MASTER THESIS

FOODBORNE ZOONOTIC TREMATODE INFECTIONS IN YEN BAI, VIETNAM: INTEGRATED APPROACH

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PROGRAM: MASTER OF HEALTH SCIENCES
TRACK: INNOVATION IN PUBLIC HEALTH

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ABSTRACT

Background: FZTi is one of the public health concerns but the most neglected tropical disease due to helminthes. The transmission of FZTi is linked to human behavior patterns related to producing, processing, and preparing foods, particularly, habits eating raw fish and raw vegetables. The present study was undertaken to investigate the knowledge, attitude, and practice regarding to FZTi among local people in Yen Bai, Vietnam, and understand the reasons why local people show risk behaviors regarding to FZTi.

Materials and method: This cross-sectional descriptive study with a representative sample was designed and involved local people aged from 15 to 65 in Yen Bai, Vietnam. The study used mixed method including quantitative and qualitative approaches. In the KAP Survey (quantitative part), 375 participants were face-to-face interviewed with a structured questionnaire. In the Risk Behavior Investigation (qualitative part), 27 participants were in-depth interviewed. The current knowledge, attitude, and practice regarding to FZTi were described. Associations were analyzed using correlation test, independent-samples t test, and post hoc test. The qualitative data were analyzed by deductive approach.

Results: Of all participants (n=375), only 36.3% passed the knowledge assessment (n=136), 86.7% passed the attitude assessment (n=325), and only 24% passed the practice assessment (n=91). There were differences on average knowledge score among different gender (men higher than women, $p<0.05$), among different ethnicities ($p<0.0001$) and among different education ($p<0.00001$). There was a difference in the frequency of the habit of eating raw fish between men and women (men higher than women, $p<0.001$). There was difference on average practice score between men and women (women higher than man, $p<0.05$). There was weak correlation between the knowledge score and practice score ($p<0.00001$). Eating raw fish/vegetable and drinking untreated water from Thac Ba lake are risk behaviors. The performance of these risky habits can be explained by the lack of knowledge on liver fluke infections, poor economic conditions and typical cultural features of local people.

Conclusion: Current knowledge of local people is poor, and local people still perform bad practice which leads to infecting with liver fluke; therefore, an integrated intervention in order to improve the current status in Yen Bai, Vietnam is essential.

Keywords: *Foodborne Zoonotic Trematode Infections, FZTi, Clonorchiasis, Opisthorchiasis, Fascioliasis, KAP.*

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LIST OF ABBREVIATIONS

ARES	Académie de Recherche et D'enseignement Supérieur (Academy of Research and Higher Education)
C. sinensis	*Clonorchis sinensis*
F. gigantica	*Fasciola gigantica*
F. hepatica	*Fasciola hepatica*
FOODTINC	Foodborne Zoonotic Trematode Infections and Integrated Control in Vietnam
FZTi	Foodborne Zoonotic Trematode infections
KAP	Knowledge, Attitude, and Practice
NIMPE	National Institute for Malariology and Parasitology Entomology (Vietnam)
O. viverrini	*Opisthorchis viverrini*
PHI	Public Health Innovation
WHO	World Health Organization

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I. INTRODUCTION

Foodborne Zoonotic Trematode infections (FZTi), or foodborne trematodiases, are conditions that can be passed from animals to humans. They comprise a group of parasitic infections caused by trematodes (flatworms or "flukes") that are acquired through ingestion of food contaminated with the larval stages of the parasite (1) (2). With the infection of foodborne zoonotic trematode, people may face potentially severe outcomes. According to the World Health Organization (WHO), it is estimated that 200,000 illnesses and more than 7,000 deaths are caused by 4 species of FZTi annually, which leads to over 2 million disability-adjusted life-years globally (2, 3). Clearly, FZTi is one of the public health concerns particularly within the high-prevalent regions, but FZTi is the most neglected tropical disease due to helminthes (4, 5).

Small liver fluke infection (*Clonorchiasis/Opisthorchiasis*) and large liver fluke infection (*Fascioliasis*) are two popular types of FZTi in Vietnam. People may suffer these types of FZTi if they consume raw or undercooked food that harbor the minute larval stages of the parasites including fish and aquatic vegetables (2). Vietnam, a tropical country with the use of stools for fertilizing and traditions consisting of raw or undercooked fish/vegetable preparations, is particularly susceptible to the development and transmission of small and large liver fluke. According to reports of General Department of Preventive Medicine in Vietnam and National Institute for Malariology and Parasitology Entomology (NIMPE), small liver fluke infection in humans is reported in 32/63 provinces in at least 21 Northern and Central provinces with high prevalence from 15 to 37%, whereas large liver fluke infection in humans is reported in 51/63 provinces nationwide (6, 7). Although there are no statistic date on the prevalence of large liver fluke infection among 63 provinces in Vietnam, the total number of human cases of large liver fluke infection was reported up to 8,780 cases by the end of September 2017, and over 90% of patients are above 15 years old (7). These data are really alarming because small and large liver flukes not only weaken the body by nutrition absorbing but also cause numerous diseases such as inflammation of the liver, gallbladder, and pancreas (8).

Although liver flukes have complex life cycles and epidemiology, their direct transmission from person to person is not possible. The transmission is linked to human behavior patterns that are related to methods of producing, processing, and preparing foods, particularly, habits or traditional customs such as eating raw fish and raw vegetables. Therefore, trying to understanding the knowledge, attitude, practice (KAP) related to FZTi and the reasons why people show the risk behaviors related to FZTi particularly liver fluke is essential and plays an important role in building effective interventions to fight FZTi.

Yen Bai province is a Northern mountainous region in Vietnam with the representation of a vulnerable group who are ethnic minority people with low education. Thac Ba Lake, which is one of the biggest lakes in Vietnam, is providing the main source of fish in Yen Bai province, so the majority of fish is supplied by fishing in Thac Ba lake. Although the liver fluke is reported in Yen Bai, it is also reported that local

people have the habit of eating raw or undercooked fish and vegetables, which means local people are under very high risk of suffering FZTi particularly liver fluke. Currently, there were no any studies investigating the KAP regarding to FZTi in Yen Bai province.

From the fact above, we aim to analyze the current knowledge, attitude, practice related to FZTi of local people in Yen Bai province and the reasons why people perform risky habits of eating raw fish and vegetable. In order to contribute to efforts of FZTi prevention and control in Vietnam in general and in Yen Bai in particular, under the project *Foodborne Zoonotic Trematode Infections and Integrated Control in Vietnam (FOODTINC)*, we conducted the study named ***Foodborne Zoonotic Trematode Infections in Yen Bai, Vietnam: Integrated Approach***.

In this thesis study, we answer the two research questions: (1) What is current situation of knowledge, attitude, and practice (KAP) regarding to liver fluke infection of local people aging from 15 to 65 in Yen Bai province?, and (2) Why do local people aging from 15 to 65 in Yen Bai province show risk behaviors regarding to liver fluke infection? The findings obtained by answering these two questions will not only help the researchers and the intervention planers to understand the current situation in Yen Bai, Vietnam and design the suitable intervention, but also contribute to the further knowledge or academic work in the FZTi field and KAP model.

KAP regarding to liver fluke infection used to be studied in Thailand (9) and other provinces in Vietnam (10, 11). In these studies, the concepts of Knowledge, Attitudes, and Practice were used to describe the circumstance of KAP regarding to liver fluke among local people. With regards to the reasons of eating raw fish, there was very little evidence on this field. Many people remarked that they eat raw fish because it is tasty and they desired to eat raw fish (48). Many male adults even said they maintain this bad habit because they knew that liver fluke infection can be treated well by drugs (22). Besides that, there was no evidence on other factors explaining for the habit of eating raw fish.

This thesis study is one component of the project FOODTINC which aims at developing and conducting a public health innovation (PHI) that is an awareness raising campaign in two provinces (Yen Bai and Thanh Hoa, Vietnam). Therefore, the results of the study will contribute as the baseline evidence to build the intervention in Yen Bai province as well as contribute to the effort of reducing the prevalence of FZTi in Yen Bai and other similar communities of Vietnam.

II. THEORETICAL BACKGROUND

In this chapter, the researcher will present the knowledge that associates to the current study in three main sections. Firstly, the section of background information will provide basic knowledge such as causes, life cycles, symptoms, preventions, etc. regarding to small/large liver fluke. Then the status of liver fluke infection among animals and human will be presented in the section of epidemiology. The final section will describe the concepts and framework of the current study.

2.1. Background information

2.1.1. Small liver fluke

Clonorchiasis and *Opisthorchiasis* are two types of small liver fluke diseases (ICD-10 B66.1) caused respectively by *Clonorchis sinensis* and *Opisthorchis viverrini* or *Opisthorchis felineus*. Small liver flukes infect the liver, gallbladder, and bile duct in humans. A case of small liver fluke infection is identified if the eggs are found in faeces or duodenum fluid. Individuals who get infected with small trematode may have the following symptoms: abdominal pain, gastrointestinal disorders such as poor appetite, dyspnea. There may be hepatic related symptoms, such as skin rash or jaundice, depending on the severity of the disease. In order to identify a person with small liver fluke infection, we have to take his/her stool sample to find the eggs.

Figure 1 presents the life cycle of *Clonorchis sinensis*. Firstly, embryonated eggs are discharged in the biliary ducts and in the stool of an infected person, and then eggs are passed in feces in water environment. Next, eggs are ingested by snails as first intermediate host. Each egg releases miracidia, which go through several developmental stages (sporocysts, rediae, and cercariae). The cercariae are released from the snail and after a short period of free-swimming time in water, they come in contact and penetrate the flesh of freshwater fish, where they encyst as metacercariae. Infection of humans occurs by ingestion of raw or undercooked freshwater fish. After ingestion, the metacercariae excyst in the duodenum and ascend the biliary tract through the ampulla of Vater. Maturation takes approximately 1 month. The adult flukes (measuring 10 to 25 mm by 3 to 5 mm) reside in small and medium sized biliary ducts. The life cycles of *Opisthorchis viverrini* and *Opisthorchis felineus* are similar to the life cycle of *Clonorchis sinensis*. While the adult flukes of *O. viverrini* measure 5 to 10 mm by 1 to 2 mm, the adult flukes of *O. felineus* measure 7 to 12 mm by 2 to 3 mm (12). In addition to humans, carnivorous animals (e.g. dogs, cats) can serve as reservoir hosts (13, 14). Adult worms may live in the host for 25 years (15) and most infected persons have no symptoms, so long-term infections in human can result in severe symptoms and serious illness.

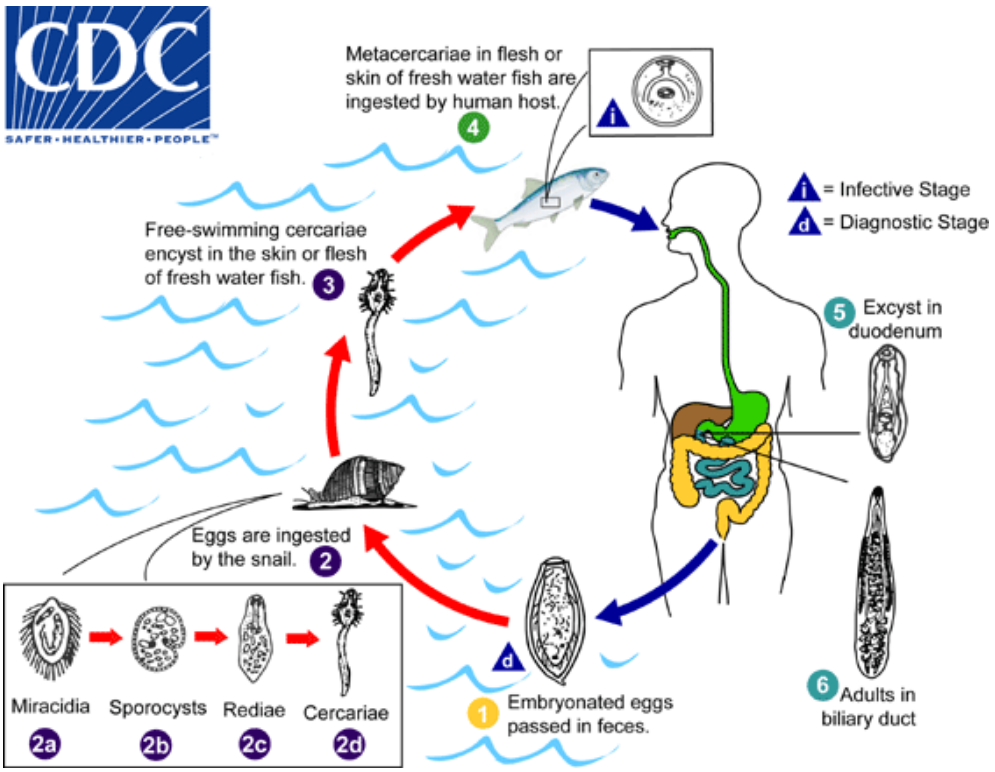

Figure 1. Life cycle of small liver fluke (*Clonorchis sinensis*) (13)

In conclusion, people become infected by eating raw or undercooked freshwater fish containing the larvae. Lightly salted, smoked, or pickled fish may contain infectious parasites. Drinking river water or other nonpotable water will not lead to infection with small liver flukes(16). In order to prevent small liver flukes, it is advised that people should not eat raw or undercooked freshwater fish.

2.1.2. Large liver fluke

Fascioliasis (ICD-10 B66.3), or large trematode or large liver fluke infection, is the other type of liver fluke infection. A case of large liver fluke infection is identified if the eggs are found in faeces or if a blood test (ELISA technique) shows there is antibody against *Fascioliasis* in the serum of patients. Individuals who get infected with large trematode may have the following symptoms: (lower) back pain or pain in the epigastrium. Pain is not specific, sometimes severe pain. There are also cases of no abdominal pain. Other symptoms are fatigue, indigestion, gastrointestinal disturbances, nausea, fever or joint pain, muscle aches and rash.

Fascioliasis is caused by *Fasciola hepatica* and less often by *Fasciola gigantica*. Figure 2 presents the life cycle of the large trematode. Fasciola parasites develop into adult flukes in the bile ducts of infected mammals such as human, cows, or buffalos, which pass immature Fasciola eggs in their faeces. The next part of the life cycle occurs in freshwater. After several weeks, the eggs hatch, producing a parasite form known as the miracidium, which then infects a snail host. Under optimal conditions, the development process in the snail may be completed in 5 to 7 weeks; cercariae are then

shed in the water around the snail. The cercariae lose their tails when they encyst as metacercariae (infective larvae) on water plants. In contrast to cercariae, metacercariae have a hard outer cyst wall and can survive for prolonged periods in wet environments (17).

In humans, maturation from metacercariae into adult flukes takes approximately 3 to 4 months. The adult flukes (*F. hepatica*: up to 30 mm by 13 mm; *F. gigantica*: up to 75 mm) reside in the large biliary ducts of the mammalian host (18).

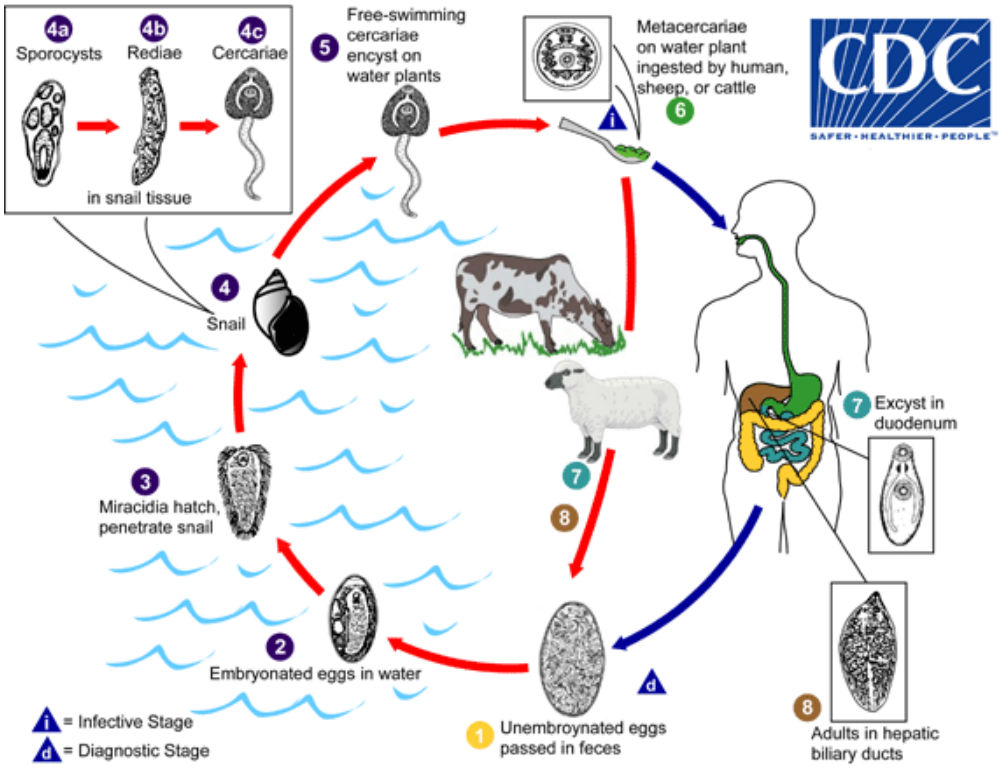

Figure 2. Life cycle of large liver fluke (*Fasciola hepatica*) (17)

Individual people can protect themselves by not eating raw watercress and other water plants, especially from endemic areas. As always, travelers to areas with poor sanitation should avoid food and water that might be contaminated. Vegetables grown in fields that might have been irrigated with polluted water should be thoroughly cooked, as should viscera from potentially infected animals (19).

2.2. Epidemiology of liver fluke infection

2.2.1. Small liver fluke infection

Small liver fluke infection in animals

Many studies were conducted to examine the infection in the animals along with the life cycle of small liver fluke, which included small liver fluke infection in fish at metacercariae form and small liver fluke infection in mammals.

In 2017, a study conducted in the Central region of Vietnam reported that *O. viverrini* was observed in 10 among 12 examined fish species. In which *Carassius auratus*, the fish species that was raw eaten commonly, had the highest prevalence of 74.0%, which was followed by *Rasbora aurotaenia* and *Pundits brevis* with 55.8% and 31.6%, respectively (20). Other studies also figured out high prevalences of fish-born zoonotic trematodes (21) (22) (23). It was reported that nearly a half of examined fishes held small liver fluke at metacercariae form (44.6%, n = 716 fishes) in Nghe An Province, Vietnam, and the prevalence ranged from 12.5% to 61% at the different fish species (22). In the study of Tran Thi Kim Chi (2009), samples of raw fish muscle and remainder parts of fish were collected from 113 restaurants in an endemic area, Nam Dinh province, and from the capital of Vietnam, Hanoi; as the results of the study, 6.1% of the fish-flesh samples were positive with liver fluke trematodes, and 34.9% samples of remainder parts including head, gills, fins, skin, and muscle tissue from the tail were positive with liver fluke trematodes (23). Raw fish dishes from endemic area were more infected than dishes from the capital with 11.8% compared to 3.1% respectively (23).

In mammals, small liver fluke infection was examined in domestic animals such as pets like dogs, cats, and animals raised for meat like pigs. In 2009, a study in an endemic area in the North of Vietnam reported that small trematode eggs were found in feacal samples of 70.2% of cats (n=94), 56.9% of dogs (n=186), and 7.7% of pigs (n=168) (24). In 2015, Nguyen Manh Hung reported that in another endemic area in the North of Vietnam, small trematode eggs were found in 32.7% of faecal samples from dogs (n=104), 49.0% from cats (n=100), and 13.0% from pigs (n=100) (25).

Small liver fluke infection in humans

Small liver fluke infections occur mostly in people living in some areas where the parasites are found. *Clonorchis* is found mainly in Korea, China, Taiwan, Northern Vietnam, Japan, and Asian Russia (4, 26, 27) . Travelers to Asia who consume raw or undercooked fish are at risk for liver fluke infection. According to the WHO, over 19 million people in China, South Korea, Taiwan, Japan, and North Vietnam are infected with *C. sinensis*. It was estimated that there were 200 million populations at risk of *C. sinensis*, but only 1.5 - 2 million people showed symptoms or complications (28).

In Thailand, small liver fluke infection caused by *O. viverrini* was one the most concerned public health issues, particularly in highly endemic areas such as Sakon Nakhon, Yasothon, Lamphun. The morbidity rate of *Opisthorchiasis* was estimated to range from 0.64 to 1.74 per 100,000 between 2001 and 2006 (29). In China, it was estimated that more than 15 million patients are affected with *C. sinensis* in 2016 (27).

In Vietnam, human cases of small liver fluke infection were reported at least in 21 provinces in the North (Nam Dinh, Ninh Binh, Ha Nam, Thai Binh, Hai Phong, Quang Ninh, Bac Giang, Ha Tay, Hoa Binh, Ha Giang , Thanh Hoa, Nghe An), and the Central Vietnam (Thua Thien-Hue, Quang Nam, Quang Ngai, Binh Dinh, Phu Yen, Dak Lak, Gia

Lai, Kon Tum, Dak Nong, Binh Dinh). Prevalence of infection varies from 15-37%, including Ninh Binh, Nam Dinh, Phu Yen and Binh Dinh (6).

There were evidences to proof that small liver fluke even more popular in the North of Vietnam (30). Hung et al reported that 20.5% of faecal samples of local people in Gia Vien, Ninh Binh, a province in Northern Vietnam, contained small trematodes eggs in 2015 (n=1,857) (25). Table 1 presents the statistical data as the results of numerous examinations of small liver fluke infection conducted by NIMPE from 2015 to 2018. The prevalence ranged from 4.8% to 21.4% with the highest prevalence in Kim Son, Ninh Binh in Northern Vietnam (7). Another study conducted in Binh Dinh Province, Central Vietnam, reported that 11.4% of 254 stool samples of local people were positive with *Opisthorchiasis* (31). The South region of Vietnam, which belongs to Mekong River Delta, was also identified as endemic area of *Opisthorchiasis* because of the tropical ecosystem and life style with risky behaviors (32) (33).

Table 1. Prevalence of small liver fluke infection in Vietnam from 2015 – 2018 (7)

Region	**District/Province**	**Year**	**No. Exam**	**No. (+)**	**Prevalence (%)**
Northern	Gia Vien - Ninh Binh	2015	510	84	16.5
	Thanh Liem – Ha Nam	2016	402	52	12.9
	Kim Son – Ninh Binh	2018	309	66	21.4
Central	Binh Dinh	2015	702	48	6.8
	Quang Tri	2015	710	63	8.9
	Dak Lak	2015	707	34	4.8
	Tuy Hoa – Phu Yen	2018	352	54	15.3

With regards to *Clonorchis*, *C. sinensis* was reported to be more observed in Northern than Southern provinces, whereas *O. viverrini* was more distributed in Central and Southern provinces (33). Figure 3 and Figure 4 show the distribution of *C. sinensis* and *O. viverrini* throughout Vietnam (7, 33). In these maps, Yen Bai was highlighted as the endemic region of small liver fluke infection (*C. sinensis)* with a prevalence rate of 1 to 10%.

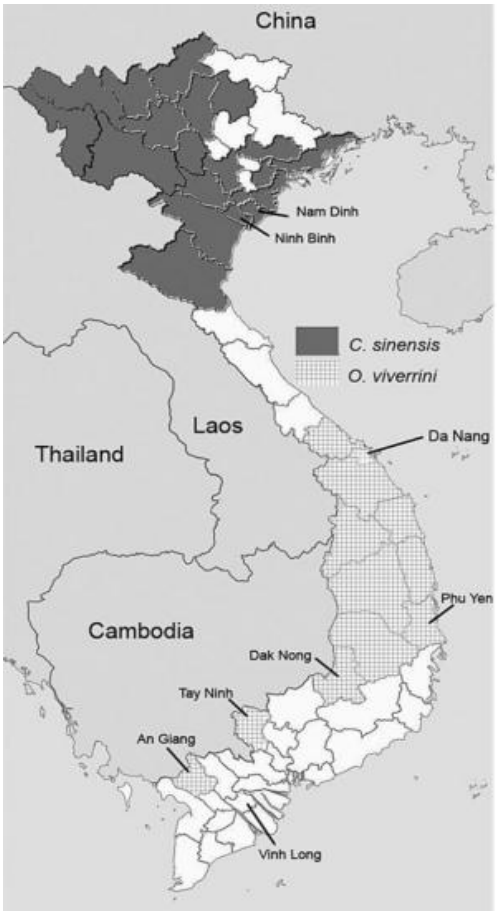

Figure 3. The distribution of *Clonorchis sinensis* and *Opisthorchis viverrini* in Vietnam in 2016 (33)

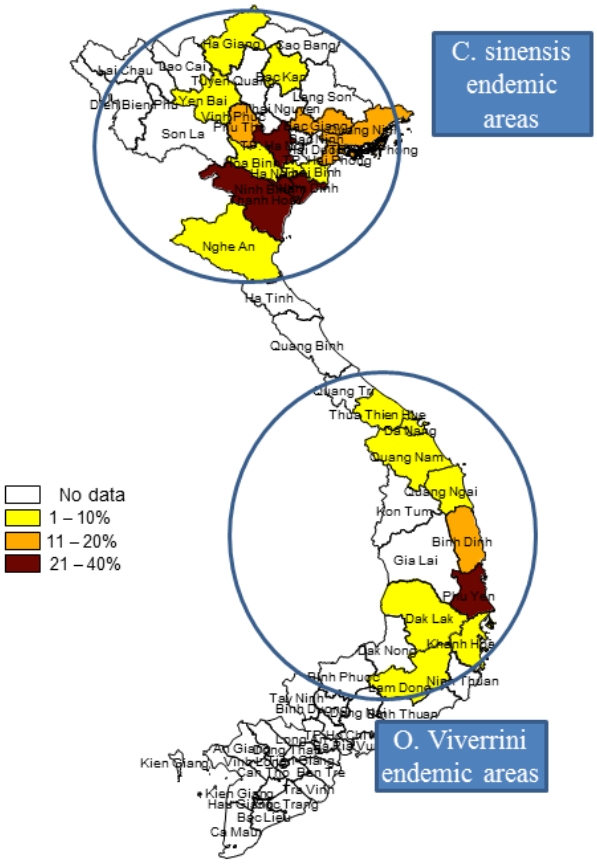

Figure 4. The distribution of *Clonorchis sinensis* and *Opisthorchis viverrini* in Vietnam from unpublished data of NIMPE (7)

2.2.2. Large liver fluke infection

Large liver fluke infection in animals

Large liver fluke infection was observed in animals who consume grass or raw vegetables such as buffalos or cattle. In 2017, 572 cattle feacal samples were collected and examined for *Fasciolasis* from 9 districts in the Central Vietnam, and it was reported that 23.4% of feacal samples contained *Fasciola* eggs (34). Another study in Quang Nam province reported that 40.8% of the buffalos and cows in the study were positive with *Fasciolasis* (n=100/245) (10).

Table 2 presents the high prevalence rate of *Fascioliasis* among some types of animals in Vietnam. The highest prevalence was presented for buffalos and the lowest prevalence for cattle with 98% and 31% respectively, and the highest prevalence was observed among buffalos and cattle living in the river banks (7).

Table 2. Prevalence of *Fascioliasis* among animals in Vietnam (7)

Animal	Reported prevalence	Note
Buffalo	up to 98%	Highest among those living in river bank
Cattle	up to 31%	
Goat	up to 71%	

Large liver fluke infection in humans

With regards to *Fasciolasis* in humans, *F. hepatica* is found in more than 50 countries, in all continents except Antarctica. It is found in parts of Latin America, the Caribbean, Europe, the Middle East, Africa, Asia, and Oceania. *F. gigantica* is less widespread. Human cases have been reported in the tropics, in parts of Africa and Asia, and also in Hawaii (35).

In Vietnam, *Fascioliasis* has occurred in 47 provinces and cities, and the highest prevalence is in some provinces in Central Vietnam, Central Highlands (Binh Dinh, Phu Yen, Quang Nam, Quang Ngai, Khanh Hoa, Gia Lai and Da Nang) (6) (7). In 2010, it was reported that 5% of feacal samples of local people in Dai Loc, Quang Nam contained *Fasciola* eggs (36). In 2012, Nguyen Van Van reported that there were 3,590 people positive with large liver fluke infection, accounting for 2.5% of the population in Quang Nam Province in Vietnam (37). Figure 5 below shows the map of *Fasciolasis* distribution in Vietnam from unpublished data from NIMPE. Coastal and Central Highland provinces were hot spots of *Fasciolasis* with the number of human cases above 101, followed by Northern region and Southern region respectively.

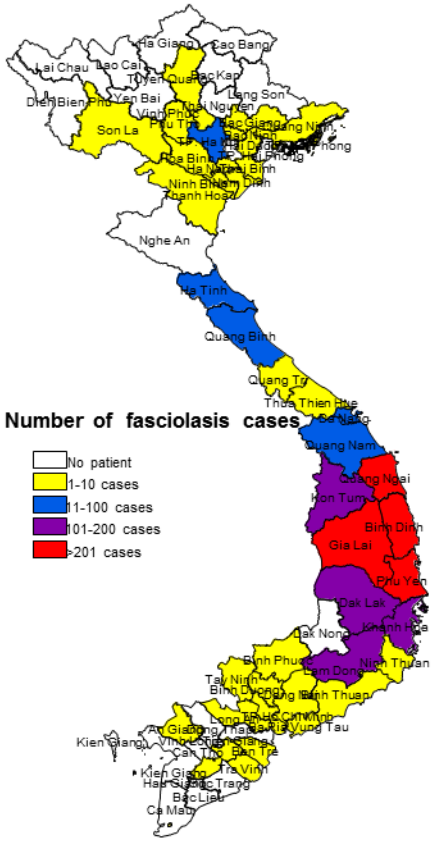

Figure 5. The distribution of *Fasciolasis* cases in Vietnam, based on unpublished data of NIMPE (7)

From chapter 2.1 and 2.2, we can conclude that liver flukes have complex life cycles, in which they exist in different stages and pass through different intermediate hosts such as snails and fishes before they are ingested by humans. People may be infected with liver flukes if they consume raw fishes, raw vegetables, or drink contaminated water which contaminates with metacercaria of *Fasciola*, particularly in the endemic areas. Interestingly, if people drinks contaminated water, they cannot be infected with small liver fluke, but they may be infected with large liver fluke.

In Vietnam, liver fluke infections were commonly reported in fishes, domestic animals such as cats or dogs, and grass-eating animals such as cattle, buffalos, or goats. Human cases were reported in three regions in Vietnam (Northern, Central, and Sothern). While small liver fluke infection was popular in the Northern and the Central region, large liver fluke infection had higher prevalence rate in the coastal and central highlands areas.

The concepts and theories related to the thesis study will be described in the next section.

2.3. Understanding Knowledge, Attitude, and Practice (KAP)

In this section, the researcher will describe the theoretical framework of the thesis study by giving the concepts used in the thesis included Knowledge, Attitude, and Practice. After that, the existing theories and ideas in relation to KAP regarding to FZTi will be presented.

Based on the background and epidemiologic information provided in the previous sections, it is clearly acknowledged that FZTi, liver fluke infection, is a common disease among many provinces throughout Vietnam. Liver fluke infection is not transmitted directly from human to human, yet it is transmitted through contaminated food and water. People can be infected with liver fluke by performing risk behaviors or not performing health behaviors. Therefore, in order to fight FZTi, one of the intervention components is to change behaviors/habits of individuals and communities, which can be supported by health education. This idea was referred in the study of Tran Minh Quy in 2016 to evaluate a broadly-based control model of liver fluke infection in Central Vietnam (38). However, before any intervention in communities is developed and implemented, the understanding about knowledge, attitude and practice regarding to the disease prevention among a specific community is essential.

Behaviors of humans are not formed without reasons, but they are affected by many factors. In the field of public health particularly health promotion, a few theories were introduced and applied to explain the individual behaviors such as the Health Belief Model, the Theory of Planned Behavior, the Stages of Change Model, or Social Cognitive Theory (39). These theories emphasized the important role of knowledge and attitude (or belief) of individuals toward a specific health behavior. To illustrate, the Health Belief Model (Stretcher & Rosenstock in 1997) suggested that the knowledge and attitude of an individual may affect the likelihood of behavior (40). Specifically, the demographic features such as age, sex, ethnicity, personality, and socio-economic features, and personal knowledge together may affect the perceived severity and perceived threat toward to a specific health problem, which influences the behaviors of individuals (40). Therefore, in this current study, we believe that FZTi can be solved by understanding the practice of local people and their knowledge and attitude toward FZTi. KAP model is a quantitative method that is used popular in public health in order to understand the current situation of a specific population toward a certain health issue. In the current study, the KAP model was applied to investigate the current situation of local people in Yen Bai, Vietnam toward the FZTi. Compared to other models, this model is stronger because it focuses on the aspects of individuals (their knowledge, their attitude, and their practice), which helps to obtain deep understand the target population. This model also allow the researcher to test the association among demographic features, knowledge, attitude, and practice of the target population.

The Figure 6 presents the theoretical framework of the thesis study. In which, there were three important concepts, which included (1) Knowledge on FZTi, (2) Attitude toward FZTi, and (3) Practice related to FZTi. Besides that, demographic

characteristics of individuals were also studied to identify the relationship between these factors to the KAP. These concepts will be described below.

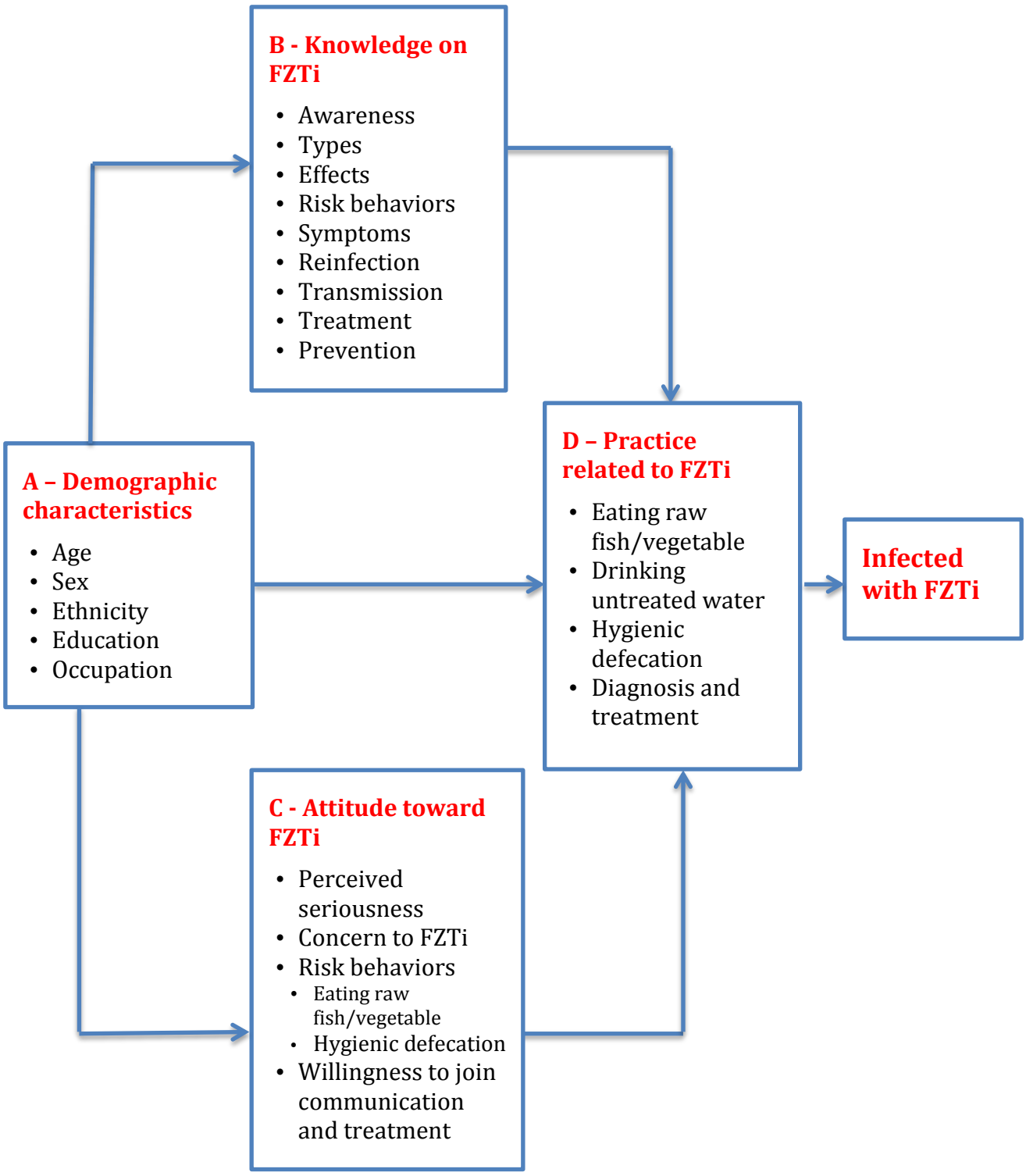

Figure 6. Theoretical framework of the thesis study

Knowledge on FZTi

In the guideline for conducting a KAP study presented by K. Kaliyaperumal in 2004, the knowledge was defined as the understanding of any given topic, and the knowledge questions should be designed to test the knowledge of participants (41). In 2011, knowledge in the KAP survey model was defined as "a set of understandings,, knowledge, and of science" (42).

In the current study, knowledge on FZTi is the understanding of a set of items regarding to liver fluke infection among local people. The knowledge section assesses the extent to which individuals know or understand public health concepts regarding to liver fluke. Because the target population consists of local people, it is expected that they know and understand basic information that includes awareness (to assess whether people heard about liver fluke), types of liver flukes (to assess whether people distinguish small and large liver flukes), effects of liver fluke infection on humans, risk behaviors that cause liver fluke infection, symptoms, reinfection, transmission, and the way to treat liver fluke infection.

Attitude toward FZTi

In 2004, attitude was defined by K. Kaliyaperumal as *'the feelings towards the subject as well as any preconceived ideas that they may have towards it'* (41). In 2011, attitude in the KAP survey model was defined as *'a way of being, a position'* and it was an intermediate variable between the circumstance and the response to this circumstance. The attitude helps to explain that people may adopt a specific practice and not another when reacting to a stimulus (42).

In the thesis study, the attitude toward FZTi assesses the feelings and belief of people about liver fluke infection and the extent to which individuals agree with risk behaviors. The attitude questions include perceived seriousness and concern toward liver fluke infection of an individual, their attitude toward risk behaviors, and their willingness to join communication and diagnosis/treatment program.

Practice related to FZTi

Previously, practice was defined as the ways that people demonstrate their knowledge and attitude through actions (41), or practices were the observable actions of an individual in response to a stimulus (42).

In this thesis study, the practice related to FZTi is defined as behaviors of people, in their real life which includes both risk behaviors and protective behaviors regarding liver fluke infection. The risk behaviors include eating raw fish/vegetable, and drinking untreated water from surface water bodies. The health behaviors include hygienic defecation and diagnosis/treatment of liver fluke infection.

Demographic characteristics

In the theory of Health Belief Model (Stretcher & Rosenstock in 1997) (40) suggested the demographic features may affect the attitude, which influences the

behaviors of individuals. Therefore, the demographic characteristics such as age, sex, ethnicity, education, and occupation are also considered in the thesis study.

In the framework of the thesis study, demographic characteristics together with three aspects of the KAP survey which included Knowledge, Attitude, and Practice regarding to liver fluke infection were explored. These aspects of Knowledge, Attitude, and Practice were put in the relationship. To be specific, demographic characteristics are associated with all knowledge, attitude, and practice of an individual. Knowledge on FZTi and attitude toward FZTi may affect the practice of an individual.

In the field of helminthes, the KAP framework was applied widely over the world (32, 43-46), and it was also used in many researches in South East Asia and Vietnam in the area of FZTi in general and liver fluke in specific (9-11, 36-38, 47).

In the KAP studies, the Knowledge, Attitude, and Practice variables are usually divided into different levels. In Thai Lan (2007), 1077 persons were interviewed in a KAP survey related to liver fluke infection; as a result, 55.11% of the population had good level of knowledge on disease transmission, 79.72% of the population had a good level of knowledge on prevention including defecation and consumption, but only 39.26% of the studied population had good health behavior, and 41.42% of the population had risk behaviors including unhygienic defecation and ate raw fish (9).

In Vietnam, Do Thai Hoa (2005) explored KAP on small liver fluke infection in one commune of Thanh Hoa Province and reported that only 46.5% (n=372) of the participants passed the knowledge assessment that included mode of transmission, causes, symptoms, way to prevention and treatment, less than 50% of the participants passed the attitude assessment, and only 30.6 % passed the practice assessment (10). The risk among people who had poor knowledge was 3.6 times higher than the risk among those who had enough knowledge ($p<0.001$), and the risk among people who had negative knowledge was 5.4 times higher than the risk among those who had positive knowledge ($p<0.001$) (10).

Another cross-sectional study about small liver fluke infection in 2012 with a sample size of 375 persons reported that only 39.32% of the participants had good general knowledge, in which only 38.8% knew *Opisthorchis viverrini* was caused by eating raw fish, 38.54% knew the effects of *Opisthorchis viverrini* infection?, 33.33% knew *Opisthorchis viverrin*i prevention, 40.1% passed the general attitude assessment of *Opisthorchis viverrini*, 35.68% passed general practice assessment, 33.3% of the population used to eat raw fish, of which 52.3% had eaten raw fish more than 5 times/years (11).

While there were healthy behaviors to prevent liver fluke infection mentioned in the previous study such as hygienic defecation (9), there were many risk behaviors that put people at risk such as eating raw vegetable, drink contaminated water, and eating raw fish. Numerous studies showed that eating raw fish was the main reason of getting liver fluke infection (31) (28, 43). In Thailand, *Opisthorchiasis* has been studied for 50 years, and eating raw fish was identified as the main cause leading to liver fluke

infection (29). In Vietnam, it was reported that people who ate raw fish were 2.3 higher at risk than people who did not eat raw fish, and among people who ate raw fish, those eating at restaurants were at higher risk compared to those eating at home (22).

Other personal characteristics such as gender, fish-food sharing among neighbors, proximity to water bodies such as rivers or lakes, frequency of eating raw fish from natural water bodies and low education were also factors related to the liver fluke infection and its transmission (25), (31), (48). In Vietnam (2008), Dang Thi Cam Thach proofed that prevalence of small liver fluke infection in males was 3.6 times higher than that in females, and the habit of eating raw fish was significant risk behavior risk that increase the risk of *C. sinensis* infection 53 times (30). In 2017, Hoang Quang Vinh reported that the prevalence of *Clonorchis sinensis* infection among people eating raw-fish taken from a nearby river was remarkably higher than among people consuming fish caught from farmed ponds ($p<0.05$); people who lived in villages also consumed more raw fish per resident/year than people in other areas because of their strong network of sharing raw fish ($p<0.001$) (48).

With regards to reasons why people eat raw fish in Vietnam, the characteristics of this habit, such as fish species, origin of fish, location of eating fish, season to eat, frequency, were investigated in the study of Phan Thi Van et al. Many people remarked that they eating raw fish because it was tasty and they desired to eat raw fish (49). Many male adults even maintained this bad habit because they knew that liver fluke infection can be treated well by drugs (22). Besides that, there was no evidence on the other factors explaining for the habit of eating raw fish.

III. RESEARCH QUESTIONS

Liver fluke infection is a concerned public health problem in Vietnam, particularly in Yen Bai, where local people have the habit of eating raw fish. However, there are no any studies investigating on KAP on liver fluke infection among local people in Yen Bai province. In this study, we answered the two research questions below:

Questions 1: **What is current situation of knowledge, attitude, and practice (KAP) regarding to liver fluke infection of local people aging from 15 to 65 in Yen Bai province?**

Question 2: **Why do local people aging from 15 to 65 in Yen Bai province show risk behaviors regarding to liver fluke infection?**

The thesis study was a part of the project *Foodborne Zoonotic Trematode Infections and Integrated Control in Vietnam (FOODTINC).* The findings in this study will contribute as the baseline data to help designing intervention to improve the current FZTi problem in Yen Bai as well as contribute to the effort of reducing the prevalence of FZTi in other similar communities of Vietnam.

IV. MATERIALS AND METHOD

4.1. Study setting

The current study was a component of Human Part of the project *Foodborne Zoonotic Trematode Infections and Integrated Control in Vietnam (FOODTINC)* funded by ARES- Académie de Recherche et D'enseignement Supérieur (Academy of Research and Higher Education) - Belgium under the collaboration between Vietnam and Belgium. This project aims at contributing to reduce the impacts of FZTi on Vietnamese population and especially at developing an integrated control of FZTi in North Vietnam; therefore, awareness raising and capacity building are key activities of this project.

As being a part of a project, the method of the thesis study had to fit with the methods chosen in other components of the project. Specifically, the thesis study was combined and conducted together with the parasitological part inside the Human part of FOODTINC project. One of the aims in the parasitological part was to investigate the prevalence and incidence of liver fluke infection in Yen Bai by testing participants' stool sample and blood sample. Therefore, the participants who joined the parasitological were also invited to join the current study.

4.2. Study design

Study sites

The study was conducted in 2 communes in Yen Bai Province, which is a Northern mountainous province located in the center of mountainous and midland in Vietnam (Picture 1). Due to the resource limitation of the project, only two communes in Yen Bai, Vu Linh and Phuc An, were selected to conduct the study for a number of reasons. Firstly, these communes are 2 mountainous communes that are located together beside the East of Thac Ba lake, one of the biggest lakes of Vietnam that represents the main source of fishes in Yen Bai province. Secondly, Vu Linh and Phuc An have a population of approximately 9,400 people that cover 2059 households, 10 ethnic groups, and 21 villages. The habit of eating raw fish is very common in Vu Linh and Phuc An. Finally, based on the unofficial survey and interviewing the local health workers, there are many small liver fluke cases reported in these two communes. In 2017, according to the reports of Commune Health Stations, it was estimated that 10 – 15% of the population in Phuc An commune has small liver fluke, and in Vu Linh about 10 – 20% the population has small liver fluke (50, 51). Therefore, Vu Linh and Phuc An are seen as hot spots of eating raw fish habit and liver fluke infection.

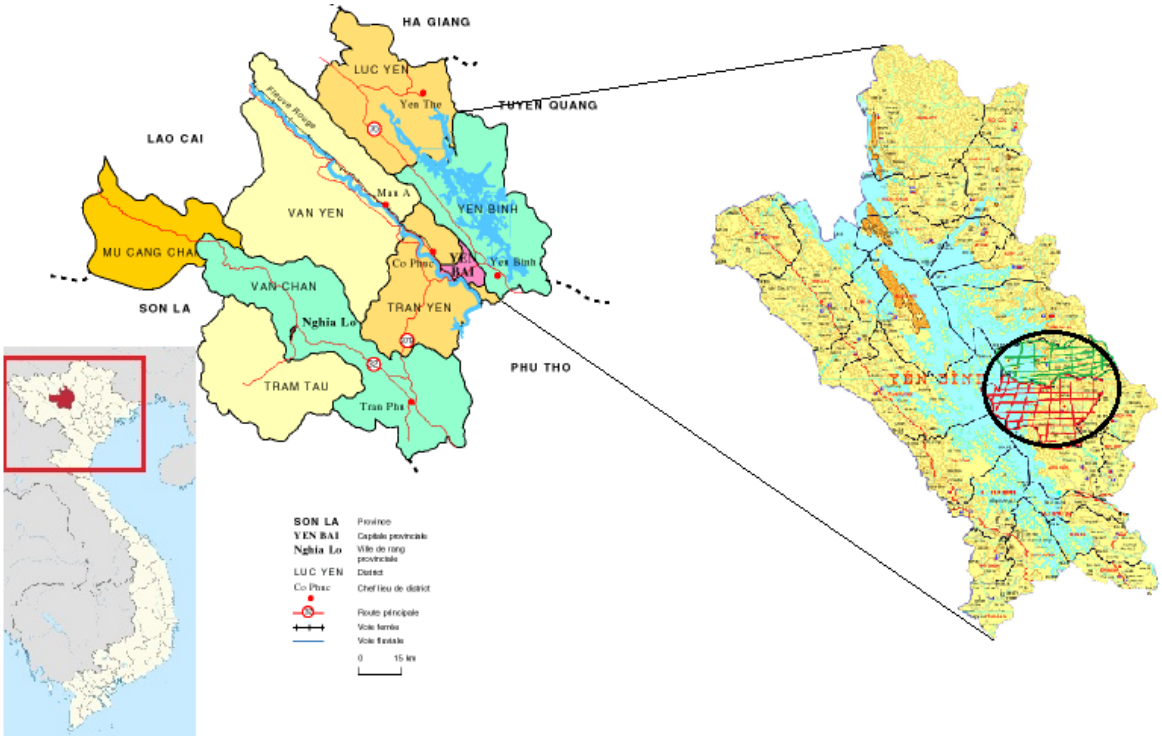

Figure 7. Study sites: Vu Linh and Phuc An communes, Yen Binh District, Yen Bai Province.

Study population

The study population consisted of the local people who are living in Vu Linh and Phuc An communes, Yen Binh district, Yen Bai Province. The participants had to meet the following selection criteria: (1) living in Vu Linh and Phuc An, Yen Bai, Vietnam, (2) Aged from 15 to 65 years old, and (3) Have ability to understand and answer the questions in the research. Anyone who refused to participate in the study or whose age did not correspond to the defined age group was excluded.

Study period

The study was conducted in 5 months from 17 February to 17 July, 2018, and the data were collected in 2 months from 2 April to 27 May, 2018.

Study design

The study was designed as a cross-sectional descriptive study using mixed method including quantitative and qualitative approaches.

There were 2 parts for each approach respectively, including KAP survey and Risk Behavior Investigation. KAP survey is a quantitative approach that enables the researcher to study the Knowledge (K), Attitude (A), and Practice (P) of the target population. In other words, KAP may help the researchers to identify what is known and

done regarding to a specific public health issue. Therefore, it is the first step done to establish the baseline data to be used in the future assessment (41, 42). KAP studies that integrate both quantitative and qualitative data were also conducted to serve as the baseline data before designing and implementing the public health interventions (52) (38).

The first part was the quantitative survey regarding to the knowledge, attitude, and practice (KAP Survey) on liver fluke infection of people aging from 15 to 65 at Vu Linh and Phuc An, Yen Bai. This survey aimed to conduct the 1st objective of the study. In this part, participants were invited randomly to be face-to-face interviewed by researchers with the use of a structured questionnaire.

The second part of the study was the qualitative investigation about risk behaviors of getting liver fluke infection among people aging from 15 to 65 at Vu Linh and Phuc An, Yen Bai. The KAP Survey and Risk Behavior Investigation were combined and conducted respectively. The risk behavior investigation aimed to conduct the 2nd objective of the study. In this part, participants were invited to an in-depth interview to provide more detailed information about eating raw fish and raw vegetable and the reasons that explain why they conduct those risk behaviors.

The method for each part will be described in the following sections.

4.3. Knowledge, Attitude, and Practice (KAP) Survey

In the KAP survey, all the participants in the parasitological part of the project were considered to take part in the survey to explore what they have known or done regarding to liver fluke infection. The method to conduct the KAP survey will be described below.

4.3.1. Population

Inclusion/Exclusion criteria

The inclusion and exclusion criteria for the KAP survey were primarily based on the criteria to select the study population that was mentioned in the part the study design above. However, all the participants were also the participants in the parasitological part of the FOOTINC Project.

Sample size

As described above, the current study was a part of the FOODTINC project, and the method was utilized to fit with other components of the project; therefore, the sample size of the KAP survey was all people selected for the parasitological part of the study.

The estimated sample size required for each of commune, Vu Linh and Phuc An, was calculated using the following formula:

$$N = \frac{z^2_{1-\alpha/2} \times p \times (1-p)}{d^2}$$

With:

z = 1.96 95% confidential (α =0.05)

d = 0.05 acceptable margin of error

p = 0.15 estimated prevalence rate liver fluke infection

Therefore, sample size for two communes is: N = 392.

Sample selection method

As the results of selection from parasitological part, 392 residents with 196 residents in each commune, Vu Linh and Phuc An, were randomly selected from the community population aged 5-65 years old. They came to the commune health station to take the blood test and feacal test for liver fluke infection. Among 392 participants in the parasitology part, only 375 participants between the ages from 15 to 65 years old were invited to the KAP survey.

4.3.2. Data collection

Procedure

When participants came to the commune health station to take the blood and feacal test, they were tagged with the unique identification number. Then they were invited to be interviewed face-to-face in order to obtain personal data and to determine knowledge, attitudes and practices regarding prevention methods and risk behaviors related to disease. The interview lasted for around 15 minutes.

Before each interview, participants were given information on the purposes of the study and signed the consent form. After that, the researcher interviewed them using the designed questionnaire in the tablet or mobile phone (described in the next part). The identification numbers and answers were saved on the electrical devices when the interview ended.

Measuring tool

Data were collected through face-to-face interview with the interview-led structured questionnaire (Appendix 1). To design the questionnaire, the researcher created a list of variables based on the theoretical framework. Table 3 below shows the final list of variables. Basic demographic characteristic includes birth year (to calculate the age of participants), gender, ethnicity, education, occupation. In order to measure the knowledge of the participants, there are 3 questions on general awareness, 1 question on reasons to get liver fluke infection, 6 questions on basic knowledge included transmission, reinfection, treatment, prevention, and symptoms. In order to measure the attitude of the participants, there are 1 question on perception of seriousness, 1

question on concerns, 4 questions on attitude towards specific habits, and 2 questions on attitudes towards prevention events and medication programs. In order to measure the practice of the participants, there are 3 questions on eating raw fish, 2 questions on eating raw vegetables, 1 question on drinking water, 1 question on hygiene defecation, and 2 questions on diagnosis and treatment.

Table 3. List of variables in the thesis study

No.	Name of variable	Definition	Type	Question
Part 1: General information				
1	Name	Name of the participant	Nominal	A1
2	Address	Address of the participant	Nominal	A2
3	Birth year	Year of birth of participant	Discrete	A3
4	Gender	Gender of the participant: Male, female, or other	Nominal	A4
5	Ethnicity	Ethnic groups that the participant belong to: Kinh, Tay, Nung, other	Nominal	A5
6	Education	Level of education of the participant: Never attended school, Primary school, Secondary school, High school, College, Bachelor degree, Postgraduate, other	Ordinal	A6
7	Occupation	Major occupation of the participant: Farmer, Worker, Student, Government employee, Freelance, Other	Nominal	A7
Part 2: Knowledge, Attitude, and Practice on liver fluke				
Variable Group on Knowledge				
8	Heard about liver fluke	Question if the participant has ever heard about liver fluke	Binary	B1
9	Liver fluke types	The types of liver fluke that the participant knows	Nominal	B2
10	Liver fluke effects to human health	Question if the participant knows that liver fluke affects human health	Nominal	B3
11	Reasons to get liver fluke	Question if the participant knows how people get liver fluke	Nominal	B4
12	Transmission	Question if the participant knows liver fluke can be transmitted from human to human	Nominal	B5.1
13	Reinfection	Question if the participant knows that a person can be reinfected with liver fluke	Nominal	B5.2

14	Eating cooked infected fish	Question if the participant knows eating well-cooked infected fish can prevent infection	Nominal	B5.3
15	Treatment	Question if the participant knows how liver fluke infection can be treated by drugs	Nominal	B5.4
16	Prevention	Question if the participant knows liver fluke infection can be prevented	Nominal	B5.5
17	Symptoms	Question on symptoms of people who get infected with liver fluke	Nominal	B6
Variable Group on Attitude				
18	Level of seriousness	Level of seriousness if a person gets infected with liver fluke	Ordinal	C1
19	Level of concern	Level of concern about liver fluke infection	Ordinal	C2
20	Attitude to eating raw fish	Attitude to habit of eating raw fish	Ordinal	C3.1
21	Attitude to eating raw vegetable	Attitude to habit of eating raw vegetable	Ordinal	C3.2
22	Attitude of defecating	Attitude to defecating in public space	Ordinal	C3.3
23	Attitude to feeding fish	Attitude to feeding fish with fresh feces of human and animal	Ordinal	C3.4
24	Join communication event	Attitude of the participant to communication event about prevention of liver fluke infection in the community	Binary	C4
25	Join examination	Attitude of the participant to a medical examination event and mass drug administration programs	Binary	C5
Variable Group on Practice				
26	Eating raw fish	Question if the participant is used to eat raw fish	Binary	D1
27	Frequency of eating raw fish	Question on the frequency that the participant usually eats raw fish	Nominal	D2
28	Drinking alcohol	Question if the participant drinks alcohol when eating raw fish	Binary	D3
29	Reasons to eat raw fish	Reasons why the participant eats raw fish	Nominal	D4
30	Eating raw vegetable	Question if the participant eats raw vegetable	Binary	D5

31	Frequency of eating raw vegetable	Frequency that the participant eats raw vegetable	Ordinal	D6
32	Drinking water from river/lake	Question if the participant drank water directly from river/lake in last 3 months	Nominal	D7
33	Toilet	Type of toilet that the participant is using	Nominal	D8
34	Diagnose liver fluke	Question if the participant's feces or blood has ever been examined to diagnose liver fluke infection	Nominal	D9
35	Liver fluke treatment	Question if the participant has ever used drugs to treat liver fluke infection	Nominal	D10

For each variable, one question was created. After the questionnaire was revised by colleagues in the FOODTINC Project, a test was organized to ensure all the questions were understandable, using the right local language, and to ensure the skip steps were corrected. The researcher visited the study sites and interviewed 10 local people under the assistant of the staff from commune health stations in Vu Linh and Phuc An communes. After the test, the questionnaire was edited and finalized to be used officially.

Table 4 below gave the final structure of the questionnaire. The final questionnaire included 35 questions that covered the four following parts: A- Demographic characteristics of the participant, B- Knowledge regarding to liver fluke infection, C – Attitudes toward liver fluke infection, and D- Practice regarding to liver fluke infection prevention.

Table 4. Structure of the KAP questionnaire

Part and sub-part	Range	Number of questions
1. General Information on demographic characteristics	A1 to A7	7
2. Knowledge, attitude, and practice on liver fluke		
Knowledge	B1 to B6	10
Attitude	C1 to C5	8
Practice	D1 to D10	10
Total	**A to E**	**35**

4.3.4. Data analysis

Data were entered and managed by application named Kobo Tool Box. Koto Tool Box is an application that allows the researcher to create survey forms and collect or

entry data on Android, iOS online or offline (http://www.kobotoolbox.org/). During the interview, the answers were entered directly to the application on the Android or iOS devices.

Before the data was analyzed, the name of the participants and their ID-numbers were copied and saved separately in another file. In the file used for analysis, only the ID-numbers of participants was kept to ensure the confidential data of the participants.

In the step of data analysis, data were processed and analyzed by SPSS IBM 23.0. Firstly, the answers for each question of each individual were given a score. The correct answers and the maximum score for each question are described in Appendix 3. By giving the score for each question, the maximum score for the Knowledge, Attitude, and Practice were 10, 8 and 6 respectively. The action of giving score was conducted by using the recode and compute commands in SPSS 23.0. Next, each individual had their own score in Knowledge, Attitude, and Practice based on their answers. Finally, descriptive statistics were conducted through estimating mean, median, standard deviation (for numberic variables) and frequencies, rates (for categorical variables). The relation between demographic characteristics and K-A-P score of individuals were tested using correlation test (between two numeric variables), independent-samples T test (compare means of two independent groups), and One-way ANOVA/post hoc test (compare means of many independent groups).

4.3. Risk Behavior Investigation

In the Risk Behavior Investigation, in-depth interviews were organized to provide more information of risk behaviors including eating raw fish/ raw vegetable, and drinking untreated water from lakes/ rivers so that the researcher understood about the risk behaviors and reasons why people perform those actions. The method to conduct Risk Behavior Investigation will be described below.

4.3.1. Population

Inclusion/Exclusion criteria

The participants were not only the participants in the KAP survey or microbiological part, but all the people who met the criteria mentioned in the study design part were considered as the population in this investigation.

Sample size

27 people were invited to participate in the in-depth interview, and this part ended when the information collected reached the saturation.

Sample selection method

Two methods were applied to select the participants. The first method was purposive sampling, which was the researcher's intentional choice of individuals or groups of people to help with the study. During the KAP survey, the researcher identified the people who were at risk and showed the risk behaviors of eating raw fish. Besides that, people positive with liver fluke infection were considered to be invited to the in-depth interview. The second method was snowball sampling. After the interview was ended, the interviewee was asked to introduce or refer to other individuals who were showing risk behaviors. Therefore, the participants were not only participants of the KAP survey or parasitological part.

4.3.2. Data collection

In the risk behavior investigation, data were collected through in-depth interview by the guideline (Appendix 2). A 45-minute face-to-face interview was conducted by the researcher. In order to understand the potential risk behaviors especially eating raw fish and their reasons to perform risk behaviors, participants were asked about their habit of eating raw fish and raw vegetable. Topics in the in-depth interview included:

Eating raw fish/raw vegetable

- Reasons to eat (cultural/ economic)
- origin of fish/vegetable
- frequency of eating
- fish species
- preparation procedure
- location of eating
- seasons/ occasion of eating

Drinking raw water from river/lake

- reason
- location
- frequency

4.3.3. Data analysis

Each interviewee was given an ID-number and his/her name was saved in a different file to ensure the confidentiality of the data. All the in-depth interviews were recorded and transcribed. In this part, the data were coded by deductive approach, which means data were analyzed based on the topics and questions given in the interview. The transcription was re-read at least three times by the researcher. A matrix including rows and columns was created in Excel Microsoft. Each row was one record of one interviewee, and each column was one label of information which was in line with interview topics/questions. Each interview record was filled in the matrix, and synthesized according to topics.

4.4. Research Ethics

The activities in the current study were under the FOODTINC project that was approved by The Science, Technology and Ethics committee at the National Institute of Malariology, Parasitology and Entomology (NIMPE, Decision number 113/QĐ-VSR, January 25th, 2018). Besides that, the study was also approved by the Ethic Committee of the Faculty of Behavioral, Management and Social sciences (BMS) of the University of Twente (Request number 18299). Before the field trip, the Provincial and District Health Office were informed and asked for the permission.

Participants who took part in the study were informed and explained sufficiently about the aims and the contents of the research by documents, including two forms: 1) Rights and Responsibilities, and 2) Consent Form. Participants could ask questions about the study and interview, and it was the responsibility of the researchers to answer those questions. Participants had the right to refuse or reject (stop) taking part in the research if they were in doubt without giving any reasons. In case of children under 18 years old, we obtained their assent and written consent of their parents.

All the information of the research subjects was completely kept confidential. The research results do not mention their names if their opinions are quoted. All the information collected is only used for this study and not for other purposes. The results are reported in appropriate formats without affecting the subjects.

V. RESULTS

In this section, the results of the thesis study will be presented in two main parts in line with the two research questions, which included the results of the KAP survey and the results of the Risk Behavior Investigation. In the KAP survey, after the information of participants has been described, the current situation of knowledge will be presented, which will be followed by the current situation of attitude and practice. In the risk behavior investigation, the characteristics of risk behaviors will firstly be given, and then the reasons for performing risk behaviors will be described in detail.

5.1. Knowledge, Attitude, Practice (KAP) Survey

5.1.1. Background information of participants

There are totally 375 participants in the KAP survey. Table 5 gives an overview of the demographic characteristics of participants in the KAP survey. Of all participants, 59.2% were female, and 53.6% were at the age between 31 to 50 years old. Of all participants, 61.9% belonged to minority ethnic groups (Dao, Tay, Cao Lan, Nung, Muong, Pati), with Dao having the highest numbers (48.3%). In terms of education, 77.6% of all participants were under level of secondary school with 10.9% people not having attended school at all (n=41). Only 2.7% of the participants had bachelor degree (n=10). With regards to occupation, the main occupation of participants was farmer with 60.8%, and only 6.9% were government officers.

Table 5. Background information of participants

Demographic Information	Number (n)	Percentages (%)
Gender		
Male	153	40.8
Female	222	59.2
Age group		
15 – 30	76	20.3
31 – 50	201	53.6
51 - 65	98	26.1
Ethnicity		
Kinh	143	38.1
Dao	181	48.3
Tay	24	6.4
Cao Lan	24	6.4
Other (Nung, Muong, Pati)	3	0.8
Education		
No education	41	10.9

Primary school	103	27.5
Secondary school	147	39.2
High school	62	16.5
Vocational School	12	3.2
Bachelor	10	2.7
Occupation		
Farmer	228	60.8
Freelance	60	16.0
Government officer	26	6.9
Fisherman	13	3.5
Worker	9	2.4
Student	5	1.3
Business	15	4.0
Unemployed	14	3.7
Other	5	1.3
Total	**375**	**100**

5.1.2. Current situation on FZTi Knowledge

Of all participants, 88.5% had heard about liver fluke (n=332), 11.5% have never heard about liver fluke (n=43), and only 1% could list at least one type of liver fluke (small or large liver flukes), 98.9% did not know the types of liver fluke.

There were 86.7% of all participants who knew that liver fluke affects human health (n=325), and only 1.9% of all participants who did not know that liver fluke affects human health (n=50).

Of all participants, only 13.1% knew that people can get liver fluke by eating raw fish, raw vegetable, raw meat (pork, beef, and buffalo) (n=49).

24.3% of all participants did not know or had the wrong knowledge about the transmission of the liver fluke infection (n=91). They believed that liver fluke can be transmitted from human to human. 15.2% of all participants did not know the way liver flukes are transmitted. Less than a half of participants gave the correct answer that liver flukes cannot be transmitted directly from human to human (49.1%, n=184).

Of all participants, only 61.6% understood that people can get re-infected after successful treatment (n=231), and 17.1% misunderstood that people will not get re-

infected after successful treatment (n=64), and 9.9% did not know about the reinfection (n=37).

Of all participants, 38.4% had the wrong knowledge that eating infected fish always causes liver fluke infection, whether or not the fish is cooked (n=144), and only 32.3% of respondents knew that cooking raw fish well can prevent the liver fluke infection (n=121), 17.9% did not know about this information (n=67).

Only 58.4% of all participants knew that liver fluke infection can be treated with drugs (n=219), 19.7% of all respondents thought that liver fluke infection cannot be treated by drugs (n=74), and 10.4% of all respondents did not know whether liver fluke infection can be treated by drugs or not.

Of all participants, only 58.1% understood that liver fluke can be prevented (n=218), many people thought that liver fluke cannot be prevented (21.3%, n=80), and 9.1% did not know whether liver fluke can be prevented or not.

As mentioned above in the method chapter, there were 10 knowledge questions used to examine the knowledge of the participants. For each correct answer, people got one score. Therefore, the maximum score of an individual on knowledge was 10. The score table is presented in Appendix 2. Figure 8 gives the distribution of the knowledge score among participants. In the current study, the researcher considers that each participant may pass the knowledge if his/her score is more than 6, which means he/she can give at least 6/10 correct answers. Of all participants, only 36.3% had the knowledge score more than 6, which means only 36.3% of all participants could give more than 6/10 correct answers in the part of knowledge and passed the knowledge assessment (n=136).

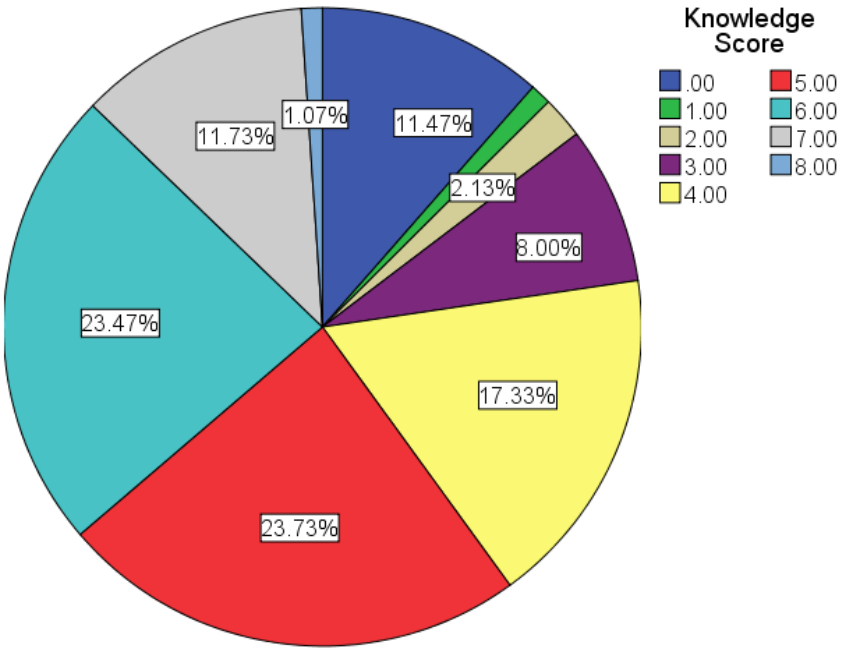

Figure 8. Distribution of knowledge score presented as the percentage of the 375 participants with the scores 0 till 10

With regards to the symptoms of liver fluke infection, this was an open question and only 44% of all participants did not know the symptoms of liver fluke. Weight loss and Jaundice were 2 popular symptoms that participants had listed, followed by the symptoms of Inappetence, Itch, and Dyspepsia. The frequency of symptoms listed by the participants was presented in Figure 9.

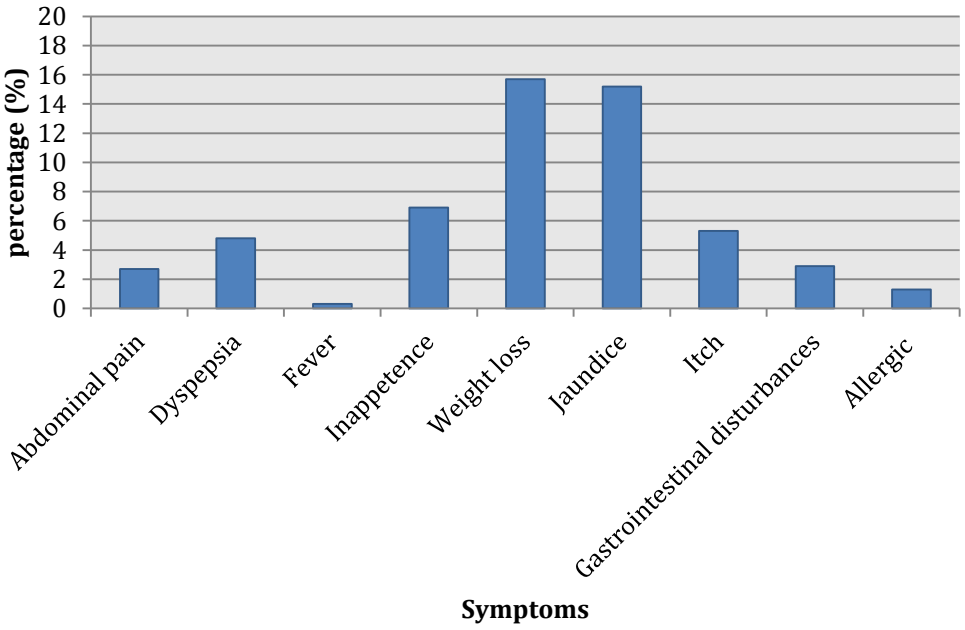

Figure 9. Frequency of symptoms listed by the participants on an open question (n=375)

Next, associations between the demographic characteristics and the knowledge score were tested. The correlation between the age of participants and their knowledge score was explored using the correlation analysis. Results indicated that the higher the age of the participant, the lower the knowledge score he/she had. The old people highly likely had low knowledge about liver fluke infection. The correlation was weak ($r = -0.17$). The correlation was significant ($p<0.005$).

Table 6 presents the knowledge average score by demographic characteristics. Firstly, the study explored the average knowledge score among 2 groups of participants, female and male (table 7). The average knowledge scores were 4.25 ± 2.13 and 4.84 ± 1.92 respectively. The average score among females was lower than average score among males. In other words, males had better knowledge than females. The difference was significant (Independent-samples T test, $t = 2.735$, $df = 373$, $p<0.05$).

Table 6. Knowledge average score and Standard Deviation by demographic characteristics of the 375 participants

Demographic characteristics	N	Mean	SD	Min – Max
Gender				
Female	153	4.25	2.13	0 – 7
Male	222	4.84	1.92	0 – 8
Ethnicity				
Kinh	143	4.96	1.85	0 – 7
Dao	181	4.05	2.18	0 – 8
Tay	24	3.88	2.25	0 – 7
Cao Lan	24	5.42	1.32	2 – 8
Other	3	6.00	1.00	5 – 7
Education				
No education	41	3.02	2.17	0 – 8
Primary school	103	3.91	2.14	0 – 8
Secondary school	147	4.73	1.93	0 – 7
High school	62	5.32	1.59	0 – 7
Vocational School	12	5.75	1.14	4 – 8
Bachelor	10	6.20	1.03	5 – 8
Occupation				
Farmer	228	4.29	2.08	0 – 8
Worker	9	4.44	1.94	0 – 7
Student	5	6.20	1.64	4 – 8
Government officer	26	5.54	1.53	0 – 8
Freelance	60	4.48	2.11	0 – 7
Fishseller	5	7.00	0	7 – 7
Fisherman	13	4.75	1.48	1 – 6
Business	15	4.87	1.77	0 – 7
Unemployed	14	4.36	2.90	0 – 7

The study explored the average knowledge score of ethnic groups. The post hoc test showed the statistically differences in Kinh and Dao people. Kinh people had better knowledge than Dao people. The average score of Kinh people was 0.91 higher than that of Dao people. The differences between groups were significant (One-way ANOVA test, p <0.0001). Although the data illustrated differences between the ethnic groups, there were no statistically significant differences between other ethnic groups.

The study explored the distribution of knowledge average score by education groups. The average score of people with bachelor degree was 3.18 higher than those with no education, 2.29 higher than people finished primary school, and 1.47 higher than people at secondary school level. The average score of people at vocational school was 2.73 higher than people with no education, 1.84 higher than people finished primary school. The average of people at high school was 1.41 higher than people finished primary school, and 2.30 higher than people without education. We can conclude that the higher the education of the participant, the better knowledge on liver fluke he/she had. Average scores ranged from 3.02 (no education) to 6.20 (bachelor) The differences were significant (One-way ANOVA test, p <0.00001).

The study explored the distribution of knowledge average score by occupation groups, but the differences among groups were not statistically significant (p>0.05). In other words, the occupation is not related to the knowledge of the participants.

5.1.3.Current situation on FZTi Attitude

Table 7 presents the distribution of the participants' perception of the seriousness of a liver fluke infection and participants' concern about liver fluke infection. Of all the participants, 84.3% believed that being infected with liver fluke is moderate or very serious (n=316), but only 54.4% really concerned to liver fluke infection (n=204).

Table 7. Distribution of participants' attitude by severity and concern

Attitude Scale	Number	Percentage
Seriousness		
Not aware of liver fluke	43	11.5
Not at all serious	1	.3
Slightly serious	15	4.0
Moderate serious	148	39.5
Very serious	168	44.8
Concerns		

Not aware of liver fluke	43	11.5
Not concerned	4	1.1
Slightly concerned	124	33.1
Very concerned	204	54.4
Total	**375**	**100**

Table 8 summarizes the distribution of participants' attitude toward the risk behaviors and health behaviors to prevent liver fluke infection. It is noted that only people who have heard about the liver fluke infection (n=332) were asked to give a reaction on statements behaviors to prevent liver fluke. High proportion of participants showed their positive attitude to dropping the habit of eating raw fish (85.3%, n=320). However, only 62.7% of all participants agreed to drop the habit of eating raw vegetables (n=235), 18.4% still maintain this habit (n=69). Of all participants, 87.7% agreed to not defecate in public space (n=329), and 81.6% agreed to not feed fresh human and animal faeces for fish (n=206).

Table 8. Distribution of participants' attitude toward risk and health behaviours, measured with four statements

Statement	**Attitude Scale**					
	Disagree		**Neither agree nor disagree**		**Agree**	
	n	%	n	%	n	%
To prevent liver fluke infection, I do not eat raw fish or undercooked fish any more	4	1.1	7	1.9	320	85.3
To prevent liver fluke infection, I do not eat raw vegetable anymore	69	18.4	27	7.2	235	62.7
To prevent liver fluke infection, I do not defecate in public space	1	0.3	2	0.5	329	87.7
To prevent liver fluke infection, I do not feed fresh human and animal faeces for fish	11	2.9	15	4.0	306	81.6

99.5% of all participants were willing to take part in the communication event to receive the information about liver fluke infection (n=373), 99.5% were willing to take part in free diagnosis program and willing to be treated if they got the disease (n=373).

With regards to the attitude score, the answers on the 8 questions/ statements were transformed to a sum score. Because for each positive attitude in answers, people get one score, the maximum score of an individual will be 8. The table with all scores can

be found in Appendix 2. Figure 10 gives the distribution of the attitude sum. In the current study, the researcher considers that each participant may pass the attitude if his/her score is more than 4, which means he/she can give at least 5/8 positive answers in the attitude. As the results, of all participants, 86.7% had the attitude score more than 4, which means only 86.7% pass the attitude (n=325). 11.73% of all participants gave only 2 correct answers because they have not heard about liver fluke infection, but they were willing to take part in the communication and treatment program.

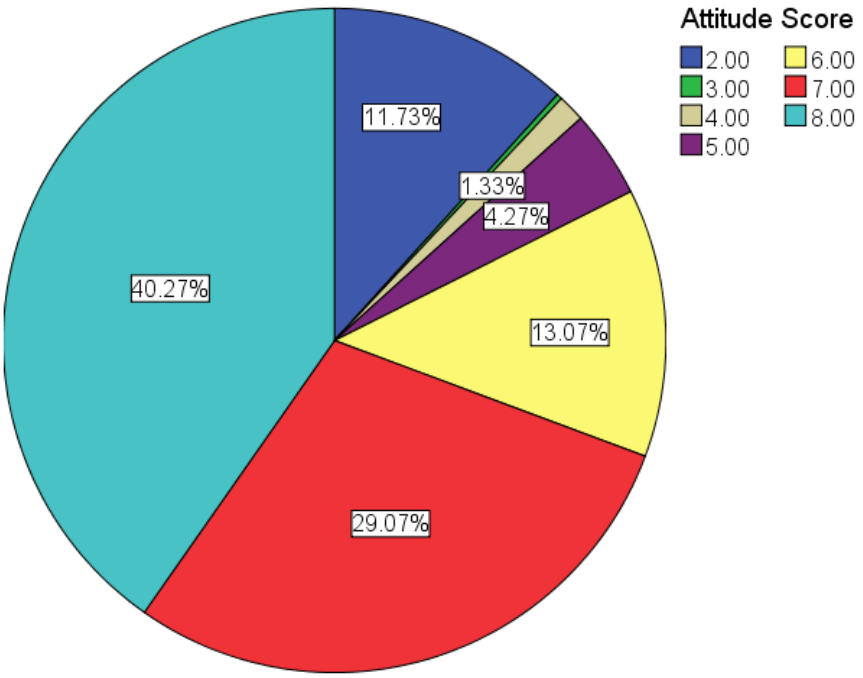

Figure 10. Distribution of attitude score presented as the percentage of the 375 participants with the scores 0 till 8

Next, associations between the demographic characteristics and the attitude score were tested. The study explored the correlation between age of participants and their attitude score. However, there was no correlation between them ($p>0.05$).

Table 9 presents the attitude average score by demographic characteristics. The study explored the attitude average score among 2 groups of participants, female and male, and the average attitude scores in two groups were 6.59 ± 2.05 and 6.50 ± 1.66 respectively. The difference was significant (Independent-samples T test , $t = 0.445$, $df = 373$, $p<0.05$).

Table 9. Attitude average score and Standard Deviation by demographic characteristics of the 375 participants

Demographic characteristics	N	Mean	SD	Min – Max
Gender				
Female	153	6.59	2.05	2 – 8
Male	222	6.50	1.66	2 – 8
Ethnicity				
Kinh	143	6.71	1.69	2 – 8
Dao	181	6.38	2.08	2 – 8
Tay	24	6.17	2.30	2 – 8
Cao Lan	24	7.21	0.78	5 – 8
Other	3	7.33	0.58	7 – 8
Education				
No education	41	5.90	2.44	2 – 8
Primary school	103	6.56	2.12	2 – 8
Secondary school	147	6.63	1.82	2 – 8
High school	62	6.63	1.44	2 – 8
Vocational School	12	7.33	0.78	6 – 8
Bachelor	10	6.50	1.18	4 – 8
Occupation				
Farmer	228	6.64	1.98	2 – 8
Worker	9	6.22	2.17	2 – 8
Student	5	6.20	1.48	4 – 8
Government officer	26	6.54	1.39	2 – 8
Freelance	60	6.32	1.88	2 – 8
Fishseller	5	8.00	0	8 – 8
Fisherman	13	6.67	0.98	5 – 8
Business	15	7.00	1.60	2 – 8
Unemployed	14	5.64	2.53	2 – 8

The study explored the distribution of attitude average score by ethnic groups. Other ethnic groups had the highest attitude average score, followed by Cao Lan people and Kinh people respectively. However, the differences were not statistical significant (One-way ANOVA test, $p>0.05$), which means there are no association between ethnicity and the attitude toward liver fluke infection among the participants.

The study explored the distribution of attitude average score by education groups, in which participants with vocational school education had the highest attitude average score, followed by people with high school and secondary school education. However, the differences were not statistical significant (One-way ANOVA test, $p>0.05$), which means there are no association between education and the attitude toward liver fluke infection among the participants

The study explored the distribution of attitude average score by occupation groups, but the differences among groups are not statistically significant ($p>0.05$), which means there are no association between ethnicity and the attitude toward liver fluke infection among the participants

5.1.4. Current situation on FZTi Practice

In terms of eating raw fish, of 375 participants, 54.9% have eaten raw fish at least one time in their life (n=206), and 48.6% of them drink alcohol together with raw fish (n=99).

Regarding to the habit of eating raw vegetable, 91.2% of all participants have eaten raw vegetable at least one time in their life (n=342), and 10.4% have drunk water directly from lakes/rivers in the last three months (n=39).

Regarding to hygienic defecation, only 71.1% of all participants used hygienic toilet (n=269). The rest of participants dis not use hygienic toilet, and 8.3% of all participants even did not had toilet in their house (n=31), and they discharge feaces free to the surrounded environment.

With regards to diagnosis and treatment, only 29.3% used to examine their feces for liver fluke infections (n=110), and only 19.2% received treatment (n=73).

The frequencies of eating raw fish/raw vegetable were presented in Figure 11. The frequency of eating raw vegetable at least once a week and at least once a month was much higher than that of eating raw fish (27.2% compared to 1.9% and 39.2% compared to 8.3% respectively). Of all participants, the number of people eating raw fish at least once a year was nearly equal to the number of people eating raw vegetable at least once a year with 22.9% and 22.1% respectively. However, while 45% of all respondents did not eat raw fish, only 8.8% did not eat vegetable.

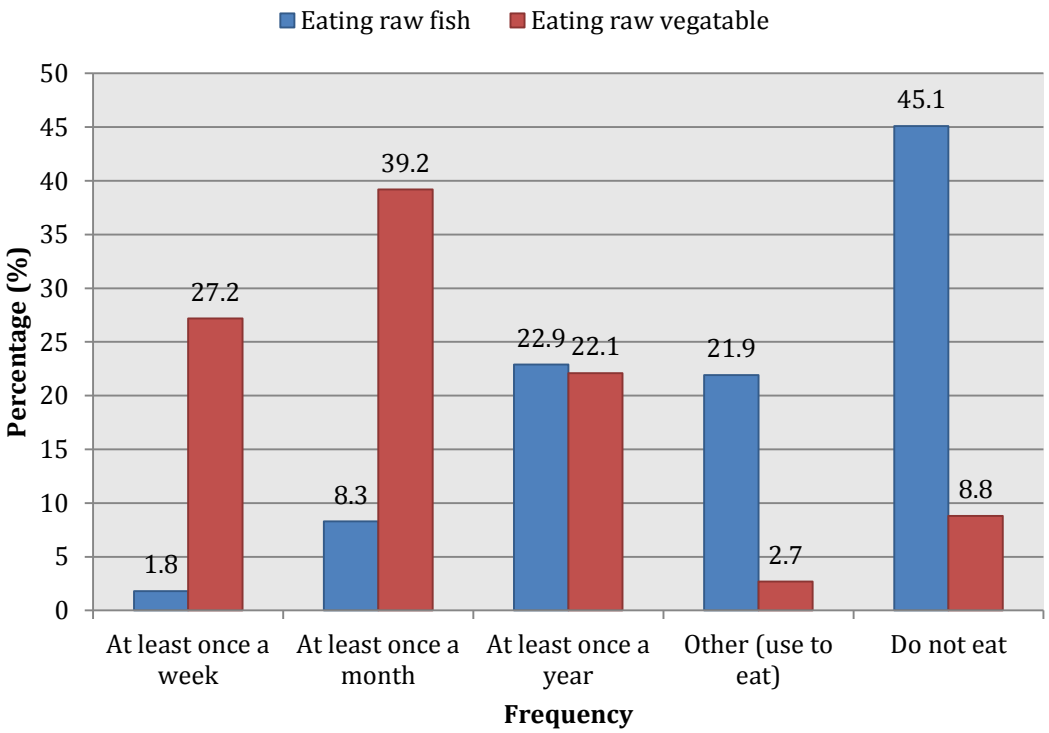

Figure 11. Distribution of raw fish and raw vegetable eating frequency of 375 respondents

Figure 12 gives the distribution of reasons explaining why people eat raw fish. Many people explained that they ate raw fish because it was delicious (20.5%, n=77). 1.6% of all participants thought it was cool and tonic for their body and also, 1.6% confirmed it was their habit (n=6). Only 5.6% of all respondents did not like eating raw fish, but they just enjoyed with family and friends (n=21).

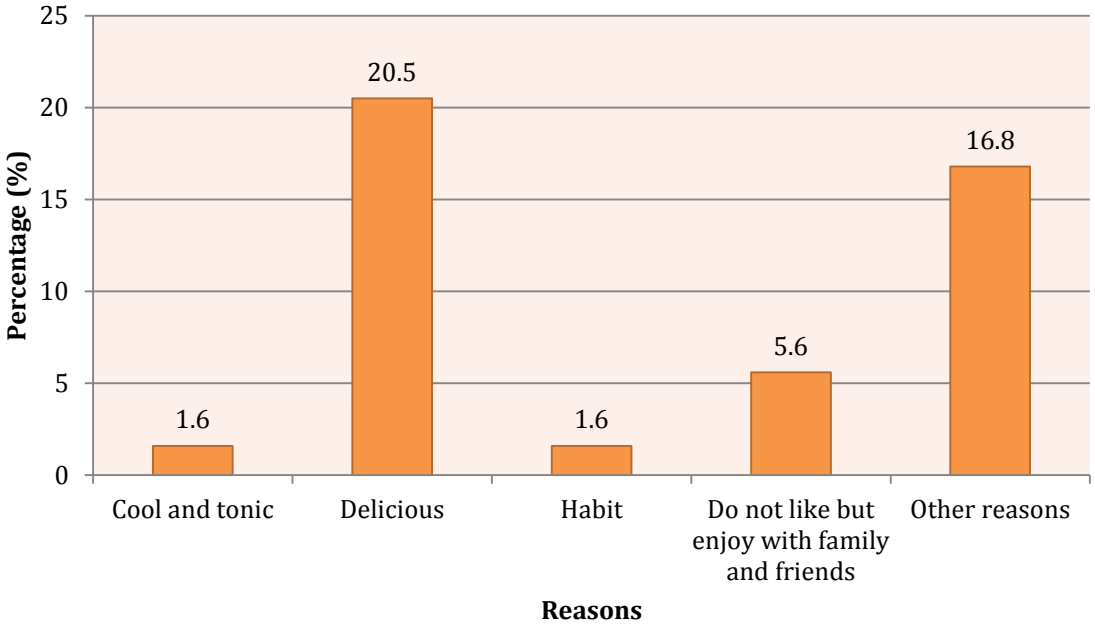

Figure 12. Distribution of reasons of people why they eat raw fish (n=375)

The habit of eating raw fish was more popular among men than women. Among male (n=222) and female (n=153) respondents, the proportion of those eating raw fish was 61.65% and 38.35% respectively. The difference was significant (Independent-samples T test, $t = 2.239$, $p<0.001$).

The study also explored the distribution of eating raw fish by age groups, ethnic groups, but the differences were not significant ($p>0.05$), which means there were no association between age groups and ethnicity with the habit of eating raw fish.

Figure 13 reports the distribution of practice score among all participants. As mentioned above in the method chapter, there were 6 practice questions used to examine the practice of the participants. For each good practice, people got one score. Therefore, the maximum score of individual in practice will be 10. The score table was described in the Appendix 2. In the current study, the researcher considers that each participant may pass the practice if his/her score is more than 3, which means he/she can give at least 4/6 good habits. Of all participants, only 24% had the practice score more than 3, which means only 24% passed the practice (n=91).

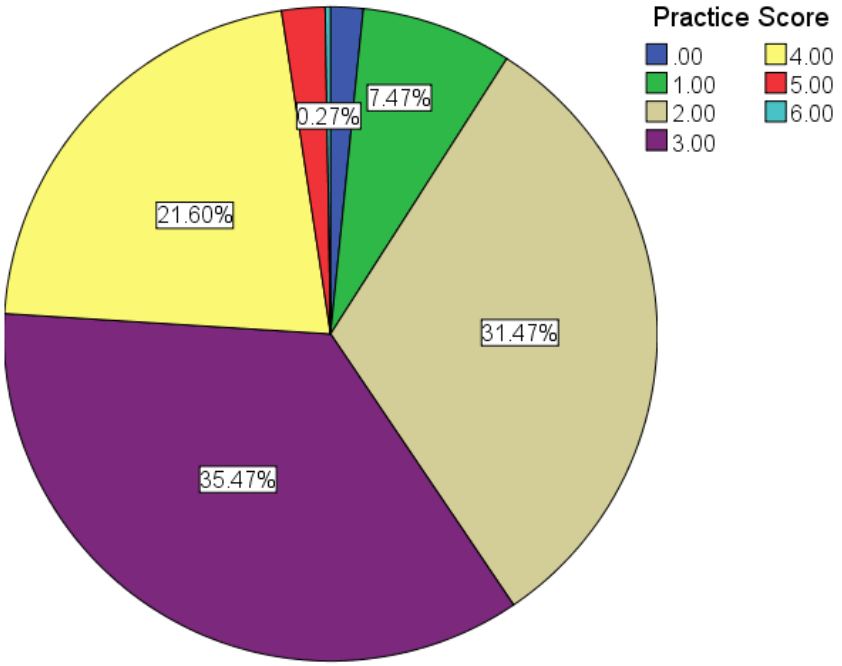

Figure 13. Distribution of Practice Score presented as the percentage of the 375 participants with the scores 0 till 6

Next, associations between the demographic characteristics and the practice score were tested. The study explored the correlation between the age of participants and their practice score, and there was no correlation between the age of participants and their practice score ($p>0.05$), which means there were no association between age and the practice of the participants.

Table 10 presents the practice average score by demographic characteristics. The study explored the practice average score among 2 groups of participants, female and male, and the average practice scores in two groups were 2.85 ± 0.98 and 2.61 ± 1.05 respectively. The average practice score among women was higher than average score among men, which means women had better practice than men. The difference was significant (Independent-samples T test, t =2.239, df = 373, p<0.05).

Table 10. Practice average score and Standard Deviation by demographic characteristics of the 375 participants

Demographic Characteristics	N	Mean	SD	Min – Max
Gender				
Female	153	2.85	0.98	0 – 6
Male	222	2.61	1.05	0 – 5
Ethnicity				
Kinh	143	2.88	1.00	0 – 5
Dao	181	2.69	1.08	0 – 6
Tay	24	2.58	0.65	2 – 4
Cao Lan	24	2.71	0.81	1 – 4
Other	3	2.33	0.58	2 – 3
Education				
No education	41	2.80	0.95	1 – 6
Primary school	103	2.63	1.17	0 – 5
Secondary school	147	2.74	0.98	0 – 5
High school	62	2.82	0.88	1 – 5
Vocational School	12	3.08	0.90	2 – 4
Bachelor	10	3.20	0.79	2 – 4
Occupation				
Farmer	228	2.74	1.04	0 – 5
Worker	9	2.56	0.88	2 – 4
Student	5	2.60	1.14	1 – 4
Government officer	26	3.19	0.80	2 – 4
Freelance	60	2.73	1.06	0 – 6

Fishseller	5	4.00	0	4 – 4
Fisherman	13	2.42	1.08	1 – 4
Business	15	2.80	0.86	1 – 4
Unemployed	14	2.86	0.86	1 – 4

The study explored the distribution of practice average score by ethnic groups, Kinh people had the highest average practice score (2.88), followed by Cao Lan people and Dao people with the average practice score was 2.69 and 2.58 respectively, but the differences were not statistically significant (One-way ANOVA test, $p>0.05$).

The study explored the distribution of practice average score by education groups, but the differences were not statistically significant (One-way ANOVA test, $p>0.05$).

The study explored the distribution of practice average score by occupation groups, but the differences among groups were not statistically significant ($p>0.05$).

The study explored the correlation between the knowledge score and the attitude score. The correlation was regression correlation, and the correlation was weak ($r = 0.699$). The correlation was statistically significant ($p<0.00001$).

The study explored the correlation between the knowledge score and the practice score. The correlation was regression correlation, and the correlation was very weak ($r = 0.083$). The correlation was not statistically significant ($p>0.05$).

The study explored the correlation between the attitude score and the practice score. The correlation was regression correlation, and the correlation was very weak ($r = 0.081$). The correlation was not statistically significant ($p>0.05$).

In conclusion, of all participants (n=375), only 36.3% passed the knowledge assessment (n=136), 86.7% passed the attitude assessment (n=325), and only 24% passed the practice assessment (n=91). There were differences on average knowledge score among different gender (men higher than women, $p<0.05$), among different ethnicities ($p<0.0001$) and among different education ($p<0.00001$). There was a difference in the frequency of the habit of eating raw fish between men and women (men higher than women, $p<0.001$). Finally, there was difference on average practice score between men and women (women higher than man, $p<0.05$). There was weak correlation between the knowledge score and practice score ($p<0.00001$).

5.2. Risk Behavior Investigation

In the risk behavior investigation, 27 local people aged from 25 to 64 years olds were invited to take part in in-depth interviews. Of these 27 people, 16 people came from Vu Linh commune and 11 people from Phuc An commune. 13 participants of them were collected from KAP survey when they were showing the habit of eating raw fish and they were opened to share the story of eating raw fish. The rest of participants were referred by the previous interviewee or the village health workers.

5.2.1. Characteristics of risk behaviors

Eating raw fish (Gỏi cá)

In fact, "Gỏi cá" is a popular raw fish dish eaten by local people in Vu Linh and Phuc An, Yen Bai. Three respondents reported that the habit of eating raw fish has started in the 1970s when Thac Ba lake was shaped, and it was the result of building Thac Ba Hydropower, and the rest of the respondents confirmed that they have seen the habit of eating habits for decades. Many other people reported that they had eaten raw fish since they were young (for many years ago). The information of eating raw fish ("Gỏi cá") is summarized in Table 11 below.

Table 11. Summary of information on habit of eating raw fish

Interview topic	Main answers
Origin of fish	Mostly in Thac Ba lake, rarely in fish ponds
Fish species	Mainly: Ditch fish (cá mương), Snake-head fish (cá quả), Tilapia fish (cá rô) Others: cá chép, cá trắm, cá mè, cá thiểu, cá chày
Preparation procedure	Fish is washed and cleaned, and then it is cut in to thin slices (2-3 mm). After that, it is mixed with lime juice, salt and seasoning and wait for 15 to 30 minutes. Finally, it is mixed with fried rice powder and herbs (or raw vegetable)
Location of eating raw fish	Home or friend's home
Occasion	No special occasion, usually after people caught good fishes and drink alcohol together
Seasons of eating	Mainly in summer, raining season, avoiding breading season, from April to September. Some people reported that they eat raw fish all around year.

Interview participants reported that, because Thac Ba lake is the main source of fish in Yen Bai and enables residents who live by the Thac Ba lake side to go fishing, mostly consumed raw fish is taken from Thac Ba Lake. Although there are a few of fish pond in the study sites, local people believe that fishes from Thac Ba lake are much

fresher, cleaner, and they are much more delicious than fishes taken from fish ponds: *"Fishes from lake are much cleaner than fishes in fish ponds, there is nothing inside their intestine"- "Cá hồ sạch hơn cá ao nhiều, mổ ra trong bụng không có gì luôn" (IIPA22)*. Besides that, fish in the lake is available and it is easy to catch fish there.

The favorite fish species that were used to prepare raw fish were Ditch Fish and Snake-head Fish since they were firm and brought very good taste to people who enjoy them. However, Tilapia Fish was the most common fish species for making raw fish because of its availability in the lake. Some people reported other fish species such as *ca chep, ca tram, ca thieu, ca me, ca chay* also used to prepare raw fish.

According to interview participants, the procedure of making *Gỏi cá* may differ from family to family; however, generally fishes were not well-cooked. After fishes are washed and cleaned, they are cut into thin slices (the thinner the better) and mixed with lime juice, salt, and seasoning in 15 – 30 minutes. After that, fishes are mixed with fried rice powder and herbs or raw vegetables, and they are ready to serve without cooked under high temperature.

Most fishermen had the habit of sharing raw fish together. After going fishing, they usually gather to prepare raw fish and drink alcohol. During this time, their family members included women and children may also join and enjoy raw fish. It is reported that raw fish was consumed mainly in the summer and autumn which are also the raining season in the North of Vietnam. These seasons usually last from April to September. Local people said that during this period, fish had finished the breading season, so the fishes were firm, fat and, there were no eggs inside the female fishes, which leads to better taste. This period of time was also reported as fishing time annually. However, some people admitted that they may eat raw fish anytime in a year, and they did not care about the seasons. *"We do not care about seasons, and we even eat twice a day, 4 to 5 times a week" - "Bọn anh ăn chả cứ mùa nào, có ngày ăn 2 bữa, tuần ăn 4 – 5 bữa" (IIPA17)*

With regards to population who consumed raw fish, people admitted that there were no any differences between the age groups among adults who eating raw fish. However, it is highly likely that men consumed raw fish than women because the action of eating raw fish came with the action of drinking alcohol. In other words, men usually made raw fish as a dish to enjoy together with alcohol: *"If I do not drink alcohol I will not make raw fish"- "Nếu mà không uống rượu thì tôi cũng chẳng ăn gỏi cá" (IIVL16),or "We only eat raw fish when we drink alcohol"-"Tôi chỉ ăn gỏi cá khi uống rượu thôi" (IIPA23)*. Fishermen or people who lived by the lakeside tended to have habit of eating raw fish.

Eating raw vegetable

Interview participants told that eating raw vegetable is a popular habit not only in Yen Bai but also nationwide. However, eating raw vegetable in the dynamic area of liver fluke may put local people under the risk of getting liver fluke infection. In study sites, people usually grow some types of herbs and vegetable in their garden and water

them with water from well or Thac Ba lake. Raw vegetable was also used as an ingredients served together with raw fish: *"You need to eat raw vegetable with raw fish"*- "Ăn gỏi cá thì phải ăn cả rau sống" (IIPA19)

Drinking untreated water

Many fishermen reported that they have a habit of drinking untreated water directly from Thac Ba lake during the time they go fishing: *"I am thirsty but I do not have clean water with me so I drink water in the lake"-"Đi hồ khát quá không có nước uống thì uống nước ở hồ luôn" (IIVL4).*

5.2.2. Reasons that local people perform risk behaviors

Habit shaped from previous generation

Firstly, it was confirmed by local people that consumption of raw fish *(Gỏi cá)* is not a traditional custom or culture. 26/27 participants agreed that raw fish was not traditional customs, and a few of them said that because it was not served in the traditional festivals or in local special occasions. They just simply thought that it was a dish that appeared many years ago: *"This dish was eaten for a long time ago, about 30 or 40 years ago" – "Món này có từ lâu lắm rồi, khoảng ba bốn chục năm trở lại đây (IIVL5); "I have been eating raw fish since I was 20, and it has been 20 years" – "Anh ăn gỏi cá từ lúc anh 20 tuổi, đến nay phải 20 năm rồi" (IIPA25).*

The habit of eating raw fish was passed from former generation to later generation, particularly in families in which parents ate raw fish, *"even little child asked for eating raw fish" - "Kể cả trẻ con bé tí nó cũng đòi ăn" (IIVL12)*. Therefore, eating raw fish is the habit shaped when people were young: *"When I was young, my father used to go fishing and made raw fish for me, so I ate many raw fish from different species and I really liked it" - Từ hồi em bé bố em hay đi hồ, cứ được cá về là làm gỏi nên em được ăn nhiều loại cá lắm, em rất thích ăn (IIVL12); "Most of fishermen and his family members eat raw fish, adults enjoy raw fish with alcohol and children eat raw fish with rice" – "Dân đi hồ ai cũng ăn, cả nhà ăn luôn, người lớn uống rượu thì uống còn trẻ con không uống rượu thì ăn với cơm" (IIVL8)*

Consequences of poor economic condition and culture factors

From the response of the participants, we figured out that the habit of eating raw fish was the consequence of poor economic condition. In fact, most of local people were farmer without stable income, and they produced and consumed by themselves; therefore, going fishing was the way for them to earn more money and improve their daily meals, and fish became one of their the main food resources. A numerous respondents reported that because of poor economic condition, they did not concerns to their health: *"our life style depends on our economic condition, so we eat what we have and*

we do not really care about health" - "sinh hoạt phụ thuộc vào điều kiện của nhà mình, có gì chúng tôi ăn nấy, không quan trọng đến sức khỏe lắm (IIVL1). Sometimes, fish was the only food that they had, so they tried to prepare fish in different ways to eat, so they made raw fish: *"We are poor, so we do not have enough money to buy other good food. If I have money, I will not eat raw fish, I will buy beef and other good dishes, but I do not have money, so we only eat fish, and I make raw fish to make fish different" - "Nghèo không có tiền chả mua được cái ngon. Nếu có tiền thì tôi không cần ăn gỏi cá, mua thịt trâu, các thứ ngon, nhưng không có tiền thì chỉ ăn cá, rồi làm món nào lạ lạ hay hay để ăn cho đỡ chán" (IIVL10).*

The researcher found out that culture factors also affect the habit of eating raw fish. People usually shared and enjoyed raw fish together: *"When our friends visit my family, and we catch a big fish about 4 to 5 kilograms, we usually invited our friends to make and enjoy raw fish" – "Khi mình bắt được con cá to 4 5 cân thì rủ nhau thái gỏi ăn" (IIVL10); "My friends invited me, so I eat" – "Bạn bè mời thì mình ăn thôi" (IIPA19).* This action enabled to pass this bad habit from person to person: *"I do not like it very much but people eat it, so I enjoy with them" – "Em không thích ăn gỏi cá lắm nhưng thấy mọi người ăn thì ăn cũng ăn" (IIVL3).*

In those meals or parties, people enjoy raw fish with alcohol, and it is seen as the way for people socialize to each other: *"People usually go fishing together and then they make raw fish and enjoy it with alcohol" – "Người ta thường hay đi hồ với nhau rồi tụ tập làm gỏi cá để uống rượu" (IIVL1)*

Another culture in Yen Bai was that people respected each other, so they usually invite their friends to try strange or delicious dishes such as raw fish. Therefore, it was difficult for people to refuse these kinds of invitation especially in meals or parties. Some people reported that they did not like or did not want to eat raw fish, but they could not refuse the invitation from the host: "My friends invited me, and I respected them so I eat" – "Người ta đã mất công mời, mình cũng tôn trọng người ta mình ăn" (IIVL5). Some people may be aware of the risk but they cannot refuse: *"I know that it is dangerous, but I cannot refuse when I drink alcohol with friends" – "Cũng biết là nguy hiểm nhưng ngồi uống rượu cùng chẳng lẽ lại không ăn" ((IIVL7).*

Lack of knowledge on liver fluke infection

The researcher also figured out that one of the important reasons which lead to risk behaviors among local people is that local people lack the knowledge on FZTi infection and they were not aware of liver fluke infection. Instead of thinking that eating raw fish was a bad habit, they believed that raw fish was tonic and good for their health: *"Raw fish is good and tonic, it is good taste, fat and more delicious than pork" - Ăn gỏi cá bổ chứ, ăn thấy ngọt, béo, còn ngon hơn cả thịt" (IIVL8); "It is really easy to eat and after eating, I feel cooler inside my body" – "Rất dễ ăn mà ăn vào thấy trong người mát lắm" (IIVL9); "After eating, I feel cooler, so I eat it raw fish regularly" – "Ăn goir xong cảm thấy mát trong người nên là hay ăn" (IIPA21).*

More seriously, we explored that raw fish was interested by local people. 19/27 interviewees who got this habit reported that they liked eating raw fish, and they found it was really tasty and delicious: *"Raw fish is tasty, so I eat it, I do not know about its harmfulness" – "Cứ thấy ngon là mình ăn thôi, còn hại cho bản thân thế nào thì chú không biết" (IIVL9).* Some people even showed their desire to eat raw fish.

Many participants admitted they were not aware of the risk of getting liver fluke when eating raw fish or raw vegetable: *"I found it really tastety and do not think that it may lead to any kinds of fluke infection" – "Cảm thấy nó ngon thì ăn thôi, không nghĩ đến là ăn gỏi cá có thể bị nhiễm giun sán" (IIVL1); "I don't know that eating raw vegetable may leads to liver fluke infection" – "Tôi không biết là ăn mỗi rau sống cũng có thể dẫn đến nhiễm sán lá gan"(IIVL2); " I don't think that eating raw fish may leads to liver fluke infection" – "Em không nghĩ ăn gỏi cá có thể bị nhiễm sán lá gan" (IIVL3); "Fish is fresh and good so I invite my friends, nobody thinks about fluke infection" – "Cá ngon thì mời bạn bè đến ăn, chả ai nghĩ đến sán đâu mà" (IIPA20).*

A few of participants showed that they were aware of the disadvantages of eating raw fish, but their knowledge was insufficient they understand incorrectly about the risk: *"I am aware that eating raw fish or raw vegetable may get infections, but it depends on individual's immunity ability" – "Cũng nghĩ là ăn gỏi cá có thể nhiễm bệnh nhưng cái này phụ thuộc sức đề kháng của từng người thôi (IIVL4); "I heard that eating raw fish may get liver or intestine diseases, but I do not understand clearly about the harmfulness" – "Cũng nghe ăn gỏi cá có thể hay bệnh về gan hay đường ruột, nhưng mà cũng chưa nắm rõ được tác hại của nó" (IIPA21).*

As the consequences of lacking knowledge on liver fluke infection, many people even knew the risk of FZTi, but they underestimated the harmfulness of the liver fluke infection and showed to bad attitude towards the prevention: *"We cannot die immediately and we can be treated by drugs, so I am not scared very much. If eating raw fish may lead to cancer and death, I will not eat it anymore" – "Chết từ từ chứ không chết ngay được và có thuốc chữa, chữa nên là mình không sợ. chứ giả dụ như bảo ăn cái này bị ung thư rồi chết luôn thì chắc là mình sẽ không dám ăn" (IIVL6); "If you eat raw fish, you cannot die immediately" – "Ăn gỏi cá này không chết ngay được đâu" (IIVL8).*

In conclusion, eating raw fish/vegetable and drinking untreated water from Thac Ba lake are risk behaviors observed among local people in Yen Bai province. The performance of these risky habits can be explained by the lack of knowledge on liver fluke infections, poor economic conditions and typical cultural features of local people.

VI. DISCUSSION

Food-borne zoonotic trematode infection (FZTi) is one of the primary public health problems in Asian countries, particularly South-East Asian countries. Many studies regarding to FZTi, specifically liver fluke infection were conducted in this region and in Vietnam in order to enhance the knowledge on the disease, the prevalence of liver fluke infection in animals such as dogs, cats, pigs (small liver fluke infection) and buffalos, cattle, goats (large liver fluke infection), the prevalence of liver fluke infection in humans together with behaviors that put people at risk of getting liver fluke. This thesis study aimed to understand the current knowledge, attitude, and practice regarding to liver fluke infection among local people in two lakeside communes in Yen Bai province. In this mountainous area, people performed risk behaviors including eating raw fish/vegetable, and drinking untreated water from the Thac Ba lake. The results of the current study will be served as the baseline data for the FOODTINC project in Vietnam as well as contribute a small part to the knowledge among this research field.

By applying the integrated approach with both quantitative and qualitative components in this thesis study, we found that: (1) the knowledge regarding to liver fluke infection among local people was low with 11.5% of all participants having never heard of liver fluke, and only 36.27% passing the knowledge assessment (more than 50% good answers); (2) the attitude regarding to liver fluke infection and its prevention was quite positive, which was determined by 86.6% of all respondents passing the attitude assessment; and despite of the fact that many people had not heard about the disease, they were willing to join the communication or treatment program if applicable; (3) the proportion of people with good practice was low with only 24% of all participants passing the practice assessment; and (4) the habit of eating raw fish in Yen Bai was the consequence of not only the lack of knowledge but also of others factors including economic and cultural factors.

In comparison to other KAP studies, the knowledge, attitude, and practice scores of the population in the current study were lower than that among people in the study conducted by Natthawut Kaewpitoon (2007), who reported a proportion of people with good knowledge, attitude, and practice of 79.72%, 72,1%, and 60.83% respectively in Thailand (9). Although Thailand and Vietnam have many common features on the climate, the culture, and the habit of eating raw fish, there are important differences as well. Thailand is one of the top developed country in the region, of which the economic conditions are much more higher than that of Vietnam with the GDP per capita of 6,591 USD compared to the GDP per capita of 2,354 USD in Vietnam (53, 54). So the population in the Thai study had higher education than the population in Vietnamese study. Besides that, the differences on the study design can be also the reasons for the differences on KAP results. For example, Natthawut Kaewpitoon (2007) designed that knowledge was ranked as poor and good scores if his/her score was lower or higher than the median score (9), which is different from the current study.

In comparison to other areas in Vietnam, there are differences in the KAP between Yen Bai's and other area's population. Specifically, the knowledge and practice

assessment levels of residents in Yen Bai are lower than the knowledge and practice levels of people in Thanh Hoa, Central region of Vietnam (2005) where 46.5% of the studied population passed the knowledge assessment and 30.6% passed the practice assessment (10). The proportion of good knowledge and practice people in current study are lower than the proportion of good knowledge and practice people in the study conducted by Le Duc Tho (2014) in Phu Yen, Southern region in Vietnam, with 39.2% passed knowledge assessment and 40.1% passed practice assessment (11). While only 33.3% of all the studied population in Phu Yen ate raw fish, 54.9% of all participants in Yen Bai used to eat or had habit of eating raw fish. However, the attitude of people in Yen Bai was more positive than other areas, and most of people were willing to take part in the communication and treatment programs to receive more information on liver fluke and to be treated if they get the infection. The differences among these studies may be explained by the study design and there are no any test done to confirm whether the differences among population in three provinces are statistically significant or not. However, interestingly, these three provinces in three studies may be represented for three regions in Vietnam, the North, the Central land, and the South.

In the current study, the populations were living in the rural mountainous area with low education, and a high proportion of the population was farmer with the habit of going fishing in Thac Ba lake, so they had much free time and had the habit of sharing raw fish while drinking alcohol together. The results in the risk behavior investigation showed that the habit of eating raw fish was affected by gender. Specifically, men were more likely to eat raw fish than women because men had usually gone fishing together, after going fishing, they liked to gather to drinking alcohol and eating raw fish. Raw fish was seen as the popular favorite dishes in the alcohol party among village men. Women who ate raw fish were mostly from the household in which the men such as the father, the husband or the son had the habit of eating raw fish.

The study also showed that men still keep their habit of eating raw fish after knowing the risk of getting liver fluke infection because they know the disease may be treated well by drugs. This result is in line with the findings in the report conducted by Dang Thi Cam Thach (2008) (30). Additionally, people who live in the villages with the habit of sharing raw fish is also one factor that transmits the habit of eating raw fish and makes it more popular, which is consistent with the findings in the study implemented by Nguyen Thi Nga (34). The risk behavior investigation revealed that the action of eating raw fish was not associated with a few of demographic characteristics such as age groups, ethnic groups, and education levels. This result was confirmed by the results in the KAP survey, which reported that the differences in the number of people eating raw fish among different age groups, ethnic groups, and education levels were not significant. Education level was not associated with the habit of eating raw fish because most of people in the thesis were low educated (77.6% of all participants were lower than high school level).

The thesis study also revealed that gender and age is a factor affecting the knowledge because the knowledge average score among men was higher that among

women, and there was association between the age of participants and the knowledge score, and the younger the participant is, the better knowledge they have. This fact is understandable because the young is achieving higher education and it is much easier for them to assess information via mobile phones or internet.

The findings showed that there was association between the knowledge score and attitude score, and the better knowledge, the better attitude. However, there was not enough evidence to confirm the relationship between knowledge and practice of population, and between attitude and practice of population. This revealed that the bad practice was not only because of the knowledge and attitude, but it was caused by other factors in the living environment, which was consistent with the results in the risk behavior investigation that reported the habit of eating raw fish was the consequence of poor economic condition and cultural features. However, a high proportion of respondents agreed to not eat raw fish anymore to prevent liver fluke infection (85.3%).

The findings of the study contributed to filling in the gap of knowledge regarding to liver fluke infection in Vietnam, and they confirmed again the findings of the previous studies in different contexts. The results reflected the weak knowledge and bad practice of residents not only in two studied communes but also all around the Thac Ba lake. It is apparent that living near natural water bodies, specifically Thac Ba lake in Yen Bai, plays an important role in the context of eating raw fish and infecting with liver fluke. The lake is the origin of the raw fish eating habit, and it provides huge source of fish, so it is easy for nearby residents to exploit and form the habits of going fishing and sharing raw fish. This study can be translated to other similar areas in which the residents live near high-density natural water bodies and eat raw fish.

The results of this study must be interpreted taking into account both strengths and limitations. An important strength of the study is using the integrated approach with both quantitative (KAP) and qualitative methods, so the results in each part may support and complement each other. In the KAP survey, the respondents may give different answers in different context although their KAP is constant, for example, respondents may have given social desirable answers if they feel unsafe at the health station. However, the in-depth interview at home provided the participants with comfortable environment and safe feeling to answer the questions. The information from the qualitative part of the study can also explain the relation among variables in KAP. With regards to limitations, the sample of KAP was taken based on the parasitological part, which may have led to bias due to sample. Although the parasitological part of the study randomly selected people with the age from 5 to 65 for the blood and feacal test, our thesis study only took the people from 15 to 65 years old for the KAP test with dropping people from 5 to 14 years old. The differences among demographic characteristics and KAP that we observed were statistically significant, but the differences were small and the correlation does not show a strong relationship among variables. Besides that, the current knowledge, attitude, and practice are described primarily through the scores, and in the way to calculate the scores, the scores for the questions are equal without the different weight for different questions. For

further use of the KAP model, this is a good framework to apply in the similar health problem, helminthes for example, and it would return much more accurate results if there is the revision in the weight of the different questions in the questionnaire.

In conclusion, residents in two communes in Yen Bai, Vu Linh and Phuc An still have poor knowledge and perform bad practice regarding to liver fluke infection. The findings suggest that the lack of knowledge is not the only reason leading to the habit of eating raw fish but also the economic and cultural factors; therefore, to control the FZTi in Yen Bai province, particularly in the lakeside areas, integrated control intervention is essential.

VII. CONCLUSION AND RECOMMENDATIONS

Food-borne zoonotic trematode infection, particularly liver fluke infection, is drawing concerns in Vietnam. By using the integrated approach, the thesis answered two research questions. Firstly, we understood the current situation of knowledge, attitude, and practice regarding to liver fluke infection of local people aging from 15 to 65 in Yen Bai province. Although their attitude is quite positive toward the liver fluke infection and its prevention, their current knowledge is poor and they still perform bad practice which leads to infecting with liver fluke. Secondly, the action of performing the risk behaviors is the consequences of not only the lack of knowledge on liver fluke, but also the poor economic conditions and cultural factors. The findings of the study not only contribute to enhancing the knowledge on liver fluke in Vietnam, but they are also served as the baseline assessment for the FOODTINC project in Vietnam.

The circumstances of FZTi and related risk habits are really situational and specific for Yen Bai province with the existing Thac Ba lake. The reasons behind local people's risky habits were not only the lack of knowledge and bad practice regarding to FZTi, but the habits were also affected by socio-economic and cultural factors. Therefore, the researcher recommends that it is essential to have an integrated intervention in order to improve the current status in Yen Bai. Awareness raising campaign can be considered as a suitable way in the intervention to equip local people with FZTi knowledge because nearly 100% of local people are willing to join a communication program to receive information and improve their knowledge on liver fluke infection. The raising campaign should educate and advocate local people to drop the habit of eating raw fish, raw vegetable, and drinking untreated water directly from Thac Ba lake and village ponds. It should focus much on the subjects who are men and fishermen. The information or materials used in the campaign should be easily understandable for low education subjects. Besides that, the campaign should be combined with diagnosis and treatment for infected people to reduce the prevalence of liver fluke infection and make the area not endemic area. Last but not least, in the integrated intervention, it is essential to gather stakeholders included authorities and the local people particularly of the high risk population (men and fishermen) to take their voices into account on how to eliminate the risky habits. The group discussion among the stakeholder groups, workshops, or competition seeking for the initiatives can be used in this integrated intervention.

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APPENDIX

Appendix 1. Questionnaire on Knowledge – Attitude – Practice regarding to liver fluke

QUESTIONNAIRE FOR INDIVIDUAL ON KNOWLEDGE, ATTITUDE, AND PRACTICE ON LIVER FLUKE

INTERVIEWER

Name of interviewer:.....

Date of interview:...../...../2018

Place of interview:.....

Individual code:.....

PART I: GENERAL INFORMATION

A1. Full name: .....

A2. Address:

Village: .....Commune:.....

District:.....Province:.....

A3. Year of birth:.....

A4. Sex: 1. Male 2. Female 3. Other

A5. Ethnicity:

1. Kinh 2. Nung 3. Tay 4. Other (please specific):.....

A6. Level of education:

1. Never attended school
2. Primary school
3. Secondary school
4. High school
5. Vocational School
6. Bachelor degree
7. Postgraduate
8. Other (specify).....

A7. Major Occupation

1. Farmer
2. Worker
3. Student

4. Government employee
5. Freelance
6. Other (specify)……

PART 2: KNOWLEDGE, ATTITUDE AND PRACTICE ON LIVER FLUKE INFECTION

B. Knowledge

B1. Have you ever heard about liver fluke?

1. Yes
2. No (***move to C4***)

B2. What kinds of liver fluke do you know?

1. Large liver fluke and small liver fluke
2. Large liver fluke
3. Small liver fluke
4. Don't know
5. Other (specify)…….

B3. Does liver fluke affect to human health?

1. Yes
2. No
3. Don't know

B4. How can people get liver fluke infection? ***(Multiple choices)***

1. Eating raw fish/undercook fish
2. Eating raw pork
3. Eating raw beef/buffalo
4. Eating raw vegetable
5. Other (specify)……..
6. Don't know

B5. What is your opinion of the statement below? ***(read out-loud each statement)***

	True	**False**	**Don't know**
1. Liver fluke can be transmitted directly from human to human			
2. After patients with liver fluke infection are successfully treated, they cannot get reinfected			

3. Eating infected fish always causes liver fluke infection, whether or not the fish is cooked.			
4. Liver fluke infection can be treated by drugs			
5. Liver fluke CANNOT be prevented			

B6. What are the symptoms of people get infected with liver fluke? ***(Multiple choice)***

1. Abdominal pain
2. Dyspepsia
3. Fever
4. Inappetence
5. Weight loss
6. Jaundice
7. Itch
8. Gastrointestinal disturbances
9. Allergic
10. Other (specify)…… 11. Don't know

C. Attitude

C1. In your opinion, which level of serious if a person gets infected with liver fluke?

1. Not at all serious
2. Slightly serious
3. Moderate serious
4. Very serious

C2. How much do you concern about liver fluke? ***(read all choices for the interviewee)***

1. Not concerned
2. Slightly concerned
3. Very concerned

C3. How much do you agreed with the statement below?

(Likert scale: 1-Disagree; 2-Neither agree nor disagree; 3-Agree)

	1	**2**	**3**
1. To prevent liver fluke, I do not eat raw fish or undercooked fish any more			
2. To prevent liver fluke infection, I don't eat raw vegetable			
3. To prevent liver fluke, I do not defecate in public space			
4. To prevent liver fluke, I do not feed fresh human and animal feces for			

fish			

C4. If we organize a communication event about prevention of liver fluke in the community, do you want to participate?

1. Yes
2. No

C5. If we organize a medical examination event and implement mass drug administration programs, do you participate?

1. Yes
2. No

D. Practice

D1. Have you ever eaten raw fish/undercooked fish?

1. Yes
2. No ***(move to D5)***

D2. How often do you eat raw fish?

1. At least once a week
2. At least once a month
3. Once a year
4. Other (specify)……

D3. Did you drink alcohol when you eat raw fish?

1. Yes
2. No

D4. Why do you eat raw fish? ***(Multiple choice)***

1. Tonic
2. Delicious
3. Habit
4. Don't want to eat, but enjoy with family member/friend
5. Other (specify)……

D5. Have you ever eaten raw vegetable?

1. Yes
2. No ***(Move to D7***)

D6. How often do you eat raw vegetable?

1. Every day

2. At least once a week
3. At least once a month
4. At least once a year
5. Other, (specify)……..

D7. Did you drink water directly from lake/river in last 3 months?

1. Yes
2. No
3. Don't remember

D8. What type of toilet are you using? (***One choice***)

1. Single tank
2. Double tank
3. Temporary pit
4. Septic tank
5. Cầu tõm (direct to the pond)
6. Other (specify)……
7. Don't have toilet (where do you do defecate?.....)

D9. Have you ever examined feces or blood to diagnose liver fluke?

1. Yes
2. No
3. Don't know/Don't remember

D10. Have you ever used drug for liver fluke?

1. Yes
2. No
3. Don't know/Don't remember

Appendix 2. Questions and ideas to guide the in-depth interview for risk behaviors

1. Ask background information: name, age, occupation, family's members
2. Have you ever eat raw fish/raw vegetable? If yes, WHY do you do that?
3. Where do you usually take fish/vegetable from to eat raw fish/raw vegetable? WHY?
4. How often do you eat raw fish/ raw vegetable? WHY?
5. What fish species do you usually eat raw fish? WHY do you eat that species?
6. How do you prepare raw fish? Please describe.
7. Where do you usually eating raw fish? (at home/restaurant/friend's home) WHY?
8. In what season/ occasion do you usually eat raw fish/ vegetable? WHY?
9. Which group of population usually eats raw fish? WHY do they do that?
10. What do you think about the habit of eating raw fish/ raw vegetable?
11. Do you know that eating raw fish/ vegetable may lead to liver fluke infection? If yes, WHY do you still eat raw fish/ raw vegetable?
12. Have you ever drink uncooked water directly from river/lake? If yes, WHY?
13. How often do you drink uncooked water directly from river/lake? WHY?
14. What else do you want to share?

Appendix 3. Score table for answers of the KAP questionnaire

Question code	Question	Correct Answers	Score
	KNOWLEDGE		
B1	Have you ever heard about liver fluke?	Yes	1
B2	What kinds of liver fluke do you know?	Large liver fluke & small liver fluke Or Large liver fluke Or Small liver fluke	1 (if participants gave one of the correct answers)
B3	Does liver fluke affect to human health?	Yes	1
B4	How can people get liver fluke infection?	Eating raw fish/ undercook fish Eating raw pork Eating raw beef/ buffalo Eating raw vegetable	1 (if participants gave all correct answers) 0 (if participants did not give all correct answers)
B5.1	Liver fluke can be transmitted directly from human to human	False	1
B5.2	After patients with liver fluke infection are successfully treated, they cannot get reinfected	False	1
B5.3	Eating infected fish always causes liver fluke infection, whether or not the fish is cooked.	False	1
B5.4	Liver fluke infection can be treated by drugs	True	1
B5.5	Liver fluke CANNOT be prevented	False	1
B6	What are the symptoms of people get infected with liver fluke?	Abdominal pain Dyspepsia Fever Inappetence Weight loss Jaundice Gastrointestinal disturbances Allergic	1 (if participants gave all correct answers) 0 (if participants did not give all correct answers)
		Maximum Score for Knowledge	**10**
	ATTITUDE		
C1	Which level of serious if a	Moderate serious	1

	person gets infected with liver fluke?	Or Very serious	
C2	How much do you concern about liver fluke?	Very concerned	1
C3.1	To prevent liver fluke, do not eat raw fish or undercooked fish any more	Agree	1
C3.2	To prevent liver fluke infection, don't eat raw vegetable	Agree	1
C3.3	To prevent liver fluke, do not defecate in public space	Agree	1
C3.4	To prevent liver fluke, do not feed fresh human and animal feces for fish	Agree	1
C4	If we organize a communication event about prevention of liver fluke in the community, do you want to participate?	Yes	1
C5	If we organize a medical examination event and implement mass drug administration programs, do you participate?	Yes	1
		Maximum Score for Attitude	**8**
		PRACTICE	
D1	Have you ever eaten raw fish/undercooked fish?	No	1
D5	Have you ever eaten raw vegetable?	No	1
D7	Did you drink water directly from lake/river in last 3 months?	No	1
D8	What type of toilet are you using?	Single tank Or Double tank Or Temporary pit Or Septic tank	1
D9	Have you ever examined feces or blood to diagnose liver fluke?	Yes	1
D10	Have you ever used drug for liver fluke?	Yes	1 (both answers in D9 and D10 are Yes)
		Maximum Score for Attitude	**6**