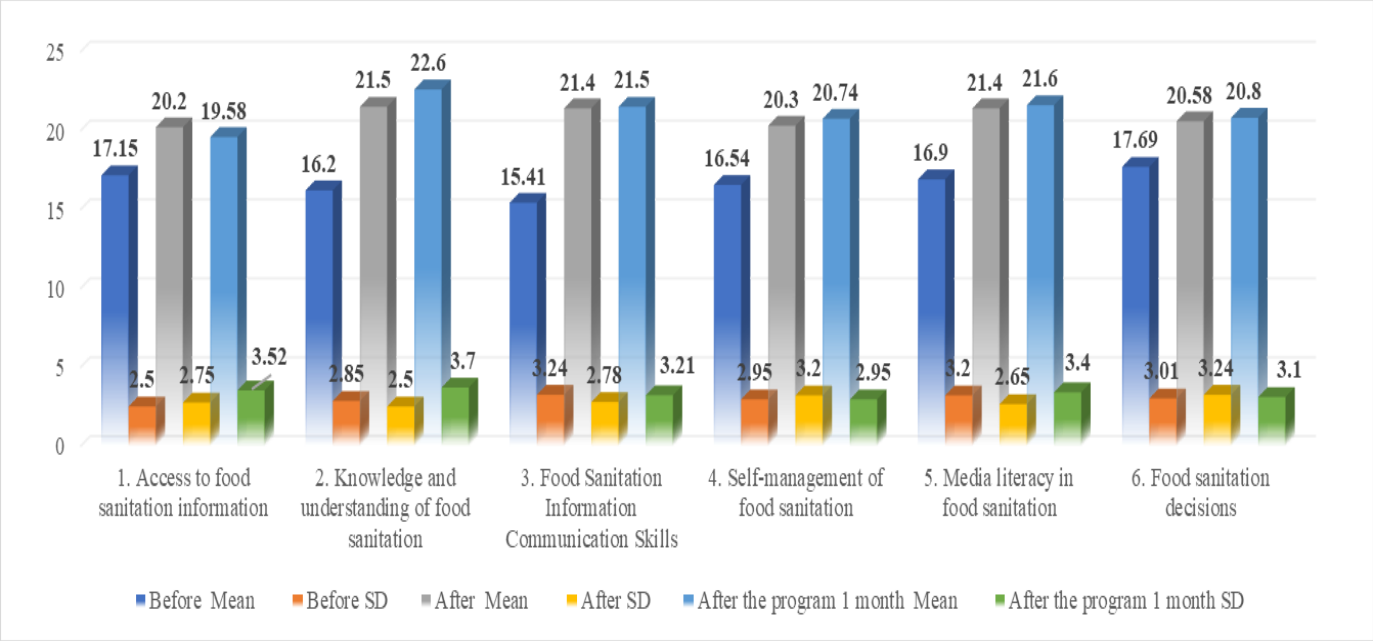

Fig 1. Score levels of food literacy of food handlers of each item before and after the program, and 1 month after the FSLDP (n = 135)

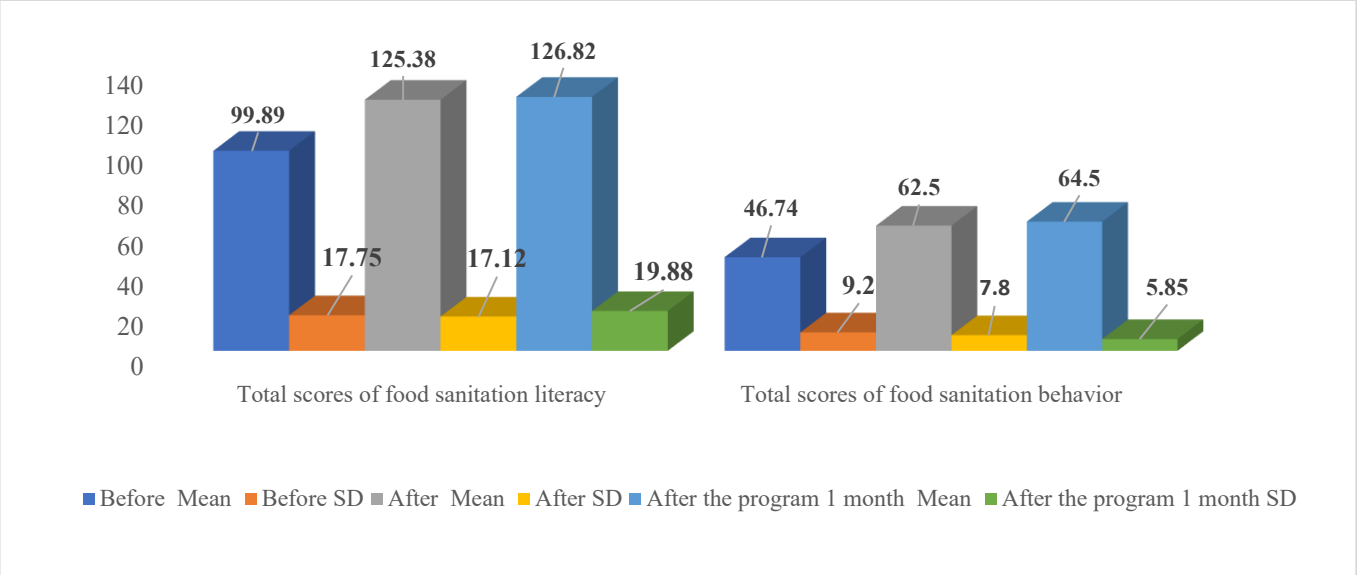

Fig 2. Score levels of food literacy and hygiene behavior of food handlers before and after the program, and 1 month after the FSLDP (n = 135)

Before the program, the overall mean score of personal hygiene behaviors was 2.64±0.07, which is interpreted as a moderate level. After the program, the mean score increased to 3.03±0.05, indicating a high level. One month after the program, the mean score was slightly reduced to 2.95±0.08, but it remained at a high level (Table 1).

Table 1. Score levels of personal hygiene behaviors

Personal hygiene behaviors	**Before, Mean (SD)**	**After, Mean (SD)**	**After the program 1 month, Mean (SD)**
1) Appearance when handling food (5 items)	3.02±0.34	3.14±0.28	2.95±0.27
2) Behavior during work (5 items)	2.54±0.39	2.68±0.31	2.79±0.32
3) Hand washing habits (5 items)	2.65±0.25	3.21±0.19	3.04±0.34
4) Correct hand-washing steps (5 items)	2.38±0.31	3.07±0.38	3.01±0.28
Total scores of personal hygiene behaviors	2.64±0.07, moderated	3.03±0.05, high	2.95±0.08, high

Analysis using repeated-measures ANOVA revealed that participants' food sanitation literacy and behavior significantly improved after participating in the food sanitation promotion program ($p < 0.001$, $F=30$), both immediately after the intervention and one month later. While there was no statistically significant difference between the immediate post-program scores and the one-month follow-up for literacy ($p = 0.145$, $F=2$), the knowledge levels remained consistently high. Similarly, food sanitation behavior improved significantly immediately after the program and remained stable over the one-month period without a significant decline ($p = 0.520$, $F=0.65$).

The assessment of personal hygiene behaviors demonstrated significant improvements following the program. Improvements were most notable in handwashing habits and correct hand-washing steps, while changes in appearance when handling food and behavior during work were minimal. No significant difference was observed

between scores immediately after the program and those at the one-month follow-up (p = 0.062, F=3), indicating that the gains in personal hygiene behaviors were largely maintained over time (Table 2).

Table 2. Comparison of differences in food sanitation literacy and behavior before and after the immediate literacy development program, and 1 month after FSLDP (n = 135)

Food Sanitation Literacy and Behavior	df (between, within)	Estimated F	p-value	Effect Size (Partial η^2)
Food Sanitation Literacy				
Before programming - After programming immediately.	1,134	30	<0.001*	0.18
Immediately after the program, 1 month after the program	1,134	2	0.145	0.03
Before giving the program, 1 month after giving the program	1,134	25	<0.001*	0.15
Food Sanitation Behavior				
Before programming - After programming immediately.	1,134	28	<0.001*	0.17
Immediately after the program, 1 month after the program	1,134	0.65	0.520	0.01
Before giving the program, 1 month after giving the program	1,134	22	<0.001*	0.14
Personal hygiene behaviors				
Before programming - After programming immediately.	1,134	27	<0.001*	0.16
Immediately after the program, 1 month after the program	1,134	3	0.062	0.03
Before giving the program, 1 month after giving the program	1,134	23	<0.001*	0.15

* Repeated-Measures ANOVA; Statistically significant at < 0.05.

The assessment results showed that: Food Distribution Locations: The mean score increased from 35.20 (SD = 6.21) before the program to 36.50 (SD = 5.40) one month after the program. Both scores were interpreted as a moderate level of management, with no statistically significant difference (p = 0.580). Food Processing, Assembly, Cooking, Storage, and Distribution: The mean score improved from 39.50 (SD = 7.89) before the program (moderate level) to 47.45 (SD = 6.34) after the program, which indicated good management. However, the difference was not statistically significant (p = 0.065). Hygiene of Containers, Equipment, and Utensils: The mean score increased from 36.60 (SD = 8.59) (moderate level) to 49.21 (SD = 7.21) after the program, reflecting good management, with a statistically significant difference (p < 0.01). Personal Hygiene of Business Operators and Food Handlers: The mean score rose from 32.46 (SD = 5.84) (moderate level) to 50.57 (SD = 5.98) after the program, which was interpreted as an extreme level of appropriate behavior, with a statistically significant difference (p < 0.01) (Table 3).

Table 3. Suitability levels of food sanitation standard assessment (n=135)

Assessment Issues	Before, Mean (SD)	After (1 month after giving the program) mean (SD)	p-value
Food Distribution Locations	35.20(6.21) moderated	36.50(5.40) moderated	0.580
Food, the process of making, assembling/ cooking. Storage and distribution of food	39.50 (7.89) moderated	47.45 (6.34) good	0.065
Container hygiene, equipment, and appliances	36.60(8.59) moderated	49.21(7.21) good	<0.01*
Personal hygiene of business operators and food contacts	32.46(5.84) moderated	50.57(5.98) extreme good	<0.01*

*Statistically significant at < 0.05.

DISCUSSION

The results of this study suggest that the program was effective in promoting and maintaining food sanitation literacy and behavior over both the short and medium term. The results were supported by Mushota *et al*, who reported that the mean post-intervention knowledge score (34.13) was higher than the mean pre-intervention score (15.17) ($F = 16513.36$, $P < 0.001$) (10). In addition, when classifying literacy on each item, it was found that the first aspect of literacy was access to food and sanitation information after receiving the program, and after receiving the program for 1 month. This study demonstrated that the food sanitation promotion program effectively enhanced participants' knowledge and behavior regarding food sanitation. The program effectively strengthened food handlers' knowledge of hygiene principles and the risks associated with unsafe food and water. Access to digital resources, including websites, video clips, and mobile applications, enhanced literacy and supported the practical implementation of food sanitation practices (11,12,13). In this study, digital resources, including websites, videos, and mobile applications, improved both literacy and practical skills. However, variations in participants' prior experience, motivation, and digital literacy influenced the translation of knowledge into behavior, highlighting the need to tailor interventions to individual and contextual factors. In addition, Hicks (14) reported that personalizing interventions to account for individual, social, cultural, and environmental factors, combined with the use of mobile technology, enables food handlers to access relevant information effectively. This approach supports evidence-based practices and enhances the implementation of food sanitation operations in their restaurants. For the second aspect of knowledge and understanding of food sanitation, it was found that immediately after receiving the program, and 1 month after receiving the FSLDP. These results are supported by Sibanyoni *et al*, who reported that food safety assurance in food service restaurants depends heavily on the availability of adequate infrastructure, appropriate management support and commitment, as well as knowledgeable and skilled food handlers (15). In addition, Geboers reported that low health literacy in older adults was also found to be associated with low educational level (16). This finding aligns with the current study, suggesting that participants' prior experience, motivation, and digital literacy influence the extent to which knowledge of food sanitation translates into behavior. Therefore, interventions should be tailored to individual characteristics and educational backgrounds to enhance the effective application of acquired knowledge.

The third aspect of knowledge is information communication skills in food sanitation. It was found that immediately after receiving the program and 1 month after receiving the program. As a result, the experimental group of food contact participants participated in communication skills training activities. Explain the characteristics of good personal hygiene and the communication of food sanitation information. There is an exchange of learning and listening to suggestions together, resulting in food contact people having higher scores in food sanitation information communication skills. These results, supported by Borah et al, reported that information, education, and communication interventions have been employed using various methods to improve food hygiene and food safety behaviors (17). This suggests that participatory approaches, which combine information delivery with opportunities for discussion and feedback, can strengthen not only knowledge acquisition but also practical communication skills, ultimately facilitating safer food-handling practices. For the aspect of self-management in food sanitation. It was found that immediately after receiving the program, and 1 month after receiving the FSLDP. As a result, the food handlers group received lectures to enhance their knowledge of food sanitation. There are also activities to participate in, such as checking personal hygiene, so that food handlers have knowledge and can analyze good and bad personal hygiene. This can be used in planning self-management according to the principles of food sanitation. These results are supported by Cramm et al, who reported that self-management abilities are known to be strongly associated with well-being (18). This suggests that engaging participants in hands-on, reflective activities not only enhances knowledge but also strengthens their capacity to apply hygiene principles autonomously, reinforcing sustainable behavior change in food handling. For the fifth aspect of literacy: media literacy in food sanitation. It was found that immediately after receiving the FSLDP and 1 month after receiving the FSLDP. As a result of the food contact group practicing checking the correct data. Have the skills to choose the right and appropriate media. It is up-to-date and can provide food sanitation information to consumers.

This result, supported by Elliott et al, reported that the media literacy programming related to food marketing highlights the importance of media literacy for giving children the skills to navigate a complex food environment (19). In addition, strategies for promoting critical thinking and strategies for measuring critical thinking were identified. Cavallo et al. reported the benefits of using social media for collecting and sharing food literacy when the aim is to promote positive health behaviors (20). Thus, integrating interactive and reflective strategies, including digital platforms, may enhance participants' analytical skills and enable the practical application of food sanitation knowledge, reinforcing both understanding and behavior change. In addition, Stevens et al. mentioned the risks of communicating food-related information through social media. In terms of knowledge in the aspect of food sanitation decisions (21).

The result of this study can be used as information to make decisions in choosing to comply with food sanitation principles. The average score of literacy was statistically significantly higher than before the program. As a result of the food contact group being strengthened by lecturing, demonstrating, and practicing food sanitation operational skills to food contact people, as follows: the skill of the 7 steps of hand washing. Ahmednur et al support this finding, stating that improper handwashing when handling food puts people at risk for infections that may be avoided (22). The skill of washing vegetables. This is supported by Manafe M et al. and Ehuwa et al. who indicated that food handlers demonstrated appropriate food safety practices concerning handwashing and the sanitation of food preparation surfaces and utensils (2)(23). These results indicate that the program was particularly effective in enhancing hand hygiene practices, while other aspects of personal hygiene behaviors showed minimal improvement. The program was particularly effective in improving hand hygiene practices, likely because handwashing is a concrete and easily reinforced behavior. In contrast, minimal changes were observed in other aspects of personal hygiene, such as appearance and workplace behavior, which may require longer-term reinforcement or additional strategies to achieve measurable improvements. At the same time, research has increased the skills. Surveillance of food contaminants with test kits such as borax, bleach, fungicide, and formalin substances.

This result is supported by Michelly S et al, which states that evaluating cost, practicality, feasibility, and benefits can be a valuable input to the decision (24). Chiou et al reported that the development of rapid, accurate, user-friendly, and cost-effective testing methods can empower food handlers and the public to proactively monitor food contaminants, complementing government surveillance and enhancing overall food safety (25). These findings indicate that the program was effective in promoting and sustaining improvements in both knowledge and behavior related to food sanitation in the short and medium term. This finding is corroborated by Begley et al (26), who indicated that at follow-up, participants with low food literacy after the program exhibited significant improvements in their follow-up domain scores for planning and management (60%) and selection (73.3%). In contrast, participants with moderate or high food literacy at the program's end maintained their follow-up scores. From activities to develop food sanitation literacy. Food contact can be used to modify behavior in food sanitation operations. This result is supported by West et al. (27), who reported that the food literacy interventions program was shown to improve food security and increase food literacy skills, enabling participants to stretch their food budgets, select and cook healthier foods, and save money. Together, these results suggest that structured literacy-focused programs not only increase knowledge but also translate into concrete behavioral changes and improved practical skills in food management, reinforcing both hygiene practices and overall food-related competencies. However, Parletta et al., reported that increased self-efficacy has been shown to improve an individual's capabilities across both the access and utilization dimensions of food security (28).

This study found that those with higher average values showed an average score of better food sanitation behaviors ($p<0.001$). The study found that the program significantly improved the hygiene of containers, equipment, and utensils, as well as the personal hygiene of food handlers ($p < 0.01$). These findings are consistent with previous research showing that food safety training can enhance food handlers' knowledge and practices, particularly in areas directly under their control (29). This suggests that structured, targeted training can produce measurable improvements in operational hygiene, reinforcing the importance of practical, hands-on interventions that focus on controllable aspects of food handling to ensure safer food practices. In contrast, food distribution locations and food processing, assembly, storage, and distribution showed only modest, non-significant improvements. This may be due to structural and environmental factors that cannot be easily changed through training alone, a challenge also highlighted in earlier studies (30). Overall, the intervention effectively enhanced personal and equipment hygiene,

but more comprehensive strategies—such as infrastructure improvements, supervision, and continuous monitoring—may be required to achieve significant change in broader aspects of food sanitation management.

This study recognizes that the one-group pretest-posttest design is subject to internal validity threats that may influence the interpretation of the program's effectiveness. Potential influences include maturation, external events occurring during the study period, and familiarity with repeated assessments. Acknowledging these limitations clarifies the interpretive scope of the findings and indicates the need for future research using more rigorous comparative designs. Recognizing these factors clarifies the boundaries of causal inference, provides a balanced interpretation of the observed improvements, and highlights the need for future studies employing more robust designs, such as comparison groups or randomized approaches, to more confidently attribute behavioral changes to the program.

CONCLUSION

The results of this study showed that the use of health education strategies that emphasized food exposure to facilitate a smooth experience from participating in training and various activities was accompanied by activities designed to reinforce the knowledge gained from lectures. Watching videos, demonstration of practice, and exchange of experiences together. Visits: Observe the practice and provide advice on how to solve problems continuously throughout the activity, resulting in an appropriate change in behavior. Therefore, the findings suggest the need to integrate structured sanitation-literacy training into local public health systems and support the use of context-appropriate educational strategies in routine practice. Further investigation is warranted to assess long-term behavioral maintenance and to evaluate the program's applicability in diverse community settings.

AUTHOR'S CONTRIBUTION STATEMENT

Somsiri Decharat conceived and designed the study, conducted the literature review, collected and entered the data, and drafted the manuscript. Pimpenjun Pan-in contributed to the study conception and design and participated in data collection. Pimpiengjun Pan-in contributed to the study conception and design and participated in data collection.

CONFLICTS OF INTEREST

The authors report no declarations of interest.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

None.

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