

The Prevalence of Porcine Cysticercosis and Risk Factors for Taeniasis in Iringa Rural District

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Abstract: The present study aimed at determining the prevalence of porcine cysticercosis and associated risk factors for taeniasis in Iringa rural. A total of 110 households rearing pigs from sixteen villages were involved in a survey in which 308 pigs were examined for *Cysticercus* cysts by antemortem and postmortem methods. The risk factors for taeniasis were assessed and evaluated through questionnaires, interviews and by direct observation. Of 308 pigs examined by lingual palpation, 23 (7.5%, $p < 0.001$) had cysticerci; the prevalence rates was higher in male pigs than female 16 (69.5%) and 7 (30.4%), respectively. Likewise the prevalence was higher in villages away from the main roads where there were pigs that customarily ran loose or fed human faeces. The triceps muscle had the highest number of cysts 44 (51.1%) and the diaphragm had the lowest 6 (6.9%). Of 4020 people who sought for treatment in five wards per month, 155 (21.8%) had history of intestinal worms, 6 (2.2%) consumed uninspected pork from peoples house, 82 (74.5%) lack tap water, 13 (12%) had no toilets and 40 (22.7%) practiced free range pig husbandry or tethering method. The findings from this study identified community behavioral, household hygiene and environmental practices that should be modified to prevent continued transmission of cysticercosis and taeniasis in Iringa rural district.

Keywords: Behavior, cysticercosis, pig husbandry, taenia solium

INTRODUCTION

Porcine cysticercosis is due to the establishment of the larva stage of *Taenia solium* in different parts of the body (Flisser *et al.*, 2006). It is acquired by ingestion of eggs released by human tapeworm carriers (Ngowi *et al.*, 2007). In endemic areas, *T. solium* infection is associated with poverty, absence of latrines and free access by scavenging pigs to human faeces on the environment (Moses *et al.*, 2010). Lingual palpation is the preferred and simple method of examination of cysts in live pigs (Boa *et al.*, 1995; Praet *et al.*, 2009). However, the method has high specificity but low sensitivity, thus likely to detect only heavily infected pigs (Secka *et al.*, 2008).

The prevalence of porcine cysticercosis is reported to vary from one region to another (Ngowi *et al.*, 2004). However, in Western and Central Africa the true prevalence of *T. solium* cysticercosis in pigs remains underestimated because of unreliable slaughterhouse data (Zoli *et al.*, 2003). In Tanzania, the documentation of the disease is still scanty with available reports only from three districts namely; Mbulu District where the prevalence was 17.4% (Ngowi *et al.*, 2007), Iringa rural and Mbinga district, with a prevalence of 8.4 and 16.9%, respectively (Boa *et al.*, 2006).

Eradication of the parasite is possible by getting rid of the reservoirs of *T. solium* from the food chain (Sarti *et al.*, 1992; Lescano *et al.*, 2007). This can only be achieved through effective postmortem pork inspection (Gonzalez *et al.*, 1996; Mafojane *et al.*, 2003), good sanitation and enclosed pig keeping systems (Food and Agricultural Organization, 1994; Verastegui *et al.*, 2003). Unfortunately, the behavior of consuming infected and undercooked pork promotes the existence of porcine cysticercosis and taeniasis in communities where traditional pig husbandry is practiced (Secka *et al.*, 2008). Furthermore, the environmental sanitation and hygiene practices are inadequate, thus people are still at risk of acquiring infection. Therefore, the goal of the present study was to determine the current prevalence of porcine cysticercosis and associated risk factors for taeniasis in Iringa rural district.

MATERIALS AND METHODS

The study area: The study was carried out in sixteen villages within ten wards of Iringa rural district in the Southern Highlands of Tanzania (Fig. 1). The district lies at 1600-2700 m above sea level, with an area of

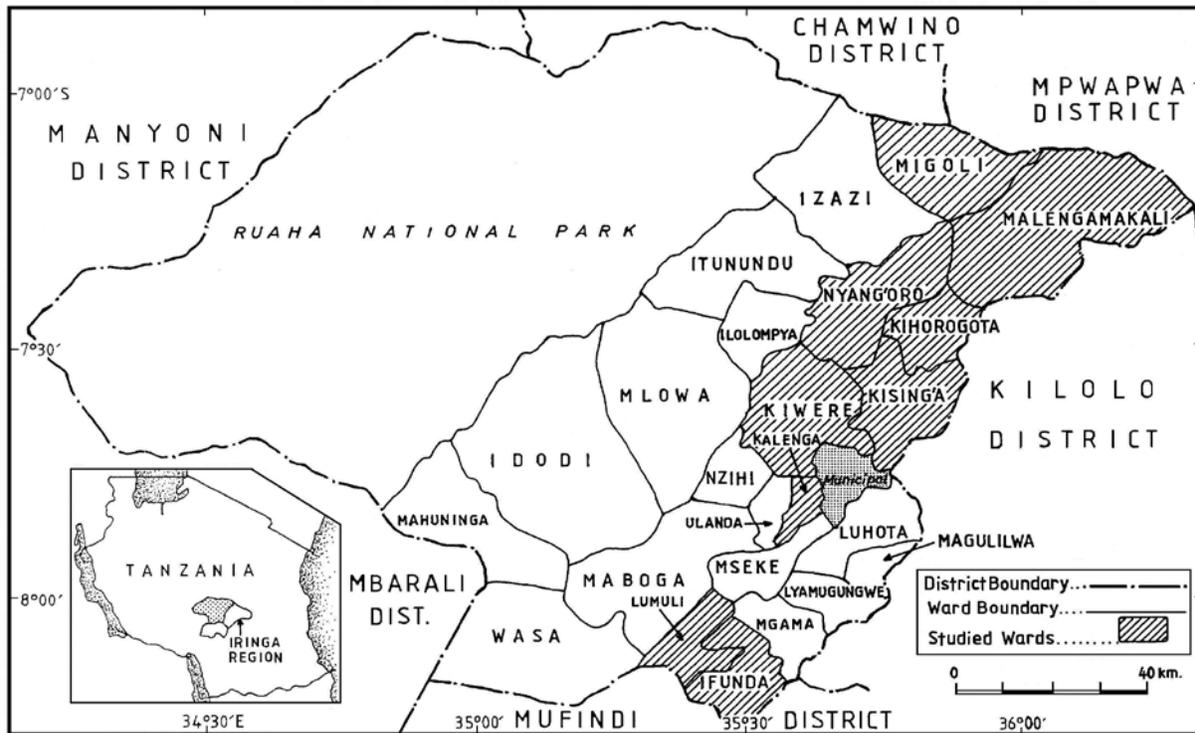
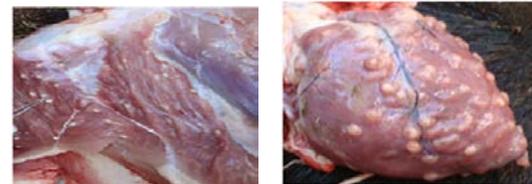


Fig. 1: Iringa rural district showing the studied wards

20,576 km² and an estimated population of 245,625 people. Average temperatures are normally below 15°C with rainfall ranging between 1000 mm to 1600 mm per annum falling in a single season from November to May. The dry and cold season occurs after the rain season and lasts from June to September.

Study design and population: The survey was carried out in selected villages from July to August 2012. The households with pigs were randomly selected to participate in the study. The infection in pig was inspected by lingual palpation and confirmed through postmortem examination. The questionnaire and interviews were used to collect data on risk factors for taeniosis, which was verified via direct observation.

Sample size estimation: The sample size estimation was calculated using the equation: $n = Z^2PQ/L^2$ (Ngowi *et al.*, 2004) where: n is the number of pigs, Z is the score for a given confidence interval, P is a known estimated prevalence, Q = (1-P) and L is the permissible error of estimation. In this study the desired confidence interval was 95% with the permissible error of an estimation of 0.05% and P was estimated at 8.4%. Therefore $n = 1.96^2 \times 0.084 \times 0.916 / 0.05^2 = 118$. In order to maximize the number of pigs sampled, the sample size was then multiplied by 1.5 or $150/100 \times 118 = 177$. Using simple random sampling method a total of 308 pigs were selected and examined and 110 households were selected for assessment of risk factors for taeniosis.



Live cysts in pork

Cysticercosis affected heart

Fig. 2: *Taenia solium* cysts in muscles and heart of an infected pig

Data collection:

Prevalence of porcine cysticercosis: The prevalence of porcine cysticercosis was determined by lingual palpation. Pigs were restrained using a hog catcher. The mouth was gagged with a wooden bar twisted across the upper and lower jaws, the tongue pulled out with an aid of forceps covered with piece of cotton clothes and examined for the presence of *T. solium* cysts on the entire ventral surface (Moses *et al.*, 2010). Those found positive by the lingual method were sacrificed and further examined for the presence of cysts in different predilection sites including the cardiac muscle, the quadriceps muscles, lingual muscle and diaphragm. The live cysts were identified as fluid-filled and translucent in different parts of the body (Fig. 2). The pigs examined were categorized into two groups, those with less than six months were categorized as piglets and more than six months were considered as mature pigs.

Table 1: Prevalence of *T. solium* cysticercus in pigs per wards in Iringa rural

Wards	Households surveyed (%)	Pigs examined (%)	Infected pigs (%)
Ifunda	22 (20)	83 (26.9)	12 (52.2)
Lumuli	06 (5.5)	12 (3.9)	00 (0)
Malengamakali	29 (26.4)	80 (25.9)	11 (47.8)
Nzihi	10 (9.1)	29 (9.4)	00 (0)
Kising'a	06 (5.5)	17 (5.5)	00 (0)
Kihorogota	05 (4.5)	08 (2.6)	00 (0)
Nyang'oro	15 (13.6)	36 (11.7)	00 (0)
Kiwere	17 (15.5)	43 (13.9)	00 (0)
Total	110 (100)	308 (100)	23 (100)

Table 2: Prevalence of *T. solium* cysticercus cysts in pigs by age and sex (n = 308)

(Months)	Number of pigs examined		Number of infected pigs (%)		Total positive (%)
	Female	Male	Female	Male	
<6	24	32	02 (28.6)	07 (43.7)	09 (39.1)
06<	156	96	05 (71.4)	09 (56.3)	14 (60.9)
Total	180	128	07 (100)	16 (100)	23 (100)

The risk factors for taeniosis in Iringa rural: To determine the risk factors for taeniosis a survey was conducted through questionnaires, interviews and direct observations. The structured interview comprised questions that aimed to collect information on availability of pigpen, presence and utilization of toilet, water supply, presence of bushes around houses, boiling drinking water and the distance of the pigpen from the toilet.

Statistical analysis: The statistical package for social sciences version 19.0 for windows (SPSS Inc., Chicago, IL, USA) was used for data analysis. A univariate analysis was performed by calculating the Odds Ratios (OR) and 95% confidence intervals for various factors at the individual level. The significance of the variables in the study was done by one way Analysis of Variance (ANOVA). During data analysis, categorical variables were analyzed using a chi-squared test, p-values of less than or equal to 0.05 was considered statistically significant.

RESULTS

Prevalence of porcine cysticercosis: A total of 110 households rearing pigs were surveyed and 308 pigs were examined. The number of households surveyed and pigs examined per village varied depending on the availability of pigs in wards and villages. Malengamakali had the highest number of households surveyed 29 (26.4%) and kihorogota the lowest 05 (4.5%). Ifunda had the highest number of pigs examined 83 (26.9%) and kihorogota again the lowest 08 (2.6%). The prevalence of PCC was higher in Ifunda ward 12 (52.2%) than in Malengamakali 11 (47.8%) though the difference was statistically insignificant (Table 1). About 180 (58.4%) of the examined pigs were females and 128 (41.5%) were males (p<0.05). Additionally, 56 (18.2%) were piglets and 252 (81.8%) were mature. The prevalence of PCC was higher in males than in female pigs 16 (69.5%) and 7 (30.5%),

Table 3: Identified risk factors for human taeniosis (n = 110)

Variables	Responses (%)
Households without tap water	82(74.5)
Households not boiling drinking water	98(89)
Households with poorly constructed toilet	97(88)
Households without toilet	13(11.9)
Households without pigpen	40(22.7)
Pigpen near toilet	11(10)
Households surrounded by bushes	26(23.7)

Table 4: The prevalence of intestinal worms (data pooled) as determined from dispensary records by wards

Wards	No. Sick people/month	Prevalence of IW (%)
Mfyome	750	25 (16.1)
Kising'a	750	22 (14.2)
Malengamakali	810	60(38.7)
Ifunda	1,710	48 (31)

respectively. Likewise the prevalence of PCC was higher in mature pigs 14 (60.9%) than in piglets 9 (39.1%) (Table 2).

Risk factors for taeniosis: The risk factors for taeniosis were assessed through interview and direct observation and a total of 110 households were surveyed. The results shows that 82 (74.5%) of the surveyed households had no access to tap water. 98 (89%) do not boil drinking water, 13 (12%) had no toilets at all, 88% had toilets many of which were poorly constructed and maintained. 22.7% of the available pigs foraged freely or were tethered. About 24% of the 110 surveyed households were surrounded by bushes (Table 3).

An average of 155 (21.8%) of all people visiting dispensaries per month were affected with intestinal worms including; round, tape, thread and hookworms. The average number of people that sought treatment at dispensaries varied from ward to ward; the highest and lowest was 1710 and 750, respectively. The prevalence of people affected by intestinal worms (IW) varied from one place to another and the highest was found at Malengamakali 60 (10.9%) and Ifunda had the lowest 8 (1.1%) (Table 4).

DISCUSSION

A total of 308 pigs were examined for *T. solium* cysticercosis in sixteen villages of Iringa rural. The results indicate that more female pigs were available in the studied area possibly due to being reserved for breeding purpose, whereas males were frequently sold to meet economic needs of the family. The prevalence of cysticercosis in the area was found to be 7.5% (23) less than 8.4% previously reported by Boa *et al.* (2006). This decrease in the current survey indicates a raise in awareness to pig farmers and a relative decline in the risk factors as outlined elsewhere in this study.

The lingual palpation method though with high specificity, is less sensitive and thus capable of detecting *T. solium* cysts in heavily infected pigs and slightly infected pigs can go unnoticed (Secka *et al.*, 2008). The method is encouraged when rapid indication of presence of *T. solium* cysticercosis in live pigs is required. In this study, few pigs were further sacrificed for evidence of cysts in different parts (Table 3) and the infected pork was discarded thereafter in accordance to standard meat inspection regulation. Postmortem method enables the detailed examination in different predilection sites that could not be examined in the course of lingual examination. Therefore, using postmortem methods and other techniques like Ag-ELISA the prevalence of porcine cysticercosis in Iringa rural could be higher than that obtained in this study (Pondja *et al.*, 2010).

Prevalence of *T. solium* cysticercosis was high in male pigs than female pigs though the difference was statistically insignificant. The reason was male pigs tend to move out of piggens much more frequently to roam around and could therefore easily encounter the risks for being infected. Piglets consisted of growers and needed high nutritional feed for rapid growth. Consequently, piglets scavenge more than mature, thus infection could easily occur in piglets compared to mature pigs as previously observed by Moses *et al.* (2010). Therefore, infection in piglets could lead into high prevalence in mature pigs henceforth, to prevent *T. solium* infection confining pig is necessary from the beginning (piglets).

The prevalence of PCC and taeniosis was reported to be high in areas where free range pig keeping is practiced and sanitation is inadequate (Ngowi *et al.*, 2004). The same was observed in this study, as areas with high prevalence of PCC were those where free range pig keeping and tethering methods are practiced. Furthermore, these are the villages located far away from the main roads, inaccessible to veterinary services and bylaws are not reinforced. Therefore confined pigs were found in villages nearby the main roads and where people cultivate food crops to prevent crops destruction and conflict with neighbours.

The presence of risk factors in a particular area may cause environmental contamination with parasites

that put people at risk of acquiring diseases (Acka *et al.*, 2010). The absence or poorly constructed pit latrines and presence of bushes in some villages of the study area cause people to defecate on the open ground and thus human faeces contaminate the environment. If these individuals are infected by taeniosis, which is more probable, *Taenia* eggs are likely to spread to water wells and streams commonly used by human and livestock. Consequently, PCC/*Taeniosis* infection cycle is maintained in these communities as observed in this study, particularly in remote villages of Malengamakali. In addition, the behavior of consuming uninspected pork and unhygienic environmental sanitation poses another serious public health risks and provides the perfect conditions for maintenance of *T. solium* cysticercosis and taeniosis in Iringa rural district.

Moreover, strict meat hygiene and sanitation are vital in the removal of *T. solium* in the food chain (Mafojane *et al.*, 2003). Unfortunately, lack of human resources and facilities to support veterinary services in some of the studied villages make this requirement nearly to impossible. The paravets are not provided with transport to enable them commute from one village to another. Absence of telephone network which could facilitate communication in case of need for meat inspection services is another problem in Iringa rural areas. As a result people slaughter and eat uninspected pork which results into spread and maintenance of the *T. solium* parasite in these remote villages.

Another behaviour that is widely spread in both rural and urban areas is that of consuming pork as a delicacy along with alcohol drinking. The fried pork which is often undercooked is mostly consumed in local bars with further possibilities of maintaining taeniosis infection in the community (Maridadi *et al.*, 2011). Consumption of undercooked meat could be due to drunkenness that may erode people's patience to wait for the meat to be well cooked. Or else this might be due to high demand of pork at a given time and insufficiency of cooking facilities and hence meat is saved undercooked. *T. solium* cysticerci to be killed the carcasses should be boiled at 60°C throughout for 30 min (WHO, 2010). Nevertheless, the possibility of maintaining such heat and the specified time in villages and local bars is relatively difficult.

CONCLUSION

Taenia solium porcine cysticercosis was investigated in this study and the results revealed that PCC is slightly lower than it used to be in Iringa rural district. Such prevalence, however lower is an indication that the area is still at risk. The existence of *T. solium* cysticercosis is promoted by unhygienic condition, tethering and free range pig husbandry and poor pit latrines utility in the studied villages. Meat inspection is essential for the removal of *T. solium* in

food chain but this is not frequently practiced in remote areas of Iringa rural district.

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