

Factors Associated with Pre-Service Teachers' Willingness to Teach *Opisthorchis viverrini* Prevention Education in Lao PDR: A Cross-Sectional Study

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Abstract

Background

This study examined factors associated with willingness to teach *Opisthorchis viverrini* (OV) prevention education among pre-service teachers at teacher training colleges (TTCs) in Lao PDR using a framework informed by the Theory of Planned Behavior (TPB).

Methods

A cross-sectional study was conducted among pre-service teachers at Pakse and Savannakhet TTCs in Lao PDR. Of 808 registered students, 550 completed an online questionnaire between 18 February and 12 March 2026. The present analysis included 372 students who had previously heard of OV. The questionnaire was developed from a literature review and a TPB-informed conceptual framework and refined through expert review. In the main analytical sample of 372 participants, the 12-item knowledge scale demonstrated acceptable internal consistency (KR-20 = 0.77). Willingness to teach OV prevention education was measured on a five-point Likert scale and dichotomized into lower and high willingness. Bivariable and multivariable logistic regression analyses were performed.

Results

Among the 372 participants, 271 (72.8%) reported high willingness to teach OV prevention education. In the multivariable model adjusted for TTC, female students had higher odds of high willingness than male students (adjusted odds ratio [AOR] 2.79, 95% CI 1.43–5.45). Students who agreed or strongly agreed that teaching OV prevention education would benefit schoolchildren had higher odds of high willingness than those who disagreed or strongly disagreed (AOR 3.03, 95% CI 1.05–8.76). Perceived expectations from teachers were also associated with high willingness (AOR 4.87, 95% CI 1.60–14.80). Compared with students who were not at all or only slightly confident, moderately confident students had higher odds of high willingness (AOR 2.56, 95% CI 1.30–5.05), while confident or very confident students had substantially higher odds (AOR 12.90, 95% CI 4.64–35.90).

Conclusions

Attitude, subjective norm, and perceived behavioral control were independently associated with willingness to teach OV prevention education; the largest adjusted odds ratio was observed for perceived behavioral control. Female pre-service teachers were more likely than male pre-service teachers to report high willingness. Strengthening practical teaching experience, confidence, supportive professional norms, and positive attitudes may help TTCs prepare future teachers to deliver OV prevention education in endemic areas.

Background

Opisthorchis viverrini (OV) infection is an important neglected tropical disease in the Greater Mekong Subregion and remains a significant public health concern in the Lao People's Democratic Republic (Lao PDR). The parasite is transmitted primarily through the consumption of raw or insufficiently cooked freshwater fish containing infective metacercariae [1,2]. Chronic infection can lead to hepatobiliary disease and is strongly associated with cholangiocarcinoma [3,4]. Therefore, the prevention of OV infection remains an important public health priority. OV infection remains prevalent in several areas of Lao PDR. Previous studies have documented infections in different regions of the country, including Vientiane Capital, Khammouane, and southern Lao PDR [3,5–6]. A recent systematic review and meta-analysis showed that Lao PDR had the highest pooled prevalence of OV infection (34.1%) among countries in the Greater Mekong Subregion [7]. In areas where OV transmission has historically been reported, including Pakse and Savannakhet, raw fish consumption and environmental factors continue to contribute to the risk of infection [3,8]. Preventing OV infection requires more than the treatment of infected individuals. Health education addressing raw fish consumption, food preparation, sanitation, and transmission pathways is an important component of prevention and control strategies [9,10]. School-based health education provides an opportunity to promote preventive behaviors from an early age and to extend health messages from schools to families and communities. Previous studies in Thailand have demonstrated the potential of school-based education and teacher training to improve knowledge and understanding of OV infection and cholangiocarcinoma prevention [11].

Teachers are particularly important in this context because they can integrate health-related topics into classroom activities and influence students' knowledge and attitudes. Teacher preparation is therefore an important component of school health promotion [12,13]. However, knowledge alone may not be sufficient to determine whether future teachers are willing to deliver health education. Future teachers' attitudes toward teaching the topic, individual characteristics, previous training and teaching experience, perceived support, and confidence in their ability to teach the topic may also influence their willingness to do so [14–16].

The Theory of Planned Behavior (TPB) provides a useful framework for examining such willingness. According to Ajzen, behavioral intention is determined by three key constructs: attitude toward the behavior, subjective norm, and perceived behavioral control [17]. Previous studies have applied the TPB to examine teachers' intention to implement health-related curricula and willingness to engage in other health-related behaviors [15,18,19]. Perceived behavioral control may be particularly important for pre-service teachers because they have limited classroom experience and may be uncertain about their ability to teach disease-specific content. Previous conference reports and presentations have examined confidence and motivation related to OV prevention education among students at teacher training colleges in Lao PDR [20,21]. However, evidence regarding factors associated with pre-service teachers' willingness to teach OV prevention education remains limited. A better understanding of these factors may help teacher training institutions develop educational approaches that better prepare future teachers to participate in OV prevention.

Therefore, this study aimed to identify factors associated with willingness to teach OV prevention education among pre-service teachers at two teacher training colleges (TTCs) in Lao PDR.

Methods

Conceptual framework

The study used a TPB-informed conceptual framework. Attitude, subjective norm, and perceived behavioral control were examined as the main factors associated with willingness to teach OV prevention education. Background characteristics, exposure to OV prevention education, history of OV infection, and knowledge about OV were also examined as potential explanatory factors (Fig. 1).

<Insert Fig. 1>

Fig. 1 Conceptual framework of factors associated with willingness to teach OV prevention education

Study design and participants

A cross-sectional study was conducted among pre-service teachers at Pakse Teacher Training College (TTC) in Champasak Province and Savannakhet TTC in Savannakhet Province, Lao PDR. Both colleges are located in OV-endemic areas. Students aged 18 years or older who were enrolled at either TTC were eligible to participate. The required sample size for the broader survey from which the present analysis was conducted was estimated using the single-population proportion formula [22]. Based on preliminary unpublished data from a previous survey conducted by the research team (56.3%), an expected proportion of 60% was assumed for the sample-size calculation. With a 95% confidence level and a precision of $\pm 5\%$, the minimum sample size was 369. Assuming a 50% response rate, at least 738 students needed to be invited. All 808 students registered at the two TTCs were therefore invited to participate.

Questionnaire development and data collection

The questionnaire was developed using a TPB-informed framework and previous studies on OV prevention and health education. The questionnaire was developed and administered in Lao. Because it was developed directly in Lao, translation and back-translation were not performed. The wording and content were reviewed by Lao experts and Japanese experts proficient in Lao, revised, and pilot-tested among 75 students at the National University of Laos. After further revision, the final questionnaire was administered online using Google Forms between 18 February and 12 March 2026.

Measures

Background characteristics included TTC, age, gender, year of study, and academic major. Participants were also asked whether they had learned about OV prevention at their TTC and whether they or a close

contact had ever been infected with OV. Knowledge about OV was assessed using 12 items covering transmission, symptoms, complications, diagnosis, treatment, sanitation, animal reservoirs, and preventive practices. Correct responses received one point, whereas incorrect and “don’t know” responses received zero points. Total scores ranged from 0 to 12. For descriptive interpretation, the categories were defined a priori as low (0–3), moderate (4–6), or high (7–12). These study-specific categories were used to facilitate interpretation and were not intended as validated proficiency thresholds. Attitude and subjective norm were assessed as single-item indicators of the corresponding TPB constructs. Perceived behavioral control was operationalized as confidence in the ability to teach OV prevention and was also assessed using a single item. Attitude was assessed with the statement, “My teaching of OV prevention to schoolchildren would be highly beneficial for their health.” Subjective norm was assessed with the statement, “I think that teachers expect me to actively promote health education, including OV prevention, within my community.” Both were rated on five-point Likert scales ranging from “strongly disagree” to “strongly agree.” Perceived behavioral control was assessed by asking participants how confident they were in their ability to teach OV prevention to schoolchildren and was rated from “not confident at all” to “very confident.” The primary outcome was willingness to teach OV prevention education, rated on a five-point scale from “not willing at all” to “very willing.” For binary logistic regression, responses of “not willing at all,” “slightly willing,” and “moderately willing” were categorized as lower willingness, whereas responses of “willing” and “very willing” were categorized as high willingness. This dichotomization was intended to distinguish participants who expressed clear willingness to teach OV prevention education from those who did not. “Moderately willing” was included in the lower-willingness category because it represented an intermediate response rather than a clearly affirmative willingness to teach. Willingness to teach OV prevention education was used as an operational indicator of behavioral intention within the TPB-informed framework. The primary analysis was restricted to respondents who had previously heard of OV because the OV-specific knowledge and TPB items were designed to assess variation in knowledge and perceptions among students with prior awareness of OV. Of the 550 respondents, 178 who had never heard of OV were excluded, resulting in an analytical sample of 372 students.

Statistical analysis

All analyses were performed using EZR version 1.70 [23]. Participant characteristics were summarized using frequencies and percentages or medians and interquartile ranges, as appropriate. Associations between explanatory variables and high willingness to teach OV prevention education were examined using Fisher’s exact test or Pearson’s chi-square test, as appropriate. Binary logistic regression was used to estimate unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs). The primary multivariable model included TTC as a fixed-effect covariate, together with gender, year of study, academic major, exposure to OV prevention education, history of OV infection, knowledge, attitude, subjective norm, and perceived behavioral control. TTC was included to account for potential institutional and regional differences between Pakse and Savannakhet TTCs; the analysis was not intended to estimate a causal institutional effect. For regression analysis, attitude and subjective norm were each recategorized as disagree/strongly disagree, neutral, or agree/strongly agree. Perceived

behavioral control was recategorized as not confident/slightly confident, moderately confident, or confident/very confident. Multicollinearity was assessed using $GVIF^{(1/(2 \times df))}$. No missing values were observed for any variables included in the analysis. All tests were two-sided, and $p < 0.05$ was considered statistically significant. For Table 3, percentages were calculated within each category of participant characteristics (row percentages).

Ethical considerations

The study was approved by the Ethics Committee for Medical and Health Research Involving Human Subjects of the University of the Ryukyus, Japan (No. 25-2619), and the National Ethics Committee for Health Research of Lao PDR (No. 101). Participants provided electronic informed consent after receiving information about the study. Participation was voluntary, and responses were collected anonymously.

Results

Participant characteristics

Of the 808 registered students invited to participate, 550 completed the questionnaire (response rate, 68.1%). After excluding 178 respondents who had never heard of OV, 372 participants (67.6% of respondents) were included in the analysis. Of these, 151 (40.6%) were from Pakse TTC and 221 (59.4%) were from Savannakhet TTC. The median age was 20 years (IQR 19–21), and 262 (70.4%) participants were female. Participant characteristics are shown in Table 1. Overall, 140 participants (37.6%) reported having previously learned about OV prevention education at their TTC. Thirty-eight students (10.2%) reported that they or a close contact had experienced OV infection. Overall, 271 participants (72.8%) reported high willingness to teach OV prevention education. This group comprised 171 participants (46.0%) who were willing and 100 (26.9%) who were very willing to do so. Regarding attitudes toward teaching OV prevention education, 68.3% agreed that providing OV prevention education would benefit schoolchildren. For subjective norm, 63.7% agreed or strongly agreed that their teachers expected them to promote health education, including OV prevention. In contrast, perceived behavioral control was relatively low, with only 28.5% reporting that they were confident or very confident in their ability to teach OV prevention education.

Table 1
Characteristics of study participants (n = 372)

Median age (IQR)		20 (19–21)	
		n	%
Teacher training college	Pakse TTC	151	40.6
	Savannakhet TTC	221	59.4
Gender	Male	110	29.6
	Female	262	70.4
Year of study	First	245	65.9
	Second	99	26.6
	Third	18	4.8
	Fourth	10	2.7
Academic major	Kindergarten Education	34	9.1
	Primary Education	146	39.3
	Science Education (Biology, Chemistry, Physics)	32	8.6
	Mathematics and ICT	49	13.2
	English Education	88	23.7
	Other Education Majors (History, Geography, Lao language, French)	23	6.2
Having Exposure to OV prevention education at TTC		140	37.6
Having a history of OV infection in the participant or a close contact		38	10.2
Willingness to teach OV prevention education	Not willing at all	21	5.7
	Slightly willing	24	6.5
	Moderately willing	56	15.1
	Willing	171	46.0
	Very willing	100	26.9
Attitude toward teaching OV prevention education	Strongly disagree	20	5.4
	Moderately disagree	33	8.9

Median age (IQR)		20 (19–21)	
		n	%
	Neutral	65	17.5
	Moderately agree	153	41.1
	Strongly agree	101	27.2
Subjective norm toward teaching OV prevention education	Strongly disagree	23	6.2
	Moderately disagree	33	8.9
	Neutral	79	21.2
	Moderately agree	167	44.9
	Strongly agree	70	18.8
Perceived behavioral control over teaching OV prevention education	Not confident at all	49	13.2
	Slightly confident	83	22.3
	Moderately confident	134	36.0
	Confident	87	23.4
	Very confident	19	5.1

<Insert Table 1>

Knowledge about OV prevention

Table 2 shows knowledge about OV prevention. The median knowledge score was 5 (IQR: 2–7) out of a possible 12 points. Overall, 133 participants (35.8%) had low knowledge, 137 (36.8%) had moderate knowledge, and 102 (27.4%) had high knowledge. Knowledge gaps were evident across several OV-related topics. Although 287 participants (77.2%) correctly identified consumption of raw or undercooked fish as the primary route of transmission, only 28 participants (7.5%) correctly rejected the incorrect statement that insects are involved in the OV transmission cycle. In addition, only 68 participants (18.3%) knew that cats can contribute to OV transmission. Knowledge of preventive measures was also limited. Fewer than half of participants correctly recognized that using toilets helps prevent OV infection (178, 47.8%), that lemon juice does not prevent OV infection (153, 41.1%), and that drinking alcohol while eating raw fish does not prevent OV infection (140, 37.6%). Knowledge of the clinical characteristics and consequences of OV infection was generally limited. Only 138 participants (37.1%) correctly recognized that individuals with mild OV infection are often asymptomatic. Approximately half (194, 52.2%) correctly identified cholangiocarcinoma (bile duct cancer) as one of the most serious consequences of chronic OV infection. Only 65 participants (17.5%) correctly identified the estimated number of people infected with OV in Lao PDR, while 81 (21.8%) correctly answered the item

regarding treatment with deworming tablets. Using data from the main analytical sample of 372 participants, the 12-item knowledge scale demonstrated acceptable internal consistency (Kuder–Richardson Formula 20 coefficient = 0.77).

Table 2
Study participants' knowledge about OV (n = 372)

Knowledge item	n	%
Median (IQR)	5 (2–7)	
Total Knowledge about OV prevention (Q1-Q12)	Low knowledge (0–3)	133 35.8
	Moderate knowledge (4–6)	137 36.8
	High knowledge (7–12)	102 27.4
Q1. Approximately 2 million people are currently infected with OV in Lao PDR.	65	17.5
Q2. OV is transmitted to humans primarily by eating raw or undercooked fish.	287	77.2
Q3. Most individuals with mild OV infection remain asymptomatic.	138	37.1
Q4. The most serious consequence of chronic OV infection is liver damage, including cholangiocarcinoma (bile duct cancer).	194	52.2
Q5. OV transmission cycle includes: feces from an infected person/animal → insects → fish → humans eating raw fish.	28	7.5
Q6. OV infection can be prevented by thoroughly cooking all freshwater fish before consumption.	240	64.5
Q7. An infection with OV can be treated by taking deworming tablets.	81	21.8
Q8. The purpose of a stool examination is to diagnose OV infection.	141	37.9
Q9. Using toilets is effective in preventing OV infection.	178	47.8
Q10. Cats can contribute to OV transmission.	68	18.3
Q11. Squeezing lemon juice on raw fish effectively prevents OV infection.	153	41.1
Q12. Drinking alcohol while eating raw fish is effective in preventing OV infection.	140	37.6
Note: The figures in the table show the number and percentage of people who answered questions Q1–Q12 correctly.		

<Insert Table 2>

Bivariable analysis

Results of the bivariable analysis are shown in Table 3. Gender, knowledge, attitude, subjective norm, and perceived behavioral control were significantly associated with willingness to teach OV prevention education. High willingness was reported by 77.5% of female participants and 61.8% of male participants ($p = 0.003$). The proportion reporting high willingness increased across knowledge categories, from 63.9% among participants with low knowledge to 74.5% among those with moderate knowledge and 82.4% among those with high knowledge ($p = 0.006$). High willingness was also more common among participants with favorable attitudes, stronger perceived expectations from teachers, and greater confidence in their ability to teach OV prevention (all $p < 0.001$). In contrast, year of study, academic major, prior exposure to OV prevention education at the TTC, and a history of OV infection among participants or close contacts were not significantly associated with willingness.

<Insert Table 3>

Table 3. Bivariable analysis of factors associated with willingness to teach OV prevention education (n = 372)

Characteristics		Lower willingness (n = 101)		High willingness (n = 271)		p-value
		n	Row %	n	Row %	
Gender	Male	42	38.2	68	61.8	0.003*
	Female	59	22.5	203	77.5	
Year of study	First	59	24.1	186	75.9	0.063*
	Second	31	31.3	68	68.7	
	Third	5	27.8	13	72.2	
	Fourth	6	60.0	4	40.0	
Study major	Kindergarten Education	7	20.6	27	79.4	0.785*
	Primary Education	40	27.4	106	72.6	
	Science Education	11	23.9	35	76.1	
	Mathematics and ICT	8	22.9	27	77.1	
	English Education	27	30.7	61	69.3	
	Other Education Majors	8	34.8	15	65.2	
Exposure to OV prevention education at TTC	Yes	45	32.1	95	67.9	0.118*
	No	56	24.1	176	75.9	
History of OV infection in the participant or a close contact	Yes	8	21.1	30	78.9	0.445*
	No/Don't know	93	27.8	241	72.2	
Knowledge about OV prevention	Low knowledge	48	36.1	85	63.9	0.006*
	Moderate knowledge	35	25.5	102	74.5	
	High knowledge	18	17.6	84	82.4	
Attitude toward teaching OV prevention education	Strongly disagree	12	60.0	8	40.0	< 0.001**
	Moderately disagree	20	60.6	13	39.4	

Characteristics		Lower willingness (n = 101)		High willingness (n = 271)		p-value
		n	Row %	n	Row %	
	Neutral	38	58.5	27	41.5	
	Moderately agree	18	11.8	135	88.2	
	Strongly agree	13	12.9	88	87.1	
Subjective norm toward teaching OV prevention education	Strongly disagree	13	56.5	10	43.5	< 0.001**
	Moderately disagree	19	57.6	14	42.4	
	Neutral	41	51.9	38	48.1	
	Moderately agree	21	12.6	146	87.4	
	Strongly agree	7	10.0	63	90.0	
PBC over teaching OV prevention education	Not confident at all	22	44.9	27	55.1	< 0.001**
	Slightly confident	35	42.2	48	57.8	
	Moderately confident	38	28.4	96	71.6	
	Confident	6	6.9	81	93.1	
	Very confident	0	0.0	19	100.0	

Percentages are calculated within each participant characteristic category (row percentages)

Note : * Fisher's exact test.

** Pearson's chi-square test.

Multivariable logistic regression analysis

Results of the TTC-adjusted multivariable logistic regression analysis are shown in Table 4. After simultaneous adjustment for the variables included in the model, gender, attitude, subjective norm, and perceived behavioral control remained significantly associated with willingness. Savannakhet TTC was not significantly associated with high willingness compared with Pakse TTC (AOR 0.89, 95% CI 0.45–1.74). Female pre-service teachers were more likely to report high willingness than male students (AOR

2.79, 95% CI 1.43–5.45). Compared with first-year pre-service teachers, those in their fourth year were less likely to report high willingness (AOR 0.12, 95% CI 0.02–0.84). No statistically significant associations were observed for second- or third-year pre-service teachers. Attitude was significantly associated with willingness. Compared with pre-service teachers who strongly disagreed or disagreed with the positive attitude statement, those who agreed or strongly agreed were more likely to report high willingness (AOR 3.03, 95% CI 1.05–8.76). Subjective norm was also significantly associated with willingness. Pre-service teachers who agreed or strongly agreed that their teachers expected them to promote health education, including OV prevention, were more likely to report high willingness than those who strongly disagreed or disagreed (AOR 4.87, 95% CI 1.60–14.80). A particularly strong association was observed for perceived behavioral control. Compared with pre-service teachers who reported being not confident at all or slightly confident, those who reported being moderately confident had higher odds of high willingness (AOR 2.56, 95% CI 1.30–5.05). Those who reported being confident or very confident had substantially higher odds of high willingness (AOR 12.90, 95% CI 4.64–35.90). All $G^2_{VIF}(1/(2 \times df))$ values were below the prespecified threshold of 5, with observed values ranging from 1.06 to 1.48. Regarding, sensitivity analysis, when TTC was omitted from the multivariable model, the estimates for the individual-level variables changed only minimally (Supplementary Table S1). For example, the AORs for female gender, positive attitude, positive subjective norm, and confident/very confident perceived behavioral control were 2.81, 3.07, 4.95, and 13.00, respectively. There was no evidence that the associations of attitude, subjective norm, or perceived behavioral control with high willingness differed by TTC (global interaction $p = 0.413, 0.471, \text{ and } 0.823$, respectively).

Table 4

Univariable and TTC-adjusted multivariable logistic regression analyses of factors associated with high willingness (n = 372)

Characteristic		Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age, per 1-year increase		0.85 (0.76–0.95)	0.85 (0.72–1.01)
TTC	Pakse TTC	1.00 (reference)	1.00 (reference)
	Savannakhet TTC	0.49 (0.30–0.81)	0.89 (0.45–1.74)
Gender	Male	1.00 (reference)	1.00 (reference)
	Female	2.13 (1.31–3.44)	2.79 (1.43–5.45)
Year of study	First	1.00 (reference)	1.00 (reference)
	Second	0.70 (0.42–1.17)	0.81 (0.40–1.66)
	Third	0.83 (0.28–2.41)	0.84 (0.19–3.64)
	Fourth	0.21 (0.06–0.78)	0.12 (0.02–0.84)
Study major	Kindergarten Education	1.00 (reference)	1.00 (reference)
	Primary Education	0.69 (0.28–1.70)	1.00 (0.31–3.28)
	Science Education	0.83 (0.28–2.41)	1.56 (0.36–6.70)
	Mathematics and ICT	0.88 (0.28–2.75)	1.31 (0.29–5.96)
	English Education	0.59 (0.23–1.51)	0.69 (0.19–2.46)
	Other Education Majors	0.49 (0.15–1.61)	0.41 (0.09–2.01)
Note : OR, odds ratio; CI, confidence interval. Adjusted ORs are from the multivariable logistic regression model.			
Attitude toward teaching OV prevention education			

Characteristic		Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Exposure to OV prevention education at TTC	Yes	1.00 (reference)	1.00 (reference)
	No	1.49 (0.94–2.37)	1.18(0.61–2.29)
History of OV infection in the participant or a close contact	Yes	1.00 (reference)	1.00 (reference)
	No/Don't know	0.69 (0.31–1.56)	1.18 (0.38–3.63)
Knowledge about OV prevention	Low knowledge	1.00 (reference)	1.00 (reference)
	Moderate knowledge	1.65 (0.98–2.77)	0.76 (0.36–1.61)
	High knowledge	2.64 (1.42–4.90)	1.28 (0.56–2.94)
Attitude toward teaching OV prevention education	Strongly disagree/disagree	1.00 (reference)	1.00 (reference)
	Neutral	1.08 (0.52–2.27)	0.58 (0.17–1.98)
	Agree/strongly agree	11.00 (5.63–21.30)	3.03 (1.05–8.76)
Subjective norm toward teaching OV prevention education	Strongly disagree/disagree	1.00 (reference)	1.00 (reference)
	Neutral	1.24 (0.62–2.46)	2.08 (0.62–6.95)
	Agree/strongly agree	9.95 (5.14–19.30)	4.87 (1.60–14.80)
PBC over teaching OV prevention education	Not confident/slightly confident	1.00 (reference)	1.00 (reference)
	Moderately confident	1.92 (1.15–3.20)	2.56 (1.30–5.05)
	Confident/very confident	12.70 (5.19–30.90)	12.90 (4.64–35.90)
Note : OR, odds ratio; CI, confidence interval. Adjusted ORs are from the multivariable logistic regression model.			
Attitude toward teaching OV prevention education			

<Insert Table 4>

Sensitivity analyses excluding TTC and tests for effect modification by TTC are presented in Supplementary Tables S1 and S2.

Discussion

This study examined factors associated with pre-service teachers' willingness to teach OV prevention education at two TTCs in Lao PDR using logistic regression analysis. Three findings are particularly noteworthy. First, willingness was associated with attitude, subjective norm, and perceived behavioral control, the three core constructs of the TPB. Second, the largest adjusted odds ratio was observed for perceived behavioral control, particularly among students who reported being confident or very confident in their ability to teach OV prevention. Third, female gender was independently associated with greater willingness. Although knowledge was associated with willingness in the bivariable analysis, this association was no longer statistically significant after adjustment for other factors.

Overall, nearly three-quarters of the participants reported that they were willing or very willing to teach OV prevention education, suggesting generally positive readiness among future teachers to participate in school-based OV prevention activities. Previous research has emphasized the importance of teacher preparation in strengthening school health promotion [12, 13]. In areas where OV infection remains a public health concern, preparing future teachers to communicate appropriate prevention messages may therefore be particularly important.

The findings are broadly consistent with the TPB-informed framework. Students with more positive attitudes toward teaching OV prevention were more likely to report greater willingness. In the TTC-adjusted logistic regression model, students who agreed or strongly agreed that teaching OV prevention would benefit schoolchildren had approximately three times the odds of high willingness compared with those who expressed a negative attitude (AOR 3.03, 95% CI 1.05–8.76).

Subjective norm was also associated with willingness. Students who perceived stronger expectations from their teachers regarding the promotion of health education were more likely to report willingness to teach OV prevention. In the TTC-adjusted model, those reporting positive subjective norms had 4.87 times the odds of high willingness (95% CI 1.60–14.80).

The largest adjusted odds ratio was observed for perceived behavioral control. Students who were moderately confident in their ability to teach OV prevention had approximately 2.56 times higher odds of high willingness, whereas those who were confident or very confident had approximately 12.90 times higher odds compared with students who were not confident or only slightly confident.

Previous research has emphasized the importance of teacher confidence and self-efficacy in the implementation of health education [14–16]. The present findings extend this perspective to OV prevention education in Lao PDR. TTC programs could therefore consider incorporating practical

teaching activities, lesson planning, demonstrations, and supervised opportunities to teach OV-related content. Such activities may help students move beyond simply acquiring knowledge about OV and develop greater confidence in communicating prevention messages to schoolchildren.

Interestingly, knowledge was associated with willingness in the bivariable analysis but was not independently associated with willingness in the adjusted logistic regression model.

This finding suggests that although increasing knowledge remains important, knowledge acquisition alone may not be sufficient to strengthen willingness to teach OV prevention. Rather, willingness may depend more strongly on how students evaluate the importance of teaching OV prevention, the expectations they perceive from their teachers, and their confidence in their ability to teach the topic. The knowledge findings also identified several areas that may require greater attention in teacher preparation. Although most students recognized raw or undercooked fish as an important route of OV transmission, substantial gaps remained regarding the transmission cycle, animal reservoirs, sanitation, diagnosis, and common misconceptions concerning the effects of lemon juice and alcohol. Addressing these misconceptions is particularly important because inaccurate information could be transmitted to schoolchildren and communities if future teachers are not adequately prepared. Previous research has emphasized the need to address sociocultural factors associated with OV transmission [9] and to strengthen teacher preparation for health promotion [13].

Exposure to OV prevention education at the TTC was not independently associated with willingness in the logistic regression model. This finding suggests that simply determining whether students have previously encountered OV prevention education may not adequately capture the quality, content, intensity, or practical relevance of that educational exposure. Future studies should therefore examine not only whether OV prevention is included in teacher education but also how it is taught and whether students have opportunities to practice delivering the content.

Female students were more likely than male students to report high willingness in the TTC-adjusted logistic regression model (AOR 2.79, 95% CI 1.43–5.45). Fourth-year students showed lower odds of high willingness than first-year students in the TTC-adjusted logistic regression model (AOR 0.12, 95% CI 0.02–0.84).

Strengths and limitations

This study has several strengths. First, it addresses an underexplored aspect of OV prevention by focusing on pre-service teachers who may become future providers of school-based health education. Second, the study used a TPB-informed conceptual framework to examine willingness rather than focusing solely on knowledge. Finally, the study used logistic regression analysis to examine factors independently associated with willingness.

Several limitations should also be considered. First, the cross-sectional design precludes conclusions about causality or temporal relationships. Second, the study was conducted at only two TTCs in Lao

PDR, and the findings may therefore not be generalizable to all teacher training institutions or pre-service teachers in the country. Third, willingness was self-reported, was used as an operational indicator of behavioral intention, and may not correspond to actual future teaching behavior. Fourth, the TPB constructs were assessed using single questionnaire items. Although these items were informed by the TPB and underwent expert review, single-item measures may provide a less comprehensive assessment of multidimensional constructs than validated multi-item scales. In particular, perceived behavioral control was operationalized as confidence in the ability to teach OV prevention and may not capture all dimensions of this construct. Fifth, the primary analysis was restricted to participants who had previously heard of OV. This restriction may have selected students with greater prior awareness or interest, potentially overestimating willingness and limiting generalizability to pre-service teachers with no prior awareness of OV. Sixth, only 101 participants were classified as having lower willingness, while the multivariable model included several categorical explanatory variables and therefore multiple parameters. This limited number of observations in the smaller outcome category, together with sparse categories such as the fourth-year group ($n = 10$), may have reduced precision and model stability and increased the risk of overfitting. The adjusted estimates, particularly those for sparsely represented categories, should therefore be interpreted cautiously.

Implications for practice

The findings suggest that teacher preparation for OV prevention should extend beyond the provision of factual knowledge.

First, TTCs could provide more opportunities for students to practice teaching OV prevention education. Such practical activities may help strengthen perceived behavioral control and confidence in teaching OV prevention. Second, teacher educators could use interactive approaches that encourage students to discuss the benefits of OV prevention and develop positive attitudes toward providing health education. Third, OV prevention could be framed as a shared professional responsibility within teacher training programs. Visible support and expectations from teacher educators and TTCs may strengthen perceived professional norms regarding engagement in health promotion. Finally, OV prevention education should address common misconceptions identified in this study, particularly those concerning the transmission cycle, animal hosts, sanitation, and ineffective preventive practices, such as consuming raw fish with lemon juice or alcohol.

These approaches may be particularly relevant in endemic areas, where teachers have the potential to contribute to sustained school- and community-based prevention.

Conclusions

Most pre-service teachers at the two participating TTCs reported willingness to teach OV prevention. In the TTC-adjusted model, attitude, subjective norm, and perceived behavioral control were independently associated with willingness, with the largest adjusted odds ratio observed for perceived behavioral

control. Female students were also more likely to report high willingness, whereas knowledge and previous exposure to OV prevention education were not independently associated with willingness after adjustment for other covariates. The sensitivity analysis excluding TTC produced materially unchanged estimates for the principal individual-level associations.

The findings are broadly consistent with the TPB-informed framework for understanding willingness to teach OV prevention among pre-service teachers. Strengthening practical teaching experience, confidence, supportive professional norms, and positive attitudes toward OV prevention may help TTCs better prepare future teachers to deliver health education in OV-endemic areas of Lao PDR.

Abbreviations

AOR	Adjusted odds ratio
CI	Confidence interval
IQR	Interquartile range
Lao PDR	Lao People's Democratic Republic
OV	<i>Opisthorchis viverrini</i>
OR	Odds ratio
PBC	Perceived behavioral control
TPB	Theory of Planned Behavior
TTC	Teacher Training College

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee for Medical and Health Research Involving Human Subjects of the University of the Ryukyus, Japan (No. 25-2619), and the National Ethics Committee for Health Research, Lao PDR (No. 101). Informed consent was obtained electronically from all participants before participation. Participation was voluntary and anonymous.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to the confidentiality of participant data but are available from the corresponding author on reasonable request.

Competing interests

The authors declare no competing interests.

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Authors' contributions

STh, STo, and DN conceptualized the study; STh, KK, SPe, and SPh collected the data; STh analyzed the data in consultation with STo, DN, and MI. STh wrote the first draft of the manuscript, which was critically reviewed and revised by STo, DN, KK, SPe, SPh, TA, KM, ASand MI. All authors read and approved the final version of the manuscript.

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Figures

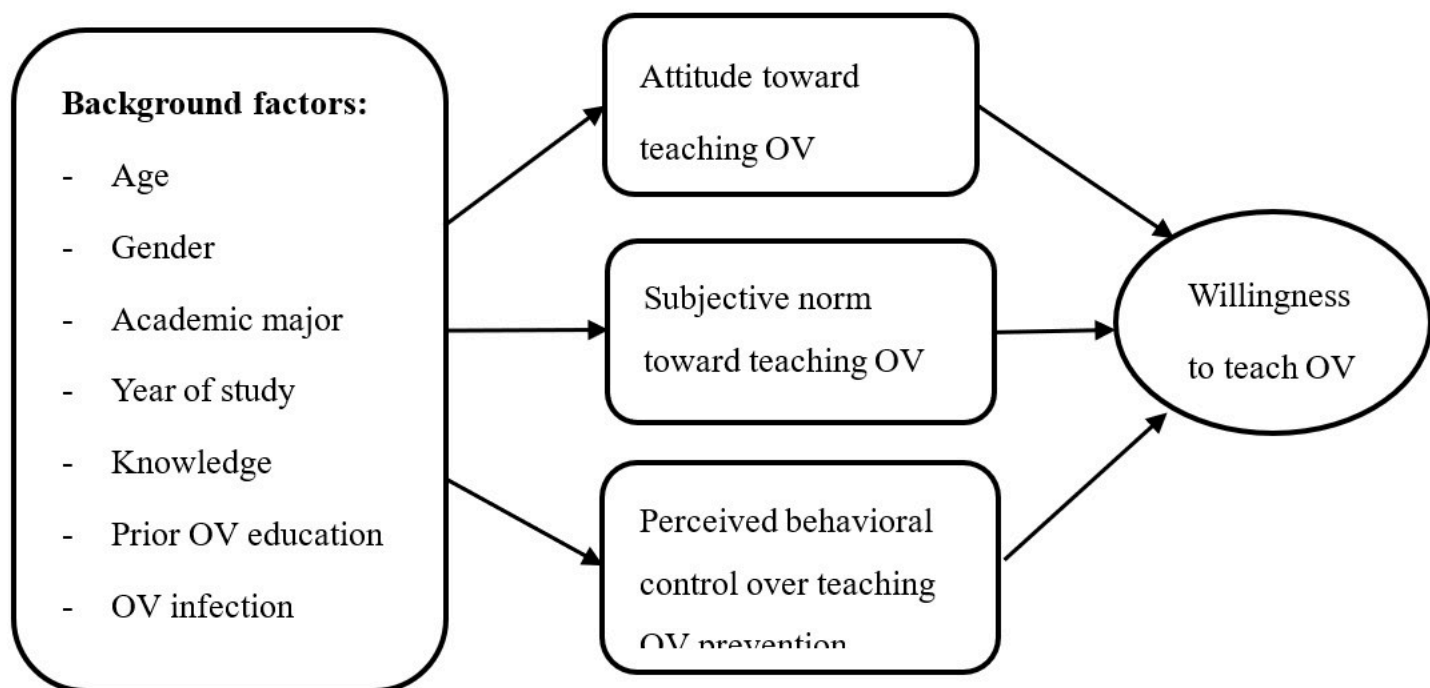


Figure 1

Conceptual framework of factors associated with willingness to teach OV prevention education

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