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REGULAR ARTICLES

Knowledge, attitudes and practices towards *cystic echinococcosis* in livestock among selected pastoral and agro-pastoral communities in Uganda

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Abstract A cross-sectional study was done from March 2013 to May 2014 to assess knowledge, attitudes, and practices towards *cystic echinococcosis* (CE) or hydatidosis among selected pastoral and agro-pastoral communities in Uganda. A structured questionnaire was administered to 381 respondents. Multivariate logistic regression analysis was done to find the relationship between knowledge about CE and factors such as age, sex, and level of education across all regions. The odds ratio and confidence interval were used to determine the difference in responses across regions. It was shown that age above 36 years was significantly ($p < 0.001$) associated with awareness about CE in livestock. Likewise, uneducated ($p < 0.0001$) and agro-pastoralists ($p = 0.01$) were significantly less knowledgeable than the educated and pastoralists across all regions. The overall knowledge towards CE in livestock was low 17.8% (95% CI = 14.0–21.6). Dog ownership was high and they never dewormed their freely roaming dogs. Dogs shared water with livestock. In conclusion, knowledge about CE in livestock was low across all regions. Therefore, public health education and formulation of policies towards its control by the relevant stakeholders should be done. Also, the true prevalence of CE in livestock needs to be done so that the magnitude and its public health significance are elucidated.

Keywords *Echinococcus granulosus* · Knowledge · Pastoralists · Livestock · Uganda

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Introduction

Cystic echinococcosis is a cyclo-zoonotic, emerging, and re-emerging neglected endemic parasitic disease of economic and public health concern in many countries (Eckert et al. 2000; Jenkins et al. 2005; Romig et al. 2011). It is caused by the cystic larval stages of the dog tape worm of the genus *Echinococcus* (Craig and Larrieu 2006). Livestock and humans act as intermediate hosts carrying metacestodes in different internal organs (Assefa et al. 2015). Both livestock and humans get infected by ingestion of tapeworm eggs in water, soil, and pastures contaminated by dog (definitive hosts harboring the adult egg producing stages in their intestinal tracts) fecal matter (Eckert and Deplazes 2004).

Echinococcosis is highly prevalent among livestock of the nomadic, pastoral, and agro-pastoral communities of East Africa (Addy et al. 2012; Getaw et al. 2010; Magambo et al. 2006; Wahlers et al. 2012). In Uganda, studies have revealed CE prevalence to be 1.84% in humans (Othieno et al. 2016), 12.2% and 66.4% in dogs (Oba et al. 2016; Inangolet et al. 2010), respectively; while (G1) sheep and (G6/7) camel strains were discovered in livestock (Chamai et al. 2016).

CE is responsible for about 10% considerable loss of livestock productivity (Savaş and Cengiz 2009) measured in form of weight loss, reduced fertility, milk yield, and growth rates (Fasihi-Harandi et al. 2012; Torgerson 2003). This is coupled with significant economic losses associated with organ condemnations commonly the liver and lungs during post-

mortem (Kebede et al. 2011). However, the exact extent of economic injury associated with CE is still unknown in Uganda.

Dog rearing practices in a community influence the level of pasture contamination, hence, high risk of livestock infection. Knowledge level, attitudes, and practices (KAP) of communities has a significant bearing on the transmission dynamics and can inform appropriate control strategies for CE. There is still very low knowledge about CE and its many predisposing factors in pastoral communities and agro-pastoral communities in Uganda (Nyakarahuka et al. 2012). Such societies may not be informed about the exact mode of CE transmission and the potential risks of close association with dogs; yet, awareness could be used to guide the design of control interventions.

Investigations conducted by Oba et al. (2016) in Bukedea and Moroto revealed gross lack of knowledge about the disease; while Nyakarahuka et al. (2012) in Kasese district, western Uganda, reported presence of stray dogs, lack of deworming of dogs, and home slaughters as major risk factors for CE transmission. However, limited studies have been done to determine KAPs towards CE among livestock in Uganda.

It is against this background that this study was designed to assess KAPs among pastoral and agro-pastoral communities in Karamoja, Teso, and Buganda regions, Uganda.

Materials and methods

Study area

This study formed part of a larger project on CE epidemiology which involved screening humans, livestock, and dog populations to establish prevalence, risk factors and identification of circulating strains. The study was carried out in the districts of: Moroto in Karamoja region with 22,506 households, Kumi (43,964), Bukedea (33,058) in Teso region, Luwero (106,285), and Nakasongola (36,526) households in Buganda region (UBOS 2014, Uganda). Fig. 1. Karamoja region was selected following the earlier reports of high prevalence of echinococcosis in dogs (Inangolet et al. 2010) and proximity with Turkana, Kenya, with reported high prevalence in humans and livestock (Magambo et al. 2006). Teso was selected due to annual migration of Karamojong to these areas in search of scarce water and pastures in dry season; while Buganda was selected due to hunting activities with dogs for the abundant wildlife. Communities in Karamoja practice pastoralism, while those in Teso and Buganda regions practice agro-pastoralism and sedentary mixed crop farming. Karamoja is typically semi-arid experiencing harsh and dry conditions, while Teso and Buganda receive moderately dry and wet conditions with two dry and wet seasons annually.

Study design

This was a cross-sectional study conducted between March 2013 and May 2014 to assess KAP towards *echinococcosis* among selected pastoral and agro-pastoral communities in Uganda.

In each region, two counties were purposively selected basing on their either pastoral or mixed crop-livestock husbandry practices. Two sub counties, each from which one village which ultimately formed the sample unit, were randomly selected as follows: in Karamoja: Matheniko county—Rupa and Nadunget subcounties; Bokora county—Matany and Ngoliaret sub counties. In Teso region: Kumi county—Ongino and Atutur sub counties; Bukedea county—Malera and Kolir sub counties and in Buganda region: Nakasongola county—Wabinyonyi and Nakasongola Town council; Budyebo county—Nakitoma and Migyera sub counties.

Structured questionnaires were designed and both individual and focus group discussions used to collect both qualitative and quantitative data incorporating participants' demographics. The questionnaires were administered with the help of trained interpreters to those who could not speak English. The respondents were deemed knowledgeable if they answered the important three questions of: having seen or heard about hydatid cysts, the organ affected, and the species of livestock affected. This was aided by the ability of the individual to identify hydatid cysts among photographs and fresh specimens from the abattoirs used interchangeably between different interviewed individuals. However, how a question was framed was agreed to by all interviewers to minimize misinterpretation.

On practices, respondents answered questions on common enabling practices by the communities. Attitudes were assessed by their feelings on the effect of CE on livestock health and productivity.

Ethical clearance was obtained from School of Veterinary Medicine, Makerere University, Kampala, Uganda.

Permission to interview the participants was sought from the Veterinary and Medical Departments of the respective districts coupled with written consent from livestock owners before enrollment into the study.

Sampling techniques and sample size determination

Using 66.4% prevalence of CE in dogs, Moroto (Inangolet et al. 2010), sample size of 374 was calculated using a formula by Thrusfield (2007) at 95% level of confidence and 5% level of precision.

$$n = 1.96PQ/D^2$$

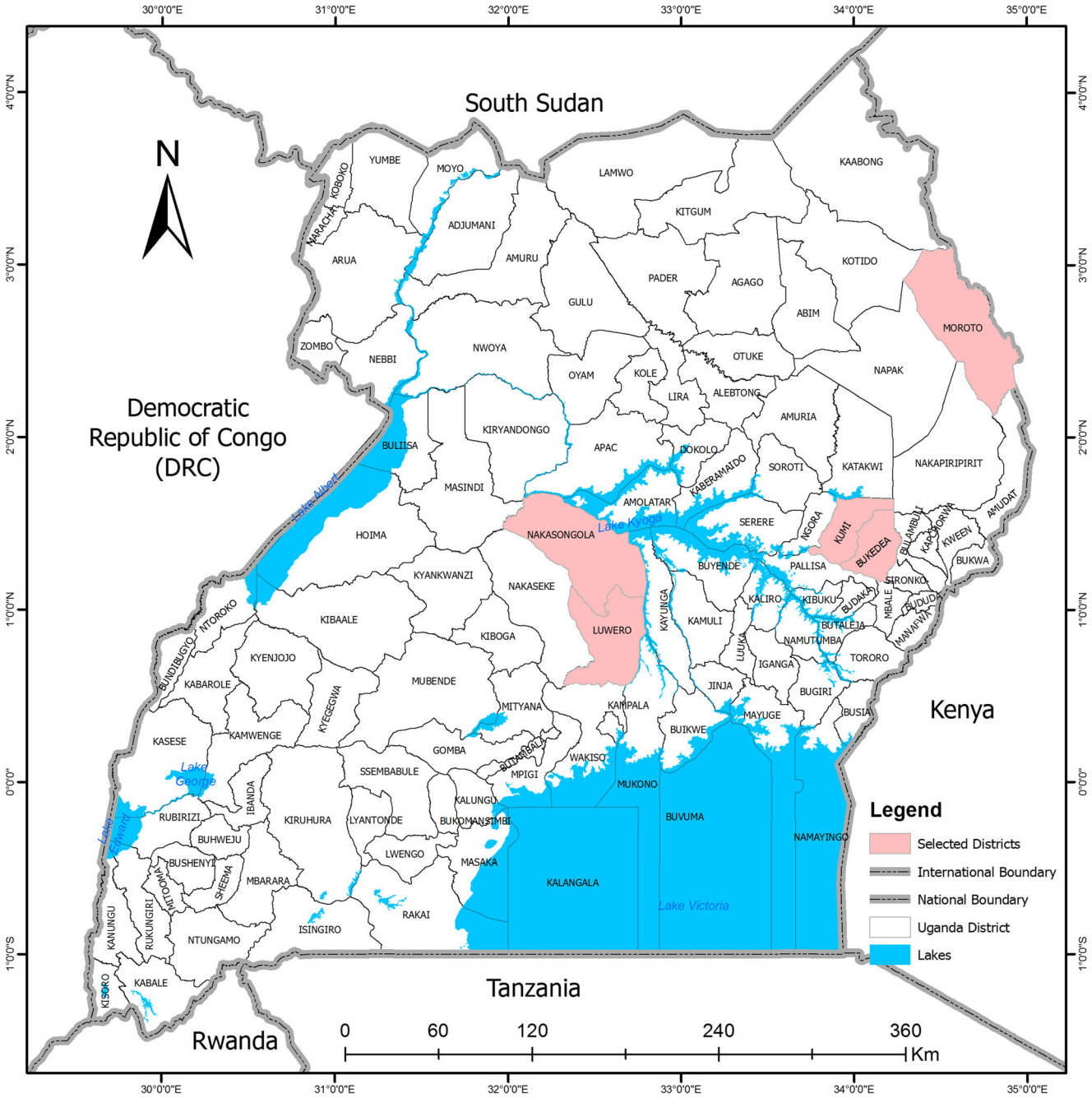

Fig. 1 Map of Uganda showing study districts

Where:

- n required sample size
- P prevalence
- Q 100-P
- D the level of precision

For precision, the total number of questionnaires administered were adjusted to 381 thus, 124 households per region, 62 households per county, and 31 per village. Five and four more agro-pastoralists were added to Karamoja and Buganda households, respectively.

Data analysis

The data set for individual variables was coded, entered into Excel 16.0, and imported into R statistical software *version* 3.1.2 with Rcmdr package used for analysis (R Core Team 2014). Descriptive statistics and categorical data presented as proportions were analyzed at 95% confidence interval. Multivariate logistic regression analysis was used to examine effect of individual factors on knowledge levels across all the regions. We used a stepwise (backward) procedure to select variables to be included in the regression model; with

only variables whose $p < 0.2$ being considered in the final model. Values of $p < 0.05$ were considered statistically significant.

Results

Socio-demographic characteristics

Of the 381 respondents who participated in this study, majority were Catholics 58% ($n = 221$) followed by Protestants 32.8% ($n = 125$) with a few Muslims 2.4% ($n = 9$). Males were 306 (80.3%) and 75 (19.7%) were females ($n = 75$). Considering levels of education: 51.7% ($n = 197$) had never attended school of whom majority were pastoralists 145 (38.15%), Karamoja and Buganda contributing 60 (41.4%) and 47 (32.4%), respectively. The mean household age was 44.1 years.

Comparison of knowledge against individual factors across all the study area

Individual factors and knowledge of *echinococcosis* in livestock were as shown in Table 1. In total, 17% ($n = 68$) of the respondents were knowledgeable about CE. Only 1.5% of the respondents below 36 years, 80.9% of the pastoralists, educated (75%), and males (79.4%) were knowledgeable about CE compared to below 36 age category, occupations, and level of education.

There was increase in knowledge level with age across all regions Table 2. Only respondents above 36 years had knowledge about echinococcosis in Buganda and Karamoja regions, 1 (4.3%) below the age of 36 and 95.7% above 36 knew about the disease in livestock in Teso.

Results of the multivariate regression analysis were as shown in Table 3. In this model, age above 36 years (OR = 86) was significantly ($p < 0.001$) highly associated with knowledge about echinococcosis in livestock. Agro-pastoralist and uneducated were comparatively 0.3 times and 0.2 times less knowledgeable compared to pastoralists and the educated, respectively. The likelihood of somebody being knowledgeable about *echinococcosis* was 0.3 and 0.03 times in Teso and Buganda regions, respectively, than in Karamoja region.

Community practices on dog management, hygiene and beliefs

Table 4 shows community practices and beliefs. Most of the farmers owned dogs (83.2%); however, majority (92.1%) do not deworm them. This practice was observed across all regions including: Karamoja (100%), Teso (90.3%), and Central (85.9%). Only 8.4% of the dogs in all regions were confined but most (62.7%) roamed unrestricted; while 12.1% accompanied livestock during grazing. On faecal removal, most dog owners: 66.7, 80.6, and 79.7% in Karamoja, Teso, and Buganda regions, respectively, never discarded dog faecal matter. Further analysis revealed 8.6% ($n = 11$) of respondents in Buganda and 5.6% ($n = 7$) in Teso made attempts to bury dog faecal matter compared to 0% ($n = 0$) in Karamoja sub region. In Karamoja (97.7%), Teso (97.6%), and Buganda (91.4%) of the respondents admitted living with stray dogs in their respective communities. Also, 16% ($n = 61$) were not aware of the source of drinking water for their dogs; while 90.6% believed CE affects meat quality, weight gain, and milk production. Nearly 40% (39.9%) of the respondents agreed and believed that dogs shared drinking water with their livestock. In Karamoja, 62% knew hydatidosis in livestock by their local name: *Ngapuletenya* in Napak, *Amilil* in Moroto and in other regions, no local name was designated for hydatid cyst in livestock hence called it by wrong names notably ticks and tick-borne diseases. Most communities (64%) grazed their livestock communally. Overall, 61.8% of the respondents in Karamoja, 33.8% in Teso, and 4.4% in Buganda were knowledgeable about CE in livestock. Most respondents (70.6%) believed that *echinococcosis* affects livestock.

Table 5 above shows households in Teso were 3.4 and Buganda 5.2 times more likely to discard faecal material compared to those in Karamoja sub region. It also revealed that

Table 1 Individual factors and knowledge of *Echinococcus granulosus* in livestock across all regions

Variable	Category	Total, yes = 68	Knowledge (%)	95% conf. interval
Age	< 36	1	1.5	(−1.4–4.4)
	> 36	67	98.5	(95.6–101.4)
Occupation	Pastoralism	55	80.9	(71.6–90.2)
	Agro-pastoralism	13	42.2	(30.5–53.9)
Education	Not educated	17	25	(14.7–35.3)
	Educated	51	75	(64.7–85.3)
Sex	Male	54	79.4	(69.8–89.0)
	Female	14	20.6	(11.0–3-.2)

Table 2 Knowledge variations with age according to different regions

Region	Age	Response, yes	Knowledge (%),	Mean (95% conf. interval)	*p* value
Teso	< 36	23	1(4.3)	0.27(−0.028–0.082)	< 0.001
	> 36		22(95.7)	0.115(0.026–0.205)	
Karamoja	< 36	42	0(0)	0(0.000–0.000)	< 0.001
	> 36		42(100)	0.389(0.222–0.556)	
Buganda	< 36	3	0(0)	0 (0.0000–0.0000)	< 0.001
	> 36		3(100)	0(0.0000–0.0000)	

females were less likely to discard fecal material compared to males (OR = 0.5, $p < 0.05$).

Discussion

Knowledge through public health education is vital in equipping people who own dogs and livestock with sufficient skills for effective containment of *cystic echinococcosis*. From our study, it is clearly evident that knowledge of CE in livestock was comparatively very low across all the regions; this agreed with the findings in Tanzania by Ernst et al. (2009). Knowledge also differed statistically significantly with age, literacy levels, and pastoralism. Older persons, educated, and pastoralists were more informed about CE than younger ones in all regions; this was in concordance with previous studies by Dawit et al. (2013) in Ayssaita, Ethiopia, and Nyakarahuka et al. (2012) in Kasese district, Uganda, that revealed a significant correlation between knowledge and age. This could be attributed to the cumulative experience and insights about the disease that accrues with increase in age. Notably, inter-region comparisons revealed that, Karamoja (mostly pastoralists) had much higher level of awareness about CE than Teso and Buganda who are majorly agro-pastoralists. This could be due to infiltration of knowledge between Karamojong and the Turkana of Kenya who once had the highest incidences of CE in the world (French and Nelson 1982). This was further hastened by unrestricted border movements, common cultures and practices to the extent of knowing CE by local names such as "*Amilil*" *in* Moroto or "*Ngapuletenya*" *in* Napak". This perhaps explains the low awareness in Buganda. However, such local nomenclatures in areas yet to understand the full epidemiology of CE could be confused with conditions such as *Cystercercus tenuicollis* infectious or abscesses among others. These posed a great challenge in recognizing and differentiating the correct cyst, species, and organs commonly affected to qualify somebody being called knowledgeable or aware of CE in livestock. This was compounded by low literacy levels in these areas (UBOS 2014), and could be responsible for the low knowledge among the uneducated.

Our findings revealed that lack of deworming, poor dog faecal disposal, method of dog keeping, and mode of grazing were the common husbandry practices across all regions. This agreed with studies conducted by Ernst et al. 2009; Nyakarahuka et al. 2012; Dawit et al. 2013 in Tanzania, Uganda, and Ethiopia, respectively. However, in Buganda, extent of these practices was less elaborate than the rest of the regions with Karamoja reporting the worst. This could be the reason for the high CE prevalence in Karamoja (Othieno et al. 2016) but rather contradictory since they are more knowledgeable. Hence, much as Karimojongs and Iteso are relatively informed, but they poorly understood the full epidemiological dynamics of CE. This is evidenced by large undewormed (0%), freely roaming dogs (67.4%) coupled with poor disposal of dog fecal matter (66.7%). Communal grazing of livestock as was the practice across all regions increases the likelihood

Table 3 Multivariate logistic regression with knowledge as the random effect variable to age and regions

Coefficients	Odds ratio (95% conf. interval)	Std. error	*Z* value	*p* value
Intercept	0.04 (0.002–0.171)	1.0293	− 3.252	0.001146 **
Age (> 36)	86.07(17.67–1556.72)	1.0319	4.317	1.58e-05 ***
Education (none)	0.24(0.10–0.51)	0.39990.	− 3.601	000316 ***
Occupation (agro-pastoralists)	0.32(0.13–0.76)	0.4502	− 2.546	0.010884 *
Region (Teso)	0.29(0.12–0.68)	0.4361	− 2.800	0.005116 ***
Region (Buganda)	0.03(0.01–0.11)	0.6665	− 5.069	4.00e-07 ***

***p < 0.001, ** $p < 0.01$, and * p < 0.05

Table 4 Dog and cattle management practices and beliefs towards CE in livestock in all regions

Question	Response	Regional percentages (95% Confidence. interval)			
		Karamoja (129)	Teso (124)	Buganda (128)	Overall (381)
Knowledge (*supported by photograph*)?	No	27.8(17.2–38.4)	42.3(30.6–54.0)	39.9(28.3–51.5)	82.2(78.0–86.4)
	Yes	61.8(50.3–73.3)	33.8(22.6–45.0)	4.4(−0.7–8.7)	17.8(14.0–21.6)
Dog ownership	No	30.2(22.3–38.1)	12.1(6.4–17.8)	7.8(2.8–11.8)	16.8(13.0–20.6)
	Yes	69.8(60.8–76.8)	87.9(82,2–93.6)	92.2(87.6–96.8)	83.2(79.4–87)
Do you deworm your dogs?	No	100(100–100))	90.7(85.5–95.5)	85.9(79.9–91.9)	92.1(89.4–94.8)
	Yes	0(0.0–0.0)	9.7(4.5–14.9)	14.1(8.1–20.1)	7.9(5.2–10.6)
How are dogs kept?	Confinement	1.8(0.0–4.1)	12.9(7.0–18.8)	11.7(6.1–17.3)	8.4(5.6–11.2)
	Roam freely	67.4(59.3–75.5)	66.1(57.8–74.4)	54.7(46.1–63.3)	62.7(57.8–67.6)
	with livestock	1.6(0.0–3.8)	8.9(3.9–13.8)	25.8(18.2–33.4)	12.1(8.8–15.4)
How do you discard dog	Deep burial	0(0.0.-.0.0)	5.6(1.6–9.6)	8.6(3.7–13.5)	4.7(2.6–6.8)
faecal matter?	Never	66.7(58.6–74.8)	80.6(73.6–87.6)	79.7(72.7–86.7)	75.6(71.3–79.9)
	Removed-Bush	3.1(0.1–6.1)	1.6(0.0–3.8)	3.9(0.5–7.3)	2.9(1.2–4.6)
Grazing method	Communal	70.5(62.6–78.4)	74.2(66.5–81.9)	47.7(39.0–56.4)	64(59.2–68.8)
	Paddocking	0(0.0–0.0)	0(0.0–0.0)	6.2(2.0–10.4)	2.1(0.7–3.5)
	Tethering	0(0.0–0.0)	12.9(7.0–18.8)	25.8(18.2–33.4)	12.9(9.5–16.3)
	Zero grazing	0(0.0–0.0)	0.8(0.0–2.4)	10.2(5.0–15.4)	3.7(1.8–5.6)
Presence of stray dogs?	No	2.3(0.0–4.9)	2.4(0.0–5.1)	8.6(3.7–13.5)	4.5(2.4–6.6)
	Yes	97.7(95.5–100.3)	97.6(94.9–100.3)	91.4(86.5–96.3)	95.5(93.4–97.6)
Local name of CE?	Correct name	62(53.6–70.4)	0(0.0–0.0)	0(0.0–0.0)	21(16.9–25.1)
	Wrong name	3.1(0.1–6.1)	23.4(15.9–30.9)	3.1(0.1–6.1)	9.7(6.7–12.7)
	Do not know	20.2(13.3–27.1)	0(0.0–0.0)	0(0.0–0.0)	6.8(4.3–9.3)
Can CE affect livestock?	No	7.8(3.2–12.4)	6.5(2.2–10.8)	6.2(2.0–10.4)	6.8(4.3–9.3)
	Yes	58.1(49.6–66.6)	91.1(86.1–96.1)	63.3(55.0–71.6)	70.6(66.0–75.2)
	Not certain	34.1(25.9–42.3)	2.4(0.0–5.1)	30.5(22.5–38.5)	22.6(18.4–26.8)
Do livestock and dogs share water?	No	31.0(23.0–39.0)	68.5(60.3–76.7)	81.2(74.4–88.0)	60.1(55.2–65.0)
	Yes	69.0(61.0–77.0)	31.5(23.3–39.7)	18.8(12.0–25.6)	39.9(35.0–44.8)
Does CE affect milk and weight of livestock?	Yes	99.2(97.7–100.7)	100(100–100)	72.7(60.1–85.3)	90.6(87.7–93.5)
	No	0(0.0–0.0)	0(0.0–0.0)	6.2(2.0–10.4)	2.1(0.7–3.5)
	Do not know	0.8(0.0–2.3)	0(0.0–0.0)	21.1(14.0–28.2)	7.3(4.7–9.9)

of infection with contaminated pastures and water from infected dog faecal matter (Wachira et al. 1991). In all regions, females were likely to remove dog faecal matter than males because they are always at home and responsible for domestic hygiene in all regions.

Table 5 Multivariate regression model for community practices towards dog fecal material

Coefficients:	Odds Ratio (95% conf. interval)	Std. error	*Z* value	*p* value
Intercept	2.63	0.20	4.73	2.24e-06 ***
Region (Teso)	3.39	0.34	3.58	0.000346 ***
Region (Buganda)	5.26	0.38	4.32	1.53e-05 ***
Sex (Females)	0.50	0.33	−2.12	0.034250 *

***p < 0.001, * p < 0.05

In conclusion, this study showed low knowledge levels on CE in livestock more so among the uneducated, agro-pastoralists and the young less than 36 years of age. Majority of households owned dogs, but did not regularly deworm them, and never discarded their faeces from the environment. Dogs shared water with other animals and communities also believed that CE affected their livestock productivity.

It is prudent therefore to determine and educate people on the risk factors for CE transmission between dogs and livestock. This would increase awareness and knowledge of the communities and public health, consequently enabling effective disease control and mitigation. Further studies should be done on prevalence and economic impact of the disease in livestock.

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Compliance with ethical standards

Statement of animal or human rights This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of interest The authors declare that they have no conflict of interest.

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