

RESEARCH ARTICLE

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Development of a School-Based Health Literacy Model for Liver Fluke Prevention and Control Using Participatory Action Research

Natnapa Heebkaew Patchasuwan¹, Pannee Banchonhattakit², Nathkapach Kaewpitoon Rattanapitooon³, Nathakon Nilnate⁴, Werayuth Srithumsuk⁵, Seksan Heebkaew⁶, Surachai Phimha^{1,7*}

Abstract

Background: Liver fluke caused by *Opisthorchis viverrini* is a serious health problem in the northeastern region of Thailand. It is associated with endemic cholangiocarcinoma (CCA) in this region. This study was performed to develop a school-based health literacy model for liver fluke prevention and control using participatory action research. **Method:** The participants of this study included 3 school administrators, 5 teachers, 45 senior high school students, 2 health officers, and 5 health volunteers. in Phanom Phrai District, Roi-et Province, Thailand. The study employed mixed methods for data collection, including qualitative methods namely policy analysis, interview, and problem-solving as well as quantitative methods namely pre and post-tests and implementation of health literacy. Six months later, researchers evaluated the outcome. The average scores of the participants' health literacy and their practical skills were measured. **Result:** The participants' health literacy and practical skill mean score increased after the intervention (mean difference=20.20, 95%CI 15.37-25.03, p-value <0.001) and (mean difference=21.10, 95%CI 19.10-23.10, p-value <0.001). School activities were concluded regarding public relations for one time a week, exhibitions, learning summary speech contests, and organizing a school food safety club. In addition, school rules were agreed and included: (1) cooked food consumption (2), stopping undercooked cyprinoid fish by the household cooker (3), correcting misunderstanding in each household in the community (4), hygienic defecation, and (5) reminding friends to stop consumption of undercooked food. **Conclusion:** The results indicated that school-based model was effective. The stakeholder experiences and learning processes using teamwork will help the development of skills to cooperate and coordinate students choosing the best method for Liver fluke prevention and control. Moreover, they should continue to improve the suitable network for each school to ensure that the models are sustainable.

Keywords: Health literacy-liver fluke prevention- participatory action research

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Introduction

Liver fluke caused by *Opisthorchis viverrini* (*O. viverrini*) is one of the major public health problems in various countries of Southeast Asia, including the Lao People's Democratic Republic, Cambodia, Vietnam, and Thailand (Sithithaworn et al., 2012). Cholangiocarcinoma (CCA) and bile duct cancer (Sripa et al., 2010; IARC, 1994) are induced by liver fluke. The *O. viverrini* is endemic among rural populations who live in the northeastern and northern parts of Thailand, where raw fish is frequently consumed, especially cyprinoid fish

made of fermented fish, minced finely chopped raw fish, and sourced fish (Chavengkun et al., 2016; Sithithaworn et al, 1997; Sripa et al., 2011). Raw-fish-eating behavior increases because they believe that consuming minced or finely chopped raw fish with sticky rice is good for their health (Grundy-Warr et al., 2012). According to a nationwide survey in Thailand, the prevalence of liver fluke infection was 5.1% in this country. However, it is also shown that the highest prevalence (9.2%) was found in the northeastern region, followed by the northern region (5.2%) (Wongsaroj et al., 2014). It was estimated that 6 million people in Thailand were at risk of developing

¹Faculty of Public Health, Khonkaen University, Khonkaen Province, Thailand. ²Faculty of Public Health, Valaya Alongkorn Rajabhat University under the Royal Patronage, Pathumthani Province, Thailand. ³Parasitic Disease Research Center, Nakhon Ratchasima, Thailand. ⁴Department of Public Health, Faculty of Nursing and Allied Health Sciences, Phetchaburi Rajabhat University, Phetchaburi, Thailand. ⁵Department of Nursing, Faculty of Nursing and Allied Health Sciences, Phetchaburi Rajabhat University, Phetchaburi, Thailand. ⁶Kuchinarai District Public Health Office, Kalasin Province, Thailand. ⁷ASEAN Cancer Epidemiology and Prevention Research Group, Thailand. *For Correspondence: suraphi@kku.ac.th

liver fluke (Sithithaworn et al., 2012). Nevertheless, Thai people with a greater risk of liver fluke infection consume raw cyprinoid fish species as a part of their daily lives. Open defecation was also common, especially in the rice fields (Smout et al., 2011). Therefore, liver fluke infection is a serious issue in Thailand and effective intervention needs to be implemented.

The Ministry of Public Health found that the percentage of infection of liver fluke disease among Thai people was 8.7%, or around 6 million people, from 2009 to 2013 and Thai people tended to have risky behaviors in their daily life (Wongsaroj et al., 2014). Whereas, in the region of northeast Thailand, 16.6% of people were infected, especially those living in the area of 'Roi Kean SaRa Sin' (shortened form for the provinces of Roi Et, Maha Sarakham, Khon Kaen, and Kalasin). The percentage of people infected with liver fluke infection was 11.8% in Roi Et province (Aunpromma et al., 2012). Roi-et province ranked 3 for the prevalence of liver fluke infection and Phanom Phrai district had the highest prevalence of liver fluke infection in this province (18%) (Roi-et Provincial Health Office, 2018). Phanom Phrai district is located near a main fresh river, called the "Chi River", which is one of the big rivers in the northeastern part of Thailand. Moreover, people who live in this area still prefer to consume raw cyprinoid fish.

Liver fluke infection is a health challenge issue in Thailand, especially in the northeastern part of the country. The prevalence of liver fluke infection is greater among school students. High school students have a similar pattern of consuming raw cyprinoid fish as adults. Moreover, they will grow to adulthood in a few years. If their raw fish consumption behavior is not modified, they will face the risk of developing liver fluke infection in the near future. About 84.09% of adolescents in Northeast Thailand consume raw cyprinoid fish (Patchasuwan et al., 2018). The prevalence of *O. viverrini* in school age children was high (14–37%) in Thailand according to a previous study (Khuntikeo et al., 2016). The Ministry of Public Health set the plan to reduce the incidence of liver fluke infection to less than 5% within the year 2020 in the northeastern part of Thailand (Ministry of Public Health, 2016). However, effective and realistic intervention, especially behavior modification in the school-age population, needs to be implemented to reach this goal. The integrated health literacy contributed the students to reach the desired level of knowledge, personal skills, and confidence in practice. These skills were used to improve self-health and the health of people in the community through modifying lifestyle and living conditions. Perry (2014) studied the effect of using educational resources on classroom-based mental health literacy in teenagers. It was revealed that provision of school-based educational approach could enhance health literacy significantly (Laithavewat, 2020). Therefore, the objective of this study was to develop the competencies of school health leaders to prevent and control liver fluke infection and CCA in Phanom Phrai district, Roi-et province, Thailand, by using participatory action research.

Materials and Methods

Participants' area

A simple random sampling was used to select an area of the high-risk area in Thailand, which is 'Roi Kean Sara Sin' region (the shortened form of Roi Et, Maha Sarakham, Khon Kaen, and Kalasin provinces), among which Roi Et province was selected randomly. The purposive sampling was used to select the area with the highest prevalence of liver fluke infection in this province, which was Phanom Phrai District.

Participants

Sixty participants were included in this study consisting of 3 school administrators, 5 teachers, 2 health officers, 5 health volunteers, and 45 high school students who lived in Phanom Phrai district, Roi-et province. Purposive sampling was implemented because the focus was on information-rich cases and obtaining in-depth understanding of the topic. Inclusion criteria were 1) having important roles or positions in the school, 2) being able to read and write, and 3) willing to participate in the study.

Health literacy assessment

Data collection was done using a questionnaire developed by the researchers. The questionnaire consisted of 38 items addressing 6 domains, including cognitive, access, communication, self-management, decision, and media literacy skills. The questionnaire was validated by 5 experts and tested for reliability. Its validity was 0.81. Cognitive domain had adequate internal consistency with Kuder Richardson-20 coefficients of 0.76. In addition, the Cronbach's alpha coefficients of health literacy skills for access, communication, self-management, media literacy, decision-making, and practice regarding liver fluke prevention and control domains were 0.74, 0.81, 0.78, 0.72, 0.82, and 0.76, respectively. The total score of the questionnaire was 130. A higher score indicated higher health literacy regarding prevention of liver fluke infection.

Practical skill assessment and stool examination

The practical skill to prevent liver fluke infection was also assessed by a questionnaire. The questionnaire consisted of 6 questions regarding consumption of raw cyprinoid fish, hygienic defecation, hand washing before and after cooking, hand washing before and after meals, elimination of cyprinoid fish residue from cooking by feeding dogs and cats, and elimination of cyprinoid fish residue from cooking by dump landfill. The total score of the questionnaire was 65. A higher score reflected higher practical skill to prevent liver fluke infection. Stool specimens were collected and initially studied by experienced medical technologists and parasitologists. The deposit was then examined microscopically using physiological saline and iodine for the eggs, trophozoites, and larvae of intestinal parasites (one with saline and the other with iodine).

Health Literacy Related to Liver Fluke Prevention and Control
teamwork, leadership, and project management. This step was implemented 2 times.

Participatory action research

The process of assessing health literacy development and practice to prevent liver fluke among school health leaders was done by using participatory research comprising of 4 main phases as follows:

Planning and policy making phase

All the participants were recruited in this phase, which consisted of 6 minor steps and lasted 6 hours.

Participants preparation

The researchers held a meeting with the participants and then informed them concerning the objective of the project, the principles and concepts of participation in the project, the project benefits, the principles and concepts of liver fluke prevention, and the experiences of school health leaders regarding liver fluke prevention.

Participants' responses analysis

The participants presented and discussed the information regarding the current situation, desirable scenario, and consensus to get the final information. In this phase, the participants analyzed 1) the size of the problems, 2) severity of the problems, 3) difficulty to solve the problems, and 4) interest in solving the problems. The prioritized problems comprised 1) consuming fermented fish with herbs and pickled fish, 2) consuming raw cyprinoid fish with the family and community, and 3) eliminating cyprinoid fish residue from cooking by feeding dogs and cats.

Policy formation

After analysis of the community, the policy to prevent liver fluke infection consisted of 1) promoting consumption of cooked fish by students in the school, 2) promoting consumption of cooked fish by family and community, and 3) promoting the elimination of cyprinoid fish residue from cooking by dump landfill. We focused on creating relationships between the school, family, and community as well as developing competencies by school health leaders for enhancing health literacy regarding liver fluke prevention.

The development of guidelines

This phase involved finding the methods and offering choices to develop a desirable scenario. The participants brainstormed to find the appropriate measurements and methods as well as the rationales for setting goals, activities, and priorities of the activities. After brainstorming, the activities needed to be implemented consisting of 5 activities: 1) audio line broadcasting about liver fluke infection knowledge, 2) competition for a brochure and board about liver fluke infection knowledge, 3) establishing a school charter, 4) making short film activity against liver fluke infection, and 5) promoting liver fluke infection knowledge in the local community.

Development of school health leaders' competencies

This phase included development of the competencies of the school health leaders regarding health literacy and practical skills needed to prevent liver fluke infection,

Action plan

The researchers held a meeting to discuss an action plan, working process, agreement plan, and appointing the committee and to set the minor activities to get the final decision before implementation of school-based health literacy model for liver fluke prevention and control.

Implementation period

The school health leaders and researchers implemented the activities as planned, which included 5 activities over 3 months as follows:

Audio line broadcasting about liver fluke infection knowledge

The audio line broadcasting was organized by the school health leaders, and the target group included students in the school. They prepared the content script about Cholangiocarcinoma (CCA) and bile duct cancer disease, causes, signs and symptoms, severity, treatment, and prevention. They implemented audio line broadcasting every Monday during lunchtime, which included playing games and answering questions to win prizes at the end of the broadcast.

Competition for a brochure and board about liver fluke infection knowledge

The competition was announced through the audio broadcast, notice board, and school's Facebook the competition was for a brochure and board about liver fluke knowledge. The administrators and teachers were the judges.

Establishing a school charter

The responsible persons were school health leaders, while the target group comprised of 45 students at different grades. The school health leaders notified the objectives and details of the activities. They also invited public health officers from Phnom Phrai Hospital to provide educational material on liver fluke infection, propose the liver fluke infection prevention guideline, and set the agreement together, leading to the establishment of a school charter to prevent liver fluke infection. This charter consisted of 1) cooked food consumption, 2) stopping undercooking cyprinoid fish by household cooker, 3) correcting knowledge in each household, 4) hygienic defecation, and 5) reminding friends to stop consuming undercooked food. The school health leaders and representatives of each level distributed a school charter on prevention of liver fluke infection to other students in the school.

Making short films on liver fluke infection

The school health leaders produced a short film about student life in the community, prevention of liver fluke infection, and promotion of liver fluke prevention behaviors.

Promoting local knowledge

The school health leaders provided education about liver fluke infection prevention to the local community people to encourage them to practice liver fluke infection prevention behaviors, in accordance with 5 items indicated in the school charter.

Monitoring phase

The school health leaders met with the working groups every first Friday of the month to have discussion about the improvement of the implementation of all activities. This process consisted of a preliminary evaluation, discovering the strengths and weakness of the activities, searching the information on the obstacle against the implementation of each activity, and appropriate enhancement of the process.

Evaluation

The researchers along with the school health leaders and stakeholders evaluated the project for 3 hours. The data were presented using both quantitative and qualitative methods. The researchers gave the project's results information back to the people in the community at the end of the project.

Statistical analysis

The health literacy on liver fluke prevention was analyzed by a one-group pretest-posttest design using paired t-test. The liver fluke eggs analyzed were presented as yes/no groups. In-depth interviews were done to obtain qualitative data. Both content analysis and thematic analysis were done by 2 researchers independently. In case of disagreement between researchers, consensus was sought during a consensus meeting.

Ethical considerations

This research was approved by the research ethics committee of Khon Kaen University, Thailand (HE622167). All the study participants provided informed consent before participating in the study. The participants were acknowledged about the study objectives and confidentiality of their information.

Results

A total of 60 participants took part in this study, the majority of whom were females (75.82%). The mean distance between the participants' houses and a river was 2.06 km (SD = 2.33), ranging from 0.01 to 16.00 km. Nearly, half of the participants (46.18%) had never received information about liver fluke. About 89.36% of the participants had no history of stool examination, and 53.18% had history of taking anti-parasitic drugs. Most of the participants (96.73%) did not smoke. In addition, 73.00% of the participants did not drink alcohol.

The results showed that mean of health literacy on liver fluke prevention was 92.57 (SD=12.58) before the intervention, while it was 112.77 (SD= 9.64) after the-intervention, causing a significant difference (95% CI = 15.37 - 25.03, p <0.001). In addition, it was found that the mean practical skills on liver fluke prevention was 33.78 (SD= 7.92) before the intervention, and it was 54.88 (SD=3.63) after the intervention, leading to a significant difference (95% CI = 19.10 - 23.10, p <0.001), as shown in Table 1. Moreover, the results of the assessment of liver fluke egg in the stool revealed that it did not change after the intervention.

The results of the participatory action research showed that a participatory community health promotion process consisted of 4 phases including:

Phase 1: The planning and policy-making phase applied a key implementation mechanism, which included supporting and promoting competency in the community to develop individuals, families, community health literacy, and practical skills. It consisted of 6 steps, including 1) community preparation, 2) community analysis, 3) policy formation, 4) the development of guidelines, 5) development of school health leaders, and 6) designing action plan.

Phase 2: The implementation phase must be focused on bringing competency and building relationships between the community and other local organizations to promote proper cooperation and enable the implementation of the plan.

Phase 3: In the monitoring, the feedback of participants and stakeholders to develop a liver fluke prevention policy and improve the development processes to prevent liver fluke infection were used. This phase consisted of 4 steps, including 1) preliminary evaluation, 2) discovering the strengths and weakness of the activities, 3) searching the information on the obstacle against the implementation of each activity, and 4) appropriate enhancement of the process.

Phase 4: In this phase, the researchers along with the school health leaders and stakeholders evaluated the project. For this purpose, they summarized the processes for the development of liver fluke infection prevention program and suggested a process model for developing the participatory action research to prevent liver fluke infection in schools.

Moreover, the overall development process for preventing liver fluke infection in schools used participatory action research also resorted to the school-based approach.

The lessons learned from this participatory action research to prevent liver fluke infection were as follows:

- The processes of solving community problems consisted of community participation in determining measures for community health promotion, implementation

Table 1. Comparison of Health Literacy and Practical Skills to Prevent Liver Fluke Infection in the Intervention Group (n=60)

Factors	Before (Mean±SD)	After (Mean±SD)	Mean differences	95% CI	t	p-value
Health literacy	92.57±12.58	112.77±9.64	20.20	15.37-25.03	8.37	<0.001
Practical skills	33.78±7.92	54.88±3.63	21.10	19.10-23.10	21.15	<0.001

of the measures, periodic monitoring through community participation processes, and evaluation of the project. This step focused on understanding the relevant context and the school's needs for the prevention of liver fluke infection, planning for solving problems according to the ability of the community, creating opportunities for capacity building in the community to solve problems, supporting the community to develop a problem-solving process, follow-up, and evaluation of problem-solving process.

- The school health leaders felt that they had the opportunity to develop knowledge from real practice using the common goals of the group. They implemented various projects and learned that the implementation of the projects was time-consuming and needed high determination and patience because they had to learn to deal with other people. These activities were the results of school health leaders' commitment to the school, attention of the research team, and collaboration of the students, making it possible to proceed until achieving success according to the plan.

- Using a participatory approach for the development of liver fluke infection prevention plan caused experimental learning for individuals, schools, and the community. The development process for liver fluke infection prevention made 4 lessons to be learned, namely 1) improving attitude towards having consciousness in the solving problems-of the community, 2) enhancing the problem learning experience and requirements for liver fluke infection prevention, 3) developing student leadership ability in the prevention of liver fluke infection, and 4) monitoring and evaluating the prevention of liver fluke infection.

- The strategies for participatory approach toward prevention of liver fluke infection resulted in public understanding of community needs for health promotion, which enabled moving towards creating a model for developing community participation. This phase consisted of 4 steps, including 1) studying the problems and needs of the community regarding liver fluke infection prevention, 2) building knowledge and enhancing understanding of liver fluke infection prevention, 3) developing skills in the prevention of liver fluke infection, and 4) expanding the liver fluke infection prevention network in both the school and community.

- Factors affecting the success and failure of the implementation of the projects comprised of 1) knowledge and perception of the participatory approach toward school development guideline, 2) understanding the development process which lead to the formation of steps for the implementation of the plan, 3) the ability to communicate about the implementation of the project requires coordination with many stakeholders consisting of a project-responsible team, school health leaders, school administrators, teachers, parents, healthcare workers, and village health volunteers, which must have a clear communication process involving objectives, details of each process, and benefits that the community receives at each stage. Therefore, the stakeholders had positive thinking, determination, and volunteer spirit for participating in the activities and were able to participate in the development process with high quality, leading to development of true liver fluke infection prevention

plan in the community, 4) time management for the implementation of the plan in the community was one of the most important aspects for the agility of participatory action, 5) knowledge, ability, and related skills for situation analysis in the health promotion, lesson transcription, small group discussions, and group meeting, 6) the concepts and objectives for liver fluke infection prevention plan with the participation of relevant organizations affected the supporters and jointed efforts to resolve the obstacles in all aspects of the project implementation such as time, coordination, location, equipment, and vehicles, and 7) the preparation and development of school health leaders' ability, including supervision and monitoring, as well as the development of knowledge and understanding of the research team and school health leaders to build an understanding of the systematic process and determine the period of tracking work according to the plan, counting the transcription of success lessons learned and obstacles of the periodical implementation, and then return information to the community along with improving the implementation process to be appropriate was a key mechanism for successful project implementation.

Discussion

This study aimed to use a participatory approach toward development of a process for implementing liver fluke prevention plan in the school. Participatory action research process integrated the concept of using schools as a platform for solving problems. In other words, it meant using resources from the school to develop the means in enabling to think, analyze, plan and execute, monitor, and evaluate the results of a problem-solving in the school. Our finding was consistent with the results of previous studies suggested that cooperative action research could develop the community's capacity to sustain critical thinking and problems solving in the school. (Abraczinskas and Zarrett, 2020; Anselma et al., 2019; Ozer et al., 2010).

Participatory action research using school-based approach toward solving problems involved the use of resources from the school to develop the capability of the school and the community to enable critical thinking, analyzing plan, implementing, monitoring, and evaluating a process of solving problems in the school and the community. Similarly, Phillips (2010) revealed that participatory action research projects could promote youth's sense of meaningful engagement in the school and a sense of efficacy which can be particularly powerful given the challenges of this development stage.

The well-being analysis was the current situation and desirable scenario for liver fluke infection prevention project in the school since provided the opportunities for stakeholders to propose information about the current situation and desirable scenario before the representors of each group presents their information and exchanges ideas constructively until everyone is aware of the current situation and desirable scenario. This allowed the school to set up a policy for liver fluke infection prevention project in the school, leading to the design of a project and activities to solve the problems of the school appropriately related to the community participation process. The power of the

community contributes to the strength of the community, as a result leads to the formation of opportunities to participate in activities together, 2) obtaining adequate information, 3) exchanging information together, and 4) participating in the expression of opinions for decision making (Phalasuek et al., 2017).

Participants of the study gained more health literacy on liver fluke prevention and control after the implementation of the project due to gaining knowledge through audio line broadcasting about liver fluke infection, competition for a brochure and board about liver fluke infection, doing activities for establishing a school charter, short film activity against liver fluke infection, and activity to promote knowledge of the local community. Wongba (2011) also found that it encouraged participants to have more appropriate health literacy and behavior.

The research team found a better understanding of liver fluke prevention. In addition, the participatory development approach allowed participants to frame their ideas and guidelines. The cognitive domain of the development process leads to the implementation process planning.

Additionally, preparing and developing leadership team potential can improve cognition, access, and use of the information to develop a systematic process, according to Nutbeam (1999, 2008) and Leger (2000) that said cognitive and social skills could motivate and empower individuals to understand and use health information to promote and maintain the health of themselves and their community.

The results of this study were consistent with the action researches that explored ways to prevent and control liver fluke, including one done by Khon Kaen in province of Thailand (Wongba et al., 2011) and the other done by Duangsong et al., (2013). On school-based approach provides opportunities to improve health behavior by promoting 'anti-raw fish dishes behavior' (Laithavewat, 2020). The prevention and control of Opisthorchiasis and CCA by community participation using quantitative and qualitative methods are suggested by previous studies (Songserm et al., 2020).

In a nutshell, our school-based educational approach could enhance health literacy and participation to prevent and control liver fluke infection in the school. However, the stability of this effect can be increased by combining our school-based learning with other strategies, such as social support to enhance the participation of family members and community education. The success of such public health educational approach suggested that it can be used as a school policy in affected areas and could be modified to include other potential diseases when needed. In addition, limited access to public health information in this area was one of the limitations of this study.

In conclusion, the health literacy and practical skill mean score increased after the intervention in this study. Network development uses stakeholder participation to share experiences, thereby facilitating participants in recognizing similar issues and choosing the best method for liver fluke prevention and control. It seems that learning processes using teamwork will help the development of cooperative skills among students.

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Conflict of interest

The authors declare that there are no conflicts of interest.

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