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The socioeconomic characteristics influencing knowledge, attitudes, and practices in toxocariasis prevention among the adult Khmer population in Tra Vinh province, Vietnam

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ABSTRACT

Objective: To assess the socioeconomic characteristics influencing knowledge, attitudes, and practices in preventing toxocariasis among the adult Khmer population in Tra Vinh Province, Vietnam.

Methods: This cross-sectional study was conducted across 30 communities in eight districts and cities of Tra Vinh Province using a 30-cluster random sampling method during 2023.

Results: The study encompassed 760 participants (median age: 52 years; interquartile range: 39-63 years), female 65.9%. There existed moderate levels of knowledge, attitudes, and preventive practices among participants, with variations across sociodemographic groups. Education (*OR* 0.53; 95% *CI* 0.36-0.53; *P*=0.002), and average family income (*OR* 0.40; 95% *CI* 0.24-0.68; *P*=0.001) were inversely associated with poor knowledge. Participants aged ⩾60 years had higher odds of negative attitudes (*OR* 5.26; 95% *CI* 2.31-11.96; *P*<0.001) towards toxocariasis prevention. Not owning pets (*OR* 1.53; 95% *CI* 1.13-2.08; *P*=0.006) and age⩾60 years (*OR* 5.33; 95% *CI* 2.61-10.86; *P*<0.001) were associated with significantly higher odds of poor preventive practices. Conversely, higher education (*OR* 0.11; 95% *CI* 0.06-0.20; *P*<0.001) and higher income (*OR* 0.14; 95% *CI* 0.06-0.33; *P*<0.001) were protective factors, significantly reducing the risk of poor preventive practices.

Conclusions: Knowledge, attitudes, and practice levels regarding toxocariasis prevention among Khmer adults in Tra Vinh were moderate and associated with age, education and income. Targeted health education efforts, especially in rural and low-income groups, are essential to improve preventive behaviors and reduce infection risks.

KEYWORDS: Knowledge, attitude, and practice; Toxocariasis; Risk factors; Southern Khmer Ethnicity; Tra Vinh Province

Summary

Question: Among adult Khmer residents in Tra Vinh Province, which socioeconomic characteristics influence knowledge, attitudes, and practices regarding toxocariasis prevention?

Findings: In a cross-sectional survey of 760 adults from 30 communities, overall knowledge, attitudes, and practices were moderate. Participants who are educated (*OR* 0.53; 95% *CI* 0.36-0.53; *P*=0.002), and average family income (*OR* 0.40; 95% *CI* 0.24-0.68; *P*=0.001) were inversely associated with poor knowledge, while non-pet owners (*OR* 1.53; 95% *CI* 1.13-2.08; *P*=0.006) and those aged ⩾60 years (*OR* 5.33; 95% *CI* 2.61-10.86; *P*<0.001) had significantly higher odds of poor preventive practices and negative attitudes. Conversely, higher education (*OR* 0.11; 95% *CI* 0.06-0.20; *P*<0.001) and higher income (*OR* 0.14; 95% *CI* 0.06-0.33; *P*<0.001) were protective factors, significantly reducing the risk of poor preventive practices and negative attitudes.

Meaning: Targeted health education interventions for low-income, less educated, and rural Khmer adults are needed to strengthen preventive behaviors and reduce toxocariasis risk.

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1. Introduction

In the current context of globalization, the transmission of parasitic infections from animals to humans, including toxocariasis, is becoming increasingly complex, diverse, and poses significant challenges to public health around the world, especially in developing countries[1]. However, the prevention of toxocariasis does not solely rely on the implementation of medical treatment interventions. Community knowledge, attitudes, and practices (KAP) regarding disease prevention play a crucial role. Lack of knowledge, poor health practices, or overly subjective attitudes can increase the risk of infection, reduce the effectiveness of health campaigns, and heighten the risk of transmission within communities[2,3]. Moreover, implementing toxocariasis prevention faces many challenges. Applying knowledge in practice, such as maintaining personal hygiene, limiting exposure to infection factors, and ensuring sanitary living habits, especially in food hygiene, often encounters difficulties in community implementation due to cultural, economic reasons, or due to limited public knowledge[3,4].

Vietnam, situated in a tropical climate zone, has been documented to experience a higher burden of parasitic infections, including toxocariasis, than the global average[5,6]. Tra Vinh Province, located along the Mekong Delta coastline and spanning 2 341 km^2 with over 1.1 million residents, is notable for its large Khmer ethnic population, accounting for more than 30% of inhabitants, ranking among the provinces with the highest Khmer representation nationwide[6,7]. Recent epidemiological surveys indicated a toxocariasis seroprevalence of 66.3% in 2022[7] and a toxocariasis prevalence reaching 48% in 2023[6]. Despite these high rates, community awareness and preventive practices remain limited: only 41.3% demonstrated adequate knowledge and 22.5% engaged in preventive measures, as reported by Nguyen Thanh Binh *et al*. in a 2022 study at Tra Vinh University Hospital[3]. A subsequent investigation in 2023 among the Khmer community found that merely 25.66% possessed good knowledge and 42.63% had average knowledge about toxocariasis, while good and average preventive practices were observed in just 9.61% and 57.76% of respondents, respectively[8]. Collectively, these data highlight toxocariasis as a persistent public health issue within the Southern Khmer population[3,6]. Therefore, this study was conducted to explore these issues, with the aim of guiding the development and improvement of communication and education strategies in health intervention, to effectively raise awareness and change community behaviors in preventing toxocariasis infection.

2. Methods

2.1. Study design

This cross-sectional study was carried out in 30 communities across eight districts in Tra Vinh Province during 2023.

2.2. Study subjects

The study focused on adult Khmer men and women, aged 18 and older, who have been permanent residents of Tra Vinh Province for more than one year prior to the commencement of the research.

2.3. Sample size

$$n=Z^2_{(1-\frac{\alpha}{2})}\frac{p(1-p)\times DE}{d^2}$$

The sample size was determined using the formula for estimating a proportion, p: estimated prevalence of the disease. The calculation of the sample size was based on the knowledge level in preventing toxocariasis, based on the findings from Phu's study (2023), which indicated a good knowledge rate of 25.66%[8], the estimated current good knowledge rate was set at P=0.256 6. The study incorporated a design effect coefficient, denoted as DE, which was set at 2. To account for potential sample attrition, an additional 10% was added to the sample size calculation, leading to an estimated 647 participants. In practice, the study was executed with a slightly higher participant count, involving 760 individuals.

2.4. Sampling method

The probability proportionate to size sampling method was employed[9]. Each cluster corresponds to a geographical area, with the 30 clusters representing 30 communities across the districts of Tra Vinh Province. A list of 106 clusters (communities/wards) was compiled. Tra Vinh includes one city and seven districts/towns, all arranged in numerical ordered. Subsequently, a list of the Khmer adult population, totaling 318 231 individuals, residing in all communities/wards within each district/town/city was prepared. A cumulative population table was then created, calculating the sample interval k=total cumulative population/30 clusters, which is 10 608. Using random number tables, the first cluster with a population<k was selected, followed by additional clusters by adding k to the previous cluster. Random systematic selection from the household list in each commune was then conducted to reach the calculated number of households required; finally, within each household, The Leslie Kish sampling method[10], a statistical tool used to randomly select individuals from a household, was employed to choose one adult to participate in the survey.

2.5. Data collection methods

The data were gathered through direct interviews, utilizing structured questionnaires. A structured questionnaire was developed and used to collect the data[3,5], which comprised two main sections. The first section included the demographic and socioeconomic characteristics of the participants (*i.e.*, age, sex, education level, and income). The second section included questions regarding the

knowledge, attitudes, and practices related to toxocariasis. All the questionnaires were checked for accuracy and completeness. The internal consistency of the questionnaire was acceptable, with a Cronbach's alpha coefficient of 0.73 for the overall scale.

The knowledge level about toxocariasis was assessed by requesting respondents to answer 12 questions with response options comprising "Yes," "No," and "Not sure." The knowledge score was calculated as one for every "Yes" and zero for every "No" or "Not sure." The total score ranged from 0 to 12. Respondents with scores of equal or less than 4 were considered to have poor knowledge about toxocariasis.

The attitude toward toxocariasis was determined using a questionnaire containing 7 questions. A 3-point Likert scale was used in assessing the answers of this questionnaire, with one points awarded for an "Agree," zero points for "Not sure," and deduct a point if the answer was "Disagree" for each questions. The total scores ranged from negative to positive. Respondents with scores negative were considered to have a poor attitude.

The practice level related to toxocariasis consisted of a 3-point Likert scale, which was determined using a questionnaire containing 15 questions. The practice score was calculated as one for every "Yes" and zero for every "No" or "Not sure." Respondents with scores of less than 5 were considered to have poor practices.

2.6. Statistical analysis approach

The collected data were meticulously input using Epidata version 3.1 and cleaned and analyzed using Stata software version 13.0. The study employed descriptive analysis to calculate percentages; comparative analysis to assess differences in practice level among different groups; and utilized the odds ratio (*OR*) and 95% confidence interval (*CI*) to quantify the association and its precision, with significance if the *CI* excludes 1.

2.7. Ethical considerations

The study protocol was approved by the Ethics Committee in Bio Medical Research-National Institute of Hygiene and Epidemiology (approval No.: NIHE IRB-22/2023) and by the Ethics Committee in Bio Medical Research-Tra Vinh University (approval number 240/GCT-HĐĐĐ, dated July 20, 2023). All procedures were conducted in accordance with the ethical standards of the institutional and national research committees and with the Declaration of Helsinki and its later amendments.

3. Results

3.1. Baseline characteristics of participants in the survey

A total of 760 participants were enrolled in this survey, with a median age of 52 years (interquartile range: 39-63 years). Demographically, the participants were predominantly female (65.9%), married (93.0%), and residing in rural areas (93.0%). Regarding age distribution, the 40-60 years age group was the largest (42.6%), followed by those aged ⩾60 years (31.8%). In terms of education, nearly half of the participants had primary education or lower literacy (25.3% illiterate; 27.2% primary education), while 28.7% and 18.8% had secondary and higher education (diploma/college/university), respectively (Table 1).

Table 1. General characteristics of the study participants (n=760)*.

Factors	Frequency
Age, years, median (Q1-Q3)	52 (39-63)
Age group, years	
18-30	75 (9.9)
31-39	119 (15.7)
40-60	324 (42.6)
⩾60	242 (31.8)
Sex	
Male	259 (34.1)
Female	501 (65.9)
Education	
Illiterate	192 (25.3)
Literate/Primary education	207 (27.2)
Secondary education	218 (28.7)
High education (Diploma/College/University)	143 (18.8)
Occupation	
Farmer	210 (27.6)
Worker	131 (17.2)
Officer/Civil servant	25 (3.3)
Business	102 (13.4)
Other	292 (38.4)
Employment status	
Unemployed	217 (28.6)
Unstable employment	154 (20.3)
Stable employment	389 (51.2)
Family economic status#	
Poverty	62 (8.2)
Average income	611 (80.4)
Above average income	87 (11.5)
Marital status	
Single	53 (7.0)
Married	707 (93.0)
Number of household members	
1	27 (3.6)
2-4	505 (66.6)
5-10	220 (29.0)
⩾10	8 (1.1)
History of family members diagnosed with toxocariasis	
Yes	72 (9.5)
No	688 (90.5)
Neighboring households owning dogs/cats	
Yes	598 (78.7)
No	162 (21.3)
Owning dogs/cats	
Yes	419 (55.1)
No	341 (44.9)
Residence	
Rural	707 (93.0)
Urban	53 (7.0)

*Data were expressed as n (%), unless otherwise indicated. #Family economic status: classified under the Vietnamese national multidimensional poverty standards for 2022-2025[11].

Table 2. Univariate logistic regression analysis of socioeconomic factors of poor knowledge in the study [*N*=760, *n* (%)].

Factors	Knowledge level in preventing toxocariasis		*OR* (95% *CI*)	*P*-value
	Poor (*n*=241)	Good (*n*=519)		
Age group, years				
18-30	12 (16.0)	63 (84.0)	1	
31-39	17 (14.3)	102 (85.7)	0.88 (0.39-1.95)	0.744
40-60	103 (31.8)	221 (68.2)	2.44 (1.26-4.73)	0.008
⩾60	109 (45.1)	133 (54.9)	4.30 (2.21-8.39)	<0.001
Sex				
Male	73 (28.2)	186 (71.8)	1	
Female	168 (33.5)	333 (66.5)	1.29 (0.93-1.78)	0.134
Education				
Illiterate	106 (55.2)	86 (44.8)	1	
Literate/Primary education	82 (39.6)	125 (60.4)	0.53 (0.36-0.53)	0.002
Secondary education	50 (22.9)	168 (77.1)	0.24 (0.16-0.37)	<0.001
High education (Diploma/College/University)	3 (2.2)	140 (97.8)	0.02 (0.01-0.06)	<0.001
Occupation				
Farmer	74 (33.5)	147 (66.5)	1	
Worker	4 (3.1)	127 (96.9)	0.06 (0.02-0.18)	<0.001
Officer/Civil servant	8 (32.0)	17 (68.0)	0.93 (0.39-2.27)	0.881
Business	38 (37.2)	64 (62.8)	1.18 (0.72-1.92)	0.508
Other	117 (41.6)	164 (58.4)	1.42 (0.98-2.04)	0.062
Employment status				
Unemployed	93 (42.9)	124 (57.1)	2.94 (2.04-4.24)	<0.001
Unstable employment	69 (44.8)	85 (55.2)	3.19 (2.13-4.76)	<0.001
Stable employment	79 (20.3)	310 (79.7)	1	
Family economic status[#]				
Poverty	34 (54.8)	28 (45.2)	1	
Average income	200 (32.8)	411 (67.2)	0.40 (0.24-0.68)	0.001
Above average income	80 (8.1)	80 (91.9)	0.07 (0.03-0.18)	<0.001
Marital status				
Single	15 (28.3)	38 (71.7)	1	
Married	226 (31.9)	481 (68.1)	1.19 (0.64-2.21)	0.581
Number of household members				
1	10 (37.1)	17 (62.9)	1	
2-4	164 (32.5)	341 (67.5)	0.82 (0.37-1.83)	0.623
5-10	64 (29.1)	156 (70.9)	0.70 (0.30-1.61)	0.397
⩾10	3 (37.5)	5 (62.5)	1.02 (0.20-5.21)	0.981
History of family members diagnosed with toxocariasis				
Yes	14 (19.5)	58 (80.5)	1	
No	227 (32.9)	461 (67.1)	2.04 (1.11-3.74)	0.021
Neighboring households owning dogs/cats				
Yes	184 (30.8)	414 (69.2)	1	
No	57 (35.2)	105 (64.8)	1.22 (0.85-1.76)	0.284
Owning dogs/cats				
Yes	119 (28.4)	300 (71.6)	1	
No	122 (35.8)	219 (64.2)	1.40 (1.03-1.91)	0.030
Residence				
Rural	233 (32.9)	474 (67.1)	2.77 (1.28-5.96)	0.009
Urban	8 (15.1)	45 (84.9)	1	

[#]Family economic status: classified under the Vietnamese national multidimensional poverty standards for 2022-2025[11].

Table 3. Univariate logistic regression analysis of socioeconomic factors of poor attitude in the study [*N*=760, *n* (%)].

Factors	Attitude level in preventing toxocariasis		*OR* (95% *CI*)	*P*-value
	Poor (*n*=163)	Good (*n*=597)		
Age, years				
18-30	7 (9.3)	68 (90.7)	1	
31-39	16 (13.5)	103 (86.5)	1.51 (0.59-3.86)	0.391
40-60	55 (16.9)	269 (83.1)	1.99 (0.87-4.56)	0.105
⩾60	85 (35.1)	157 (64.9)	5.26 (2.31-11.96)	<0.001
Sex				
Male	44 (17.0)	215 (83.0)	1	
Female	119 (23.7)	382 (76.3)	1.52 (1.04-2.23)	0.032
Education				
Illiterate	62 (32.3)	130 (67.7)	1	
Literate/Primary education	57 (27.5)	150 (72.5)	0.80 (0.52-1.22)	0.300
Secondary education	38 (17.4)	180 (82.6)	0.44 (0.28-0.70)	0.001
High education (Diploma/College/University)	6 (4.2)	137 (95.8)	0.09 (0.04-0.22)	<0.001
Occupation				
Farmer	52 (23.5)	169 (76.5)	1	
Worker	8 (6.1)	123 (93.9)	0.21 (0.10-0.46)	<0.001
Officer/Civil servant	3 (12.0)	22 (88.0)	0.44 (0.13-1.54)	0.200
Business	24 (23.5)	78 (76.5)	1.00 (0.58-1.74)	>0.99
Other	76 (27.1)	205 (72.9)	1.20 (0.80-1.81)	0.370
Employment status				
Unemployed	63 (29.0)	154 (71.0)	2.48 (1.65-3.74)	<0.001
Unstable employment	45 (29.2)	109 (70.8)	2.51 (1.60-3.93)	<0.001
Stable employment	55 (14.1)	334 (85.9)	1	
Family economic status[#]				
Poverty	26 (41.9)	36 (58.1)	1	
Average income	127 (20.8)	484 (79.2)	0.36 (0.21-0.62)	<0.001
Above average income	10 (11.5)	77 (88.5)	0.18 (0.08-0.41)	<0.001
Marital status				
Single	8 (15.1)	45 (84.9)	1	
Married	155 (21.9)	552 (78.1)	1.58 (0.73-3.42)	0.246
Number of household members				
1	5 (18.5)	22 (81.5)	1	
2-4	114 (22.6)	391 (77.4)	1.28 (0.48-3.46)	0.623
5-10	42 (19.1)	178 (80.9)	1.04 (0.37-2.90)	0.943
⩾10	2 (25.0)	6 (75.0)	1.47 (0.23-9.53)	0.688
History of family members diagnosed with toxocariasis				
Yes	8 (11.1)	64 (88.9)	1	
No	155 (22.5)	533 (77.5)	2.33 (1.09-4.96)	0.029
Neighboring households owning dogs/cats				
Yes	131 (21.9)	467 (78.1)	1	
No	32 (19.8)	130 (80.2)	0.88 (0.57-1.35)	0.554
Owning dogs/cats				
Yes	87 (20.8)	332 (79.2)	1	
No	76 (22.3)	265 (77.7)	1.09 (0.77-1.54)	0.611
Residence				
Urban	5 (9.4)	48 (90.6)	1	
Rural	158 (22.4)	549 (77.6)	2.76 (1.08-7.06)	0.034

[#]Family economic status: classified under the Vietnamese national multidimensional poverty standards for 2022-2025[11].

Table 4. Univariate logistic regression analysis of socioeconomic factors of poor practices in the study [*N*=760, *n* (%)].

Factors	Practices level in preventing toxocariasis		*OR* (95% *CI*)	*P*-value
	Poor (*n*=248)	Good (*n*=512)		
Age, years				
18-30	10 (13.3)	65 (86.7)	1	
31-39	28 (23.5)	91 (76.5)	2.00 (0.91-4.40)	0.085
40-60	101 (31.2)	223 (68.8)	2.94 (1.45-5.96)	0.003
⩾60	109 (45.0)	133 (55.0)	5.33 (2.61-10.86)	<0.001
Sex				
Male	85 (32.8)	174 (67.2)	1	
Female	163 (32.5)	338 (67.5)	0.99 (0.72-1.36)	0.937
Education				
Illiterate	93 (48.4)	99 (51.6)	1	
Literate/Primary education	89 (43.0)	118 (57.0)	0.80 (0.54-1.19)	0.276
Secondary education	53 (24.3)	165 (75.7)	0.34 (0.22-0.52)	<0.001
High education (Diploma/College/University)	13 (9.1)	130 (90.9)	0.11 (0.06-0.20)	<0.001
Occupation				
Farmer	90 (43.0)	120 (57.0)	1	
Worker	11 (8.4)	120 (91.6)	0.12 (0.06-0.24)	<0.001
Officer/Civil servant	7 (28.0)	18 (72.0)	0.52 (0.21-1.28)	0.155
Business	28 (27.5)	74 (72.5)	0.50 (0.30-0.84)	0.008
Other	112 (38.0)	180 (62.0)	0.82 (0.57-1.17)	0.266
Employment status				
Unemployed	85 (39.2)	132 (60.8)	1.97 (1.38-2.81)	<0.001
Unstable employment	67 (43.5)	87 (56.5)	2.35 (1.59-3.48)	<0.001
Stable employment	96 (24.7)	293 (75.3)	1	
Family economic status[#]				
Poverty	28 (45.2)	34 (54.8)	1	
Average income	211 (34.5)	400 (65.5)	0.64 (0.38-1.09)	0.098
Above average income	9 (10.3)	78 (89.7)	0.14 (0.06-0.33)	<0.001
Marital status				
Single	17 (32.1)	36 (67.9)	1	
Married	231 (32.7)	476 (67.3)	1.03 (0.57-1.87)	0.929
Number of household members				
1	11 (40.7)	16 (59.3)	1	
2-4	167 (33.1)	338 (66.9)	0.72 (0.33-1.58)	0.412
5-10	67 (30.5)	153 (69.5)	0.64 (0.28-1.45)	0.281
⩾10	3 (37.5)	5 (62.5)	0.87 (0.17-4.43)	0.870
History of family members diagnosed with toxocariasis				
Yes	17 (23.6)	55 (76.4)	1	
No	231 (33.6)	457 (66.4)	1.64 (0.93-2.88)	0.089
Neighboring households owning dogs/cats				
Yes	190 (31.8)	408 (68.2)	1	
No	58 (35.8)	104 (64.2)	1.2 (0.83-1.72)	0.332
Owning dogs/cats				
Yes	119 (28.4)	300 (71.6)	1	
No	129 (37.8)	212 (62.2)	1.53 (1.13-2.08)	0.006
Residence				
Rural	237 (33.5)	470 (66.5)	1.93 (0.97-3.81)	0.060
Urban	11 (20.8)	42 (79.2)	1	

[#]Family economic status: classified under the Vietnamese national multidimensional poverty standards for 2022-2025[11].

3.2. Demographic and socioeconomic characteristics of the participants regarding knowledge in the study

The overall assessment of knowledge on toxocariasis prevention showed that 519 individuals had a good level of knowledge, with the age group from 18 to 39 years achieving the highest good knowledge scores. Higher age groups appeared to have lower knowledge levels, with statistically significant differences in knowledge levels across these age groups: 40-60 years (*OR* 2.44, 95% *CI* 1.26-4.73, *P*=0.008) and ⩾60 years (*OR* 4.30, 95% *CI* 2.21-8.39, *P*<0.001). Furthermore, individuals with higher educational levels significantly reduced the odds of poor knowledge compared to those who were illiterate. The worker profession group (*OR* 0.06, 95% *CI* 0.02-0.18, *P*<0.001) and those with stable income significantly exhibited lower odds of poor knowledge levels compared to other groups. However, no significant difference in knowledge was observed between males and females. Additionally, individuals with above average income (*OR* 0.07, 95% *CI* 0.03-0.18, *P*<0.001) were significantly less likely to have poor knowledge compared to those with lower income levels. Families that do not own dogs or cats (*OR* 1.40, 95% *CI* 1.03-1.91, *P*=0.03), or do not have household members previously diagnosed with the disease (*OR* 2.04, 95% *CI* 1.11-3.74, *P*=0.021), and rural residents (*OR* 2.77, 95% *CI* 1.28-5.96, *P*=0.009) were associated with higher odds of poor knowledge (Table 2).

3.3. Demographic and socioeconomic characteristics of the participants regarding attitude in the study

The overall assessment of attitudes towards toxocariasis prevention revealed that 597 individuals had a good attitude level, with younger age groups seemingly achieving higher good attitude levels compared to those over 60 years old. Additionally, individuals with higher educational levels (*OR* 0.09, 95% *CI* 0.04-0.22, *P*<0.001), the worker profession group (*OR* 0.21, 95% *CI* 0.10-0.46, *P*<0.001), and those with a stable income were significantly associated with a lower likelihood of negative compared to other groups. Furthermore, the rural group had higher odds of negative attitudes compared to urban residents (*OR* 2.76; 95% *CI* 1.08-7.06; *P*=0.034) (Table 3).

3.4. Demographic and socioeconomic characteristics of the participants regarding practices in the study

The overall assessment of practices in toxocariasis prevention showed that 512 individuals had a good practice level, with individuals aged above 60 years having higher odds of poor practices compared to younger age groups (*OR* 5.33, 95% *CI* 2.61-10.86, *P*<0.001), and those who do not own dogs or cats also having higher odds of poor practices (*OR* 1.53, 95% *CI* 1.13-2.08, *P*=0.006). Higher educational levels were protective factors that reduced the likelihood of poor practices, with secondary education (*OR* 0.34, 95% *CI* 0.22-0.52, *P*<0.001) and high education (*OR* 0.11, 95% *CI* 0.06-0.20, *P*<0.001). Stable and higher economic status also acted as protective factors, with above average income (*OR* 0.14, 95% *CI* 0.06-0.33, *P*<0.001), reducing the odds of poor practices (Table 4).

4. Discussion

Previous studies have emphasized the significant influence of socioeconomic and educational variables on community awareness regarding helminth infection prevention. For example, Nguyen Thanh Binh *et al*[7] reported that rural residents in Tra Vinh were 48% less likely to possess correct knowledge compared to urban residents (*OR* 0.52; 95% *CI* 0.31-0.80; *P*=0.010). Additionally, individuals with more than 12 years of education were 1.89 times more likely to have adequate knowledge (*OR* 1.89; 95% *CI* 1.10-3.37; *P*=0.031), and those earning at least 217 USD monthly were 1.9 times more likely to understand the disease than lower-income counterparts (*OR* 1.90; 95% *CI* 1.17-3.08; *P*=0.009). In contrast, sex and age showed no significant correlation with knowledge levels. However, older adults were 68% less likely to exhibit positive attitudes toward prevention (*OR* 0.32; 95% *CI* 0.12-0.83; *P*=0.019)[7]. Similarly, Nguyen Duc Giang's research on trichinellosis in Thanh Hoa[12] noted that participants over 35 demonstrated better knowledge (7.5% *vs.* 5.5%) and practices (3.5% *vs.* 1.8%) than younger individuals. Farmers, in particular, exhibited poorer awareness (2.9%) than other occupations (23.0%), with non-farmers being 10.15 times more likely to be knowledgeable (95% *CI* 5.52-18.64). Educational background remained a strong predictor: only 2.1% of illiterate respondents had good knowledge, versus 29.2% of those with vocational or higher education[12]. In our current study, similar patterns emerged: higher education, income, and urban residence correlated positively with knowledge and practices, while older age and agricultural occupation were associated with lower scores. These findings are consistent with previous literature and further highlight the need for targeted interventions among rural, low-education populations.

In addition, multiple studies have shown that participants' socio-demographic variables, such as age, sex, education, and household characteristics, play an important role in predicting individual knowledge levels regarding helminth infections. Knowledge scores, combined with socio-demographic characteristics, serve as key predictors of individuals' handwashing and hygiene practices[13]. Notably, educational attainment is strongly associated with both knowledge and hygiene practices, which are in turn closely linked to infection rates[14]. This suggests that one of the critical conditions for reducing infection prevalence is the implementation of programs aimed at enhancing community knowledge and practices. Therefore, helminth prevention and treatment strategies should integrate community-based health education campaigns to improve and sustain positive hygiene behaviors, particularly in rural areas[13,14].

Overall, the influence of socioeconomic factors, especially economic status and educational attainment, should be carefully considered when designing health education campaigns and policy investments. Addressing these factors is crucial for improving population health and promoting equity in access to healthcare services. The importance of health education and communication campaigns has been emphasized in various studies, such as the research conducted by Lee *et al*, Indonesia in 2023, which demonstrated that health promotion and education are cost-effective strategies to complement helminth infection prevention efforts. Additionally, the study highlighted that quantitative tools and KAP surveys play a crucial role in monitoring the effectiveness of community-level helminth prevention interventions[13]; this study also reaffirmed the correlation between knowledge and educational attainment, with adults holding a university degree scoring nearly twice as high as those with no formal education. Knowledge scores were lowest among students, farmers, and unemployed individuals, and highest among public sector employees[13]. Similarly, practice scores increased with educational level, with significant differences observed across occupations and income levels. Post hoc analysis showed that public sector employees demonstrated better hygiene practices compared to other occupational groups, while students, self-employed individuals, and the unemployed exhibited the lowest practice levels. Notably, helminth infection status was significantly associated with differences in knowledge and practice scores between infected and non-infected participants[13]. Similarly, a study by Oyebamiji in Nigeria reported a high risk of transmission, as 66.8% of respondents lacked sufficient knowledge on how to prevent helminth infections. Furthermore, the high proportion of individuals lacking adequate preventive knowledge contributed to increased reinfection risks in the study area, even after treatment[15]. However, it is important to note that recent studies on community KAP regarding helminth infections have indicated that improved knowledge does not necessarily translate into behavioral change[13]. The 2023 study by Lee *et al*. in Indonesia hypothesized that economic hardship may contribute to delays in seeking treatment among infected individuals, despite demonstrating higher levels of knowledge compared to uninfected individuals. This may be attributed to financial constraints preventing individuals from affording transportation and medical services, especially in rural or remote communities. In such settings, poor sanitation and inadequate environmental conditions (*e.g.*, lack of clean water) pose significant barriers to implementing deworming programs or health education initiatives on helminth infections[13].

In addition, the study found that households owning dogs or cats exhibited higher levels of good preventive practices compared to those without pets. This suggests that pet-owning households may engage more actively in infection prevention behaviors. One possible explanation is that pet owners are directly involved in caring for and protecting their animals' health, which in turn positively influences their knowledge and preventive practices. Through pet ownership, individuals may proactively seek information on maintaining hygiene for their dogs and cats, including regular deworming, and may develop habits of cleaning their homes and pet living areas more frequently. This knowledge not only helps safeguard pet health but also enhances owners' awareness of zoonotic diseases, including those transmissible from animals to humans. Therefore, the study suggests that pet ownership should not necessarily be regarded as a risk factor requiring restriction, as some other studies have advised. Particularly in the context of the Khmer community's long-standing agricultural traditions and cultural practices rooted in Khmer Theravada Buddhism[16], where keeping dogs and cats is an established cultural norm, it is more important to focus on improving community awareness and providing appropriate knowledge. This approach would empower individuals to adopt proper pet care practices and maintain environmental hygiene, rather than emphasizing efforts to discourage pet ownership.

This study has several limitations: First, its cross-sectional design precludes causal inferences between socio-demographic factors and KAP outcomes. Second, reliance on self-reported data may introduce recall and social desirability biases, potentially inflating reported knowledge or behaviors. Third, the use of structured questionnaires limited the exploration of nuanced cultural or contextual factors influencing behaviors. Finally, the study's

findings may not generalize beyond the Khmer population in Tra Vinh, limiting external validity. Future research incorporating qualitative methods and longitudinal designs is warranted to deepen understanding and guide tailored interventions. Although multivariate logistic regression was not conducted, univariate analysis was deemed sufficient for the study objectives, which aimed primarily to explore associations rather than establish predictive models. Given the descriptive, exploratory nature of the research and its focus on identifying potential factors associated with KAP, the univariate results provided relevant insights to inform future in-depth studies. Moreover, the sample size and proportionality of subgroups limited the feasibility of including multiple covariates without overfitting.

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This study highlights moderate levels of knowledge, attitudes, and practices regarding toxocariasis prevention among Khmer adults in Tra Vinh Province, with socioeconomic and educational disparities significantly influencing outcomes. Interventions should prioritize low-income, low-education, and rural populations through culturally tailored health education campaigns and community-based approaches. Regular monitoring and evaluation are essential to assess long-term impact and inform policy development aimed at reducing parasitic infection rates and promoting health equity among marginalized communities.

Conflict of interest statement

The authors declare no conflicts of interest in this research.

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Authors' contributions

TGP developed the research design, performed the data analysis, and wrote the manuscript. TGH played a key role in the data collection process and provided valuable assistance in data processing. Both authors contributed equally to the revision and final version of the manuscript.

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