School-based Training Effects on Liver Fluke and Cholangiocarcinoma Prevention: A Comparative Case Study of Individual Differences Among Elementary Teachers in Northeast Thailand

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Abstract

Liver fluke and Cholangiocarcinoma (CCA) infestations pose significant health challenges, particularly in northeastern region of Thailand. Addressing health issues through an educational lens is of paramount importance to stakeholders in various fields of education, including health education and social education. Collaboratively, stakeholders strive to develop initiatives that enhance understanding of this disease among people in the region. An essential step toward achieving this objective involves recognizing the variations in individuals' responses to educational activities, thereby facilitating the development of locally contextualized and effective learning programs. This study was to explore the differences among elementary teachers participating in training courses for the prevention of cholangiocarcinoma and liver fluke disease in Khon Kaen province. Employing a pre-experimental design, the study involved one hundred and thirty-nine elementary teachers as research participants. Pre- and post-test served as the research instrument, and data analysis entailed the use of descriptive statistics and a t-test. The findings revealed that most of the participants were female, held bachelor's degrees, and were affiliated with schools in Ban Phai district. Moreover, the study demonstrated a significant enhancement in participants' understanding of liver fluke and CCA prevention following the training. Notably, the study identified a significant impact of the school's geographical location on training effectiveness. This study contributes to the existing knowledge base, offering insights to tailor more precise training programs in regions where liver fluke and Cholangiocarcinoma disease are prevalent.

Keywords: elementary, differences, liver fluke, teacher training, cholangiocarcinoma

1. Introduction

1.1 Introduce the Problem

In the educational landscape, schools act as vital learning hubs, promoting continuous development and the dissemination of crucial knowledge to local communities (Vorley, & Williams, 2017: 116-120). This knowledge transmission occurs through school-based methods, including teaching, training sessions, and knowledge network expansion, facilitating practical applications (Spillane, & Lowenhaupt, 2019). Effective leaders must be cognizant of current knowledge status, aligning it with community needs (Azorín et al., 2020; Hairon, & Goh, 2015). Furthermore, comprehending problem-solving processes is essential for accurate knowledge transmission and resolving local community issues, including health literacy.

The northeastern region of Thailand, known as the Isan region, is a vibrant cultural center with unique traditions reflected in various aspects of its people's lives. Its distinctive food consumption practices, including raw fish, dancing shrimp, and raw beef, set it apart from other regions. However, these cultural dietary habits have given rise to health issues, notably the development of cholangiocarcinoma, primarily linked to the consumption of raw and undercooked food (Kamsa-Ard, et al., 2018). The prevalence of this health concern, well-documented in rural areas of Thailand, particularly in the northeastern region, presents a significant challenge (Suwannatrai, Saichua, & Haswell, 2018; Thinkhamrop, et al., 2020).

Addressing cholangiocarcinoma and liver fluke infection in Khon Kaen province is of utmost importance due to its geographical characteristics, featuring flat terrain and abundant water sources, especially in the central and lower regions of the province (Kamsa-Ard, et al., 2019; 2020). These conditions have led to a high incidence of cholangiocarcinoma and liver fluke infection, causing emotional distress through the loss of loved ones and economic hardship due to the local workforce's impact, resulting in reduced job opportunities and income. Achieving a sustainable solution for these health issues demands a comprehensive interdisciplinary approach, encompassing health sciences (Chanchai, et al., 2019), technology, and social sciences (Harrison, et al., 2019).

In the past, the application of knowledge on preventing cholangiocarcinoma and liver fluke infection in the local communities has had some positive impact at a certain level. However, it has not been able to cultivate desired characteristics or sustainably modify the dietary behaviors of the local people. Therefore, it is crucial to adapt the knowledge transfer methods to bring about a lasting change in the consumption patterns of the local population (Rushmer, et al., 2019). The dissemination of knowledge through the education dimension is a significant approach to effectively transmit knowledge from teachers to students and extend it to the local community. Thus, it is imperative to implement strategies that promote sustainable changes in the dietary habits of the local people through education (White, Habib, & Hardisty, 2019).

The organization of activities to prevent cholangiocarcinoma and liver fluke disease in Khon Kaen province, using an educational context as a significant driving force for knowledge development and dissemination, poses a considerable challenge for those involved in disease prevention efforts (Khuntikeo, et al., 2023). Local education plays a pivotal role in facilitating knowledge transfer, as most schools are situated within communities that have close interactions between schools and local communities, between teachers and students. This allows for the expansion of knowledge beyond the classroom and into families and communities through students and educational networks in the area (Epstein, 2018). Therefore, the approach of conducting activities to prevent cholangiocarcinoma and liver fluke disease in Khon Kaen province is carried out through collaboration with local schools, making use of the school-based training strategy, which can prove to be highly effective (Samiphak, & Syme, 2017).

A certain research study highlights the significance of area-based education and its relationship with learning outcomes or training activities. The influence of the environment, culture, or surroundings on human learning processes, whether directly or indirectly, can transform the educational experience and quality of life through science and technology. This transformation can lead to improved critical thinking, learning, and overall quality of life. Consequently, students become more eager to learn and develop positive relationships with their teachers. In the context of preventing liver fluke disease, teacher training becomes a crucial component (Qian, & Zhou, 2022). It has been found that to cultivate effective awareness and learning motivation among students, teachers must create an environment or provide facilities for learning that aligns with students' needs and is suitable for them (Thomas, Pavlechko, & Cassady, 2019). This teacher training is essential for promoting healthy consumption habits among students, which plays a pivotal role in preventing liver fluke disease.

In light of these considerations, this research aims to explore the differences among elementary teachers participating in training courses for the prevention of cholangiocarcinoma and liver fluke disease in Khon Kaen province. The findings from this study will contribute to the design of more accurate and suitable teacher training activities in the future, catering to the specific learning needs of the trainees.

1.2 Liver Fluke Infections and Cholangiocarcinoma in Northeastern Thailand: A Comprehensive Review

Liver fluke disease and cholangiocarcinoma (CCA) represent significant public health challenges in the northeastern region of Thailand. These intertwined health issues have garnered considerable attention due to their profound impact on the local population's well-being. Liver fluke disease, caused by parasitic trematodes of the Clonorchis and Opisthorchis species, is endemic in many parts of Southeast Asia, including the northeastern region of Thailand (Saijuntha, et al., 2019). This parasitic infection is primarily associated with the consumption of raw or undercooked freshwater fish, which serves as the intermediate host for these parasites (Sripa et al., 2017). Infected fish release metacercariae, the infectious stage of the parasite, into the water, where they can contaminate aquatic plants and eventually enter the human host when these contaminated plants are consumed (Gabriël, et al., 2022). The Isan region's culinary traditions, characterized by the consumption of raw or lightly cooked fish dishes, particularly the well-known “pla ra” and “koi pla”, have contributed to the high prevalence of liver fluke infection in the area (Sripa et al., 2017). The metacercariae encyst in the bile ducts of the human host, leading to chronic inflammation, biliary tract obstruction, and increased susceptibility to CCA (Sa-Ngiamwibool, et al., 2022).

Cholangiocarcinoma (CCA), a malignant tumor arising from the bile ducts, is a severe consequence of chronic liver fluke infection (Prueksapanich, et al., 2018). The northeast region of Thailand has one of the highest incidences of

CCA. CCA is a complex disease with multifactorial etiology, including parasitic infection, genetic predisposition, and environmental factors (Tavolari, & Brandi, 2023). The long-term presence of liver flukes in the biliary system induces chronic inflammation and irritation, promoting the development of CCA. This form of cancer is often diagnosed at an advanced stage, making it difficult to treat and resulting in poor prognosis. Moreover, its aggressive nature and resistance to conventional treatments present significant challenges for healthcare professionals in the region.

1.3 Integrated Approach to Mitigate the Health Issues

Liver fluke disease and CCA remain a significant health concern in the northeastern region of Thailand, particularly in areas where traditional culinary practices involve the consumption of raw or undercooked freshwater fish. The prevalence of liver fluke infections and CCA in the Isan region has been influenced by various factors, including cultural traditions, dietary habits, and access to clean water sources (Kamsa-Ard, et al., 2018).

Given the intertwined nature of liver fluke disease and CCA, an interdisciplinary approach is essential to address these health issues effectively. This approach should encompass health sciences, technology, and social sciences, as it is not limited to medical interventions alone (Kamsa-Ard, et al., 2018). Health education plays a pivotal role in raising awareness about the risks associated with raw fish consumption and promoting safer culinary practices (Sripa et al., 2017). Moreover, preventive measures such as regular deworming and screening for early detection of liver fluke infection can contribute to reducing the incidence of CCA. Advances in diagnostic techniques and treatment modalities are also crucial in improving the management of CCA cases. However, given the aggressive nature of CCA, the prognosis remains challenging for many patients (Khuntikeo, et al., 2023; Wang, et al., 2023; 2022).

In conclusion, liver fluke disease and cholangiocarcinoma pose significant health challenges in the northeastern region of Thailand, where cultural practices and environmental factors have contributed to their high prevalence. A comprehensive and multidisciplinary approach is imperative to mitigate the impact of these diseases, encompassing health education, early detection, and advanced medical interventions.

1.4 Individual Differences and Its Implication in Education

The concept of "individual differences" is a psychological educational concept that has evolved from the stimulus-response paradigm. Underlying this concept is the notion that individuals exhibit differences in personality traits and psychological conditions. These differences arise from variations in individual learning experiences and exposure to different environments, leading to distinct patterns of learning. Learning from diverse environments contributes to the formation of unique attitudes, values, beliefs, and personalities among individuals (Stamps, 2016).

Individual differences can be attributed to both internal factors within individuals, such as personality, attitudes, intelligence, and interests, as well as external factors stemming from social and cultural contexts, resulting in varying behavioral patterns. Additionally, individual differences are influenced by demographic characteristics, including factors such as age, gender, and socioeconomic status. Age is of paramount importance since as individuals grow older, there may be a decline in their learning capabilities and comprehension due to physical aging processes (Clark, Freedberg, Hazeltine, and Voss, 2015). However, it is noteworthy that the age-related differences do not necessarily imply learning deficits. In fact, older individuals often exhibit a heightened motivation to learn new things, especially to adapt to societal changes and to enrich their personal experiences (Chopik, Bremner, Johnson, & Giasson, 2018). Gender; gender plays a significant role in learning outcomes, and numerous studies have addressed gender disparities in learning, whether among adolescents or adults (Ansong et al., 2023; Yu, 2021). Nevertheless, access to education remains restricted for the majority of females, particularly in vocational or skill-based courses, such as automotive repair or engineering studies (OECD, 2019). This limitation is primarily influenced by cultural and societal factors that dictate distinct roles and activities for each gender. Additionally, educational level is a crucial characteristic that significantly influences diverse perceptual and learning experiences. Individuals with access to higher levels of education tend to engage in broader and more specialized forms of learning, which, in turn, have a substantial impact on their professional development and future career prospects. Moreover, even the field of study pursued during one's educational journey can exert a notable influence on learning outcomes.

Aside from individual differences stemming from demographic characteristics, external environments also contribute to disparities among individuals. The environment serves as a significant factor that affects or relates to individuals, both physically and psychologically, leading to distinctions between them. For instance, schools or educational institutions are social institutions responsible for providing children with learning experiences, encompassing academic, adaptational, and personality development dimensions. Key factors within schools influencing individuals include the teacher's personality, curriculum, teaching methods, school culture, and even the physical location of the

educational institution. Variations in school environments, such as urban versus rural settings, also have an impact on students' learning abilities (Adebayo, Daniel, and Oladipupo, 2018). This article incorporates demographic variables, such as gender, age, education level, and environmental-related variables, including the school's location, to examine differences among individuals affecting the outcomes of training courses on liver fluke prevention among elementary school teachers in Khon Kaen, Thailand.

1.5 State Hypotheses and Their Correspondence to Research Design

In this article, the hypothesis is that a training program will significantly improve teachers' knowledge about liver fluke and Cholangiocarcinoma prevention. This is investigated using a pretest-posttest design to measure knowledge changes. Another aspect considers whether teachers' demographics affect the training's effectiveness, analyzed through their demographic data. Additionally, the impact of schools' geographical locations on the program's effectiveness is examined, highlighting environmental and cultural differences in different districts. The study employs various methods, including pre and post-test assessments, demographic analysis, and comparative evaluations across school locations, to validate these hypotheses.

2. Method

2.1 Research Design

This research is pre-experimental research which employs a one-group pretest and posttest design to analyze the effectiveness of the training program for the prevention of liver fluke disease and CCA and the differences among elementary teachers who participate in the teacher training program. The elementary objective of this program is to equip elementary school teachers with the knowledge and understanding of liver fluke disease and CCA, enabling them to effectively implement the prevention curriculum within their respective educational institutions.

2.2 Participants and Sampling Procedure

A total of 139 participants, comprising elementary teachers from elementary schools located in the districts of Ban Haed and Ban Phai in Khon Kaen province, where presented a high prevalence of liver fluke disease and CCA, took part in the training program. The participants voluntarily joined the program, and they formed the sample group for this research. This research employed a convenience sampling method. The selection process emphasized teachers from schools in close proximity to large water sources, such as the Lawa Lake, where has been recognized as the highest rate of people with live fluke and CCA infections in Thailand (Sripa et al., 2017).

2.3 Training Program

The training program follows a school-based training approach, emphasizing the enhancement of teachers' effectiveness in disseminating knowledge to students and the broader community. The program includes various activities such as sharing experiences related to liver fluke disease and CCA, gained from practical experiences of medical professionals. Additionally, it involves practical training in curriculum development, teaching demonstrations, creating teaching materials, and hands-on practice in producing learning materials. Finally, participants collaboratively present their curriculum plans and teaching materials developed during the training program.

2.4 Measures

The research utilized a multiple-choice test to examine the understanding of the elementary school-level curriculum for the prevention of liver fluke disease and CCA among elementary school teachers. The test consisted of 12 multiple-choice questions designed to assess learning outcomes related to general knowledge of liver fluke and CCA, prevention of these diseases, and the application of the curriculum in educational settings. Additionally, the satisfaction questionnaire was implemented with a 5-Likert scale design to examine the level of satisfaction among the participated elementary teachers. The questionnaire was administered to participants after the training program concluded.

2.5 Data Collection and Data Analysis

Data collection during the training program involved conducting pre and post-testing using an experimental design to evaluate the effect of the training. The collected data were analyzed using descriptive statistics, including mean, percentages, and standard derivation. Additionally, the research employed an independent t-test analysis to examine differences among participants. Additionally, this research received ethical approval from the Khon Kaen University's Research Ethics Committee, ensuring the ethical conduct of the study.

3. Results

3.1 Characteristics of Elementary Teachers Participating in Training Program on Liver Fluke and Cholangiocarcinoma Prevention in Khon Kaen Province, Thailand

The analysis revealed that all participants were elementary teachers, totaling 139 teachers. The majority were females 82.7%, while males comprised 17.3% of the participants. Most of the teachers were over 40 years old, making up 53.2%, while those under 40 years old constituted 46.8%. The age group of 20-30 years old had the lowest participation rate at 20.1%. Furthermore, the majority of participants had completed their undergraduate degrees, with 73.4% holding bachelor's degrees, and 26.6% having higher degrees. When considering the location of the schools, it was found that most participants were from schools located in the Ban Phai district, accounting for 74.1%, while those from schools in the Ban Haed district represented 25.9% of the total participants (Table 1).

Table 1. Characteristics of the Participated Elementary Teachers, Classified by Gender, Age, Education Level, and School Location

Variables	Frequency (N)	Percentage
Gender		
Male	24	17.3
Female	115	82.7
total	**139**	**100.0**
Age		
Below 40 years old	*65*	*46.8*
40 years old and over	*74*	*53.2*
Total	**139**	**100.0**
Education level		
Bachelor's degree	10*2*	7*3.4*
Master's and doctoral degree	3*7*	2*6.6*
Total	**139**	**100.0**
School location		
Ban Phai district	103	74.1
Ban Haed district	36	25.9
total	**139**	**100.0**

3.2 Effects of the Training Program on Liver Fluke and Cholangiocarcinoma Prevention in Khon Kaen Province, Thailand

The analysis of the training program effects on liver fluke disease and CCA prevention in Khon Kaen Province revealed that a statistically significant difference in the mean scores before and after the training was observed. The average score after training ($\overline{X}$ = 11.7, S.D. = 0.7) was higher than the average score before training ($\overline{X}$ = 11.2, S.D. = 1.1) (Table 2). These findings indicate the positive effect of the training program on the knowledge and understanding of the participating teachers. It also highlights their increased awareness of the importance of disease prevention in the area. The engagement in training activities has contributed positively to the participants' learning process, knowledge acquisition, and understanding concerning the liver fluke disease and CCA prevention program. This aligns with the previous studies by Zimba, Khosa, & Pillay, (2021); Ploj Virtič, Du Plessis, & Šorgo, (2023); and Hudson, (2016), emphasizing the significance of enhancing knowledge and understanding through teacher training and building a knowledge foundation for teachers. These aspects are likely to correlate with the effectiveness of practical teaching outcomes.

Considering the average test scores, it was found that the average scores before and after the training were relatively similar. This could be attributed to the fact that the training participants were from an area with continuous activities related to liver fluke disease and CCA prevention. There have been various activities promoting the prevention of

liver fluke disease and CCA for more than 30 years because this area presented the highest rate of the prevalence of liver fluke disease (Sripa, et al., 2021). This exposure provided them with opportunities to be aware of the issues related to these diseases and acquire knowledge about disease prevention. Consequently, they were able to perform relatively well in the test. This observation aligns with Reardon (2019), who discovered that educational opportunities are correlated with the location of schools and the distance between homes and schools. Therefore, considering the external learning environment is crucial in creating educational opportunities for students from all areas (Table 2).

Table 2. Comparison of the Mean Scores of the Pre-training and Post-training Tests for Elementary Teachers in the Liver Fluke Disease and CCA Prevention Course in Khon Kaen Province

Test score	N	$\overline{X}$	S.D.	t	P-value
Before	139	11.2	1.1	- 4.5	0.000*
After	139	11.7	0.7		

Description: statistically significant at the .01

3.3 Differences Among Elementary Teachers Associated with the Effects of the Training Program on Liver Fluke and Cholangiocarcinoma Prevention in Khon Kaen Province, Thailand

The results revealed that differences in gender, age, and educational level among participants had no significant effect on the training outcomes of the Training Program on Liver Fluke and CCA Prevention, which was contrary to the initial hypothesis. Only the school location where participants worked significantly influenced the training outcomes, with statistical significance at .05. Specifically, participants working in schools located in Ban Haed District had higher average scores than those working in schools located in Ban Phai District (Table 3).

Table 3. Differences Among Elementary Teachers Associated with the Effects of the Training Program on Liver Fluke and Cholangiocarcinoma Prevention in Khon Kaen Province, Categorized by Gender, Age, Educational Level, and School Location

Variables	N	$\overline{X}$	SD.	t	P-value
Gender					
Male	24	11.7	0.8	0.248	0.804
Female	115	11.7	0.7		
Age					
Below 40 years old	65	11.7	0.7	0.499	0.618
40 years old and over	74	11.7	0.7		
Education level					
Bachelor's degree	102	11.7	0.8	0.006	0.995
Master's and doctoral degree	37	11.7	0.7		
School location					
Ban Haed	36	11.8	0.5	2.012	0.047*
Ban Phai	103	11.6	0.8		

Description: statistically significant at the .05

The above findings reveal that the location of schools has a significant statistical impact on the outcomes of the training program on liver fluke disease and CCA prevention, with a significance level of .05. The average test scores of teachers coming from schools in Ban Haed District were significantly higher than those from schools in Ban Phai District. This disparity can be attributed to the physical characteristics of the Ban Haed District area, which includes a lake known as the Lawa Lake. This area is considered to have a high prevalence of liver fluke disease and CCA. Consequently, the Ban Haed District area has continuous public health activities related to disease prevention.

This environment provides more opportunities for teachers and stakeholders to acquire knowledge through local activities than in Ban Phai District. Moreover, it raises awareness about the issues of liver fluke disease and CCA

among the local population continuously. As a result, the community and schools in the vicinity recognize the importance of the issue and actively participate in intensive training to effectively disseminate this knowledge to students and the public (OECD, 2011; Lupton, 2006; Thompson, 2002; Hu, et al., 2021; McCormack, et al., 2017; Stormacq, al., 2020).

4. Discussion

The study comparing the impact of personal factors on the effects of the Liver Fluke and CCA Prevention Course among elementary school teachers in Ban Haed and Ban Phai Districts, Khon Kaen Province, reveals several key findings that have significant implications for public health and education in the region.

Firstly, the results indicate that gender, age, and educational level had no significant effect on the training outcomes. This finding is significant because it suggests that irrespective of teachers' demographic characteristics, the training program was equally effective for all participants. This is a positive outcome, as it indicates that health literacy initiatives can be designed to cater to a diverse group of teachers without the need for customization based on these demographic factors. Conversely, the geographical location of the school was found to be a significant factor affecting training outcomes (Smith et al., 2023). Specifically, teachers practicing in schools located in Ban Haed District demonstrated significantly higher average scores than those in Ban Phai District. This discrepancy can be attributed to the physical characteristics of the Ban Haed District area, including the presence of a large reservoir known as the Lawa Lake. This area is associated with a higher incidence of liver fluke disease and liver cancer, leading to continuous public health activities related to disease prevention. These findings emphasize the need for targeted interventions in areas with a higher disease burden, such as Ban Haed District, to ensure that teachers are well-equipped to educate their students and communities about disease prevention.

Secondly, the collaborative efforts between students and public health professionals in organizing training activities for liver fluke disease and CCA prevention played a crucial role (Patchasuwan, et al., 2022). These efforts raised awareness among teachers who participated in the training, helping them recognize the dangers associated with unhealthy consumption habits. Furthermore, this collaboration facilitated networking and cooperation between schools in Ban Haed and Ban Phai Districts in organizing educational activities related to liver fluke disease and CCA prevention. This highlights the importance of community involvement and partnerships in enhancing the effectiveness of disease prevention programs (Prueksapanich, et al., 2018; Patchasuwan, et al., 2022).

Thirdly, the study findings indicate that teachers who participated in the training gained a higher level of knowledge about cancer and liver fluke disease prevention (Laithavewat, et al., 2020). This demonstrates the effectiveness of the training program in improving teachers' understanding of these health issues and their ability to convey this knowledge to their students. It underscores the importance of continuous education and professional development for teachers in promoting public health awareness in schools (Pulimeno, et al., 2020). This not only benefits the teachers themselves but also has the potential to significantly enhance health literacy levels among students and the wider community. By equipping teachers with the necessary knowledge and skills, we are effectively empowering them to serve as key agents of change in fostering health literacy within their classrooms and beyond.

Lastly, the research identifies regional differences that impact the outcomes of the Liver Fluke Disease and CCA Prevention Course among elementary school teachers. These findings provide valuable insights for the development of appropriate training activities tailored to the specific environmental conditions of each area, promoting sustainable knowledge, skills, and attitudes related to disease prevention (Pulimeno, et al., 2020). By tailoring interventions to local contexts, it becomes possible to address the unique challenges and opportunities presented by different regions, ultimately contributing to the long-term socioeconomic development of the nation (Smith et al., 2023). In summary, this study highlights the importance of location, collaboration, knowledge acquisition, and regional tailoring in the success of disease prevention training programs for elementary school teachers. These findings can guide future efforts to improve public health education in schools and reduce the incidence of diseases such as liver fluke disease and CCA in high-risk areas (Johnson & Lee, 2021).

5. Conclusion and Recommendations

This study has yielded crucial insights into the impact of individual differences on the effectiveness of the Liver Fluke Disease and CCA Prevention Course for elementary school teachers in Ban Haet and Ban Phai Districts, Khon Kaen Province. The significant influence of school location on training outcomes underscores the necessity of considering regional and contextual differences in the design and implementation of educational programs. These findings highlight the complexity of educational interventions and the importance of tailoring these initiatives to

meet the unique needs of each area, taking into account local characteristics that may affect the perception and assimilation of training content.

Therefore, stakeholders involved in implementing the above-mentioned curriculum in schools should be aware of and prioritize the factors related to the local context. This awareness can lead to improvements in the training process, making it more suitable for each unique area with differing characteristics. It is important to note that this study focused on variables related to personal characteristics and some aspects of the learning environment, leaving room for future research to explore additional variables related to the diversity among individuals, contributing to a more comprehensive understanding of factors influencing training or learning success.

Lastly, the findings from this study underscore the need for targeted teacher training programs as a cornerstone of public health policy in regions afflicted by liver fluke infections and cholangiocarcinoma. By equipping educators with the right tools and knowledge, they can effectively transmit critical health information to students and, by extension, to the wider community. This approach not only enhances disease awareness but also fosters a community-oriented model of health education. Policymakers are encouraged to integrate these findings into public health strategies, emphasizing the role of education in disease prevention. Collaborative efforts between health and education sectors are vital for the development and implementation of effective, sustainable policies aimed at reducing the incidence of these diseases through informed behavioral changes in high-risk communities.

6. Limitations

This research, while providing valuable insights into teacher training for liver fluke and cholangiocarcinoma prevention, is subject to several limitations. Firstly, the geographical scope is confined to the districts of Ban Haed and Ban Phai in Khon Kaen Province, Thailand, which may limit the generalizability of the findings to other regions with differing geographical and socio-cultural contexts. Additionally, the voluntary nature of participation introduces a potential self-selection bias, as the study may predominantly attract teachers who are already more health-conscious or interested in the subject, possibly skewing the results towards more favorable outcomes. Finally, the limitation of the post-training evaluation process must be acknowledged. The study primarily assesses immediate outcomes following the training program without a longitudinal follow-up. This restricts the ability to evaluate the enduring impact of the training on the teachers' practices and the subsequent long-term health behavior changes in students regarding liver fluke and cholangiocarcinoma prevention. Addressing these limitations in future research could provide a more comprehensive understanding of the training program's effectiveness over a prolonged period and across varied geographical settings.

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Authors contributions

Prof. Tungkasamit and Dr. Meekaew were responsible for study design and revising. Prof. Tungkasamit, Dr. Meekaew, Prof. Srisurak, and Prof. Silanoi was responsible for data collection. Prof. Tungkasamit and Dr. Meekaew drafted the manuscript and Dr. Meekaew revised it. All authors read and approved the final manuscript.

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No additional data are available.