RESEARCH ARTICLE

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Development of Fruit and Vegetable Consumption Promotion Model in a High-Risk Population for Cholangiocarcinoma in Thailand: An Action Research

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Abstract

Objective: This study aimed to develop a model for promoting fruit and vegetable consumption in Thailand's high-risk population for cholangiocarcinoma (CCA). **Methods:** Action research was used as a guiding framework for model development. Participants were divided into groups for process development and evaluation. Group discussions and practice notes were utilized as tools for process development. Data were collected through questionnaires. Qualitative data were categorized and analyzed using content analysis. Descriptive and inferential statistics were applied to analyze quantitative data. **Results:** The model development process, following the PAOR framework (Planning, Action, Observation, Reflection), involved fruit and vegetable consumption promotion. The model, named the "NONGBO NO-CCA Model" included various components: active involvement of villagers in planning, objective sharing of experiences and brainstorming to identify CCA prevention strategies, establishment of networks to support community healthcare, enhancement of community self-reliance through utilization of local resources, and encouragement of chemical-free and environmentally friendly fruit and vegetable cultivation. Following model development, at-risk individuals demonstrated a statistically significant improvement in knowledge, attitude, and practice ($p<0.001$). **Conclusion:** The findings indicate that at-risk individuals exhibited improvements in knowledge, attitude, and practice. Knowledge gains may be attributed to educational training activities, improved attitudes may result from networking processes, and modifications in practice behaviors may be influenced by community participation. Therefore, active involvement in community development can serve as a guiding principle for effective proactive CCA prevention.

Keywords: Fruit- vegetable- cholangiocarcinoma- liver fluke- model development

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Introduction

Cholangiocarcinoma (CCA) is a disease with the highest incidence in Southeast Asia, particularly in the northeastern region of Thailand (Bray et al., 2017). The World Health Organization (WHO) has defined CCA as a significant public health issue. In addition, opisthorchiasis has been recognized as the primary carcinogen responsible for causing CCA. According to Thailand public health statistics in 2019, the mortality rate from liver cancer and CCA was 36.1 per 100,000 among males and 14 per 100,000 among females. In northeastern Thailand, the incidence rate of liver cancer and CCA was 105.03 per 100,000 population (Strategy and Planning Division, Office of the Ministry of Public Health, 2020). A study assessing behavioral risk factors and CCA risk areas in five countries in the Greater Mekong Sub-region classified Ubon Ratchathani Province, Thailand, as the highest CCA risk area (Songserm et al., 2020). In addition, according to the latest Thai cancer statistics data reported by the National Cancer Institute between 2013-2015, Ubon Ratchathani Province had the highest incidence of CCA in Thailand for both men (age-standardized incidence rate, [ASR] 57.1) and women (ASR 29.3) (Imsamran et al., 2018). Therefore, addressing the problem of CCA is an urgent public health concern for Ubon Ratchathani Province.

In Thailand, the primary approach to cancer prevention is reducing the incidence rate. This can be achieved by avoiding or minimizing risk factors (National Cancer Prevention and Control Planning Committee, 2018). To reduce the incidence of CCA, risk factors must be managed while promoting a healthy lifestyle (Songserm et al., 2012; Songserm et al., 2022). A meta-analysis identified five significant risk factors for CCA, ranked in order of risk: 1) anti-OV antibody with a pooled Odds

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Ratio (OR) of 6.09 (95% CI: 2.54-14.57); 2) consuming raw scaled freshwater fish with a pooled OR of 3.26 (95% CI: 1.58-6.71); 3) drinking alcohol with a pooled OR of 2.61 (95% CI: 1.59-4.31); 4) using Praziquantel with a pooled OR of 1.93 (95% CI: 1.20-3.10) ; and 5) consuming foods high in nitrosamines with a pooled OR of 1.41 (95% CI: 1.05-1.91) (Steele et al., 2018).

Additionally, three preventive factors were statistically significant for CCA based on the meta-analysis conclusions: consuming fruits with a pooled OR of 0.79 (95% CI: 0.65-0.96); 2) consuming vegetables with a pooled OR of 0.61 (95% CI: 0.50-0.75), and 3) consuming fruits and vegetables with a pooled OR of 0.68 (95% CI: 0.57-0.80) (Songserm et al., 2016). Despite national opisthorchiasis control campaigns aimed at reducing CCA risk for over 30 years (Jongsuksuntigul & Imsomboon, 1997; 1998; 2003), the prevalence of liver fluke and other risk factors has not decreased.

Therefore, promoting a healthy lifestyle that includes consuming fruits and vegetables, which have been identified as preventive factors for CCA, should be emphasized through campaigns or promotions.

A daily intake of 400-600 grams of fruits and vegetables has been linked to a lower incidence of various cancers (Cao et al., 2022; Hori et al., 2022) and a reduced risk of heart disease and chronic diseases (Banerjee et al., 2021; López-González et al., 2022). This is due to the presence of phytochemicals in fruits and vegetables that possess anti-cancer and anti-inflammatory properties (Reyes-Farias et al., 2019; Rodríguez García et al., 2022).

The fruit and vegetable consumption survey conducted in Thailand revealed that individuals in the northeastern region consumed the least amount of fruits and vegetables (15.7%) compared to those living the northern region (18.6%), central region (19.5%), and southern region (26.5%) (National Health Examination Survey Office, 2009). However, the incidence of CCA was highest in the northeastern region (ASR 44.1 in men, 18.5 in women), followed by the northern (ASR 41.9 in men, 15.8 in women), central (ASR of 25.9 in men, 9.2 in women), and southern regions (ASR 18.3 in men, 5.4 in women) (Imsamran et al., 2015).

These findings raise questions about whether low fruits and vegetables consumption increases the risk of CCA and how it can be increased among individuals residing in high-risk areas. Therefore, this study aimed to develop a model for promoting fruit and vegetable consumption among at-risk individuals for CCA in Ubon Ratchathani Province, Thailand.

Materials and Methods

Study design

This action research aimed to develop a model for promoting fruit and vegetable consumption as a means of preventing CCA in a high-risk area in Ubon Ratchathani Province, Thailand. The Appreciation Influence Control (AIC) framework was utilized as a guide for creating the model to promote fruit and vegetable consumption among individuals at risk for CCA.

Population and Sample

The population for this study consisted of individuals residing in one of Thailand's high-risk areas, specifically the northeastern region. Therefore, a multi-stage sampling method was employed to select samples, which involved five steps.

Step 1

The northeastern region of Thailand, which has the highest incidence of CCA in the country (Chaiteerakij et al., 2017) and remains a significant public health concern today, was selected.

Step 2

Ubon Ratchathani Province was selected as it has been classified as the highest CCA risk area based on statistical data from the National Cancer Institute (Imsamran et al., 2018) and an analytical study (Songserm et al., 2020).

Step 3

Mueang District was randomly assigned from among the 25 districts in Ubon Ratchathani Province sing a simple random sampling method.

Step 4

Nongbo Sub-district was randomly selected from among the 11 sub-districts in Mueang District sing a simple random sampling method.

Step 5

This step involved the selection and division of individuals living in the randomly selected area, Nongbo Sub-district, Mueang District, Ubon Ratchathani Province, into two groups.

The development process sample consisted of 12 community leaders, including one village headman, one assistant village headman, one director of Tambon Health Promoting Hospital, two public health officers, and seven village health volunteers.

The evaluation or data collection sample comprised 38 individuals at risk of CCA, selected using the sample size calculation formula for two means-independent samples (Wayne, 1995). The sample size was determined based on the results of a previous study by Thubthim and Duangsong (2014) investigated the effects of a behavioral development program for opisthorchiasis prevention in a community of Plapak District, Nakhon Phanom Province. It was found that the mean scores of opisthorchiasis prevention practice before the experiment were 41.65 ± 4.94 points, and after the experiment, the mean scores were 43.95 ± 3.43 points. Therefore, the sample size was 36 people. To prevent the problem of sample loss, the sample size in this study was increased by 2% (Krejcie & Morgan, 1970). Therefore, the appropriate sample size for this study was determined to be 38 people at risk for CCA to prevent potential sample loss.

Inclusion criteria for this study were as follows: individuals who were at risk for CCA and screened through verbal screening with the following four answers: 1) being Isan (Northeast Thailand) people by birth; 2) being aged 40 years and over; 3) eating or having a history of eating

raw freshwater fish; and 4) having direct relatives with CCA. In addition, individuals at risk for CCA were those who answered "Yes" on two or more items (Department of Health Service Support, Ministry of Public Health, 2020). Other inclusion criteria included the ability to read and write and willingness to participate in the activities. Exclusion criteria for this study included individuals who were unable to participate in the activities or requested to withdraw from the research.

Research tools

The tools used in this study's development process included focus group discussions, observations, and practice records. Data collection was done through a questionnaire created by the researcher based on the guidelines gained from documents, textbooks, and other research reports according to the conceptual framework and research objectives. The questionnaire consisted of the following four parts.

Part 1

Collecting general information on at-risk individuals for CCA, including gender, age, marital status, education, and occupation.

Part 2

Holding knowledge test on fruit and vegetable consumption for CCA prevention: The test consisted of 15 multiple-choice questions, with a reliability coefficient of IOC = 0.80 and KR-20 = 0.74. Participants were awarded one point for each correct answer and zero points for incorrect answers.

Part 3

Assessing participants' attitudes towards fruit and vegetable consumption for CCA prevention using a questionnaire consisting of: 15 questions, with a reliability coefficient of IOC = 0.80 and Cronbach's Alpha Coefficient = 0.81. The questions were rated on a three-point Likert scale: Agree, Not Sure, and Disagree, with both positive and negative statements included.

Part 4

Examining participants' fruit and vegetable consumption behaviors for CCA prevention using a questionnaire consisting of 20 questions, with a reliability coefficient of IOC = 0.89 and Cronbach's Alpha Coefficient = 0.83. The questions were rated on a 4-point Likert scale: Usually, Often, Rarely, and Never, with both positive and negative statements included.

Data collection

Data collection involved four steps: planning, action, observation, and reflection.

Planning

During the planning stage, the researchers analyzed the situation and prepared an action plan by researching relevant documents, concepts, theories, and related research. They also coordinated with relevant organizations to clarify research objectives and studied the context and condition of CCA in the area. Additionally, data was collected on factors related to CCA risk behaviors in the community before assessing participants' knowledge, attitudes, and behaviors towards fruit and vegetable consumption for CCA prevention. Finally, an AIC process was used to develop an action plan after organizing a workshop to discuss findings from the study.

Action

Conducting activities based on established development guidelines, including knowledge dissemination on CCA, promoting fruit consumption for CCA prevention, and providing community education initiatives.

Observation

Monitoring and assessing the execution of activities, measuring participation rates, evaluating the knowledge, attitudes, and behaviors of individuals at risk for CCA who engage in these activities.

Reflection

Synthesizing the outcomes of the implemented activities in line with the development guidelines, and deriving valuable insights and lessons learned to be communicated back to the community.

Data analysis

Qualitative data analysis

Qualitative data analysis was employed for the data obtained from focus group discussions, interviews, observations, and practice records. The collected data were classified, categorized, and analyzed by content analysis.

Quantitative data analysis

Descriptive statistics were used to analyze general information, knowledge, attitudes, and behaviors using frequency distribution, median, percentage, mean and standard deviation. Moreover, inferential statistics were used to compare mean scores on knowledge, attitudes, and behaviors among at-risk people before and after implementing the model. In addition, paired t-tests with a confidence level of 0.05 were employed for this purpose.

Results

The context of the area and the problem

Nongbo Sub-district, located approximately 20 kilometers northeast of Mueang Ubon Ratchathani District Office, is home to a population of 7,971 individuals residing in 1,764 households across 13 villages. There are two health service centers. The majority of residents are engaged in agricultural work. However, the presence of numerous natural water sources has led to health concerns, as some households produce fermented fish and individuals in certain areas continue to consume raw freshwater fish. These practices have been identified as significant contributors to the prevalence of opisthorchiasis and the potential risk of CCA in the future. To address these issues, a development process was implemented in four steps.

Table 1. Number and Percentage Classified by the Levels of Knowledge, Attitudes, and Practice Behaviors on Fruit and Vegetable Consumption for CCA Prevention before and after the Model Development

Factors	Before		After	
	Number	Percentage	Number	Percentage
Knowledge				
Good	4	10.53	28	73.68
Moderate	28	73.68	10	26.32
Low	6	15.79	0	0.00
Attitudes				
Good	8	21.05	35	92.11
Moderate	29	76.32	3	7.89
Low	1	2.63	0	0.00
Practice behaviors				
Good	4	10.53	36	94.74
Moderate	34	89.47	3	5.26
Low	0	0.00	0	0.00

Step 1

Planning: The first step involved planning and contextualizing the problem of CCA within the community through a workshop with community leaders. This included one village headman, one assistant village headman, one Tambon Health Promoting Hospital, two public health officers, and seven village health volunteers. The planning phase utilized an action plan developed using the AIC process. The planning phase consisted of several steps aimed at identifying and addressing key issues related to CCA within Nongbo Sub-district.

Appreciation (A)

All the participants were given opportunities to express their opinions through drawing or writing stories to share knowledge and reach conclusion on ways to prevent CCA.

Influence (I)

The objective was to develop a community model for effectively preventing CCA. Participants collaboratively defined methods, goals, and activities, prioritizing them accordingly.

Control (C)

The aim was to foster acceptance and collaboration with the community by implementing activities and allowing them to take responsibility for their own actions.

Step 2

Action

Activities were implemented according to the development guidelines obtained from the planning process, including those aimed at providing knowledge about CCA, promoting fruit consumption for CCA prevention, and educating the community.

Step 3

Observation

The success of the operation was assessed by observing participation in activities and evaluating knowledge, attitudes, and behaviors related to CCA among high-risk groups.

Step 4

Reflection

Results of the operation were summarized according to the development guidelines and lessons learned were shared with the community.

The results obtained from the model development

After developing the model for promoting vegetable and fruit consumption among at-risk people for CCA prevention in Nongbo Sub-district, it was found that the samples were primarily females (33 people, or 86.84%), with a mean age of 60.63 ± 8.90 years. The majority of the participants were married (60.53%), had completed primary school education (71.05%), and were engaged in agricultural occupations (86.84%). The mean family income was 5,634 baht (S.D. = 3,355.05).

Regarding the knowledge assessment, following the model development, 73.68% of the at-risk individuals demonstrated good knowledge, while 26.32% had moderate knowledge (Table 1). Moreover, there was a significant difference in the mean knowledge scores before and after the model development (2.61 scores) ($p<0.001$) (Table 2).

In terms of attitudes, 92.11% of the at-risk individuals exhibited good attitudes after the model development, while 7.89% reporting moderate attitudes (Table 1).

Table 2. Compares the Mean Scores of the Knowledge, Attitudes, and Practice Behaviors on Fruit and Vegetable Consumption for CCA Prevention before and after the Model Development

Factors	n	$\bar{X}$± S.D.	Mean Difference	95% CI	t	p-value
Knowledge			2.61	2.27-4.08	7.08	<0.001
Before	38	9.84 ± 1.39				
After	38	12.45 ± 1.39				
Attitudes			4.77	3.97-5.56	12.18	<0.001
Before	38	21.97 ± 2.07				
After	38	26.74 ± 1.74				
Practice behaviors			16.47	14.85-18.10	20.57	<0.001
Before	38	32.71 ± 2.48				
After	38	49.18 ± 4.78				

Figure 1. The "NONGBO NO-CCA Model": a new model for promoting vegetable and fruit consumption among the at-risk individuals for CCA prevention in Ubon Ratchathani, Thailand

Notably, there was a significant difference in the mean attitude scores before and after the model development (4.77 scores) ($p<0.001$) (Table 2).

The assessment of practice behaviors revealed that after the development of model, 94.74% of the at-risk individuals demonstrated good practice behaviors, while 5.26% had moderate practice behaviors (Table 1). In addition, there was a significant difference in mean practice behaviors before and after the model development (16.47 scores) ($p<0.001$) (Table 2).

The development of a model for promoting vegetable and fruit consumption among at-risk individuals for CCA in the Nongbo Sub-district resulted in a new model called the "NONGBO NO-CCA Model." This model encompasses various components, including active involvement of community members in the in the planning process, brainstorming sessions, and sharing of experiences objectively to find effective strategies to prevent CCA. The model also emphasizes the importance of community networking to support and strengthen healthcare services based on traditional socio-cultural norms.

Additionally, it aims to enhance the community's self-reliance by utilizing locally available resources and promoting the cultivation of chemical-free and environmentally-friendly fruits and vegetables. The detailed components of the model are illustrated in Figure 1.

The 'N' in the model represents the establishment of network partnerships to prevent CCA. This involves collaborating with various organizations and stakeholders to collectively address CCA prevention.

The 'O' signifies the involvement of supporting organizations, such as Tambon Health Promoting Hospital, Sub-district Administrative Organization, and schools, which play a crucial role in strengthening and maintaining community health, thereby minimizing the risk of CCA.

The letter 'N' also represents the promotion of nature-friendly practices, wherein each household is encouraged to cultivate chemical-free and environmentally-friendly vegetables for their own consumption.

The 'G' component emphasizes the need to generate community-based approaches for CCA prevention, fostering a sense of collective responsibility and engagement among community members.

The 'B' component signifies the importance of conducting brainstorming sessions to facilitate the development of a community model specifically tailored to CCA prevention.

The O (Opinion) component emphasizes the importance of unbiased listening to the opinions of the community in order to find avenues for community development.

Under the N (Norms and Cultures) aspect, the focus is on integrating traditional socio-cultural norms with contemporary operations for preventing CCA.

O (Ongoing Learning) refers to a leader's commitment to continuous learning, which plays a pivotal role in fostering a model community for CCA prevention.

The C (Community) element emphasizes the active involvement of the community participation in promoting fruit and vegetable consumption as a means of CCA prevention.

C (Capacity building) involves strengthening the community's capacity for CCA prevention by fostering self-reliance in utilizing local resources and products.

A (Achievement) represents the community's -desired success, namely, becoming a role model for CCA prevention.

One crucial aspect is that this model serves as an integral driver of development. By engaging community members in the development plans, it becomes possible to obtain sustainable guidelines for community development.

Discussion

The model developed through the AIC process was implemented to promote vegetable and fruit consumption among individuals at-risk for CCA prevention in Nongbo Sub-district, Mueang District, Ubon Ratchathani Province, which is recognized as a high-risk areas in Thailand. Consequently, the discussion of the outcomes of various approaches can be presented as follows.

The findings of the study on developing a model for promoting vegetable and fruit consumption among at-risk individuals for CCA in the area revealed that the model was the result of implementing action research using the PAOR process, along with the application of the AIC process. Through this process, community members actively participated in decision-making, establishing activity guidelines, and sharing responsibilities as key stakeholders in their community. The action plan was created through community involvement, and the activities were executed according to the devised plans. Follow-ups and observations were conducted, and feedback was provided on the operations. The operation and the lessons learned were summarized. The results of this study are consistent with a study by Karsaesen and Sota (2019) that developed an opisthorchiasis prevention model in Chanuman District, Amnat Charoen Province utilizing action research and involving networks and community leaders in the process along with the application of AIC. The success of the research was attributed to the opportunity for community members to participate in the planning process, resulting in the establishment of a systematic and explicit operational model within the community. Furthermore, the results of this study are consistent with a study conducted by Seetano (2016), which developed an operational model for opisthorchiasis prevention in Ban Phon Yanang, Na Yai Sub-district, Suvarnabhumi District, Roi Et Province. The success factor in that study was the active participation of the community in establishing a continuous monitoring system, with community leaders playing a supportive role in the operations.

Following the implementation of the developed model, it was found that the mean scores of knowledge among at-risk individuals significantly increased at a significance level of 0.05. This positive outcome can be attributed to the educational training activities which covered various aspects of opisthorchiasis and CCA, including causes, risk factors, disease prevention, and control, the benefits of fruits and vegetables in disease prevention, local varieties that enhance immunity and prevent the disease, demonstrations and adherence to recommended consumption practices , as well as sharing and disseminating knowledge within the community. These findings are consistent with a study conducted by Seetano (2016), which developed a model for opisthorchiasis prevention through training the at-risk individuals via broadcasting towers and publicity boards. The results of that study also showed that the at-risk individuals exhibited higher mean knowledge scores following the model development. Moreover, the findings align with Karsaesen and Sota (2019), where training activities aimed to modify food consumption behaviors to prevent opisthorchiasis by promoting hygienic cooking practices within households and establishing network partnerships to mitigate the risk of liver flukes in the community. Consequently, the at-risk individuals in that study also demonstrated higher mean knowledge scores after the model development.

The findings also revealed a statistically significant improvement in the mean scores of attitudes among the at-risk group at a significance level the 0.05. This improvement can be the attributed to the training activities conducted. These results align with a study by Pankham (2014), which developed a model for opisthorchiasis prevention at the community level in Du Noi Sub-district, Chaturaphak Phiman District, Roi Et Province. In that study, a meeting was organized to educate community leaders and enhance public relations within the community. Additionally, a fund was established, and a contest was held, along with the establishment of a network for opisthorchiasis prevention at the community level. As a result, the community leaders exhibited higher mean scores of attitudes compared to before the intervention.

In addition, the findings demonstrated a statistically significant improvement in the mean scores of practice behaviors among the at-risk group at a significance level of 0.05. These findings are consistent with a study by Seetano (2016), which developed a model for opisthorchiasis prevention in the community through training activities. The results of that study also showed that the at-risk individuals exhibited higher mean scores on practice behaviors following the implementation of model.

Limitations

During the research conducted in the community, the COVID-19 epidemic situation has been severe and the outbreak remains uncontrollable. Consequently, the Ministry of Public Health has underscored the importance of disease prevention by advising against travel to epidemic areas and discouraging gatherings of people. In cases where activities must be carried out, additional screening measures are required. As a result, we have allocated additional time and budget to the research process to screen all samples by conducting ATK prior to their participation in the study. In addition, strict disease prevention measures have been implemented, such as the arrangement of seating spaces and limitation of the

number of participants. However, it is acknowledged that these measures may potentially hinder communication or group activities.

In conclusion, community participation emerges as the most crucial factor in driving development. It serves as a guiding principle for establishing a model community that ensures sustainable CCA prevention. Therefore, it is imperative to establish network partners and consistently promote community participation to identify appropriate approaches that align with the contextual needs of the area.

Author Contribution Statement

PS, NS, and MR conceived and designed the research. PS and NS were responsible for connecting and coordinating the fieldwork. PS collected the data. PS carried out the analyses. PS and NS reviewed the draft of the manuscript. All authors contributed to the writing and revisions of the manuscript and approved the final version.

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Ethical approval

This research was approved by the Human Research Ethics Committee at Ubon Ratchathani Rajabhat University and was conducted based on the Declaration of Helsinki and the ICH-GCP Guidelines (Ref. No. HE642016).

Availability of data (if apply to your research)

Data will be available upon request.

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Conflict of interest

The authors declare no competing interests.

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