

Awareness Level of Pork Consumers towards Human Cysticercosis: A Cross-sectional Study of Chitwan District, Nepal

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Abstract

Human cysticercosis (HCC) is one of the major public health problems in developing countries. This study explored the knowledge, attitude, and practice (KAP) related to human cysticercosis transmission, prevention, and control measures among pork consumers in the Chitwan district of Nepal. A descriptive cross-sectional study was carried out by face-to-face interviews using structured questionnaires among 400 pork consumers selected randomly from purposively selected meat shops in the Chitwan district. Data was entered in Microsoft Excel version 2019 and the responses for KAP variables were analyzed using descriptive and Chi-square tests in R Studio version 2023.06.0. More than half (51%) of the participants had heard about HCC, 47% knew it was fatal but treatable and only 41% knew it was a preventable disease. Half of the participants had some idea about meat inspection, but only one-fourth thought it was necessary to prevent HCC. More than half of the participants had a misconception that it is safe to consume pork consisting of cysts. Only one-third (33%) of the participants treat water by boiling or filtration before drinking. Knowledge about HCC was associated with education and gender ($p < 0.05$) but attitude and practice were associated with the socio-economic status and education ($p < 0.05$) of participants. Awareness campaigns focusing on food hygiene and sanitation must be conducted under the One Health approach.

Keywords: Neurocysticercosis, Zoonotic disease, Food safety, One Health

Introduction:

Human cysticercosis (HCC) is a parasitic zoonotic disease caused by *Taenia solium* larva and is a major public health problem, mostly in endemic developing countries where there is low literacy rate and poor practices of hygiene and sanitation (Del Brutto, 2022). Cysticercosis is the most prominent cause of acquired seizures and epilepsy worldwide, accounting for 30% of seizure disorders in wide endemic areas across the world (Bustos et al., 2021). However, upto 70% of epilepsy cases in high-risk areas can be attributed to it. Over 80 percent of the 50 million epileptics worldwide reside in low- and lower-middle-income nations WHO, (2022). Neurocysticercosis is the major cause of epilepsy worldwide and around 50,000 deaths per year are attributed to it (Burneo et al., 2009). Neurocysticercosis is the most frequently found parasitic disease of the central nervous system and is caused by the ingestion of pork tapeworm eggs unknowingly through contaminated food and water (García et al., 2003). Two hosts (human beings and pigs) are involved in the life cycle of *T. solium* as shown in figure 1 (García et al., 2003). Humans can serve as definitive and intermediary hosts, whereas pigs are the intermediary host. Fecal-oral contamination, or the ingestion of *T. solium* eggs directly from tapeworm carriers, is frequently the cause of human cysticercosis. Furthermore, adult individuals who have the adult

parasite in their intestines may experience auto-infection through the fecal-oral pathway. After the eggs pass through the digestive tract, they become oncospheres that are subsequently carried by the bloodstream to various organs, including the central nervous system (CNS), where they eventually grow into larval forms known as cysticerci. Although the infected pigs are involved in transmitting taeniasis to humans, they are not directly responsible for the occurrence of human cysticercosis (García and Del Brutto, 2020).

According to a report by Awale (2022), there are around 50 million people with epilepsy worldwide and every year more than 5 million new cases are diagnosed, among which 80% are from lower and middle-income countries (LMIC). In Nepal, it is assumed that more than 1% of the total population (30.5 million) suffers from epilepsy (Awale, 2022). Despite the effects of controlling human cysticercosis, the disease is still endemic in many pig farming areas of Nepal (Subedi et al., 2023). Limited understanding of risk factors, transmission, clinical manifestations in humans and animals, preventive measures, and therapeutic interventions may perpetuate the endemicity of the disease across various regions. Conducting surveys on community knowledge, attitudes, and practices (KAP) can reveal information gaps, cultural preconceptions, or behavioral patterns that could either aid or hinder attempts to control or eradicate disease

(WHO, 2008). However, information on KAPs about human cysticercosis in Nepal is limited.

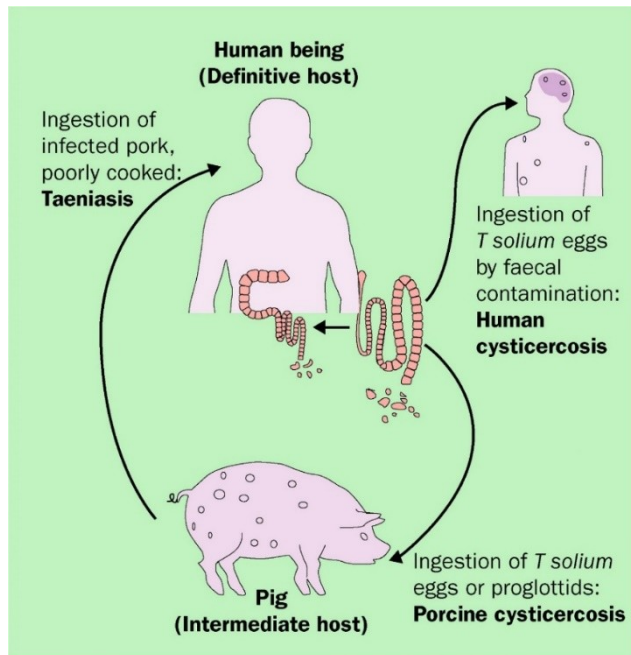


Figure 1: *Taenia solium* life cycle

A descriptive cross-sectional study was conducted to understand the knowledge, attitude, and practice (KAP) related to human cysticercosis transmission, prevention, and control measures among pork consumers in the Chitwan district of Nepal.

Materials and Methods:

Study area:

This cross-sectional study was conducted in Chitwan district of Nepal between November 2022 and May 2023. It is an initial study to see the KAP variables of pork consumers of Chitwan district towards human cysticercosis. Chitwan was purposely selected for pilot study as it is the district in the central part of Nepal.

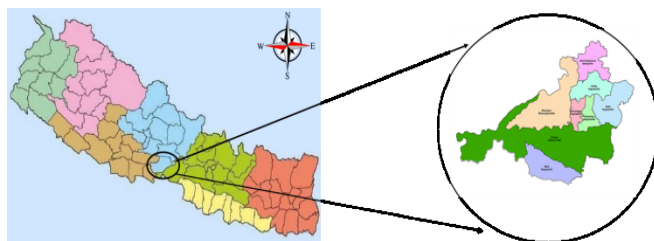


Figure 2. Map of Nepal showing Chitwan district with study area

Study design

A community-based cross-sectional survey was conducted from November 2022 to May 2023 in Chitwan district of Nepal. A list of meat shops registered in Chitwan was obtained from the District Administration Office, Chitwan. Out of 428 meat shops, 40 were purposively selected for study so that it covers overall part of district. Meat shops from the Bharatpur sub metropolitan city (n= 8), Ratnanagar municipality (n= 6); Khairahanai Municipality (n= 6); Kalaika Municipality (n= 6); Rapti municipality (n= 6); Madi municipality (n=4), and Ichhyakamana Rural municipality (n= 4) were selected. The descriptive cross-sectional study was carried out by face-to-face interviews using structured questionnaires among 400 pork consumers selected randomly from those purposively selected meat shops.

Sample size

The sample size for this study was computed using formula for qualitative variables with an infinite population (Charan and Biswas, 2013). As the knowledge, attitude and practice of people of Chitwan towards cysticercosis was unknown, the overall frequency of 50% was assumed with a significance level of 95% and a margin error of 5%, the minimum sample size calculated was 384. It was later rounded off to make a sample size of 400.

Data collection

A well-structured questionnaire was designed to assess the KAP about human cysticercosis. The questionnaire was partly adapted from similar studies conducted previously in Tanzania (Nyangi et al., 2022) and other African countries (Zulu et al., 2023). Before the questionnaire survey was started, the individual consent was taken from them and their name and identification were kept secret throughout the study and not published anywhere. The interview was conducted in local language and later answers were translated into English.

Data management and analysis

The questionnaire responses were transferred to Excel (Microsoft Excel, 2019, Microsoft Corp., Redmond, WA, USA) and made compatible with subsequent analysis using R studio version 2023.06.0. The participants were classified into four categories, including gender, age, education, and social status that were the determinant variables of the study. Age groups were classified into two groups as thirty-five or less years of age and thirty-six or more years of age. Likewise, based on their education level, they were classified as completed only higher secondary studies or had college or university degrees. The socio economic status was categorized as

lower/middle level and upper level. A descriptive analysis of data was performed to analyze the multiple responses. Chi-square test was then performed to test the association of the studied variables related to KAP.

Results and Discussion:

Demographic characteristics of participants

The study participants were a heterogenous group as shown in Table 1. They comprised more men (n = 320, 80%) than women (n = 80, 20%). In terms of age, 55.3% (n = 400) of participants were thirty-six years of age or above. Regarding the education level, 289 (72.3%) participants has completed higher secondary level whereas 111 (27.7%) had attended any college or university. It was found that 69.2% (n = 400) of participants were of lower or middle socioeconomic class and the rest 30.8 % were of upper class as shown in Table 1.

Table 1: Socio-demographic characteristics of participants (n = 400)

Variables	Characteristics	n (%)
Gender	Male	320 (80.0)
	Female	80 (20.0)
Age group	≤ 35	179 (44.7)
	≥ 36	221 (55.3)
Education level	Higher secondary school	289 (72.3)

	College/university	111 (27.7)
Socio economic status	lower/middle	277 (69.2)
	upper	123 (30.8)

Knowledge of participants about human cysticercosis

The questionnaire had five questions to assess the knowledge of pork consumers on human cysticercosis. The descriptive analysis found out that 51.5 % (n = 400) of participants had heard about HCC as shown in Table 2. It is similar to the results from previous studies (Alarakol et al., 2020; Makingi et al., 2023; Wilson et al., 2023; Zulu et al., 2023). However, another study conducted in Tanzania in 2019 found only 6% of respondents (n = 483) had heard about HCC (Nyangi et al., 2022). Likewise, 47% of participants (n = 400) in this study knew HCC is fatal but treatable disease and only 41% knew it is a preventable disease which is opposite to the study by Makingi et al. (2023) who found 72% of participants (n = 662) knew HCC as a preventable disease. The contrast is due to the fact that the previous study was conducted to assess the community health education intervention project of Tanzania which may have made participants aware about the HCC (Alarakol et al., 2020; García and Del Brutto, 2020; Makingi et al., 2023). Regarding the meat inspection, 198 participants (49.5%) had no idea about it.

Table 2: Participants' knowledge on Human cysticercosis (n = 400)

Variables	Number (%)	Gender		Age(in years)		Education		Socio-economic status	
		Male	Female	≤ 35	≥ 36	HSS	University	lower/middle	upper
Heard of HCC									
Yes	206 (51.5)	179	27	87	119	140	66	127	79
No	194 (48.5)	141	53	92	102	149	45	150	44
HCC is fatal									
Yes	190 (47.5)	138	52	79	111	126	64	123	67
No	210 (52.5)	182	28	100	110	163	47	154	56
HCC is preventable									
Yes	165 (41.3)	134	31	71	94	99	66	110	55
No	235 (58.7)	186	49	108	127	190	45	167	68
HCC is treatable									
Yes	187 (46.7)	146	41	92	95	132	55	133	54
No	213 (53.3)	174	39	87	126	157	56	144	69
Any idea about meat inspection									
Yes	202 (50.5)	166	36	93	109	145	57	141	61
No	198 (49.5)	154	44	86	112	144	54	136	62

Table 3: Participants' attitude and practice on prevention and control of HCC (n = 400)

Variables	Number (%)	Gender		Age(in years)		Education		Socio-economic status	
		Male	Female	≤ 35	≥ 36	HSS	University	lower/middle	upper
Safe to consume pork with cyst									
Yes	204 (51)	176	28	84	120	179	25	155	49
No	196 (49)	144	52	95	101	110	86	122	74
Vegetarian can acquire HCC									
Yes	98 (24.5)	80	18	42	56	73	25	62	36
No	302 (75.5)	240	62	137	165	216	86	215	87
Meat inspection necessary to prevent HCC									
Yes	99 (24.7)	73	26	44	55	0	99	56	43
No	301 (75.3)	247	54	135	166	289	12	221	80
Washing fruits/vegetables before consumption									
Yes	207 (51.7)	144	63	88	119	99	108	138	69
No	193 (48.3)	176	17	91	102	190	3	139	54
Washing hands before consumption									
Yes	313 (78.2)	250	63	140	173	202	111	229	84
No	87 (21.8)	70	17	39	48	87	0	48	39
Treatment of Drinking water									
Yes	133 (33.2)	104	29	56	77	80	53	103	30
No	267 (66.8)	216	51	123	144	209	58	174	93

Table 4: Association of participants' demographic status and KAP variables on HCC

Variables	Gender		Age		Education		Socio-economic status	
	□ 2-value	p - value	□ 2-value	p - value	□ 2-value	p - value	□ 2-value	p - value
Knowledge related variables								
Heard of HCC	12.6	<0.001**	1.1	0.29	3.9	0.04*	11.5	<0.001**
HCC is fatal	12.3	<0.001**	1.5	0.23	6.4	0.01*	3.5	0.06
HCC is preventable	0.3	0.61	0.3	0.56	21.0	<0.001**	0.9	0.34
HCC is treatable	0.8	0.36	2.8	0.09	0.5	0.48	0.6	0.44
Any idea about meat inspection	1.0	0.32	0.2	0.67	0.0	0.92	0.0	0.894
Attitude related variables								
Safe to consume pork with cyst	9.5	0.002**	9.5	0.002**	48.3	<0.001**	8.2	0.004**
Vegetarian can acquire HCC	0.1	0.74	0.1	0.75	48.3	<0.001**	1.8	0.17
Meat inspection necessary to prevent HCC	2.7	0.09	<0.001	1	337.8	<0.001**	9.2	0.002**

Practice related variables

Washing fruits/vegetables before consumption	27.9	<0.001	0.7	0.4	125.1	<0.001**	1.1	0.29
Washing hands before consumption	<0.001	1	<0.001	1	41.0	<0.001**	9.5	0.002**
Treatment of Drinking water	0.3	0.61	0.4	0.51	13.7	<0.001**	5.7	0.01*

*Significant ($p < 0.05$)

**Significant ($p < 0.01$)

Attitude and practice of participants for the prevention and control of HCC

The questionnaire had six questions to assess the attitude and practice of participants for the prevention/control of HCC, with three questions each. The descriptive statistics on Table 3 shows that more than half of participants ($n = 400$), had a misconception that it is safe to consume pork consisting of cysts. The result is lower than a past study (Nyangi et al., 2022) that resulted 71% ($n = 483$) participants thought it is safe to consume pork if cyst are found. However, the results of this study is higher than other studies (Wilson et al., 2023; Zulu et al., 2023). The attitude towards consumption of pork with cyst depends upon the education level of people and their socio-economic status. If they are very poor and uneducated, they consume pork whether it is cyst free or having cyst because they have no other choice. A few less than one-fourth of the participants ($n = 400$) thought that vegetarians can also acquire HCC through consumption of foods contaminated by *Taenia solium* eggs. Likewise, among 202 participants who heard about meat inspection, only 99 thought it is necessary to inspect pork before it is being sold in market in order to prevent and control HCC.

From the Table 3, it can be seen 48% of participants ($n = 400$) do not wash fruits and vegetables before consuming and 21% do not wash their hands before eating foods which is very less than the results obtained by previous studies (Alarakol et al., 2020; Makingi et al., 2023; Nyangi et al., 2022; Zulu et al., 2023). The difference in results may be due to poverty and illiteracy; people of Nepal are still unaware of the various diseases transmitted through dirty hands or by consuming contaminated fruits and vegetables. So, they are not following hygienic practices and food safety principles. The study also found that only one-third ($n = 400$) of the participants treated water by boiling or filtration before drinking as shown in Table 3 which is similar to Nyangi et al. (2022) but higher than that of Zulu et al. (2023) who found only 8% of respondents practice water treatment before drinking. While analyzing the association between the participants' attitude towards HCC and their determinant variables, it was found that education and socio-economic status of participants highly determined their attitude towards the necessity of meat inspection to

prevent and control HCC and the association was statistically significant ($p < 0.05$) as shown in Table 4. However, participants' thinking that vegetarian can also acquire HCC was associated with their education level only. Attitude of consuming pork consisting cyst was strongly associated with all the four categorizes that are, gender, age, education and socio-economic status of participants. It can be seen from Table 4, all the practice related variables were strongly associated with participants' level of education and those were statistically significant ($p < 0.05$). However, participants practice of washing their hand before consuming any foods and treating the potable water were also associated with their socio-economic status and the associations were statistically significant ($p < 0.05$). Likewise, washing fruits and vegetables before consumption was also strongly associated with gender that was statistically significant ($p < 0.05$) too.

In short, we can say that, attitude towards HCC and practice of preventive/control measures were statistically associated with the socio-economic status of respondents and their education level ($p < 0.05$). It is in line with the results obtained in previous studies (Wilson et al., 2023; Alarakol et al. 2020; and Zulu et al., 2023). The reason for this is that college and university education give students sufficient knowledge about local illnesses and epidemics. Additionally, it educates people about the spread of infectious diseases like HCC via a variety of media, including newspapers, television, the Internet, and so on. Furthermore, people follow hygienic practices and sanitation in their daily lives only if they are well-educated. Socio-economic condition and lifestyle play important role in the food safety and hygienic practices in the family.

Conclusion:

The study revealed just over half of the participants had heard about HCC but they do not have any idea about meat inspection and its importance in controlling human cysticercosis. One fourth of the participants do not think the necessity of meat inspection to control taeniasis and human cysticercosis. Likewise, more than half of participants had a misconception that it is safe to consume pork consisting of cysts and majority thought vegetarians do not acquire HCC. Almost half of

respondents do not wash fruits and vegetables before consuming and one-fifth of respondents do not wash their hands before eating foods. Only one-third of the respondents treated water by boiling or filtration before drinking. The analysis of association between outputs and determinant variable explored the fact that knowledge about HCC was strongly associated with the sex and education level of respondents and attitude towards HCC and practice of preventive/control measures were associated with the socio-economic status of respondents and their education level. Hence, it was found that there are knowledge gaps in pork consumers towards HCC and females of families with low socio-economic status are the major actors in controlling HCC. So, efforts to improve knowledge of HCC in pork consumers of Chitwan need to be scaled up that will ultimately change their attitude towards HCC and then only they will start practicing preventive and control measures. It is recommended to provide comprehensive health education to the public through awareness campaigns and trainings emphasizing the transmission of HCC; and the importance of preventive and control measures with a focus on food hygiene and sanitation and the programs shall be conducted under One Health approach.

Conflict of interest:

The author declare that he has no known competing financial interests or any personal relationships that could have appeared to affect the work reported in this paper.

Data availability:

The data used to support the results of this study are available from the corresponding author upon reasonable request.

Authors' contribution:

In crafting this article, SP, as the sole author, undertook a comprehensive and solitary journey from conceptualization to completion. SP drafted the manuscript, structuring it according to the requirements of IJVP, and ensured clarity, coherence, and the logical flow of arguments throughout the article. This work aims to make a valuable and original contribution to the existing body of knowledge in the factors causing the prevalence of human cysticercosis in Nepal.

Ethical approval:

Ethical approval was not compulsory for this study. However, individual consent was taken from the from the pork consumers before the questionnaire survey was started and the name and identification of the participants were kept secret and not published anywhere.

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