Pig farming systems and cysticercosis in Northern Uganda

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Summary

Rudimentary non-market-oriented pig rearing systems have been implicated in the persistence of *Taenia solium* cysticercosis, an endemic disease of high public health concern in Uganda. We investigated the seroprevalence and key predisposing factors of the disease in Moyo and Lira, two pig-producing districts in Northern Uganda. Cross-sectional serosurveys were conducted in 428 pig farms (Moyo, 262; Lira, 166). Farmers kept on average two adult pigs per herd. Tethering was a common practice in rural areas; free-ranging less so. Confinement of pigs in pens was characteristic of periurban farming systems. Pigs were mainly fed crop residues and forages in the rainy season, and swill and crop residues in the dry season. The majority of farmers of the survey were women (55%) above 45 years old, and 51% of farmers had attained primary school education. A total of 723 pig serum samples were collected, 403 in Moyo, and 320 in Lira. They were analyzed for *Taenia* spp. antigens using B158C11A10/B60H8A4 Antigen-ELISA. The overall animal seroprevalence of *Taenia* spp. serum antigen was 10.4% (95% confidence interval [CI]: 4.9–17.6), with 13.2% (95% CI: 7.1–21.2) the highest in Moyo vs 6.9% (95% CI: 2.9–13.9) in Lira. The herd-level seroprevalence was estimated at 13.7% (95% CI: 9.8–18.5) in Moyo and 11.4% (95% CI: 7.0–17.2) in Lira. Out of 12 explanatory variables assessed for association with the observed seroprevalence, only the district of origin was significant ($p = 0.01$). Pigs originating from Lira were a protective factor against *Taenia* spp. cysticercosis (odds ratio: 0.54). These findings highlight the urgent need for an awareness campaign with prevention and control measures to minimize the risk of transmission to pork consumers in these districts.

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■ INTRODUCTION

In recent years the rural poor, and middle income urban communities in Uganda have come to appreciate pig production systems as an important source of income and financial security (Ouma, et al., 2014). Pork production has been promoted as a fairly inexpensive option to address protein deficiency, given the limited consumption of animal source foods in Uganda (FAOSTAT. 2014). In Central and Eastern Uganda, free-ranging, tethering and housing management systems are common farming systems for rearing pigs. These management systems tend to be used interchangeably depending on seasonal patterns (Dione et al., 2014; Muhanguzi et al., 2012). The increase in pig production in response to the increasing urban pork consumption in Uganda represents a market opportunity for rural producers if they can guarantee the production of disease-free pork. However, good biosecurity practices are not uniformly applied along the pig value chain (Dione et al., 2017). The authors of these studies observed that practices where biosecurity and hygiene are poor have a high potential for disease transmission, and this risk is greater when the pathogen is zoonotic. In free-ranging, tethering pig-rearing systems if hygiene and sanitation are poor, they are key drivers of transmission of pig diseases such as *Taenia solium* cysticercosis, a condition of high public health concern. In pig-keeping systems in Uganda, some socio-cultural practices may undermine good hygiene and sanitation; scarcity of feed and water in the dry season may encourage free-range management, compromising the implementation of strategies to control and prevent cysticercosis (Adenuga et al., 2018; Krecek et al., 2012; Kungu et al., 2017b).

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The stage of infection with *T. solium* determines the outcome and/or prognosis of infection in humans. Human infection by consumption of encysted larval stages of *T. solium* in undercooked pork completes the life cycle, with development of pork tapeworms (taeniasis), which has implications on growth and development in children. More deleterious effects to human health result when humans become intermediate hosts. Under these circumstances the larval stages of the parasite become encysted in the brain and muscles of humans. Development of larval cysts in the human brain or neurocysticercosis may result in epileptic seizures, even death. Both humans and pigs acquire cysticercosis by ingesting food or fluids contaminated with *T. solium* eggs shed in the feces of humans with taeniasis (Carabin et al., 2009; Mwape et al., 2015).

Previous prevalence studies have reported the occurrence of the condition in various developing countries in Asia, Latin America and Africa. In Uganda, available studies indicate an emerging *T. solium* cysticercosis problem (Adenuga et al., 2018; Praet et al., 2009; Rodriguez-Hidalgo et al., 2006; Sciutto et al., 2003; Sreedevi et al., 2012). Recent studies in Uganda have reported a high occurrence of the condition in pigs, in both rural and urban settings in Central and Eastern Uganda, and discussed potential risk factors (Kungu et al., 2017a,b). An investigation of this condition in the remote rural settings of Northern Uganda where pig production is steadily increasing will provide more insight on the situation in larger geographical parts of the country. Although there have been efforts to undertake studies to document cysticercosis in Uganda, limited research has been done to assess the magnitude of infection in pig production systems in the Northern area. This study thus aimed to describe the pig production systems and determine the prevalence and risk factors for cysticercosis in the Northern districts of Lira and Moyo.

■ MATERIALS AND METHODS

Study area

Cross-sectional surveys were conducted in July 2015 in Lira and Moyo districts (Figure 1). Lira has a human population of 410,516 and Moyo of 137,439. The target subcounties surveyed constituted 47% and 39% of this population, respectively. Together these two districts have 11% of the total pig population in Northern Uganda with 28,631 pigs in Lira and 9,034 pigs in Moyo (UBOS and MAAIF, 2009).

Site selection

In Moyo and Lira, the district veterinary officers (DVOs) and subcounty veterinary personnel assisted to identify the subcounties with the highest pig population densities, and these subcounties were included in the current surveys. African swine fever (ASF) disease outbreak reports were used as an additional indicator for high pig population density. For data validation, the DVOs and para-veterinarians operating in the areas were consulted about their perceptions on pig populations in the target subcounties. Two subcounties in Moyo (Moyo, Metu) and five in Lira (Ojwina, Barr, Lira, Adyel and Adekokwok) were selected for the study. Based on the pig value chain domain classification that was previously used (Ouma et al., 2015), Moyo subcounties were all classified in the rural production domain. In Lira District, Adyel, Ojwina and Lira divisions were classified as periurban domains, whereas Barr and Adekokwok were classified as rural domains.

Sample size calculation

The pig population sample size was calculated considering an infinite population using the formula $n = [Z^2 P (1-P)] / d^2$ (Thrusfield, 2007), and an estimated cysticercosis seroprevalence of 12.3%, reported in Central and Eastern Uganda (Kungu et al., 2017a). The minimum sample size to detect a seroprevalence of cysticercosis with an 80%–95% confidence interval was 166 pigs. We adjusted the sample size for intra-cluster correlation using a coefficient of 0.2. As a result, the adjusted sample size was estimated at 200 pigs per district. However, we sampled 320 pigs in Lira and 403 pigs in Moyo. Households enrolled in the survey were randomly selected from a list of farmers generated for each subcounty. In each household, up to three pigs were enrolled under random selection with the exclusion of pigs less than three months old, pregnant sows, and weak piglets.

Ethical considerations

Ethical approval was granted by the Research and Ethics Committee of the College of Veterinary Medicine, Animal Resources and Biosciences of Makerere University (Ref. No. SBLS/REC/15/128) and by the Ugandan National Council for Science and Technology (Ref. No. A508). All farmers signed a consent form to participate in the study and to allow their pigs to be sampled.

Collection of household information and pig serum

A pig biological data form and a household questionnaire were used to collect information on the individual pigs (age, sex and breed), farmers' demographic information (gender, age, nature of pig business, level of formal education, main source of income, etc.) and pig farming characteristics. For blood collection, pigs were restrained using a pig snare and bled from the anterior vena cava into 10-ml plain vacutainers using 20-gauge needles. Blood samples were transported in cold boxes to the district laboratories and kept overnight at room temperature to facilitate coagulation. Serum was harvested from the whole blood by pipetting into 2-ml cryovials and stored at -20°C pending serological analysis.

Key informant interviews

Key informant interviews were carried out with DVOs and district production officers of respective districts in order to gain more information on pig production constraints. Such information was considered to support findings.

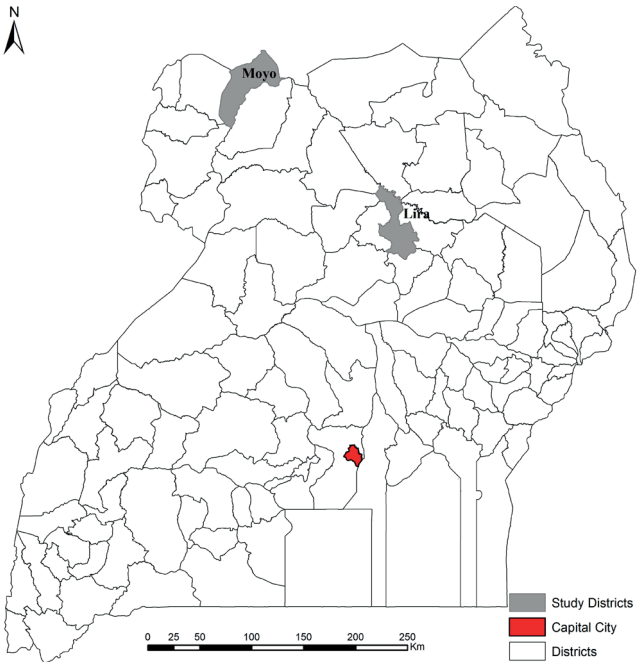

Figure 1: *Map of Uganda showing the two districts of the study.*

Serological analysis

Serological analysis for *Taenia* spp. cysticercosis was carried out at the Molecular Biology Laboratory of the College of Natural Sciences, Department of Zoology, Entomology and Fisheries Sciences in Makerere University. Analyses were performed using B158C11A10/B60H8A4 Antigen-ELISA (apDia In Vitro Diagnostic Kit, Belgium) following the manufacturer's instructions. The optical density (OD) of the samples was measured by reading the test plate at 450-nm wavelength (Multiscan Ex, ThermoScientific). For the interpretation of results, the cut-off of the antigen index (Ag Index) for porcine specimens was calculated. The mean OD of the negative control was used to calculate the cut-off by multiplying its value by 3.5. The Ag Index of each sample was calculated by dividing the OD value of the sample by the cut-off value. A positive reaction corresponded to an Ag Index greater than or equal to 1.3. A negative reaction corresponded to an Ag Index less than or equal to 0.8. When the Ag Index was between 0.8 and 1.3, it was considered as a gray zone and samples were retested. They were considered as doubtful if the results remained the same and were excluded from the analysis. Positive and negative controls were provided by the manufacturer.

Statistical analysis

Individual pig biological data was entered in SPSS 16 for analysis. Samples that did not have biological information associated to them were removed from the analysis (n = 18). Descriptive statistics were used to analyze data on farmers' demographic characteristics as well as pig keeping and feeding systems. A logistic regression was conducted to determine associations between cysticercosis seroprevalence and potential risk factors. At first, a univariable analysis using a logistic regression was performed. Factors with $p \leq 0.2$ were expected to be included in a model for multivariable logistic stepwise regression analysis. Since the seroprevalence of cysticercosis was significantly different in the two districts, the logistic regression analysis of the explanatory variables was also independently done. Multivariable analysis was not conducted in any case because none of the variables were significant at univariable analysis.

■ RESULTS

Farmers' demographic characteristics

A total of 428 pig-keeping households were visited. Female respondents predominated (55%) and most farmers were more than 45 years old. Almost all pig farmers characterized their livelihood as a pig-keeping business (98%), as opposed to communal village boar keeping (2%). Up to 51% of household heads had received primary level education only (Table I).

Pig demographic characteristics

Demographic data are presented in Table II. Sizes of the pig herds were very small with an average of two adult pigs per farm. The pigs sampled in Lira and Moyo were predominantly local breed (58%) females (61.3%). However, a number of farmers had improved pig breeds (mainly crossbreeds).

Pig management practices

Tethering (Figure 2) was the most prevalent practice in both districts compared to free-ranging. Highly significant variations in the three management systems were observed between the rainy and the dry seasons ($\chi^2 = 6.2$, $p = 0.00$). The proportion of farmers who practiced free-ranging was higher in the dry season (16%) than in the rainy one (4%). Likewise, the number of pigs tethered was lower in the dry season (66%) than in the rainy one (78%).

Table I

Pig farmers' demographic characteristics in two districts of Northern Uganda

Characteristic	Lira District	Moyo District	Total (%)
	Num. of farmers	Num. of farmers	
Sex			
Male	81	112	193 (45.0)
Female	85	150	235 (55.0)
Age (years)			
15–24	16	36	52 (12.0)
25–34	45	69	114 (27.0)
35–44	56	65	121 (28.0)
≥ 45	49	92	140 (33.0)
Nature of pig business			
Producer	164	256	420 (98.0)
Village boar keeper	2	6	8 (2.0)
Level of education			
Primary	92	127	219 (51.0)
Secondary	36	50	86 (20.0)
Tertiary	38	85	123 (29.0)
Main source of income for the household			
Pig keeping	28	19	47 (11.0)
Crop farming	110	218	328 (76.6)
Other	28	25	53 (12.4)

Table II

Demographic characteristics of pigs sampled in two districts of Northern Uganda

	Lira District	Moyo District	
Characteristic	Num. of pigs	Num. of pigs	Total (%)
Sex			
Male	130	150	280 (38.7)
Female	190	253	443 (61.3)
Breed type			
Local	194	223	416 (58.0)
Cross	96	180	276 (38.0)
Exotic	30	0	30 (4.0)
Category			
Weaner	52	3	55 (7.6)
Gilt	108	95	203 (28.1)
Grower	15	20	35 (4.8)
Communal boar	47	34	81 (11.2)
Castrate	30	109	139 (19.2)
Sow	68	142	210 (29.1)
Age (months)			
4–6	179	39	218 (30.2)
7–12	55	159	214 (29.6)
> 12	86	205	291 (40.2)

Figure 2: *Tethered pig in a rural area of Northern Uganda.*

Pig feeding strategies

There was significant variation in the feed types used in the rainy and dry seasons ($\chi^2 = 4.01$, $p = 0.00$). During the rainy season, pigs were mainly fed on crop residues (63%) (raw or boiled cassava leaf and peelings, sweet potato vine, pumpkin and rice husk) and forages (25%). In the dry season, they were mainly fed household kitchen swill (39%) and crop residues (38%). Commercial feeds including maize, rice bran, blood and fishmeal were used to supplement diets, but supplementation was less practiced during both the rainy and dry seasons.

Pig health constraints

Pig health challenges included ASF, and internal and external parasites (worms, lice and ticks). ASF was endemic in both districts and outbreaks occurred frequently especially during the dry season. ASF was perceived by farmers and key informants as the most important health constraint to pig systems. Besides ASF, which is known by local names, farmers could only mention clinical signs in their pigs, and the most commonly reported were diarrheas, respiratory problems, appetite and weight loss, shivering (fever sign), and skin affections. The high rate of piglet mortality and lack of feeds were also pointed out as major concerns. Farmers' knowledge of pig zoonoses was generally very poor. However, porcine cysticercosis was relatively known by farmers, traders and butchers, but its mode of transmission and impact to humans was not well understood. Pig slaughter was conducted in backyard slaughter slabs in both districts, and pork inspection did not frequently occur. In Moyo a community slaughter slab had been built in order to centralize pig slaughter, thus allowing easy meat inspection. Major constraints reported by veterinary officers, meat inspectors, extension workers and private animal health practitioners included i) failure by the community to report pig disease outbreaks to the district veterinary office, ii) uncontrolled movement of livestock and livestock products within and outside the districts, iii) high porosity of South Sudan and Moyo District border enabling easy exchange of livestock with limited sanitary control, iv) low awareness of the community about zoonotic diseases, and v) low level of farmers' knowledge regarding safe handling and processing of dead animals.

Seroprevalence and risk factor analysis

Out of 723 pig serum samples, only 75 were positive, implying that the overall prevalence was 10.4% (95% confidence interval [CI]: 4.9–17.6). Moyo had more affected pigs (95% CI: 13.2%; 7.1–21.2) than Lira (95% CI: 6.9%; 2.9–13.9) (Table III). The herd seroprevalence was estimated at 13.7% (95% CI: 9.8–18.5) for Moyo, and 11.4% (95% CI: 7.0–17.2) in Lira (Table IV). Eleven potential risk factors were assessed for association with cysticercosis seroprevalence using a univariable logistic regression analysis (Table V). However, only the district was shown to be significantly associated with the condition (Table V). Results showed that the infection increased significantly with the age increase of pigs in Moyo ($p = 0.014$; $F = 6.09$). There was no significant association observed between pig infection and age in Lira. Univariable analyses were run independently by district with no significant factors observed.

■ DISCUSSION

Pigs were kept in small numbers for subsistence mostly by women and children. The observed pig farming practices were characteristic of a typical smallholder pig farming system, which is predominant in

Table III

Pig seroprevalence of cysticercosis according to the location in two districts of Northern Uganda

District	Subcounty	Num. of pigs	Num. positive (%)	% Positive (CI)
Lira	Ojwina (U)	46	3	6.5 (2.9–13.9)
	Barr (R)	143	12	8.4 (3.5–15.2)
	Lira (U)	29	1	3.4 (0.6–8.5)
	Adyel (U)	42	2	4.8 (1.6–11.3)
	Adekokwok (R)	60	4	6.7 (2.9–13.9)
	Total	320	22	6.9 (2.9–13.9)
Moyo	Moyo (R)	188	21	11.2 (5.6–18.8)
	Metu (R)	215	32	14.9 (8.7–23.50
	Total	403	53	13.2 (7.1–21.2)
Overall total		723	75	10.4 (4.9–17.6)

CI: 95% confidence interval; R: rural pig production; U: periurban pig production

Table IV

Herd seroprevalence of cysticercosis according to the location in two districts of Northern Uganda

District	Subcounty	Num. of herds	Num. positive (%)	% Positive (CI)
Lira	Ojwina (U)	23	2	0.4 (0.1–2.2)
	Barr (R)	77	10	1.3 (0.6–2.2)
	Lira (U)	14	1	0.6 (0.1–3.4)
	Adyel (U)	20	2	0.7 (0.1–3.2)
	Adekokwok (R)	32	4	1.2 (0.4–2.9)
	Total	166	19	11.4 (7.0–17.2)
Moyo	Moyo (R)	96	11	11.4 (5.9–19.6)
	Metu (R)	166	25	15.0 (9.9–21.4)
	Total	262	36	13.7 (9.8–18.5)
Overall total		428	55	12.8 (9.8–16.4)

CI: 95% confidence interval; R: rural pig production; U: periurban pig production

Table V

Univariable regression of risk factors of cysticercosis in two districts of Northern Uganda

Variable	Num. of pigs	Num. positives (%)	P
District			
Lira	320	22 (6.9)	0.01
Moyo	403	53 (13.2)	
Pig sex			
Male	280	27 (9.6)	0.61
Female	443	48 (10.8)	
Pig breed			
Local	416	42 (10.1)	0.83
Cross	275	30 (10.9)	
Exotic	30	3 (10.0)	
Pig category			
Weaner	55	4 (7.3)	0.24
Gilt	203	17 (8.4)	
Grower	35	5 (14.3)	
Entire boar	81	5 (6.2)	
Castrate	139	14 (10.1)	
Sow	210	30 (14.3)	
Rainy season, day management			
Free-ranging	29	2 (6.9)	0.56
Tethering	567	63 (11.0)	
Housed	127	10 (7.9)	
Rainy season, night management			
Free-ranging	27	4 (14.8)	0.16
Tethering	539	61 (11.2)	
Housed	157	10 (6.4)	
Dry season, day management			
Free-ranging	114	14 (12.3)	0.62
Tethering	477	50 (10.5)	
Housed	130	11 (8.5)	
Dry season, night management			
Free-ranging	105	13 (12.4)	0.23
Tethering	465	52 (11.2)	
Housed	150	10 (6.7)	
Feed in rainy season			
Crop residues	454	47 (10.4)	0.17
Forage	178	24 (13.5)	
Concentrate	54	2 (3.7)	
Swill	37	2 (5.4)	
Feed in dry season			
Crop residues	276	28 (10.1)	0.16
Forage	87	8 (9.2)	
Concentrate	79	3 (3.8)	
Swill	281	36 (12.8)	
Dewormer used in pigs			
Levamizole	368	37 (10.1)	0.98
Ivermectin	35	4 (11.4)	
Albendazole	5	0 (0.0)	

Uganda, where up to 80% of pig farmers hold a small stock ranging from one to five pigs (Ouma et al., 2015). In this study, the majority of the pig farmers interviewed were female. The proportion of female-headed households owning pigs in Uganda has increased significantly in the last 10 years, from 15% to 32%. Regardless of who heads the household, it is widely agreed that women and children actively participate in managing pigs and other animals reared in homesteads (Uganda Bureau of Statistics, 2014).

The pig management practices reported in this study (free-ranging, tethering and housing) were similar to those reported in Central and Eastern Uganda, and in Gulu District in the North (Chenais et al., 2017; Dione et al., 2014). Although tethering was predominantly practiced in both districts, highly significant variations were noted in the three systems of management during the rainy and dry seasons. The number of free-ranging pigs was higher in the dry season than in the rainy one, a finding which concurs with previous studies in Uganda and the Democratic Republic of Congo (Dione et al., 2014; Lekule and Kyvsgaard, 2003). These changes in management systems with seasonal patterns have mainly been associated with limited feed resources and minimal crops during the dry season (Lekule and Kyvsgaard, 2003). Most farmers favored tethering as an alternative to roaming, as they could not afford building proper housing for pigs. In comparison with the housing system, it is considered to be less labor intensive (Dione et al., 2014).

A significant variation in feed types given to the pigs was noted in this study, whereby crop residues and forages were mainly used in the rainy season, whereas swill and crop residues predominated during the dry season. During the rainy season, there was an increased availability of forage and crop residues such as cassava leaf and sweet potato vine. During the dry season, feeds became scarce, resulting in farmers tethering their pigs in grazing fields with scanty pastures and supplementing them with swill (Braae et al., 2015). Limited use of commercial feed (concentrate) was reported probably because of their high cost (Lekule and Kyvsgaard, 2003).

The rearing systems reported here faced many challenges such as exposure of pigs to diseases, theft and predation, environmental stressors, poor nutrition, as reported elsewhere (Lekule and Kyvsgaard, 2003). Pig farmers also faced other challenges such as a high disease prevalence (especially ASF), feed scarcity and limited access to markets, which are the same challenges reported in other districts of Uganda (Dione et al., 2014; Muhanguzi et al., 2012).

The overall cysticercosis prevalence (10.4%) was within the range of that reported elsewhere in the country (Kungu et al., 2016; Nsadha et al., 2014; Waiswa et al., 2009). The higher odds of disease occurrence in Moyo could be attributed to a greater exposure of pigs to the infection given that Moyo had a more extensive pig system than Lira. Tethering and free-ranging represented risks that could not be underestimated.

Traditional rearing systems increase the likelihood of pigs accessing human fecal matter contaminated with tapeworm eggs, facilitating the completion and maintenance of the transmission cycle of pork tapeworms and cysticercosis (Carabin et al., 2015; Mwanjali et al., 2013; Thys, 2016; Braae et al., 2015). In Uganda, the occurrence of cysticercosis is a major public health concern given that farmers who are also consumers have little awareness of the condition and how to prevent and control it (Kungu et al., 2017b). Therefore, there is a need to raise awareness among pig value chain actors and stakeholders about the risks of infection with *Taenia* spp. through community advocacy campaigns with relevant authorities. Improved prevention and mitigation measures are highly needed to minimize transmission of the disease to people, with apparent benefits to the pig sector in terms of incomes and human health. Further studies should focus on the assessment of the roles of pig value chain actors in the management of cysticercosis and to investigate the effectiveness of approaches that promote the participation of farmers and other actors and stakeholders in the control of the disease.

■ CONCLUSION

The study reported that traditional tethering was the most popular system of pig production in the two districts, showing the challenge that impedes improving the productivity of the pig industry. The pig management systems posed the silent risk of maintaining pig-related diseases. The observed cysticercosis prevalence confirmed the endemic occurrence of the disease in the districts. Since the serological test used was not *T. solium* specific, surveys using specific tests such as whole carcass inspection and PCR should be carried out to estimate *T. solium* cysticercosis burden. In-depth studies should also be performed to understand the factors that led to the significant difference of cysticercosis seroprevalence between Moyo and Lira districts. This study and other similar works could form a preliminary basis for the development and implementation of feasible control strategies countrywide.

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Author contributions statement

MD conceptualized the study; MD and MA designed and coordinated the study; MA, JA, WCA and JMK collected the samples and household information; CM and JA performed the laboratory analysis; JMK performed the statistical analysis; JMK and MD wrote the manuscript.

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Résumé

Kungu J.M., Masembe C., Apamaku M., Akol J., Amia W.C., Dione M. Systèmes d'élevage porcin et cysticercose au nord de l'Ouganda

Les systèmes rudimentaires d'élevage de porcs, non orientés vers le marché, ont été impliqués dans la persistance de la cysticercose à *Taenia* spp., maladie endémique présentant un grave problème de santé publique en Ouganda. Nous avons étudié la séroprévalence et les principaux facteurs prédisposant de la maladie à Moyo et à Lira, deux districts producteurs de porcs au nord du pays. Des enquêtes sérologiques transversales ont été menées dans 428 élevages porcins (Moyo, 262 ; Lira, 166). Deux porcs adultes étaient gardés en moyenne par troupeau. En milieu rural ils étaient souvent attachés, la divagation étant occasionnelle. Le confinement en enclos était observé en milieu périurbain. Les animaux étaient principalement alimentés avec des résidus de culture et des fourrages pendant la saison des pluies, et des restes d'aliment des ménages et les résidus de culture en saison sèche. La majorité des éleveurs de l'enquête étaient des femmes (55 %) âgées de plus de 45 ans ; 51 % des éleveurs avaient le niveau de l'école primaire. Au total 723 échantillons sériques porcins ont été prélevés (Moyo, 403 ; Lira, 320). Ils ont été analysés pour la détection des antigènes de *Taenia* spp. en utilisant le test B158C11A10/B60H8A4 Elisa-antigène. La séroprévalence animale totale de l'antigène sérique de *Taenia* spp. était de 10,4 % (intervalle de confiance [IC] à 95 % : 4,9–17,6). Elle a été la plus élevée à Moyo avec 13,2 % (IC à 95 % : 7,1–21,2) vs 6,9 % (IC à 95 % : 2,9–13,9) à Lira. La séroprévalence au niveau du troupeau a été estimée à 13,7 % (CI 95 % : 9,8–18,5) à Moyo vs 11,4 % (CI 95 % : 7,0–17,2) à Lira. Parmi les 12 variables explicatives évaluées pour l'association avec la séroprévalence observée, seul le district d'origine était significatif (p = 0,01). Les porcs originaires de Lira étaient un facteur protecteur contre la cysticercose à *Taenia* spp. (*odds ratio* : 0,54). Ces résultats ont souligné le besoin urgent de mettre en place des mesures de lutte pour minimiser le risque de transmission aux consommateurs de porc dans ces districts.

Mots-clés : porcin, conduite d'élevage, *Taenia* spp., cysticercose, séroprévalence, facteur de risque, Ouganda

Resumen

Kungu J.M., Masembe C., Apamaku M., Akol J., Amia W.C., Dione M. Sistemas de crianza porcina y cisticercosis en el norte de Uganda

Los sistemas más rudimentarios de cría de cerdos, no orientados al mercado, se han visto implicados en la persistencia de la cisticercosis de *Taenia* spp., enfermedad endémica que representa un grave problema de salud pública en Uganda. La seroprevalencia y los principales factores predisponentes de dicha enfermedad fueron estudiados en Moyo y Lira, dos distritos productores de carne de cerdo en el norte del país. Para ello se realizaron encuestas serológicas transversales en 428 granjas porcinas (Moyo, 262; Lira, 166). Se contabilizó una media de dos cerdos adultos por rebaño. En las zonas rurales, los animales se encontraban principalmente atados, con desplazamientos libres ocasionales. En las zonas periurbanas sin embargo se observó un predominio del sistema de estabulación. También se observó que la alimentación se basa principalmente en los residuos de cultivos y los forrajes durante la época lluviosa, mientras que en la época seca se distribuyen residuos de cocina (domésticos) y otros residuos de cultivo. En la encuesta, la mayoría de los productores fueron mujeres (55%) mayores de 45 años y el 51% contaban con el nivel de escolaridad primario. Se recogieron en total 723 muestras de suero porcino (Moyo, 403; Lira, 320). Para la detección de antígenos de *Taenia* spp., las mismas fueron analizadas utilizando el test Elisa B158C11A10/B60H8A4. La seroprevalencia animal total de antígeno sérico de *Taenia* spp. resultó ser del 10,4% (intervalo de confianza [IC] del 95%: 4,9–17,6). Los valores más altos se encontraron en Moyo (13,2%; IC 95%: 7,1–21,2) vs 6,9% (IC 95%: 2,9–13,9) en Lira. La seroprevalencia a nivel del rebaño se estimó a la altura del 13,7% (IC 95%: 9,8–18,5) en Moyo y al 11,4% (IC 95%: 7,0–17,2) en Lira. Entre las 12 variables predictivas evaluadas para la asociación con la seroprevalencia observada, solo el distrito de origen resultó ser significativo (p = 0,01). Los cerdos procedentes de Lira fueron un factor protector contra la cisticercosis provocada por *Taenia* spp. (*odds ratio*: 0,54). Estos resultados indican la necesidad urgente de establecer medidas de control para minimizar el riesgo de transmisión a los consumidores de carne de cerdo en estos distritos.

Ganado bovino: cerdo, manejo del ganado, *Taenia* spp., cisticercosis, seroprevalencia, factores de riesgo, Uganda