

Original Article

An epidemiological survey of the magnitude and local perceptions of porcine cysticercosis by two methods in Nyaruguru district, Rwanda

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ABSTRACT

This study investigated the magnitude of porcine cysticercosis (PC), its risk factors, economic effects and the perceptions of 80 pig farmers from Nyabimata (n = 38) and Muganza (n = 42) and 20 registered butchers in the Nyaruguru district of Rwanda. January to December 2013 slaughter records from Kamirabagenzi market were also analysed for PC diagnoses based on the tongue test and meat inspection. During this period, the responding farmers' records showed a tongue test-based PC magnitude (3.9%, n = 984) which was lower than the collective tongue test-based PC magnitude of 9.2% (n = 1720) at Kamirabagenzi (p < .05). The overall magnitude of PC based on routine meat inspection diagnosis at Kamirabagenzi was 4%. The overall magnitude of PC for respondents using Free-range production systems (7.9%) was significantly greater than for those in Semi-intensive (2.1%) and Intensive production systems (1.5%) (p < .05). Though most farmers (90%) knew that PC is zoonotic, only 22.5% of the farmers opted for treatment of PC-infected pigs and 52.5% were willing to seek veterinary inspection while the rest (25%) opted to circumvent veterinary inspection (P > .05). Most butchers (70%) indicated they would circumvent veterinary inspection and continue to slaughter PC-positive animals whilst the rest (30%) indicated they would resell PC positive animals to defray costs (P < .05). The low sensitivity and specificity of methods used for PC detection in the study, implies that this may just be the tip of an iceberg and the actual magnitude is most likely to be much higher. In conclusion, PC is endemic in the Nyaruguru district of Rwanda with a high proportion of positive animals. The condition has public health implications and is worsening the economic plight of the impoverished Nyaruguru community.

1. Introduction

Pig production in Rwanda is largely subsistent but holds much promise (Mbuza et al., 2016). From 2000 to 2011 pork production in Rwanda has increased by 7.8% (FAO, 2014). However, increased production is seriously curtailed by factors such as feed shortage, poor genetics and the burden of diseases (Habarugira et al., 2016; Habarugira et al., 2014; Mushonga et al., 2017; Nzeyimana et al., 2015). Due to their high fecundity, a short generation interval and the possibility of large numbers being raised in a limited space, pigs have a great potential of contributing towards economic gain (Kohli et al., 2017; Mushonga et al., 2017).

Cysticercosis is one of the diseases that affect pig production and has

major public health implications as a zoonosis (Johansen et al., 2017; Nsadhya et al., 2014). *Taenia solium*, a cestode, and the causative agent for PC, has a complex two-host life cycle (Flisser et al., 2003). Pigs act as normal intermediate hosts while humans act as both aberrant intermediate hosts, harbouring the immature or larval stages (García et al., 2003; Mittal et al., 2008), as well as obligate definitive hosts harbouring the adult tapeworm in the small intestine (Garcia et al., 2014; Lightowers et al., 2015).

Taenia solium is endemic in the developing world including Latin America, Asia and sub-Saharan Africa and has recently been classified as a re-emerging infection in the developed world due to immigration of human tapeworm carriers from poor endemic regions of the world (Flisser et al., 2003; Garcia et al., 2014; Pondja et al., 2015; Pray et al.,

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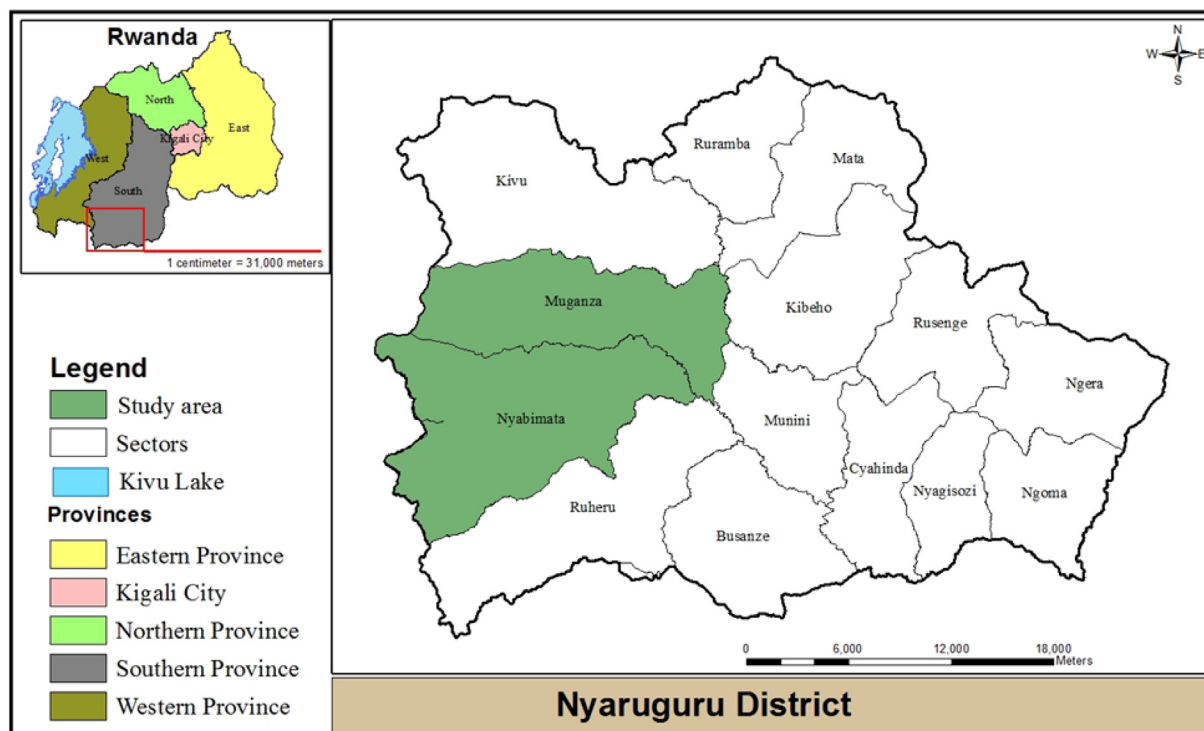


Fig. 1. Map of Nyaruguru district of Rwanda showing the study area (Map courtesy Itegere Basile: ArcMap 10.2).

2016; Trevisan et al., 2017).

Infection of humans with adult tapeworms (*Taenia solium*) is referred to as taeniasis and results from the ingestion of poorly cooked pork infected with viable cysticerci (Yamasaki et al., 2004). Cysticercosis is a condition that occurs in both pigs and humans. Infection of pigs occurs after ingestion of eggs of the tapeworm from faeces on pasture, contaminated water and other feed sources. In pigs the condition usually presents as an asymptomatic (especially in muscle) infection. Ingested eggs hatch in the host's intestines and release oncospheres, which penetrate the intestinal wall to travel through the bloodstream to striated muscles and sometimes to the brain, eyes, skin and other organs, where they develop into space occupying cysts known as cysticerci or bladder worms.

In humans, cysticercosis causes clinical signs depending on the number and location of cysts. The medical significance of PC is realised when a human accidentally ingests food contaminated with tapeworm eggs (Lightowlers and Donadeu, 2017). Cysticerci typically cause little or no observable clinical signs in pigs (Prasad et al., 2006).

PC causes economic losses as a result of condemnation of carcass parts, cost of treatment of the pigs, cost of treatment of humans for taeniasis/cysticercosis (Madinga et al., 2017) and the cost of freezing infected meat. It has been estimated that farmers lose 50–100% of the value of the animals when these are infected with PC (Trevisan et al., 2017).

Important risk factors for porcine cysticercosis include extensive production systems (in which pigs have access to human faeces on pasture), lack of or unwillingness to use latrines, open water sources (Mwanjali et al., 2013; Rottbeck et al., 2013), lack of or poor pig slaughter facilities (Krecek et al., 2012; Nsadha et al., 2014; Pondja et al., 2015; Trevisan et al., 2017) and lack of knowledge about transmission dynamics of the disease (Kungu et al., 2017). Other factors include presence of *T. solium* carriers in the vicinity (Pray et al., 2016) and the breed of pigs (Krecek et al., 2012). Previous studies have demonstrated that communal farmers have limited knowledge about the dangers of cysticercosis (Kungu et al., 2017).

The gold standard for diagnosis of PC is carcass dissection (Flecker

et al., 2017; Lightowlers et al., 2015). Other PC diagnostic methods include routine necropsy (Carabin et al., 2017; Lightowlers et al., 2015; Singh et al., 2013), and routine post mortem meat inspection (Akoko et al., 2016). Tongue palpation is an accepted ante-mortem diagnostic technique in pigs (Alarakol et al., 2017; Braae et al., 2016; Guyatt and Fèvre, 2016; Komba et al., 2013; Krecek et al., 2012). Although examination of the tongue is an old technique with a wide-ranging sensitivity of 16% to 70% (Gonzalez et al., 1990; Lightowlers et al., 2015; Phiri et al., 2003), recent publications recommend it as an appropriate epidemiological tool when economics and the data that can be obtained are taken into consideration (Alarakol et al., 2017; Guyatt and Fèvre, 2016). The technique is cheap, rapid and simple and can be used by farmers, butchers and veterinarians alike (Guyatt and Fèvre, 2016).

Available prevalence figures for Porcine cysticercosis (PC) in the East African region (Kenya, Uganda and Tanzania) vary widely between 8.5 and 32% using various serological tests and; between 5.6 and 32% (Nsadha et al., 2014) with lingual examination test (Komba et al., 2013; Trevisan et al., 2017). Lightowlers et al. (2016) suggested that serological tests for PC are seriously flawed and therefore, in recent times, some workers have tended to disregard them.

The current study was conducted to establish the magnitude of porcine cysticercosis (PC) in two sectors of Nyaruguru district using routine post mortem and tongue examination methods. The study further aimed to determine the risk factors associated with PC and to draw inferences about the potential risk for human health and to determine the economic impact of PC in the two sectors of Nyaruguru district, Rwanda. Considering our less than perfect diagnostic methods, we have taken the conscious decision to deliberately restrict ourselves to the term “magnitude” rather than prevalence in this study.

2. Material studied, area description, methods and techniques

2.1. Area description

Nyaruguru District is one of the eight districts in the Southern Province of Rwanda and has a total surface area of 1010 km². It is

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