Knowledge Levels Match Control Practices of Cerebral Coenurosis by Pastoral Community in Iringa District Council, Tanzania

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SUMMARY

Cerebral coenurosis is a disease of small ruminants which causes economic loss worldwide. Different studies in Tanzania have reported the cause, transmission, signs, prevalence, risk factors and control measures of cerebral coenurosis. Transfer of this research-based information to livestock keepers may influence practicability and efficacy of intervention. The present study aimed at assessing the knowledge levels and control practices of coenurosis by pastoralists in Iringa district. A total of 267 respondents were interviewed on livestock management practices, knowledge, losses and coping strategies of coenurosis. The average knowledge score on coenurosis detection (definition, hosts, signs, and diagnosis, including postmortem) was 90.3%. In contrast, knowledge on infection cycle and control was zero, implying that respondents were completely not informed about etiology, transmission and control of coenurosis. Involvement of dogs in coenurosis cycle was not known to respondents such that they all gave head of sheep and goats to dogs while 82.8% had never dewormed their dogs. About 83% of respondents experienced at least, one cases of coenurosis in the last 12 months. There was no formal coenurosis control program, but heating the head of sick animal with hot iron, selling, slaughter, treatment with antibiotics, or local herbs and doing nothing were the reported management strategies. Lack of knowledge on the cause, transmission and control of cerebral coenurosis may be associated with inappropriate animal management and control of coenurosis in pastoral community in Iringa rural District, including transmission facilitating practices. A coenurosis training package is recommended to farmers before intervention program is instituted.

Key words: *Taenia multiceps*, *Coenurus cerebralis*, 'Ormilo', Iringa, Tanzania, coenurosis

INTRODUCTION

Cerebral coenurosis commonly affects goats and sheep worldwide and causes significant economic losses due to death of animals, reduced weight gain and condemnation (Abera *et al.* 2016). Endemicity and large disease burden has been reported in Africa and Asia (Sharma and Chauhan , 2006). In Tanzania, where sheep and goat population is estimated to be 5.3 million and 18.8 million respectively (URT , 2019), the prevalence of coenurosis ranges from 10.9 to 46% (Miran *et al.* 2015; Hughes *et al.* , 2019). Other areas of Africa have reported the prevalence that range from 3.7% – 33.3% (Desouky *et al.* , 2011; Aliye and Deressa , 2017). Other species other than sheep and goats, such as cattle, buffaloes, camels, yak and equines have been reported to suffer from coenurosis (Abera *et al.* , 2016). Human cases of coenurosis, although rare, have also been reported in Senegal, Nigeria and Israel (Sharma and Chauhan , 2006; El-On *et al.* 2008) and this zoonotic potential draws public health attention. Goats and sheep serve as community livelihood savior due to their long known quick economic return and survival under limited resource input (Matthewman , 1980).

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Diseases are among the major constraints of sheep and goat farming, and coenurosis is among important diseases especially in developing countries (Abera *et al.* 2016; Hughes *et al.* 2019).

Different studies have been conducted in Tanzania on coenurosis. Some of these studies have investigated the burden (Miran *et al.* , 2015; Hughes *et al.* 2019) and confirmed the cause (larval stage of *Taenia multiceps* known as *coenurus cerebralis*) and related clinical manifestation (Hughes *et al.* , 2019). Other studies have investigated the transmission mode which involve dogs as definitive hosts and small ruminants as intermediate hosts; and have quantified risk factors and suggested control measures (Swai *et al.*, 2016; Hughes *et al.* , 2019).

This research-based information package plays an important role in designing, implementing and monitoring and evaluation of intervention and its proper transfer can be reflected in the knowledge and control practices of livestock keepers in the field. Despite the endemicity of coenurosis in Tanzania, there is information paucity on what livestock keepers do to control coenurosis and why. The present study, therefore, aimed at assessing the knowledge and control practices of coenurosis by pastoral community in Iringa rural District. This research identifies the gaps and may help to design appropriate control strategy.

METHODOLOGY

The study protocal was approved by Sokoine University of Agriculture ethical committee (ref: DPRTC/R/186/32) and with permission from local district council authority.

Study area, population and design

This cross-sectional study was conducted in Iringa district council from June to October 2020. Nduli, Ilolompya, Mlowa and Maboga wards were involved in the study due to comparatively high sheep and goat

population in Iringa and the areas have experienced coenurosis for a number of years (Miran *et al.* , 2015). The district council extends between 7º 00′ and 8º 30′ latitude south of the equator and 34º 00′ and 37º 00′ longitudes east of the Greenwich. The district borders Mpwapwa district (Dodoma Region) to the North, Kilolo District to the North East, Mufindi District to the South, Chunya District (Mbeya Region) to the West and Manyoni District (Singida Region) to the North West (Figure 1). The district has been classified into two Agro-ecological Zones, namely; Midland Zone and Lowland Zone. The midland zone is characterized by an undulated topography with scattered mountain hills and plateau at an altitude of 1,200 m and 1,600 m above the sea level. The District experiences moderates mean rainfalls, ranging from 600 mm and 1,000 mm annually with mean temperature being 15˚C- 20˚C. The lowland zone lies between altitudes 900 and 1,200 meters above the sea level. It is semi-arid or commonly known as the marginal area, due to low mean rainfalls which range from 500mm- 600mm and relatively hot with temperatures ranging between 20˚C- 25˚C of which the higher temperature are experienced from September to October.

The approximate total number of sheep and goats are 106,330 and 45,625 respectively, with huge population being at lower zone.

Eight villages (two from each of the wards) were randomly selected by paper and hat method, list includes the following: Kising'a, Ilambilole, Ilolompya, Mkombilenga, Malinzanga, Mafuruto, Igangidung`u and Kihanga. Households of sheep and goat keepers were also randomly selected in the selected villages to make a sample of 267 participants based on the formula $n = 1 .96^2 P(1-P)/d^2$ (Thrusfield, 2007) and expected average prevalence of 22.5% (Hughes *et al.*, 2019). Random selection of participants was done in collaboration with livestock officers and village and hamlet leaders and each village had a share of at least 33 willing participants.

Data type and collection

Face to face interview with household representatives and observation by researchers were key data collection methods. Semi-structured questionnaire was

used to collect information from respondents on socio-demographic factors, flock composition and management, animal health management, knowledge on coenurosis, experience and control of coenurosis. The questions were complemented by observation of the animals, environment and practices

Data analysis

Data were descriptively analyzed by means, frequencies and proportions (percentages). Knowledge assessment was done by using index summated scale. Each of the questions on definition, causative agent, host range, transmission, clinical signs, postmortem findings, diagnosis, dog involvement and control, were assigned one score for correct answer and zero for wrong or "I do not know" answer. Knowledge was analyzed under two segments; i) infection cycle and control, which had a total of 5 score points, sought answers about the etiology, mode of transmission and control and ii) coenurosis detection, which had a total of 4 score points, sought answers about host range, manifestation and diagnosis The sum of the scores were categorized into i) no knowledge for zero score, ii) low knowledge for 1 to 4 scores, iii) moderate knowledge for score of five and high knowledge for scores greater than five. For coping strategies, practices reported by respondent were enumerated into category frequencies

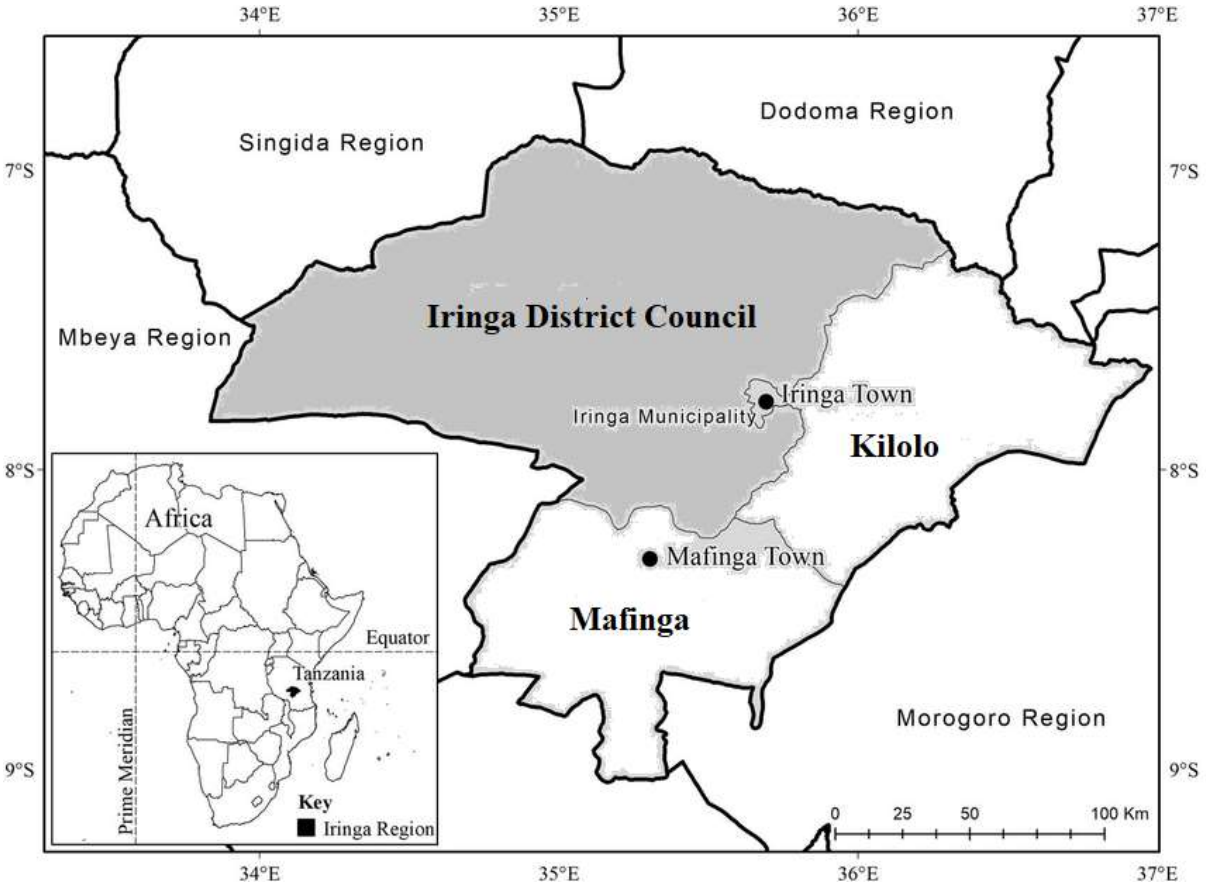

Figure 1: A map of Iringa district council, the study area shown in gray (modified from Karin Lindsjö (2018))

RESULTS

Socio-demographic characteristics of the study participants, animal management and use

Of the 267 study participants, 93% were males. The youngest participant was 20 years old while the oldest was 72 years, and the average age was 40.1±13.7 years. Among them, 31% had no formal education, while 55.2% had primary school education, 6.9% had secondary school education and 6.9% had adult education. About 83% of participants were agro-pastoralists and the rest were purely pastoralists; 96.6% practices communal grazing by mixing different flocks, whereas, 3.4% grazed animals in their own pastures separately. All 267 participants kept goats, while 48.3% kept cattle, goats and sheep, 41.4% kept cattle and goats, and 6.9% kept goats alone. The average number of cattle, goats, sheep and dogs kept were 62.4, 71.9, 16.5 and 3.2 respectively About 93% of participants kept dogs and allowed them go around with grazing livestock. A total of 82.8% of participants have never dewormed their dogs and 75.9% never vaccinated their dogs against rabies. The participants reported that they kept livestock for food (milk and meat), manure, income for household supplies, dowry, draught power, trade and capital.

Experience and impact of coenurosis

Among the problems of livestock keeping in Iringa district, diseases were the most frequent mentioned. Coenurosis, CCPP, CBPP, FMD and LSD made the list. Other problems were lack of grazing land or pasture and water for animals. Out of 267 respondents, 222 (83.1%) experienced at least one case of coenurosis in the last 12 months. Loss of animals due to death, decreased weight gain, low market price, and emergence culling by slaughter or sell were common reported consequences of coenurosis.

Knowledge about coenurosis

Out of 267 respondents, 96.6 % were able to correctly define, mention susceptible livestock species and describe clinical signs of coenurosis. About 93% of respondents gave correct procedure for diagnosis of coenurosis while 69% gave correct description postmortem picture of the head of clinical coenurosis cases. None of the respondents was able to state the correct etiology, transmission mode, including involvement of dogs, and control of coenurosis. The average knowledge score on coenurosis detection (definition, host range, clinical signs, and diagnosis, including postmortem results) was 4.52 out of 5 scores (90.3%). On the other hand, knowledge on infection cycle and control was zero, implying that respondents had completely no knowledge about etiology, mode of transmission and control of coenurosis. The overall average knowledge score (coenurosis detection and infection cycle and control) was 4.52 out of 9 (50.19%). For these scores, 3.4%, 27.6% and 69% of respondents had no, low and moderate knowledge about coenurosis respectively, while none of them had high knowledge.

Coenurosis control practices

Based on official record, there is no government or NGO lead coenurosis control program in Iringa district. Therefore, Livestock keepers take their own initiatives to overcome cerebral coenurosis in sheep and goats. Different practices are implemented as coenurosis control measures, which can be grouped as those aimed at; i) treating sick animals, ii) preventing transmission to healthy animals, and iii) reduce loss due to weight loss or death. As part of animal treatment, livestock keepers use antibiotics such as oxytetracycline, tylosine and local herbs to inject or drench sick sheep and goats. They also burn the fore part of the head of the sick goat or sheep by a hot iron in belief that the animals will recover from coenurosis. Early culling through sell of animals at reduced price or slaughter was reported to be practices which prevent spread of the disease within the flocks and reduce loss through emaciation or death of animals. Smear of pain relief ointment on the head was also reported by respondents. However, other livestock keepers let nature to take its course by doing nothing and hoping survivors will be immune.

A total of 391 responses on control of coenurosis was reported, either as single or a combination of practices. Treatment with antibiotics, sell and slaughter of goats or sheep were the most popular practice (approximately 21% each) followed by head heating (16.4%) and doing nothing (11.8%) (Table 1). The most popular control practice combination was OTC injection and head heating. However, all livestock keepers admitted that none of the practices cured the sick animals or prevented the transmission within and between flocks.

Table 1: Coenurosis control practices by pastoral community in Iringa

Coenurosis control procedure	Frequency	Percentage
Antibiotic injection (Oxytetracycline or Tylosine)	85	21.7
Sell	85	21.7
Slaughter	82	21.0
Head heating	64	16.4
Do nothing	46	11.8
Local herb drench	19	4.9
Ointment smear on head	10	2.5
TOTAL	391	100

DISCUSSION

The present study has found low level of general knowledge of livestock keepers equally across the study areas in Iringa district on cerebral coenurosis in sheep and goats. Similar low knowledge levels have been reported in Arusha region (Miran *et al.* , 2015; Swai *et al.* , 2016; Hughes *et al.* , 2019), where livestock keepers did not know the causes and transmission mode of cerebral coenurosis. However, these studies reported the general knowledge, whereas the present study, which was conducted in a different area, has also reported the knowledge index. Collectively, these reports show that livestock keepers are aware of the disease manifestation but are less informed about the disease cause, transmission and control. Moreover, reports from different areas suggest that coenurosis is an endemic and wide spread disease in Tanzania and Africa (Sharma and Chauhan, 2006; Miran *et al.*, 2015; Hughes *et al.* , 2019).

The knowledge assessment in this study was broken into disease infection cycle and control as one section and detection knowledge as another. There is a relationship between knowledge on infection cycle and control strategies. The aim was to identify exact areas of weakness along the knowledge spectrum, and this study has revealed obvious knowledge deficit on infection cycle and control than in disease detection. The reason for high knowledge on detection of cerebral coenurosis could be its dependence on clinical and postmortem features which are visible by naked eyes. Livestock keepers could see and describe proprioceptive deficits characterized by, loss of agility balance and coordination (Hughes *et al.* , 2019). Uncoordinated movement and circling have led to the disease name “ormilo” in Maasai or “kizunguzungu” in Swahili, which means “dizziness”. Fluid-filled cysts in brain or spinal cord can easily be seen by naked eyes during postmortem inspection, and thus, making diagnosis possible. On the other hand, complete lack of knowledge on infection cycle could be due to the need for training.

When livestock keepers are aware of what the cause of the disease is and how it is transmitted, it may be easy for them to embark on appropriate practices to break the transmission cycle. There are examples of other diseases where community health education has led to improved knowledge

and decrease in disease burden in intervention groups in contrast non-intervention control groups. For instance, in a health-education intervention trial to reduce porcine cysticercosis in Mbulu district, Tanzania, knowledge was improved by >42% with corresponding reduction in consumption of infected pork by 20% and a decrease in porcine cysticercosis (incidence rate ratio 0.57) (Ngowi *et al.* , 2008). Another study in the same area (Mbulu) on *Taenia solium* cysticercosis and taeniasis, a health education intervention package to school children resulted in 10% improvement in knowledge about taeniasis, porcine cysticercosis, human cysticercosis and epilepsy (Mwidunda *et al.* , 2015). Likewise, another community-based educational program in Burkina Faso resulted into a decrease in cumulative incidence of active cysticercosis (cumulative incidence ratio 0.65) and a decrease in prevalence of active cysticercosis after intervention (prevalence ratio 0.84) (Carabin *et al.* , 2018). When there is lack of knowledge and absence of informed research-based control program, livestock keepers opted for their own control measures. As result, some of the practices were not related to control of cerebral coenurosis, while some facilitated the transmission process (Miran *et al.* , 2015; Hughes *et al.* , 2019). For instance, applying heat on the head of a sick animal can not kill the larvae of *Taenia multiceps* in the head of the animal, or taking non-dewormed dogs with small ruminants to pasture and giving head of sheep or goat with coenurosis to dogs facilitate the transmission. Education to livestock keepers at community level may lead to feasible and sustainable control of coenurosis.

The present study reports that there was no formal cerebral coenurosis control program in Iringa district and livestock keepers take their own initiatives to overcome the repercussions of the disease. Some of these initiatives include treatment of sick animals with antibiotics or local herbs, or application of heat on the head of sick animals and none of these practices have succeeded in combating the disease, the same as what has been reported in Ngorongoro district, Tanzania (Miran and Makundi , 2017) . Unknowingly, some practices by livestock keepers which are not related to control of coenurosis may lead to perpetuation of transmission of coenurosis. For instance, feeding dogs with head of infected sheep and goats, taking dogs to grazing areas and not deworming dogs, can facilitated the transmission of coenurosis and consequent endemicity (Miran *et al.* , 2015; Hughes *et al.* , 2019). And since, all livestock keepers experienced non-rewarding outcome from treatment and control practices, they opted for alternative practices which minimized the total loss. This may be the reason for comparatively higher proportions (42.7%) of coping practices which aimed at reducing losses, that is sell and slaughter of sick animals, suggestion that this was the common last resort

Cerebral coenurosis in sheep and goats is common in Iringa district. The pastoral community is well informed about features for detection but had low knowledge on the cause, transmission and control of cerebral coenurosis. As a result, they implemented practices which were either risk factors or not related to coenurosis control. This calls for community education prior to participatory coenurosis control programme.

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