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AN EPIDEMIOLOGICAL AND DEMOGRAPHIC SURVEY TO INVESTIGATE THE PREVALENCE OF *CYSTIC ECHINOCOCCOSIS* (CE) IN DOMESTIC RUMINANTS

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ABSTRACT

Cystic echinococcosis (CE) is a widespread zoonotic disease that found across the globe. It is holding a significant importance due to its neglected status as a zoonotic disease. Because of the limited investigative efforts, this disease poses a challenge in ruminant's population within Pakistan. The present study was aimed to conduct a cross-sectional survey and demographical representation based confirmation of Cystic echinococcosis in sheep, goats, cows, and buffaloes. For this purpose, the research employed a community-based random cross-sectional approach, gathering data from 327 participants. The questionnaire addressed knowledge, attitude and practice (KAPs), the one health concept, risk factors, anthropogenic activities, and perceptions pertaining to Cystic echinococcosis. The interviewed respondents were adults of age group of 36-40 years old with highest percentage of 18.65% and lowest was 65 years and above with 6.72%. Most of them (38.65%) would like free medicine of CE. About half of the peoples feed their dogs often and major of them do not play with the dogs. Risk factors included resident, knowing dog could be infected, knowing eating could be route of infection, usually feed your dog by self, feed dogs with internal organs. In general, our findings showed that most of respondents had positive attitude toward treatments of the disease, but their practice about disease prevention and control was low (49.01%). While the collection of data from farmer's

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knowledge, attitude and practices (KAPs study), involved in the study were dog's owners and peoples who kept animals. The results showed that only 27% of people have heard about the disease, and 47.22% were closely associated with dogs, 18.09% peoples playing with dogs, while 33.94% respondents were known the symptoms of CE. In total 398 animals were examined during this study to find out the prevalence of Cystic echinococcosis (CE). The data were collected from slaughterhouses from December 2022 to June 2023. The samples were collected from sheep (n = 36), goats (n = 54), cows (n = 182), and buffaloes (n = 127) examined directly. A total 398 of animals were examined. The maximum prevalence of the diseases was recorded in Tehsil Mailsi (9.80%) and lowest in Vehari (1.50%). The overall prevalence rate 10.3% of Cystic echinococcosis (CE) were recorded, the prevalence observed in sheep (13.8%) whereas lowest prevalence rate 3.7% was recorded in goat. Visceral organs of all slaughtered animals were examined for the presence of Cystic echinococcosis (CE). Organ examination indicated buffalo and goat lungs (9.44%; 3.70% respectively) as the most preferred location of Cystic echinococcosis (CE) localization followed by mainly in cow liver (6.6%). The statistical analysis showed that there was highly significant difference ($P < 0.05$) among most of the practices that were associated with the prevalence of CE. The study underscored the need for improved understanding about the Cystic echinococcosis (CE). The understanding from current study could be used to improve the delivery of an efficient health education message relevant to CE control of the animal interaction of district Vehari.

1 INTRODUCTION

Livestock play a pivotal role in the agrarian economies of numerous Asian nations, serving as a cornerstone for food security, draft power, and income generation. Beyond their economic importance, livestock are critical to rural livelihoods through the provision of meat, milk, and other animal-derived commodities. However, the productivity and health of these animals are frequently compromised by parasitic diseases, which remain pervasive in many low- and middle-income countries. Among these, *Cystic echinococcosis* (CE), a zoonotic disease caused by the larval stage of *Echinococcosis granulosus*, constitutes a major veterinary and public health concern, particularly across South and Central Asia. In Pakistan, CE imposes substantial economic burdens on the livestock sector, primarily through decreased productivity, organ condemnation at slaughter, and the costs associated with treatment and control measures. It is estimated that parasitic infections, including CE, result in annual losses exceeding 26.5 million PKR (Mustafa et al., 2015). The public health dimension of CE is equally critical, as human infection can occur via the ingestion of food or water contaminated with parasite eggs shed by definitive hosts—primarily domestic and stray dogs. Once ingested by intermediate hosts

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such as sheep, goats, or cattle, the parasite establishes hydatid cysts in vital organs, particularly the liver and lungs (Eckert et al., 2002; Yang et al., 2009).

Underreporting, limited diagnostic capacity, and insufficient surveillance systems have hampered control efforts in Pakistan and similar endemic regions (Tashani et al., 2002). Globally, CE is recognized as a neglected tropical disease (NTD), with an estimated disease burden of over one million affected individuals and an annual impact of approximately 183,573 disability-adjusted life years (DALYs). The associated economic toll is considerable, exceeding USD 3 billion annually (Borhani et al., 2020). Transmission is particularly efficient in settings where traditional livestock husbandry practices facilitate close contact between animals and canines. In Pakistan, factors such as unregulated slaughtering, a high population of free-roaming dogs, and inadequate meat inspection protocols exacerbate transmission dynamics (Traub et al., 2005). Moreover, the common practice of home slaughter and improper disposal of infected viscera further propagates the life cycle of *E. granulosus* (Pednekar et al., 2009). Geographically, CE is endemic throughout Central and South Asia, with documented high prevalence rates in countries such as Iran, Afghanistan, China, and Mongolia (Bai et al., 2001; Craig et al., 2006). Within Pakistan, prevalence in slaughtered animals ranges from 9.0% to 60.6%, with the Punjab province reporting some of the highest infection rates (Tashani et al., 2002). Risk factors influencing the development of hydatid cysts in livestock include host age, sex, and species, with older and female animals exhibiting increased susceptibility due to prolonged exposure and delayed slaughter (Otero-Abad et al., 2013; Pour et al., 2012). Although seasonal variations have limited impact on CE prevalence due to its chronic nature, climatic factors such as humidity and temperature may influence the environmental survival of parasite eggs (Veit et al., 1995; Giraudoux et al., 2013).

Effective CE control necessitates a multifaceted approach embedded within a One Health framework, integrating veterinary and human health systems (Cao et al., 2021). Key control strategies include the routine deworming of definitive hosts, safe disposal of infected offal, improved slaughter practices, and widespread community education. Despite these recommendations, the lack of national surveillance infrastructure in countries like Pakistan significantly impedes the identification of high-risk populations and the implementation of targeted interventions (Tamarozzi et al., 2020). Molecular characterization has identified several genotypes of *E. granulosus*, with the G1 strain—commonly associated with sheep—being the most virulent and widespread (Cardona et al., 2013; Nakao et al., 2013). Insights into the genetic diversity of the parasite are crucial for the development of genotype-specific vaccines and diagnostics. Additionally, the co-occurrence of CE with other parasitic infections, such as *Cystic ercustenuicollis*, complicates disease management, especially when offal disposal practices are insufficient (Omadang et al., 2024). The socio-economic impact of CE is profound, affecting not only meat and milk yields but also leading to organ condemnation and financial losses in rural livestock-dependent communities (Guzelet et al., 2008; Pérez et al., 2006). Structural issues such as inadequate veterinary infrastructure, limited public awareness, and poor access to health services further perpetuate the disease cycle (Erbeto et al., 2010; Cringoli et al., 2007). This study aims to contribute critical epidemiological evidence to inform evidence-based policy and intervention strategies, ultimately reducing both the zoonotic risk and economic burden of CE in Pakistan and other endemic regions.

2 MATERIAL& METHODS

2.1 STUDY AREA

This study was conducted in three administrative subdivisions (tehsils) of District Vehari, Punjab, Pakistan: Mailsi, Burewala, and Vehari. These regions were strategically selected due to their agricultural diversity and the prevalence of smallholder and commercial farming systems. The study area is representative of rural Pakistan, where livestock farming plays a central role in socio-economic development. A total of 398

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ruminants were examined over the study period, providing a robust sample for estimating the prevalence of *Cystic echinococcosis* (CE) in the region.

2.2 STUDY DESIGN

A cross-sectional epidemiological survey was employed to estimate the prevalence of *Cystic echinococcosis* (CE) and identify associated risk factors in livestock. The study was designed to align with One Health principles, recognizing the interconnectedness of human, animal, and environmental health. Data collection was carried out from multiple sources, including butcher shops, slaughterhouses, livestock farms, and through direct interviews with local farmers. The inclusion of diverse data collection settings enabled a comprehensive evaluation of transmission dynamics and potential exposure pathways. A stratified sampling strategy was adopted to ensure representation across different livestock management practices. Rigorous protocols were followed to standardize data collection and minimize sampling bias.

2.3 QUESTIONNAIRE DESIGN

A questionnaire was designed ensuring the collection of data from their respondent's side butcher's shops, slaughterhouses, livestock farms and from the farmers as well. This questionnaire comprises seven (7) categories and having a total of 68 questions. The questionnaire had a seven parameters and have a 61 questions including 9 questions about socio-demographic backgrounds of respondents, 10 questions was designed about knowledge frequency, 2 questions regarding attitudes, 16 questions related to practices, 6 questions was related to one health concepts, 6 questions are risk factors and 6 questions related to anthropogenic activities and 6 questions was about perceptions (KAP's study) regarding of CE. Data on each animal was recorded in a data capture form where entries including age, sex, feeding behavior, breed etc.

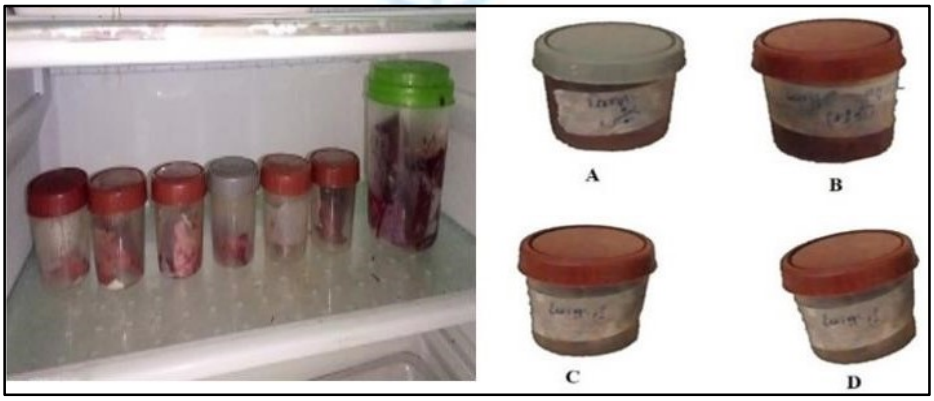

Fig. 1 (left) sample store in the urine container with 70% ethyl alcohol and preserve and (right)Samples with labeled (lung and kidney).

2.4 DATA COLLECTION & SAMPLE PRESERVATION

Data acquisition was conducted at multiple slaughterhouses across the Vehari district, with prior authorization obtained from official meat inspectors. When necessary, a concise overview of the study's objectives was provided. A randomized approach was employed to select both slaughterhouses and butcher shops for sampling. A total of 398 ruminants—comprising 127 buffaloes, 181 cattle, 54 goats, and 36 sheep—were examined for the presence of *Cystic echinococcosis* (CE). Of these, 41 animals (10.3%) exhibited macroscopic evidence of hydatid cysts upon post-mortem inspection. Tissue specimens were aseptically excised using sterilized surgical

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instruments including scalpels, blades, and scissors. The collected samples were immediately transferred to sterile, airtight plastic containers and preserved in 70% ethanol (ethyl alcohol) to maintain sample integrity for subsequent parasitological and molecular analysis.

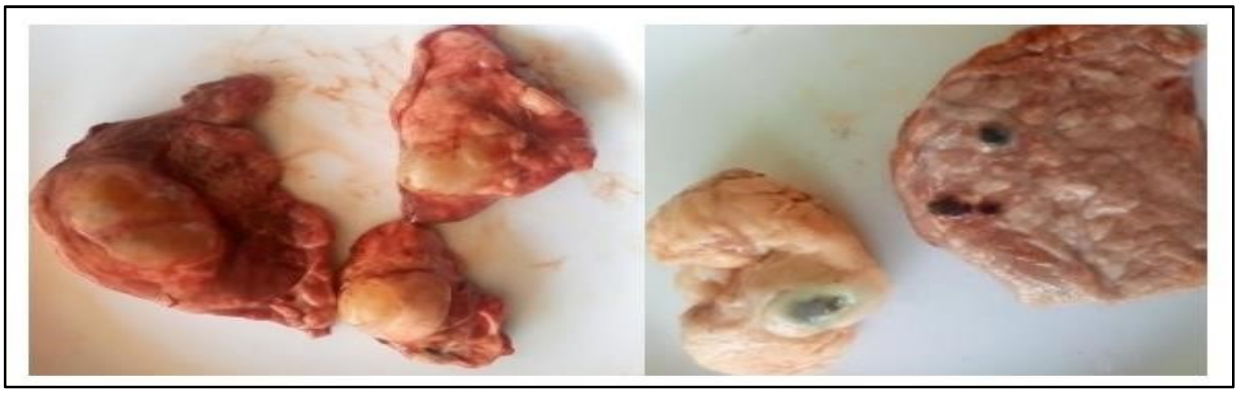

Fig. 2 *Cystic echinococcosis* present in the organs of liver in cow (A) and buffalo (B) Slaughtered animals at District Vehari.

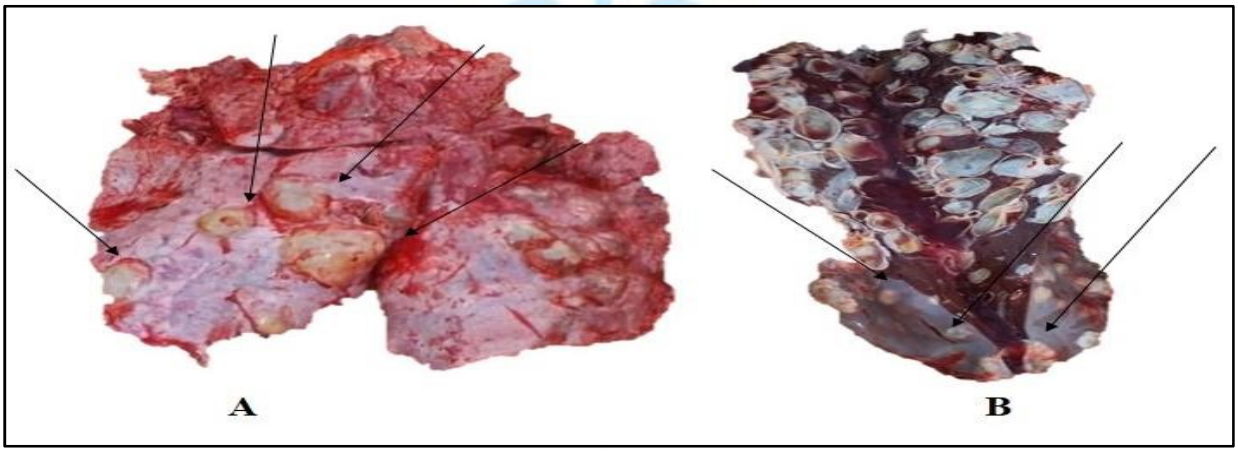

Fig. 3 *Cystic echinococcosis* (CE) in the organs (lungs) of cattle slaughtered at District Vehari.

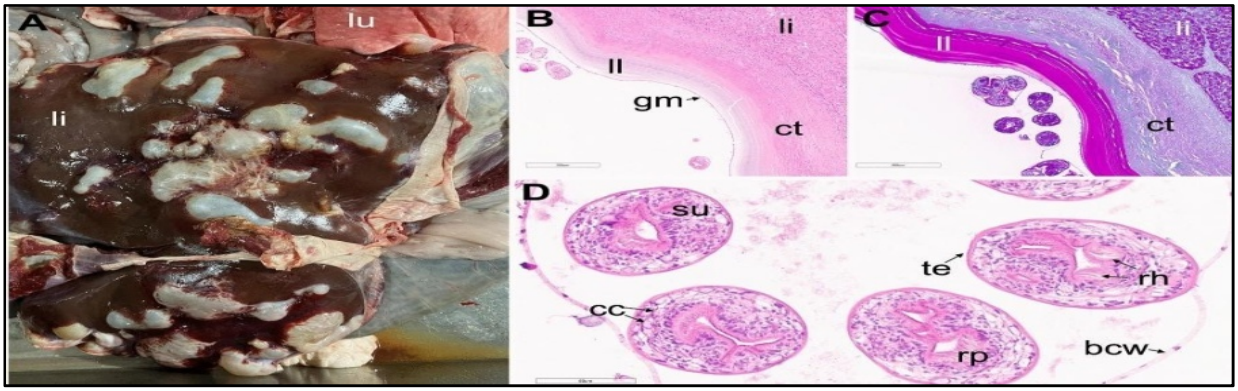

Fig. 4 Liver and lung with hydatid cysts. **(A)** Liver with cysts and lung with cyst. **(B)** Cyst with protoscoleces within the liver. **(C)** Cyst with protoscoleces within the liver. **(D)** Magnification (400x) of protoscoleces surrounded capsule wall.

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2.5 STUDY DURATION

The collection of data for this study is involved a time period from December 2022-June 2023. The data collection phase for this study spanned from December 2022 to June 2023, encompassing a substantial timeframe crucial for capturing seasonal variations and longitudinal trends. This extended period ensured a robust dataset, resilient to transient fluctuations and reflective of broader patterns over time. By incorporating data from multiple seasons, our study aimed to provide a comprehensive understanding of the phenomena under investigation, accounting for temporal dynamics and potential fluctuations.

2. 6 STATISTICAL ANALYSIS

A data was established using questionnaire paper. All the data from questionnaire was insert into Microsoft excel sheet carefully and then analyzed by using SPSS. Statistics were used for the purpose of counts, percentage and frequency for presentation of the results in tables. Statistical analysis was carried out by t test, single ANOVA factors used in the analysis of tables and find the p-value ≤ 0.05 statistically significant were considered. Chi-square test ($\chi 2$) was used to find out the significant level (<0.05) of presence of *Cystic echinococcosis* in among ruminants.

3 RESULTS

3.1 PREVALENCE OF *CYSTIC ECHINOCOCCOSIS* (CE)

A total of 398 animals were slaughtered in district Vehari and calculate the prevalence was 11.3% in all examined animals. Highest prevalence was observed in Tehsil Mailsi (9.8%) followed by Burewala (2.3%) and was least in Tehsil Vehari (1.5%) (Figure: 5). Out of 398 ruminants examined, 40 (10.05%) had cysts and had one or more cysts in various internal organs (lungs, liver, kidneys) (Figure 3).

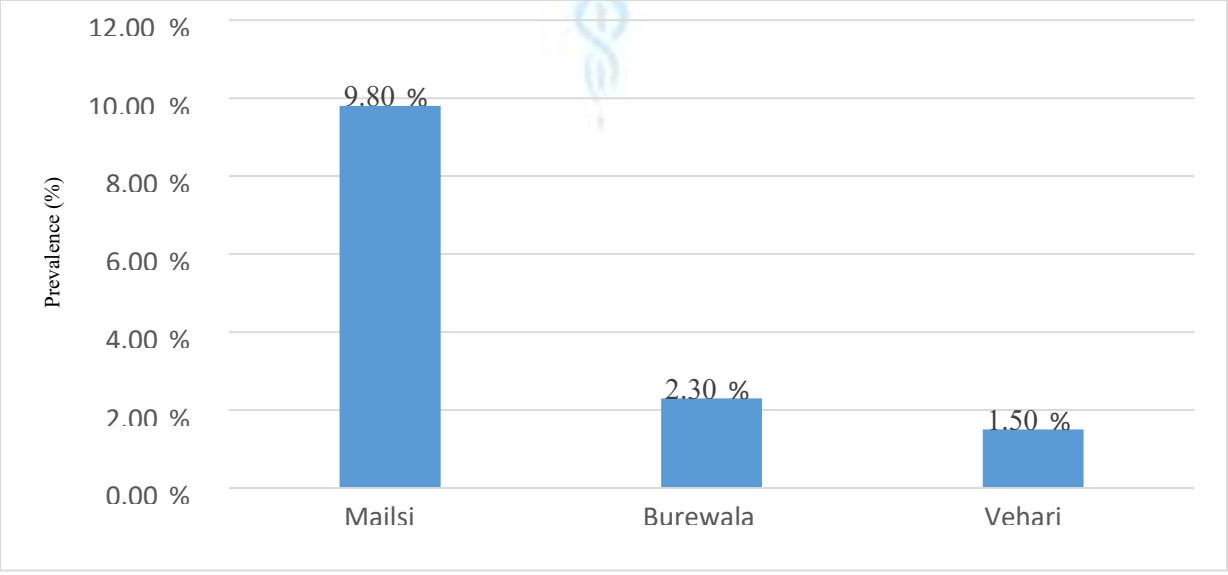

Fig. 5 Prevalence of *Cystic echinococcosis* (CE) across three tehsils (Mailsi, Burewala, and Vehari) of District Vehari.

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3.2 *CYSTIC ECHINOCOCCOSIS* (CE) DISTRIBUTION IN DIFFERENT ORGANS

The study showed that the lungs, kidney and liver were the most affected organs in buffalo, cow, goat and sheep having a prevalence rates of 12.5%, 9.94%%, 3.7% and 13.8%, respectively. This study detected a total of 41 cysts from various organs with a prevalence of 60.9%, 31.7% and 7.3%, from the lungs, liver and kidneys. The prevalence of *Cystic echinococcosis* was found from livestock. Out of a total of 398 animals examined, 41 animals were found positive for *Cystic echinococcosis* (prevalence 10.3%). The prevalence of *Cystic echinococcosis* (CE) was highest in sheep (prevalence 13.9%) followed by buffalo, goat and cow (prevalence 12.6 %. 3.7% and 9.9%). Distribution of *Cystic echinococcosis* in infected ruminants shown in (figure 2).

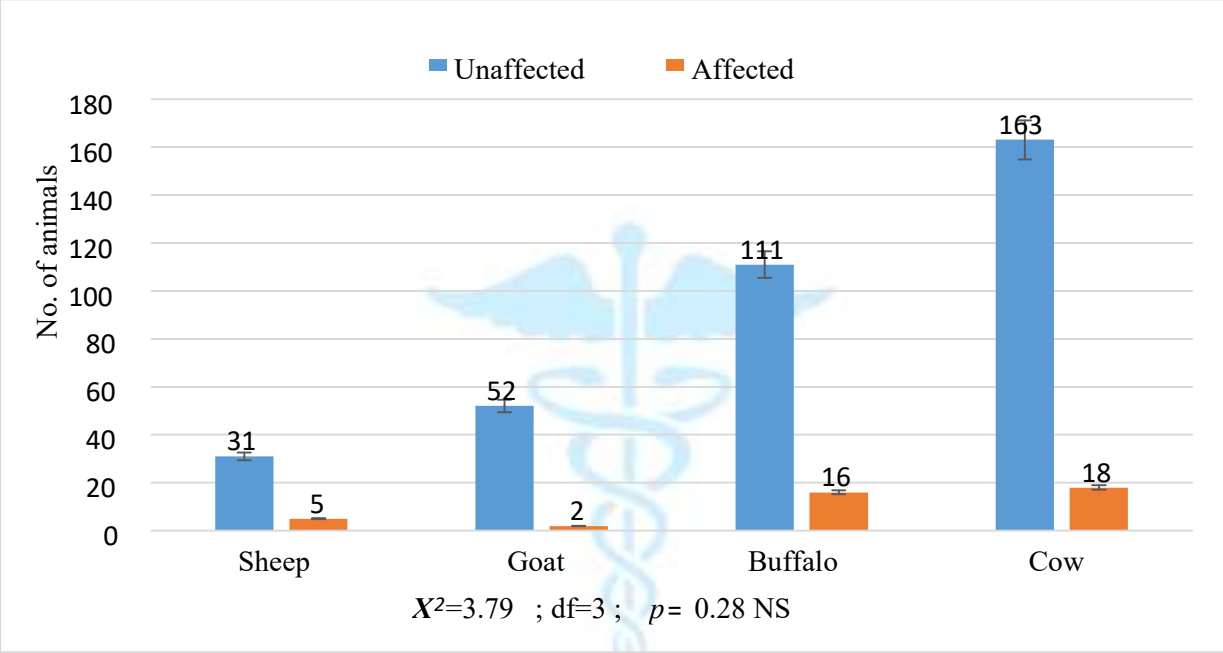

Fig. 6 Statistical Significance Value among Species wise (Sheep, Goats, Buffalo and Cow).

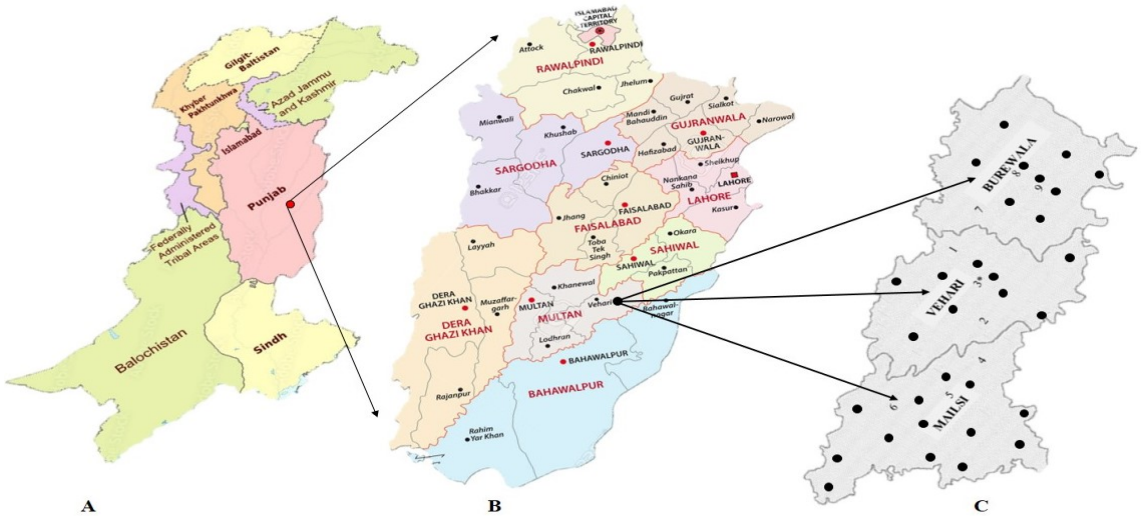

Fig. 7 Map of pakistan **(A)**is showing Pakistan with province is **(B)** is showing Punjab province with highlight district Vehari **(C)** is showing district Vehari labeled with its three tehsils of district Vehari and dots represents the areas from which data was collected.

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3.3 SOCIO-DEMOGRAPHY OF THE RESPONDENTS

The data were collected from three tehsils of district Vehari. A total 327 respondents were participated in study. According to their gender, male and female respondents were involved in this study, the proportion of male (n=300 of the total 327) respondents were greater as compared to female (07 of the total 327) in this study (male=98% and female=2%). Regarding their level of education, there was highest ratio of illiterate in comparison to others, the Matric were 51/327, intermediate were 51/327, bachelor were 8/327 and masters and above were 15/327 participants. With respect to mother tongue, the least ethnicities in this study were highest ratio in Urdu (Urdu=37%) in comparison to others, were higher as comparison to Saraiki and Punjabi (Saraiki=34% and Punjabi=29%). With respect to marital status the ratio in unmarried (married=79.51%) were higher as comparison to unmarried (unmarried=20.48%). With respect to age group the ratio in age group of 36-40 (3640=18.65%) were higher as comparison to other age groups (26-30=18.04%), (3135=16.20%), (41-45=9.48%), (46-50=7.95%), (51-55=8.86%), (56 and above=6.72%) and (up to 25 years=14.06%). When I surveying according to their rural and urban areas the highest ratio of rural (rural=66.05%) were higher as comparison to urban (urban=33.94%). With respect according to their economic status, most of the participants the monthly income >15000 (>15000=50.15%) were higher as comparison to others (10000-15000=37.92%, not applicable=11.92%). With respect to occupation wise observation, study the farmer participants (39.75%) were higher as comparison to occupations (agriculture=38.52%, veterinarian=7.64%, butchers=8.56%, doctors=2.75% and others=2.75%). With respect to the experience base study observation, study the 10-15 years (39.75%) were higher as comparison to others (1-5 years=17.12%, >5-10 years=17.73%, above 20 years=12.23% and not applicable=10.39%) participants.

Table 1 Socio-Demographic Background

Variables	Participants (No)	Frequency (%)
Gender		
Male	320	97.85
Female	7	2.14
Marital Status		
Married	260	79.51
Unmarried	67	20.48
Age of the respondent		
26-30	59	18.04
31-35	53	16.20
36-40	61	18.65
41-45	31	9.48
46-50	26	7.95
51-55	29	8.86
56 and above	22	6.72
Up to 25	46	14.06
Area of the respondent		
Rural	216	66.05
Urban	111	33.94
Religion of the Respondents		
Muslim	327	

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Non-Muslim	0	
Education of the Respondents		
Illiterate	151	46.17
Intermediate	51	15.59
Bachelor	58	17.73
Masters and above	15	5.19
Languages		
Punjabi	96	29.35
Urdu	120	36.69
Saraiki	111	33.94
Economic status		
10000-15000	124	37.92
>15000	164	50.15
N/A	39	11.92
Occupation		
Farmer	130	39.75
Agriculture	126	38.52
Veterinarian	25	7.64
Butchers	28	8.56
Doctors	9	2.75
Others	9	2.75
Experience with livestock		
1-5 years	56	17.12
>5-10 years	58	17.73
Above 20 years	130	39.75
10-15 years	49	12.23
N/A	34	10.39

3.3 KNOWLEDGE FREQUENCY

It can be seen from collected data that the knowledge about CE. Out of 327 respondents, that have they ever heard about *Cystic echinococcosis*. CE being a zoonotic disease, people had little knowledge on zoonotic infections so, according to survey, only 73.08% answered yes while, 26.91% answered in no. When ask respondents that have about ever seen the disease in animals. Among the respondents 63.60% participants answer yes while 35.55% answer no. With respect to the knowledge related questions, respondents were ask that have they do you know the symptoms of *Cystic echinococcosis* , Among the respondents 51.37% participants answer is yes. In other question that was respondents were ask that have if they found an affected person, would they you separate him/her from others, 73.39% participants answered yes to this question while 26.29% participants answered no (Table 2).

Table 2 Knowledge of *Cystic echinococcosis* (CE) among study respondents

Variable	Characteristic	Participants	Frequency (%)

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		(No)	
Have you ever heard about CE?	Yes	239	73.08
	No	88	26.91
Have you ever seen the Disease in Animal?	Yes	208	63.60
	No	117	35.77
Do you know the symptoms of CE?	Yes	168	51.37
	No	158	48.31
If you found an affected person, could you separate him/her from others?	Yes	240	73.39
	No	86	26.29
Do you know the correct treatment/medication of CE?	Chemotherapy	13	3.97
	Surgery	31	9.48
	Medicine	115	35.16
	All	48	14.67
	Don't know	108	33.02
Do you know which animal is responsible for the spread of CE?	Sheep	9	2.75
	Dog	20	6.11
	Cow	63	19.26
	Buffalo	34	10.39
	Don't know	95	28.13
	Goat	1	0.30
	None	14	4.28
	All	90	27.52
Are there stray/pets/owing dogs present in your community?	Yes	228	69.72
	No	99	30.27
What animals do you keep?	Cattle	32	9.78
	Buffalo	38	11.62
	Goat	66	20.18
	Cow	60	18.34
	All	121	37.00
Do you have proper drainage system in your area?	Yes	152	46.48
	No	175	53.51
Do you have proper disposal system for animal wastes?	Yes	168	51.37
	No	159	48.62

3.4 ATTITUDE RELATED FREQUENCY

The data was collected from the three tehsils of district Vehari about the attitudes for CE from 327 respondents. Out of 327 respondents, respondents were ask about them if they suffered with CE would they like to take a free medicine or treatment. Respondents were ask about if you want, you need surgery because of *Cystic echinococcosis* (CE), would you like to undergo surgery. Among respondents 66.05%, individuals respondents had a positive response would like treatment against the CE while 33.94% would not like treatment against the CE disease. Among respondents, 61.34% agree to take free treatment while rest disagree with this. The mean and standard deviation (STDEV.) of the data collected for the study were determined. Using the SPSS statistical software (SPSS), significant score, value ($p > 0.05$) was identified among (Table 3).

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Table 3 Attitude related frequency

Variables	Characteristics	Participants (No)	Frequency (%)
If you have suffered from *Echinococcosis*, would you like to take free medicine/treatment?	Yes No	200 126	61.34 38.65
If you need surgery because of *echinococcosis*, would you like to undergo surgery?	Yes No	216 111	66.05 33.94

3.5 PRACTICE FREQUENCY

The mean and standard deviation (STD) of the data collected for the study were determined. Using the statistical software of the social science (SPSS), significant score, value ($p > 0.05$) was identified among [Table 4].

Table 4 Practice related frequency

Variables	Characteristics	Participants (No)	Frequency (%)
Do you have dogs?	Yes No Don't have dogs	154 111 61	47.23 34.04 18.71
Do you tie up your dog?	Yes No Don't have dogs	116 140 70	35.58 42.94 21.47
Do you usually feed your dog?	Yes No Don't have dogs	115 128 83	35.27 39.26 25.46
Do you usually play with the dog?	Yes No Don't have dogs	59 178 89	18.09 54.60 27.30
Do you always clean up the dog feces?	Yes No Don't have dogs	57 172 97	17.48 52.76 29.75
Do you wash your hands before and after you eat?	Yes No	255 71	78.22 21.77
Are slaughters areas are connected with sewage system?	Yes No	138 188	42.33 57.66
Do you inspect meat at home?	Yes No	28 39	88.07 11.92
Who handle/take care of the dogs?	Veterinarian Doctors Farmer	21 21 173	6.42 6.42 52.90

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	All	79	24.15
	None	33	10.09
Does every member of house interact with dogs?	Yes	180	55.04
	No	147	44.95
Where you dispose of your domestic waste?	Throw on the streets/ land	93	28.44
	Throw outside the slaughter/farm house	67	20.48
	Keep it in the dustbin	130	39.75
	Keep it in the Garden	26	7.95
	Dumped into the Garden	1	0.30
Des your dog hunt small mammals in the bush when they go out.	Yes	206	63.19
	No	120	36.80
Do your animals graze areas where dogs defecate?	Yes	112	34.25
	No	215	65.74
Do children play with dogs?	Yes	131	40.06
	No	196	59.93
Dogs live with animals	Yes	209	63.91
	No	118	36.08
Which Organs do you give to Offal dogs to eat?	Meat	70	21.40
	Beef Kidney	15	4.58
	Milk	85	25.68
	Breed	127	38.83

3.6 ONE HEALTH CONCEPT RELATED FREQUENCY

The mean and standard deviation (S.T.D) of the data collected for the study were determined. Using the Statistical Software of the social science (SPSS), significant score, value ($p > 0.05$) was identified among. Respondents were ask them question about do you need campaigns required regarding about CE disease among respondents 63.30% participants answer yes, while regarding not need a campaigns required about it. While 36.49% participants were answer no. On the other question was about that do you need have a proper treatment facilities needed. Among respondents 49.54% were answer yes [Table 5].

Table 5 One health concept related frequency

Variables	Characteristics	Participants (No)	Frequency (%)
Do you have Need Campaigns required regarding CE disease awareness?	Yes	207	63.30
	No	120	36.69
Do you have Need Proper treatment facilities needed?	Yes	162	49.54
	No	165	50.45

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Do you have need diet would be inspect properly?	Yes	205	62.69
	No	122	37.30
Do you have Need for disposal systems?	Yes	160	48.92
	No	167	51.07
Do you have Need Awareness of the impact of the environment?	Yes	217	66.30
	No	110	33.63
Do you have Need Economic stability to improve health?	Yes	190	58.10
	No	137	41.89

3.7 RISK FACTORS RELATED QUESTIONS

In the present study, six predictable variables were studied as risk factors. The mean and standard deviation (STDEV) of the data collected for the study were determined. Using the SPSS statistical software (SPSS), significant score, value (p >0.05) was identified among. Respondents were asking about risk factor in this questionnaire, among that only 55.35% participants considered social, political and economic instability cause increased in CE were answer no while 44.46% participants were answer yes. 49.23%% respondents considered unchecked systems of animal keeping cause increased in CE, 49.23%% respondents considered lack of awareness the risk factor towards CE, 55.65%% respondents considered exposure to dog the risk factor towards CE, 44.34% respondents considered the contamination of food/water consumption the risk factor towards cause CE and 53.51%% respondents considered asymptomatic disease cause increased in CE.

Table 6 Risk factor related frequency

Variables	Characteristics	Participants (No)	Frequency (%)
Social, political, economic instability?	Yes	146	44.46
	No	181	55.35
Unchecked systems of animal keeping?	Yes	166	50.76
	No	161	49.23
Lack of awareness?	Yes	172	52.59
	No	155	47.40
Exposure to dog feces?	Yes	182	55.65
	No	145	44.34
Contaminated food /water consumption	Yes	187	57.18
	No	140	42.81
Asymptomatic disease?	Yes	175	53.51
	No	152	46.48

3.8 ANTHROPOGENIC ACTIVITIES

The questions regarding anthropogenic activities in this questionnaire respondents were ask that after dealing with dogs eating food without washing hands to increase the CE rate among 50.15% respondents were answer yes while 49.84% respondents were answer no. The questions regarding anthropogenic activities in this questionnaire respondents were ask that eating unwashed fruits and vegetables increased the CE rate among 47.70% respondents were answer yes while 52.28 % respondents were answer no. The questions regarding anthropogenic activities in this questionnaire respondents were asked that no inspection of meat at butchers the CE rate, among 45.25 % respondents were answer yes while 54.74% respondents were answer no.

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Table 7 Anthropogenic activities

Variables	Characteristics	Participants (No)	Frequency (%)
After dealing with dogs eating food without washing hands to increase the *Cystic echinococcosis* rate	Yes No	164 163	50.15 49.84
Eat unwashed fruits/vegetables/food increase the *Cystic echinococcosis* rate?	Yes No	156 171	47.70 52.29
No inspection of meat at butchers shop increase the *Cystic echinococcosis* rate.	Yes No	148 179	45.25 54.74
Threw away the infected organs openly increase the *Cystic echinococcosis* rate?	Yes No	164 163	50.15 49.84
Playing children with dogs increase the CE rate.	Yes No	172 155	52.59 47.40
Q6: Feeding dogs with raw offal increase the CE rate.	Yes No	138 189	42.20 57.79

3.9 PERCEPTION RELATED FREQUENCY

The mean and standard deviation (STDEV) of the data collected for the study were determined. Using the SPSS statistical software (SPSS), significant score, value ($p > 0.05$) was identified among. Respondents were ask regarding perception related question in this questionnaire, among only 55.35% respondents were considered proper disposal of waste material decreased the CF rate and 44.46% participants were against that perception. Respondents were ask regarding anthropogenic activities in this questionnaire; among 33.33%, participants were favor the perception killing of all dogs decreased the CE rate while 66.66% participants were against that perception. The question about think were 37.61% favor the perception killing of only stray dog reduced the CE rate while 62.38% participants against that perception.

Table 8 Perception related frequency

Variables	Characteristics	Participants (No)	Frequency (%)
Do you think that proper disposal of waste material decrease the CE?	Yes No	149 178	45.56 54.43
Do you think killing all Dogs decrease CE?	Yes No	109 218	33.33 66.66
Do you think Kill only Stray Dogs will reduce the CE?	Yes No	123 204	37.61 62.38
Which would you prefer Prevention or Treatment?	Yes No	157 171	49.01 52.29
Do you think stop Owing Dogs decrease the *Cystic echinococcosis* rate?	Yes No	154 173	47.09 52.90
Do you think stop feeding dogs on infected organs decrease the CE?	Yes No	144 183	44.03 55.96

3.10 KAPs SCORES

The study calculated the mean and standard deviation (STDEV) of the collected data. Using the SPSS statistical software, significant scores with a value of ($p > 0.05$) were identified among various factors. The scores and standard

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Deviations (SD) of Knowledge, Attitude and Practices (KAPs) were calculated and their Statistical significance across each variable was assessed through appropriate statistical tests.

Table 9 Knowledge, attitude and practices (KAPs) related questions

Variables	Knowledge ±SD	Attitude ±SD	Practice ±SD
Gender			
Male	11.61±1.64	1.26±0.77	4.47±1.59
Female	12.28±0.75	1.57±0.53	3.75±1.25
T stat (P-value)	1.07(0.14)	1.04(0.14)	-1.25(0.10)
Marital Status			
Married	4.61±1.62	1.33±0.76	4.41±1.64
Unmarried	4.68±1.68	1.03±0.75	4.62±1.37
T stat (P-value)	-0.31(0.37)	**2.87(0.00)**	-0.95(0.17)
Age Groups			
26-30	4.59±1.41	1.35±0.7	4.32±1.64
31-35	4.56±1.91	0.88±0.8	4.22±1.44
36-40	4.63±1.49	1.29±0.8	4.52±1.44
41-45	4.87±1.62	1.45±0.6	4.93±1.74
46-50	0.38±1.29	1.5±0.6	4.26±1.58
51-55	4.72±1.62	1.37±0.8	4.82±1.94
56 and above	4.22±1.82	1.59±0.7	4.40±1.29
Up to 25	0.65±1.80	1.08±0.8	4.41±1.64
T stat (P-value)	0.84(0.55)	**3.75(0.00)**	0.91(0.49)
Area of the respondents			
Rural	4.68±1.62	1.38±0.74	4.33±1.6
Urban	4.53±1.65	1.03±0.77	4.71±1.55
T stat (P-value)	0.78(0.21)	4.00(3.88)	16.02(7.76)
Religion			
Muslim	4.62±1.63	1.26±0.77	4.46±1.59
Education			
Illiterate	4.58±1.61	1.23±0.80	4.19±1.69
Metric	4.64±1.89	1.13±0.77	4.50±1.54
Intermediate	4.86±1.54	1.19±0.74	4.96±1.37
Bachelor	4.65±1.48	1.39±0.69	4.65±1.38
Masters and above	4.26±1.75	1.73±0.59	4.66±1.75
T stat (P-value)	0.43(0.78)	2.33(0.05)	**2.67(0.03)**
Language			
Punjabi	4.34±1.58	1.19±0.74	4.81±1.43
Urdu	4.95±0.48	1.27±0.75	4.8±1.41
Saraiki	4.52±0.48	1.32±0.81	3.79±1.69
T stat (P-value)	**4.22(0.01)**	0.69(0.50)	16.24(1.89)

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Economic status			
10000-15000	4.99±1.66	1.20±0.79	4.38±1.66
>15000	4.49±1.62	1.41±0.70	4.44±1.37
N/A	5±1.52	0.87±0.80	4.76±2.12
T stat (P-value)	1.68(0.18)	**8.96(0.00)**	0.87(0.41)
Economic Status			
Farmer	4.3±1.61	1.36±0.68	4.33±1.32
Agriculture	4.89±1.62	1.31±0.83	4.38±1.76
Veterinarian	4.72±1.67	1.28±0.67	5.04±1.56
Butchers	4.57±1.47	0.89±0.78	4.32±1.36
Doctors	4.47±1.09	0.88±0.78	5.88±1.96
Others	5.44±2.12	0.77±0.83	4.66±2.23
F (P-value)	2.26(0.04)	3.06(0.01)	2.44(0.03)
Experience Livestock			
1-5 years	4.91±1.79	0.81±0.94	4.14±1.99
>5-10 years	4.65±1.72	1.27±0.74	4.31±1.39
10-15 years	4.57±1.51	1.5±0.67	4.54±1.46
Above 20 years	4.45±1.58	1.38±0.78	4.60±1.45
N/A	4.55±1.58	0.73±0.83	4.76±1.81
T stat (P-value)	0.58(0.67)	10.81(3.07)	1.13(0.34)

3.11 One Health Concept, Risk Factors, Anthropogenic Activities and Perception Score

KAPs score and standard deviation was calculated and their statistically significance across each variable was evaluated by p-value through appropriate statistical test. Different variables such as one health concept, risk factors, anthropogenic activities and perception related questions (are show in Table 4.9) when asked the questions regarding gender the male (male=3.85±1.34) were higher as compare to female (3.48±1.35) and P value was non-significant (P>0.05). The marital status of this parameters married (married=3.55±1.34) participants were greater than (unmarried=3.25±1.37) and their significant value was (P<0.05). With respect to the age group of these parameters age group 26-20 (26-30=3.88±1.39) participants were greater than other age groups and their non-significant value was (P>0.05).).

Table 10 One Health Concept, Risk factors, Anthropogenic Activities and Perception score

Variables	One Health Concept ±SD	Risk factor ±SD	Anthropogenic Activities ±SD	Perception ±SD
Gender				
Male	3.85±1.34	3.13±1.44	2.89±1.48	2.57±1.41
Female	3.48±1.35	3.71±1.70	2.14±1.33	1.85±1.57
T stat (P-value)	072(0.23)	1.04(0.14)	-1.33(0.09)	4.02(0.06)
Marital Status				
Married	3.55±1.34	3.12±1.42	2.88±1.46	2.54±1.44

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Unmarried	3.25±1.37	3.20±1.57	2.85±1.53	2.61±1.31
T stat (P-value)	1.58(0.05)	-0.42(0.33)	0.18(0.42)	0.12(0.72)
Age				
26-30	3.88±1.39	2.91±1.47	2.84±1.61	2.57±1.41
31-35	3.54±1.24	3.16±1.53	3.09±1.45	2.32±1.46
36-40	3.5±1.45	3.27±1.50	3±1.50	2.40±1.50
41-45	3.22±1.20	3.32±1.30	2.61±1.40	2.61±0
46-50	3.5±1.33	3.46±1.36	2.92±1.05	2.86±1.38
51-55	3.20±1.49	2.89±1.49	2.55±1.42	2.77±1.25
56 and above	3.27±9.84	2.86±1.20	2.81±1.62	2.63±1.27
Up to 25	3.26±1.42	3.21±1.48	2.91±1.54	2.2±1.47
T stat (P-value)	1.37(0.21)	0.77(0.60)	0.57(0.77)	0.52(0.81)
Religion				
Muslim	3.48±1.35	3.14±1.45	2.88±1.47	2.55±1.41
Education				
Illiterate	3.44±1.25	3.09±1.55	2.80±1.40	2.42±1.37
Metric	3.49±1.43	2.92±1.39	2.78±1.57	2.25±1.33
Intermediate	3.60±1.35	3.29±1.30	3±1.46	3.03±1.48
Bachelor	3.32±1.46	3.15±1.37	3.20±1.54	2.89±1.38
Masters and Above	4.4±1.35	3.8±1.29	2.2±1.47	2.13±1.45
T stat (P-value)	2.09(0.081)	1.24(0.29)	1.74(0.13)	3.68(0.00)
Language				
Punjabi	3.29±1.46	3.32±1.30	2.68±1.36	2.35±1.23
Urdu	3.39±1.29	3.09±1.34	3.25±1.45	2.97±1.40
Saraiki	3.76±1.28	3.04±1.67	2.63±1.52	2.27±1.49
T stat (P-value)	3.69(0.02)	1.06(0.34)	6.43(0.00)	8.82(0.00)
Economic status				
10000-15000	3.45±1.13	2.91±1.33	3.04±1.46	2.91±1.28
>15000	3.53±1.50	3.38±1.50	2.83±1.47	2.29±1.49
N/A	3.41±1.35	2.87±1.45	2.56±1.50	2.48±1.29
T stat (P-value)	0.21(8.08)	4.60(0.01)	1.70(0.18)	0.66(0.51)
Occupation				
Farmer	3.43±1.39	3.28±1.31	2.73±1.46	2.47±1.45
Agriculture	3.69±1.36	3.09±1.55	2.98±1.44	2.70±1.40
Veterinarian	3.24±1.23	3.24±1.53	3.68±1.54	2.68±1.37

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Butchers	2.89±?	2.78±1.60	1.71±1.53	2.35±1.36
Doctors	3.66±1.32	2.88±1.61	1.66±1.11	2±1.11
Masters	3.66±1.41	2.88±1.05	3.11±0.92	2.44±1.58
T stat (P-value)	1.97(0.08)	0.74(5.93)	3.30(0.00)	0.84(0.51)
Experience with livestock				
1-5 years	3.91±1.25	2.98±1.27	3.07±1.48	2.60±1.09
>5-10 years	3.15±1.28	2.97±1.17	3.05±1.34	2.74±1.33
10-15 years	3.56±1.37	3.28±1.63	2.83±1.52	2.61±1.64
Above 20 years	3.46±1.40	3.42±1.30	2.65±1.45	2.22±1.29
N/A	3.08±1.33	2.79±1.57	2.76±1.53	2.38±1.25
T stat (P-value)	3.27(0.01)	1.18(3.19)	0.79(0.52)	1.13(0.33)

4 DICUSSION

The present study aimed to assess the prevalence of *Cystic echinococcosis* (CE) among ruminants in District Vehari, Punjab, Pakistan, revealing an overall prevalence of 11.3%. This aligns with findings from Lahore slaughterhouses (Saleem et al., 2023) and earlier work in Pakistan and Ethiopia (Kumsa et al., 1994; Jobre et al., 1996; Kebede et al., 2010). The higher prevalence in sheep (13.9%) compared to goats (3.7%) and cows (9.9%) could be attributed to feeding behavior and proximity to definitive hosts like stray dogs (Hashemi et al., 2012; Azlaf et al., 2006). Differences in infection rates across regions may stem from variations in slaughter practices, livestock age, awareness and dog management (Abebe et al., 2014; Khan et al., 1990). Comparable data from India report CE prevalence of 21% in cattle and buffalo (Singh et al., 2020), while studies in Sudan, Libya and Morocco highlight gaps in public awareness of CE transmission (Buishi et al., 2005; Khan et al., 2018). Knowledge, attitude and practice (KAP) scores in the current study also indicated limited awareness, particularly among low-income groups (Singh et al., 2020). CE affects various organs lungs being most common yet underreporting due to limited diagnostic tools persists (Haleem et al., 2018; Qingling et al., 2014). As highlighted in Uganda and Kenya (Oba et al., 2016; Njoroge et al., 2000), pastoralist practices and unprotected water sources increase zoonotic transmission risk. Therefore, improved meat inspection, offal disposal, veterinary infrastructure and public education are essential to reduce CE prevalence and its economic and public health impact in rural Pakistan.

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