

# HEALTH LITERACY ASSOCIATED WITH LIVER FLUKE PREVENTION AND CONTROL AMONG SECONDARY SCHOOL STUDENTS IN NORTHEAST THAILAND

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## Abstract

This study aimed to investigate health literacy and its association with liver fluke prevention and control among students in risk areas. A cross-sectional descriptive study was conducted among 20 schools from 20 provinces in northeast Thailand, between May to June 2017. Students were selected by cluster random sampling and they completed constructive questionnaires. The association between health literacy and liver fluke prevention and control was analyzed by using multiple logistic regressions. A total of 1,100 students was included in the study. The majority were females (75.82%). The majority of the students (84.09%) need to modify their practice level regarding liver fluke prevention and control. Health literacy at the highest level was significantly associated with good practice, and included cognitive skills ( $OR_{adj} = 2.11$ , 95%CI: 1.15-3.86,  $p = 0.026$ ), communication skills ( $OR_{adj} = 2.63$ , 95%CI: 1.58-4.40,  $p < 0.001$ ), and media literacy skills ( $OR_{adj} = 1.78$ ; 95%CI: 1.12-2.83;  $p\text{-value} = 0.030$ ). In conclusion, health literacy can be used as a desirable strategy for informing those with a lower practice level regarding liver fluke prevention and control among secondary school students in Northeastern Thailand. This study indicates that behavior intervention is urgently needed, especially cognitive skills, communication skills, and media literacy skills.

**Keywords:** Health literacy, liver fluke, prevention and control

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## Introduction

Liver fluke caused by *Opisthorchis viverrini* is one of the major public health problems in some countries in Southeast Asia, particularly Thailand, Laos, Cambodia, and Vietnam (Sithithaworn *et al.*, 2012). The infection is associated with cholangiocarcinoma (CCA), bile duct cancer (Sripa *et al.*, 2010; International Agency for Research on Cancer, 1994). CCA is the primary liver cancer in Thailand with 85% of the reported cases of liver cancer compared with developed countries such as Korea (8.75%), and Japan (3.40%) respectively (Shin *et al.*, 2010). *Opisthorchis viverrini* is endemic among rural populations in the northeast and north regions of Thailand, where raw fish is frequently consumed (Chavengkun *et al.*, 2016). Raw or undercooked fish, especially the cyprinoid fish species, has been consumed in communities for a long time and is prepared in several dishes, such as fermented fish, minced or finely chopped raw fish, and soured fish (Sithithaworn *et al.*, 1997; Sripa *et al.*, 2011). One of the reasons for the increased risk behavior among the populations in some parts of the northeast of Thailand is that they believe that consuming minced or finely chopped raw fish with sticky rice is good for their health. A nationwide survey in Thailand reported that the prevalence of liver fluke infection was 5.1%. However, it also showed that the highest prevalence (9.2%) was found in the northeast region, followed by the north region (5.2%) (Wongsaroj *et al.*, 2014); additionally, for those populations with high levels of liver fluke infection, the report found that they still consumed the undercooked cyprinoid fish species as part of their routine lives (Smout *et al.*, 2011). The study indicates that the liver fluke infection and related cancer in Thailand is still a serious issue.

A policy of liver fluke screening and elimination among populations aged 40 and over was launched by the Ministry of Public Health in 2015. In addition, those aged 15 years and over were included for screening between 2015 to 2025 (Ministry of Public, 2016). In previous studies, it had been reported that Thai school-aged children up to the age of

19 years in the northeast region comprised 16.3% of the population. Within this region, liver fluke infection was found in children aged 0-9 years and surprisingly it increased to be 4 times higher in those who were 14-19 years of age (Jongsuksuntigul and Imsomboon, 2003). Therefore, the incidence of liver fluke infection is associated with an increase of age. The prevalence of liver fluke among those lower than 20 years of age was 26.2% (Thaewongiew *et al.*, 2014). From a total number of 1136 students in grades 4-6 in 9 schools around the area of Ban Phai district, Khon Kaen province, the infection rate for liver fluke was 9.2% (Sripa *et al.*, 2015). These results indicate that this region has the highest prevalence rate for liver fluke in the country.

Health literacy is a concept of health promotion, and is the ability to: (1) obtain and understand basic health information, (2) access and assess health data, (3) properly and appropriately communicate about health, (4) confidently practice the process to promote, treat, and improve health problems, and remain healthy, and (5) modify the lifestyle and living conditions to improve individual and community health behaviour (Rootman and Gordon-Elbhiety, 2008; Nutbeam, 2009; Sørensen *et al.*, 2012). The levels of health literacy are very divergent and there is a need for individuals to specifically understand health topics and have the ability to navigate the health care system. Lower health literacy has been associated with higher rates of chronic diseases (Gazmararian *et al.*, 2005). Adolescents with low health literacy are likely to be perceived as having a low health status and to be less likely to exhibit health-promoting behavior (Chang, 2011). As a result, there is a lack of study of health literacy regarding liver fluke among secondary school students in the risk areas. Therefore, this study aimed to investigate the health literacy associated with liver fluke prevention and control among secondary school students. A large sample group was collected from secondary schools based in the region, with those students as representatives of the adolescents within northeast Thailand, with

the aim of confirming the factors associated with health literacy.

## Materials and Method

### Study Design and Sampling

A cross-sectional descriptive study was conducted between May and June 2017 in 20 provinces in northeast Thailand. The sample size was calculated following Hsieh *et al.* (1998):

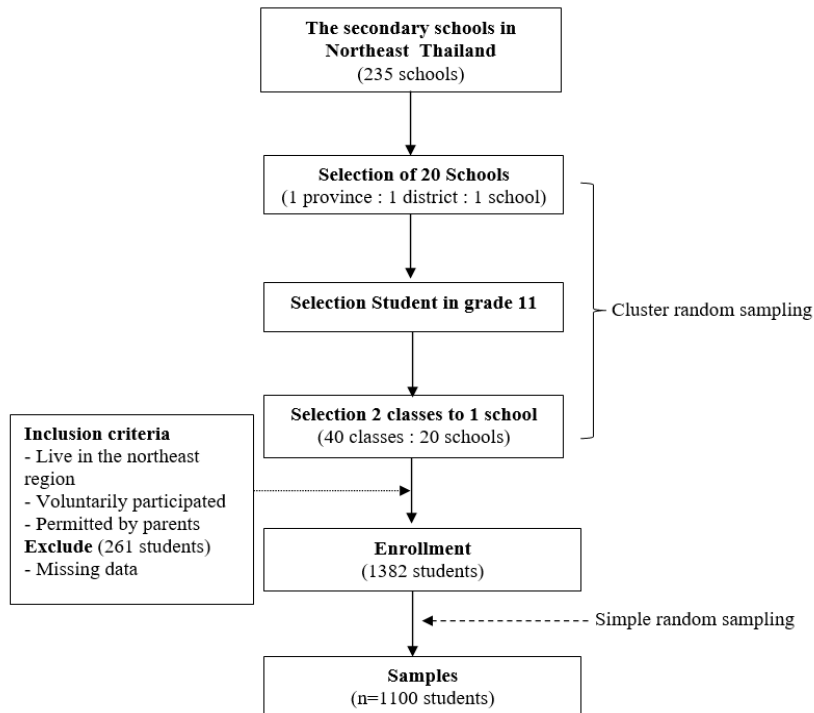
$$n_p = \frac{n_1}{(1 - \rho_{1.2.3..p}^2)}$$

There were 1100 students from the secondary schools under the control of the Secondary Educational Service Area Office. They were selected using multi-stage cluster random sampling (Figure 1). Students were

selected with the criteria that they had to live in the northeast region, participated voluntarily, were permitted by their parents, and did not provide incomplete data. The authors distributed a document to elucidate volunteers and distributed a questionnaire to all students in random classrooms. The documents were packed in sealed opaque envelopes for the students to give to their parents for acknowledgment and signature and a submission date was designated. Teachers in the classrooms collected all the documents. Students who voluntarily consented, with the signatures of both the student and parents to the completed questionnaire, were selected for the sample.

### Questionnaires

The questionnaire was modified from the health literacy scale for a Thai childhood questionnaire set by the Health Education



**Figure 1. Flowchart of study design and sampling of liver fluke prevention and control among secondary school students in Northeast Thailand**

Division, Department of Health Service Support, Ministry of Public Health. The questionnaire contained 3 parts which were: 1) demographic characteristics, 2) health literacy composed of 6 skills: cognitive, access, communication, self-management, media literacy, and decision, and 3) practice regarding liver fluke prevention and control. The questionnaire was validated by 5 experts and tested for reliability. The Kuder-Richardson-20 coefficients of health literacy skills for the cognitive question was 0.76. The Cronbach's alpha coefficients of health literacy skills for access, communication, self-management, media literacy, decision-making, and practice regarding liver fluke prevention and control were 0.74, 0.81, 0.78, 0.72, 0.82, and 0.76, respectively. Evaluation of health literacy was calculated and analyzed according to Bloom *et al.* (1971). The cognitive skills had 15 questions with a correct answer = 1 and an incorrect answer = 0, and they were interpreted to a high level, 80% (12-15 points), a fair level, 60%-79.5% (9-11 points), and a poor level, 0-59% (0-8 points). Access skills, communication skills, self-management skills, media literacy skills, and decision-making skills were calculated and analyzed according to Bloom *et al.* (1971). Communication skills and self-management skills had 5 questions each, with 4 questions each for access skills and decision skills. There were 5 rating scales (every time, often, sometimes, infrequently, never) and the interpretations were high level, 80%; fair level 60% -79.9%; and poor level, <60%. Evaluation of practice regarding liver fluke prevention and control was calculated and analyzed according to Best (1981). The practice level had 13 questions and was interpreted as high level,  $\bar{x} + SD$  (40-65 points); fair level,  $\bar{x} \pm SD$  (39-22 points); and poor level,  $<60\% \bar{x} - SD$  (0-21 points). In our study, practice was dichotomized as the need to modify practice (poor and fair levels) and as good practice (high level) regarding liver fluke prevention and control.

### Data Analysis

Descriptive and analytical statistical data were analyzed with STATA software.

Bivariate analysis using simple logistic regression was carried out to explore the association between good practice for liver fluke prevention and control and each factor, presented as crude odds (ORCrude) and their 95% confidence intervals (95% CI). Factors associated with good practice for liver fluke prevention and control in the bivariate analysis ( $p\text{-value} < 0.25$ ) and factors without association but shown to be potentially relative factors to good practice for liver fluke prevention and control, based on a literature review, were recruited for the multivariate analysis. The adjusted odds ratio (ORadj) and their 95% CI were computed by using multiple logistic regressions. All test statistics were two-tailed and the statistical significance level of 0.05 ( $p\text{-value} < 0.05$ ) was employed for data analyses.

### Ethics Committee

Ethical approval for this study was obtained from the Khon Kaen University Ethics Committee for Human Research (HE 602102).

## Results

### Demographic Characteristics

A total of 1100 students took part, the majority of whom were females accounting for 75.82% and 24.18% were males. Those who considered that the income received from their parents was sufficient totalled 78.91. The mean duration of residence in northeast Thailand of all students was 15.78 years ( $SD = 2.54$ ) and the range was from 1 to 18 years. The mean distance between the houses of students and a river was 2.06 km ( $SD = 2.33$ ) and the range was from 0.01 to 16.00 km. The mean grade point average (GPA) of the students was 3.10 ( $SD = 0.58$ ) and the range was from 1.00 to 4.00. Nearly half of the students (46.18%) had never received information about liver fluke. Students who had no history of stool examination totalled 89.36% and those with a history of taking anti-parasitic drugs totalled 83.18%. Most of the students (96.73%) did not

smoke. In addition, 73.00% of the students did not drink alcohol (Table 1).

### Health Literacy Towards Liver Fluke Prevention

Out of all the students in this study, 66.36% had moderately correct cognitive skills, 38.82% had a good level of access skills, 44.64% had communication skills at a good level, 43.64% had self-management skills that were not a good level, 42.09% had a good level of media literacy skills, and 46.00% had decision skills at a good level (Table 2).

### Number of Students with a Good Practice Regarding Liver Fluke Prevention

The overall number of those with a good practice regarding liver fluke prevention and

control was 15.91% (95%CI: 13.80-18.21) with a significant duration of residence in northeast Thailand ( $OR_{crude} = 0.92$ ; 95%CI: 0.88-0.97; p-value = 0.003). Moreover, there were significant associations between each category of characteristics as assessed using the bivariate analysis (Table 3).

The odds ratios for all health literacy factors at the highest level of each skill with a significantly good practice regarding liver fluke prevention and control were cognitive skills ( $OR_{crude} = 2.23$ ; 95%CI: 1.24-4.01; p-value = 0.016), access skills ( $OR_{crude} = 1.81$ ; 95%CI: 1.19-2.73; p-value = 0.020), communication skills ( $OR_{crude} = 2.94$ ; 95%CI: 1.78-4.84; p-value < 0.001), media literacy skills ( $OR_{crude} = 2.31$ ; 95%CI: 1.48-3.60; p-value = 0.001), self-management skills ( $OR_{crude} = 1.95$ ; 95%CI:

**Table 1. Demographic characteristics of students**

| Characteristics                                        | Number           | Percent (%) |
|--------------------------------------------------------|------------------|-------------|
| 1. Gender                                              |                  |             |
| Male                                                   | 266              | 24.18       |
| Female                                                 | 834              | 75.82       |
| 2. Sufficiency of income received from parents         |                  |             |
| No                                                     | 232              | 21.09       |
| Yes                                                    | 868              | 78.91       |
| 3. Duration of residence in northeast Thailand (Years) |                  |             |
| Mean (SD)                                              | 15.78 (2.54)     |             |
| Median (min : max)                                     | 16 (1:18)        |             |
| 4. Distance between house and river (Kilometers)       |                  |             |
| Mean (SD)                                              | 2.06 (2.33)      |             |
| Median (min : max)                                     | 1 (0.01:16.00)   |             |
| 5. Grade point average (GPA)                           |                  |             |
| Mean (SD)                                              | 3.10 (0.58)      |             |
| Median (min : max)                                     | 3.14 (1.00:4.00) |             |
| 6. Getting information about liver fluke               |                  |             |
| No                                                     | 508              | 46.18       |
| Yes                                                    | 592              | 53.82       |
| 7. History of stool examination                        |                  |             |
| No                                                     | 983              | 89.36       |
| Yes                                                    | 117              | 10.64       |
| 8. History of taking anti-parasitic drugs              |                  |             |
| No                                                     | 915              | 83.18       |
| Yes                                                    | 185              | 16.82       |
| 9. Smoking                                             |                  |             |
| No                                                     | 1064             | 96.73       |
| Yes                                                    | 36               | 3.27        |
| 10. Alcohol drinking                                   |                  |             |
| No                                                     | 803              | 73.00       |
| Yes                                                    | 297              | 27.00       |

1.23-3.10; p-value=0.017), and decision skills ( $OR_{crude} = 1.94$ ; 95%CI: 1.25-3.00; p-value = 0.014) (Table 4).

### Factors Associated with Good Practice Regarding Liver Fluke Prevention

The data for association between all potential factors using multiple logistic

regressions are shown in Table 5. Demographic factors which were significantly associated with good practice regarding liver fluke prevention and control included duration of residence in northeast Thailand ( $OR_{adj} = 0.85$ , 95% CI: 0.74-0.91,  $p < 0.001$ ) and getting information about liver fluke ( $OR_{adj} = 1.78$ , 95% CI: 1.41-4.94,  $p < 0.001$ ). Health literacy

**Table 2. Distribution of health literacy and practice level towards liver fluke prevention**

| Behaviors                                    | Number       | Percent (%) |
|----------------------------------------------|--------------|-------------|
| 1. Cognitive skills                          |              |             |
| Incorrect                                    | 236          | 21.45       |
| Moderately correct                           | 730          | 66.36       |
| Absolutely correct                           | 134          | 12.18       |
| Mean (SD)                                    | 9.41 (2.02)  |             |
| Median (min : max)                           | 9 (1:15)     |             |
| 2. Access skills                             |              |             |
| Not good                                     | 426          | 38.73       |
| Good                                         | 427          | 38.82       |
| Excellent                                    | 247          | 22.45       |
| Mean (SD)                                    | 12.43 (3.70) |             |
| Median (min : max)                           | 12 (4:20)    |             |
| 3. Communication skills                      |              |             |
| Not good                                     | 228          | 20.73       |
| Good                                         | 491          | 44.64       |
| Excellent                                    | 381          | 34.64       |
| Mean (SD)                                    | 14.47 (3.99) |             |
| Median (min : max)                           | 15 (5:25)    |             |
| 4. Self- management skills                   |              |             |
| Not good                                     | 480          | 43.64       |
| Good                                         | 444          | 40.36       |
| Excellent                                    | 176          | 16.00       |
| Mean (SD)                                    | 15.21 (4.18) |             |
| Median (min : max)                           | 15 (5:25)    |             |
| 5. Media literacy skills                     |              |             |
| Not good                                     | 414          | 37.64       |
| Good                                         | 463          | 42.09       |
| Excellent                                    | 223          | 20.27       |
| Mean (SD)                                    | 12.50 (3.59) |             |
| Median (min : max)                           | 12 (5:25)    |             |
| 6. Decision skills                           |              |             |
| Not good                                     | 421          | 38.27       |
| Good                                         | 506          | 46.00       |
| Excellent                                    | 173          | 15.73       |
| Mean (SD)                                    | 15.33 (3.97) |             |
| Median (min : max)                           | 15 (4:20)    |             |
| 7. Practice regarding liver fluke prevention |              |             |
| Need to modify practice                      | 925          | 84.09       |
| Good practice                                | 175          | 15.91       |
| Mean (SD)                                    | 30.83 (8.44) |             |
| Median (min : max)                           | 30 (13:65)   |             |

skills at the highest level which were significantly associated with good practice regarding liver fluke prevention and control, include cognitive ( $OR_{adj} = 2.11$ , 95% CI: 1.15-3.86,  $p = 0.026$ ), communication ( $OR_{adj} = 2.63$ , 95% CI: 1.58-4.40,  $p < 0.001$ ), and media literacy ( $OR_{adj} = 1.78$ ; 95% CI: 1.12-2.83;  $p$ -value = 0.030).

## Discussion

Liver fluke is associated with CCA, a major health problem particularly in the northeast and the north regions of Thailand, where the most common raw fish, known as koi pla, is consumed as a regular meal that leads to liver

**Table 3. Odds ratios for each characteristic on good practice regarding liver fluke prevention and control on simple logistic regression (Bivariate)**

| Characteristics                                         | Number | % of Good Practice | $OR_{Crude}$ | 95%CI        | p-value |
|---------------------------------------------------------|--------|--------------------|--------------|--------------|---------|
| Overall                                                 | 175    | 15.91              |              | 13.80-18.21  |         |
| 1. Gender                                               |        |                    |              |              | 0.608   |
| Male                                                    | 45     | 16.92              | 1            |              |         |
| Female                                                  | 130    | 15.59              | 0.91         | 0.63 to 1.31 |         |
| 2. Sufficiency of income received from parents          |        |                    |              |              | 0.314   |
| No                                                      | 32     | 13.79              | 1            |              |         |
| Yes                                                     | 143    | 16.47              | 1.23         | 0.81 to 1.87 |         |
| 3. Duration of residence in Northeast, Thailand (Years) |        |                    | 0.92         | 0.88 to 0.97 | 0.003   |
| 4. Distance between house and river (Kilometers)        |        |                    | 1.02         | 0.95 to 1.09 | 0.425   |
| 5. Grade point average (GPA)                            |        |                    | 0.77         | 0.59 to 1.00 | 0.260   |
| 6. Getting information about liver fluke                |        |                    |              |              | 0.392   |
| Yes                                                     | 86     | 16.93              | 1            |              |         |
| No                                                      | 89     | 15.03              | 1.07         | 0.63 to 1.20 |         |
| 7. History of stool examination                         |        |                    |              |              | 0.713   |
| Yes                                                     | 155    | 15.77              | 1            |              |         |
| No                                                      | 20     | 17.09              | 1.10         | 0.66 to 1.84 |         |
| 8. History of taking anti-parasitic drugs               |        |                    |              |              | 0.575   |
| Yes                                                     | 143    | 15.63              | 1            |              |         |
| No                                                      | 32     | 17.30              | 1.13         | 0.74 to 1.72 |         |
| 9. Smoking                                              |        |                    |              |              | 0.314   |
| Yes                                                     | 167    | 15.70              | 1            |              |         |
| 10. Alcohol drinking                                    |        |                    |              |              | 0.109   |
| Yes                                                     | 119    | 14.82              | 1            |              |         |
| No                                                      | 56     | 18.86              | 1.34         | 0.94 to 1.90 |         |

fluke infection (Kaewpitoon *et al.*, 2015). Consequently, modification of health behavior regarding liver fluke prevention and control is needed for better health. Previously, many behavior intervention projects have been undertaken; however, most of those projects evaluated only knowledge, attitude, practice, and self-efficacy. Furthermore, misunderstanding about *Opisthorchis viverrini* was still found in the populations in rural areas where liver fluke infection is epidemic. In this study, we investigated health literacy associated with liver fluke prevention and control among secondary school students who represented rural students of adolescent age. The results found the overall level of good practice regarding liver fluke prevention and control was 15.91% (95%CI: 13.80-18.21). This result is similar to Thaewongiew *et al.* (2014) for

the practice related to liver fluke infection in rural communities, in which the percentage of them with a good level of practice was 27.2%. This implied a low level of good practice and was reflected by the number of those infected with liver fluke in the risk areas. They indicate that low practice and risk behavior were related to infection with *Opisthorchis viverrini*. However, the previous study was carried out among participants who were aged 15-60 years old. Recently, the results of our study indicated that the group of school-aged children had a low level of good practice regarding liver fluke prevention. This group, more than 80% of the school-aged children in the risk areas, was the group that had risky behavior and so they had the opportunity to become infected with liver fluke.

**Table 4. Odds ratios for each health literacy skill on good practice regarding liver fluke prevention and control on simple logistic regression (Bivariate)**

| Factors                   | Number | % of Good Practice | Crude OR | 95%CI        | p-value |
|---------------------------|--------|--------------------|----------|--------------|---------|
| 1. Cognitive skills       |        |                    |          |              | 0.016   |
| Not correct               | 25     | 8.22               | 1        |              |         |
| Moderately correct        | 122    | 16.71              | 1.69     | 1.07 to 2.68 |         |
| Absolutely correct        | 28     | 20.90              | 2.23     | 1.24 to 4.01 |         |
| 2. Access skills          |        |                    |          |              | 0.020   |
| Not good                  | 56     | 11.34              | 1        |              |         |
| Good                      | 66     | 15.46              | 1.21     | 0.82 to 1.77 |         |
| Excellent                 | 53     | 21.46              | 1.81     | 1.19 to 2.73 |         |
| 3. Communication skills   |        |                    |          |              | <0.001  |
| Not good                  | 22     | 9.65               | 1        |              |         |
| Good                      | 62     | 11.21              | 1.35     | 0.81 to 2.26 |         |
| Excellent                 | 91     | 23.18              | 2.94     | 1.78 to 4.84 |         |
| 4. Self-management skills |        |                    |          |              | 0.017   |
| Not good                  | 53     | 12.59              | 1        |              |         |
| Good                      | 84     | 16.60              | 1.38     | 0.95 to 2.00 |         |
| Excellent                 | 38     | 21.97              | 1.95     | 1.23 to 3.10 |         |
| 5. Media literacy skills  |        |                    |          |              | 0.001   |
| Not good                  | 45     | 10.87              | 1        |              |         |
| Good                      | 81     | 17.49              | 1.74     | 1.18 to 2.57 |         |
| Excellent                 | 49     | 21.97              | 2.31     | 1.48 to 3.60 |         |
| 6. Decision skills        |        |                    |          |              | 0.014   |
| Not good                  | 65     | 13.54              | 1        |              |         |
| Good                      | 69     | 15.54              | 1.17     | 0.81 to 1.69 |         |
| Excellent                 | 41     | 23.30              | 1.94     | 1.25 to 3.00 |         |

Interestingly, our findings showed a significant association between the duration of residence in northeast Thailand and good practice regarding liver fluke prevention and control. An increase in the duration of residence in northeast Thailand tends to decrease the good practice regarding liver fluke prevention (8%,  $OR_{adj} = 0.92$ , 95% CI: 0.87-0.97,  $p = 0.005$ ). This result is similar to Grundy-Warr *et al.* (2005); raw fish consumption needs to be contextualized within societies, and local attitudes accept many different kinds of raw food consumption. The people of the northeast have long-established traditions of consuming raw fish dishes such as koi pla (raw minced fish with Thai herbs), pla som (raw fermented fish) and pla ra (raw fermented fish paste) (Prasongwatana *et al.*, 2013). This is particularly true of the populations living in wetland rural areas where a large proportion of the community work in agriculture and continue the traditional practice of eating

raw or undercooked cyprinoid fish products (Sripa *et al.*, 2007; Sithithaworn *et al.*, 2012). Similarly, Wongba *et al.* (2011) confirmed that northeast people enjoy the flavor of this fish and believe that liver fluke infestations can be eliminated, thereby removing any risk of cancer. In addition, food sharing plays an important factor and a potential route for distributing the infection. Thus, an increase in the duration of residence in northeast Thailand was influenced by the underlying long traditional socio-culture about raw fish consumption as practiced by the older generation of the populations.

In the current study, we also found that good practice regarding liver fluke prevention and control was associated with the receipt of information about the disease (13%,  $OR_{adj} = 0.87$ , 95% CI: 1.41-4.67,  $p < 0.001$ ). People who never got information about the disease tended to have a decreased level of good practice regarding liver fluke prevention and control.

**Table 5. Odds ratios for each factor on good practice regarding liver fluke prevention and control on multiple logistic regressions (multivariate)**

| Factors                                                | Number | %<br>of Good<br>Practice | $OR_{crude}$ | $OR_{adj}$ | 95%CI        | p-value |
|--------------------------------------------------------|--------|--------------------------|--------------|------------|--------------|---------|
| 1.Duration of residence in Northeast, Thailand (Years) |        |                          |              | 0.85       | 0.74 to 0.91 | <0.001  |
| 2.Getting information about liver fluke                |        |                          | 0.92         |            |              | <0.001  |
| Yes                                                    | 86     | 16.93                    | 1            | 1          |              |         |
| No                                                     | 89     | 15.03                    | 1.07         | 1.78       | 1.41-4.67    |         |
| 3. Cognitive skills                                    |        |                          |              |            |              | 0.026   |
| Not correct                                            | 25     | 8.22                     | 1            | 1          |              |         |
| Moderately correct                                     | 122    | 16.71                    | 1.69         | 1.72       | 1.08 to 2.74 |         |
| Absolutely correct                                     | 28     | 20.90                    | 2.23         | 2.11       | 1.15 to 3.86 |         |
| 4. Communication skills                                |        |                          |              |            |              | <0.001  |
| Not good                                               | 22     | 9.65                     | 1            | 1          |              |         |
| Good                                                   | 62     | 11.21                    | 1.35         | 1.23       | 0.73 to 2.07 |         |
| Excellent                                              | 91     | 23.18                    | 2.94         | 2.63       | 1.58 to 4.40 |         |
| 5.Media literacy skills                                |        |                          |              |            |              | 0.030   |
| Not good                                               | 45     | 10.87                    | 1            | 1          |              |         |
| Good                                                   | 81     | 17.49                    | 1.74         | 1.55       | 1.03 to 2.32 |         |
| Excellent                                              | 49     | 21.97                    | 2.31         | 1.78       | 1.12 to 2.83 |         |

This result indicates that getting information and intervention to assist in prevention and control may influence the populations. Previous study revealed knowledge, perception, and behavior about food consumption related to *Opisthorchis viverrini* among people in upper northeastern Thailand (Viriyavipart *et al.*, 2015). This result is similar to Suwannahitatorn *et al.* (2013), that inadequate knowledge, misbeliefs, and social and cultural mores were important factors leading to maintaining risk behaviors. Moreover, unhygienic defecation and insufficient diagnosis and treatment were found to facilitate *Opisthorchis viverrini* transmission. Precise and regular health education and promotion targeting the main risk factor, koi pla consumption, improving diagnosis and treatment, and promoting hygienic defecation should be used in the prevention and control program.

Surprisingly, we also found that good practice regarding liver fluke prevention and control was associated with health literacy including cognitive skills (absolutely correct) ( $OR_{adj} = 0.87$ , 95% CI: 1.41-4.67,  $p < 0.001$ ), and communication skills (excellent) ( $OR_{adj} = 2.63$ , 95% CI: 1.58-4.40,  $p < 0.001$ ). Health literacy is the capacity to acquire, understand, and use information in ways which promote and maintain good health. These skills can be developed both through formal health education and other less formal exposure to health knowledge and practices (Nutbeam, 2009). Moreover, health literacy can be improved through the provision of information, effective communication, and structured education (Nutbeam *et al.*, 2017). For those interested in increasing good practice regarding liver fluke prevention, health literacy has long been proposed as a useful outcome measure. This study found that good practice regarding liver fluke prevention and control was associated with media literacy skills (excellent) ( $OR_{adj} = 1.78$ ; 95% CI: 1.12-2.83;  $p$ -value = 0.030). Media literacy skill is the ability to understand, analyze, evaluate, and create media messages (Aufderheide and Firestone, 1993). In addition, the use of media literacy skills has positively impacted many health behaviors (Nelson and Carey, 2017). Therefore, cognitive skills,

communication skills, and media literacy skills bring about an increase in knowledge. Previous studies confirmed that knowledge is often considered as a prerequisite and predisposing factor to behavioral change. Knowledge is considered as an essential attribute of behavior, and higher rates of knowledge are correlated with higher rates of positive behavior (Geraee *et al.*, 2015).

In conclusion, this study shows a low prevalence of good practice regarding liver fluke prevention. Factors associated with good practice regarding liver fluke prevention and control included the duration of residence in northeast Thailand, getting information about liver fluke, cognitive skills, communication skills, and media literacy skills. In addition, health literacy may be a desirable strategy for informing and modifying health behavior regarding liver fluke prevention and control among secondary school students in northeastern, Thailand, especially relating to cognitive skills, communication skills, and media literacy skills.

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## References

- Aufderheide, P. and Firestone, C. (1993). Media Literacy: A Report of the National Leadership Conference on Media Literacy. The Aspen Institute, Queenstown, MD, USA, 44p.
- Best, J.W. (1981). Research in Education. 4<sup>th</sup> ed. Prentice Hall, Englewood Cliffs, NJ, USA, 431p.
- Bloom, B.S., Hastings, J.T., and Madaus, G.F. (1971). Handbook on Formative and Summative Evaluation of Student Learning. McGraw-Hill Book Company, New York, NY, USA, 923p.
- Chang, L.C. (2011). Health literacy, self-reported status and health promoting behaviors for adolescents in Taiwan. J. Clin. Nurs., 20(1-2):190-196.

- Chavengkun, W., Komporn, P., Norkaew, J., Kujapun, J., Pothipim, M., Ponphimai, S., Kaewpitoon, S.J., Padchasuwan, N., and Kaewpitoon, N. (2016). Raw fish consuming behavior among populations at risk of cholangiocarcinoma in Nakhon Ratchasima Province, Thailand. *Asian Pac. J. Cancer P.*, 17(6):2761-2765.
- Gazmararian, J., Curran, J.W., Parker, R.M., Bernhardt, J.M., and De Buono, B.A. (2005). Public health literacy in America: an ethical imperative. *Am. J. Prev. Med.*, 28(3):317-332.
- Geraee, N., Kaveh, M. H., Shojaeizadeh, D., and Tabatabaee, H.R. (2015). Impact of media literacy education on knowledge and behavioral intention of adolescents in dealing with media messages according to stages of change. *J. Adv. Med. Educ. Prof.*, 3(1):9-14.
- Grundy-Warr, C., Andrews, R.H., Sithithaworn, P., Petney, T.N., Sripan, B., Laithavewat, L., and Ziegler, A.D. (2005). Raw attitudes, wetland cultures, life-cycles: Socio-cultural dynamics relating to *Opisthorchis viverrini* in the Mekong Basin. *Parasitol. Int.*, 61:65-70.
- Hsieh, F.Y., Bloch, D.A., and Larsen, M.D. (1998). A simple method of sample size calculation for linear and logistic regression. *Stat. Med.*, 17(14):1623-1634.
- International Agency for Research on Cancer. (1994). Infection with liver flukes (*Opisthorchis viverrini*, *Opisthorchis felinus* and *Clonorchis sinensis*). *IARC Monogr. Eval. Carc.*, 61:121-75.
- Jongsuksuntigul, P. and Imsomboon, T. (2003). *Opisthorchiasis* control in Thailand. *Acta Trop.*, 88:229-232.
- Kaewpitoon, N., Kootanavanichpong, N., Komporn, P., Chavengkun, W., Kujapun, J., Norkaew, J., Ponphimai, S., Matrakool, L., Tongtawee, T., Panpimanmas, S., Rujirakul, R., Padchasuwan, N., Pholsripradit, P., Eksanti, T., Phatisena, T., Loyd, R.A., and Kaewpitoon, S.J. (2015). Review and current status of *Opisthorchis viverrini* infection at the community level in Thailand. *Asian Pac. J. Cancer P.*, 16:6825-6830.
- Ministry of Public Health. (2016). Strategic Plan for Decade of Liver Fluke and Cholangiocarcinoma. Nonthaburi, Thailand, 10p.
- Nelson, K.M. and Carey, M.P. (2017). Media literacy is an essential component of HIV prevention for young men who have sex with men. *Arch. Sex Behav.*, 45(4):787-788.
- Nutbeam, D. (2009). Defining and measuring health literacy: what can we learn from literacy studies? *Int. J. Public Health*, 54:303-305.
- Nutbeam, D., McGill, B., and Premkumar, P. (2017). Improving health literacy in community populations: a review of progress. *Health Promotion International*, dx015, <https://doi.org/10.1093/heapro/dax015>.
- Prasongwatana, J., Laummaunwai, P., Boonmars, T., and Pinlaor, S. (2013). Viable metacercariae of *Opisthorchis viverrini* in northeastern Thai cyprinid fish dishes - as part of a rational program for control of *O.viverrini* associated cholangiocarcinoma. *Parasitol. Res.* 112(3):1323-1327.
- Rootman, I. and Gordon-El-Bihbety, D. (2008). A Vision for a Health Literate Canada. Canadian Public Health Association, Ottawa. ONT, Canada, 47p.
- Shin, H.R., Oh, J.K., Masuyer, E., Curado, M.P., Bouvard, V., Fang, Y.Y., Wiangnon, S., Sripan, B., and Hong, S.T. (2010). Epidemiology of cholangiocarcinoma: an update focusing on risk factors. *Cancer Sci.*, 101:579-85.
- Sithithaworn, P., Pipitgool, V., Srisawangwong, T., Elkins, D.B., and Haswell-Elkins, M.R. (1997). Seasonal variation of *Opisthorchis viverrini* infection in cyprinoid fish in north-east Thailand: implications for parasite control and food safety. *B. World Health Organ.*, 75:125-31.
- Sithithaworn, P., Andrews, R.H., Nguyen, V.D., Wongsaroj, T., Sinuon, M., Odermatt, P., Nawa, Y., Liang, S., Brindley, P.J., and Sripan, B. (2012). The current status of opisthorchiasis and clonorchiasis in the Mekong Basin. *Parasitol. Int.*, 61:10-16.
- Smout M.J., Sripan B., Laha, T., Mulvenna, J., Gasser, R.B., Young, N.D., Bethony, J.M., Brindley, P.J., and Loukas, A. (2011). Infection with the carcinogenic human liver fluke, *Opisthorchis viverrini*. *Mol. Biosyst.*, 7(5):1367-1375.
- Sørensen, K., Broucke, S., Fullam, J., Doyle, G., Pelikan, J., Slonska, Z., and Brand, H. (2012). Health literacy and public health: A systematic review and integration of definitions and models. *BMC Public Health*, 12(80):147-159.
- Sriamporn, S., Pisani, P., Pipitgool, V., Suwanrungruang, K., Kamsa-ard, S., and Parkin, D.M. (2004). Prevalence of *Opisthorchis viverrini* infection and incidence of cholangiocarcinoma in Khon Kaen, Northeast Thailand. *Trop. Med. Int. Health*, 9:588-94.
- Sripan, B., Kaewkes, S., Sithithaworn, P.M., Mairiang, E., Laha, T., Smout, M., Pairojkul, C., Bhudhisawasdi, V., Tesana, S., Thinkamrop, B., Bethony, J.M., Loukas, A., and Brindley, P.J. (2007). Liver fluke induces cholangiocarcinoma. *PLoS Med.*, 4(7):e201.
- Sripan, B., Kaewkes, S., Intapan, P.M., Maleewong, W., and Brindley, P. J. (2010). Food-borne trematodiasis in Southeast Asia epidemiology, pathology, clinical manifestation and control. *Adv. Parasitol.*, 72:305-350.
- Sripan, B., Bethony, J.M., Sithithaworn, P., Kaewkes, S., Mairiang, E., Loukas, A., Mulvenna, J., Laha, T., Hotez, P.J., and Brindley, P.J. (2011). Opisthorchiasis and Opisthorchis-associated cholangiocarcinoma in Thailand and Laos. *Acta Tropica*, 120:S158-168.
- Sripan, B., Tangkawattana, S., Laha, T., Kaewkes, S., Mallory, F., Smith, J., and Wilcox, B. (2015). Toward integrated opisthorchiasis control in Northeast Thailand: The Lawa project. *Acta Tropica*, 141:361-367.
- Suwanmahitatorn, P., Klomjit, S., Naaglor, T., Taamasri, P., Rangsin, R., Leelayoova, S., and Munghthin, M. (2013). A follow-up study of *Opisthorchis viverrini*

- infection after the implementation of control program in a rural community, central Thailand. *Parasite. Vector.*, 6:188.
- Thaewongiew, K., Singthong, S., Kutchamart, S., Tangsawad, S., Promthet, S., Sailugkum, S., and Wongba, N. (2014). Prevalence and risk factors for *Opisthorchis viverrini* infections in upper Northeast Thailand. *Asian Pac. J. Cancer P.*, 15:6609-6612.
- Viriyavipart, C., Thaewongiew, K., and Klangburum, W. (2015). Knowledge, perception, and behavior about food consumption related to the prevention of *Opisthorchis viverrini* among people in upper northeastern Thailand. *Disease Control Journal*, 41:77-86.
- Wongba, N., Thaewongiew, K., Phathee, K., Laithavewat, L., Duangsong, R., Promthet, S., and Tangsawad, S. (2011). Liver fluke prevention and control in the Northeast of Thailand through action research. *Asian Pac. J. Cancer P.*, 12:1-4.
- Wongsaroj, T., Nithikathkul, C., Rojkitikul, W., Nakaia, W., Royal, L., and Rammasut, P. (2014). National survey of helminthiasis in Thailand. *Asian Biomed.*, 8:779-783.