PORCINE CYSTICERCOSIS RISKS: AWARENESS, ATTITUDES AND PERCEPTIONS ON SAFETY PRACTICES AMONG FARMERS, BUTCHER-OWNERS AND CONSUMERS IN WESTERN KENYA

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Abstract

Background: The demand for pork is increasing in Africa with the increasing need for animal protein in the household diets. But pork safety and quality remains a pervasive concern that needs intervention to assure consumers of protection from Porcine Cysticercosis (PC) contamination. This study assessed among farmers, butcher-owners and consumers in Western Kenya about their awareness, attitudes and perceptions about safety practices regarding risk of PC.

Materials and Methods: Data were obtained using structured questionnaires in cross-sectional survey interviews with 162 farmers, 26 butcher-owners and 92 consumers from Busia and Kakamega Counties. The data were in binary response, so were analyzed with Chi-square test.

Results: Only two in ten farmers had knowledge of Taenia solium parasite (24.1%), risk factors in PC transmission (21.6%) and could associate pig management system with PC (17.3%). A larger proportion (p<0.01) of the butcher owners perceived pork from slaughter slabs (76.9%) and home slaughters (73.1%) as presenting high risks but considered pork from the butcheries (69.1%) and eateries (61.5%) as presenting no risks. Among the consumers, majority strongly agreed (p<0.05) that pork in the market (85.9%), from slaughter slabs (92.4%) and butchery (81.5%) was safe but a larger proportion strongly disagreed that pork from the eateries expose them to cysticercosis (64.1%).

Conclusion: The awareness about risks of PC was low among farmers. Butcher-owners and consumers perceived pork safety differently along the value chain. Strengthening public education about PC risks and pork safety among all actors in the pork value chain in Western Kenya is recommended.

Keywords: Pork; quality; safety; T. solium; porcine cysticercosis; value chain actors

Introduction

The pork industry in Kenya is growing and is differentiated into specialized business units along the value, consisting of feed millers, producers, abattoirs, processors and retailers. The pork value chain is organized in a way
that live pigs are sold at the farm gate, slaughtered pigs at the abattoirs, pork sold at the butcheries and processed products sold at specialized pork eateries (Levy et al., 2013). In Western Kenya, smallholders dominate pork production but lack access to functionally good pig slaughterhouses to enhance pork safety for consumers (Levy, 2014). Improving pork safety and quality is important for consumers because in the food supply chain, the consumer level of trust depends on safety and quality associated with the product marketed (Taylor et al., 2012).

Rapid growth in pork consumption should contribute (Bett et al., 2012; FAO, 2012) to improved food security and nutrition because pork is rich in protein, Vitamin B12, iron and selenium, Vitamin C, niacin, phosphorus and zinc (USDA, 2018). However, consumption of pork may expose consumers (Davies, 2011) to hazards and risk of Porcine Cysticercosis (PC) *Taenia solium* in pigs, associated with PC, may infest people through food following ingestion of the parasite larval cysts in undercooked and contaminated pork (Saw et al., 2015). Focus on the prevention, control and reduction of the hazard and risk to PC is thus a public health objective (Schär et al., 2014; Inpankaew et al., 2015). The public health objective promotes “one health concept” for PC eradication (WHO/TDR, 2012; Torgerson et al., 2015; Schurer et al., 2016).

Integrating public health education with control strategies could promote effective and sustainable reduction of the risk of PC infestation in humans (O’Neal et al., 2012, Thys et al., 2016). Creating public awareness is an important component of “one health approach” involving human, veterinary, environmental and social sectors. Integrated into ‘One health concept’ is public health education in combination with other control strategies for effective and sustainable eradication of the risk of PC infestation in humans (Ngowi et al., 2008; Sorvillo et al., 2011). Knowledge of awareness, attitudes and perceptions of safety practices among farmers, animal health workers, butcher-owners and consumers in addressing risks of PC infestation is important for the control of *Taenia solium* (GALVmed, 2017; Kungu et al., 2017). This study examined the extent of awareness, attitudes and perceptions on safety practices among farmers, butcher-owners and consumers in Western Kenya on the risk factors for PC.

**Materials and Methods**

Farmers were randomly selected from local villages known for high concentration of pigs, slaughter slabs, pork butcheries and consumers. Structured questionnaires were administered to 280 respondents of which 162 were farmers, 26 were butcher-owners and 92 were consumers. Snowball sampling was adopted for the survey to reach the targeted study population. The questionnaire had binary responses at production, trade and consumer levels. The responses were on demographic characteristics, farmer awareness about pig management, and risk transmission factors for PC. Butcher-owners and consumers were interviewed on attitudes and perceptions on safety practices for pork in the market.

**Statistical analysis**

Data collected was entered in Excel database, and thereafter exported to the Statistical Analysis System version 9.1.3 (SAS, 2006). The analysis was on frequency distribution with Chi-square test statistics to examine the relative differences in awareness, attitudes, and perceptions about safety practices.

**Results**

**Demographic characteristic of respondents.**

Out of the 162 farmers interviewed, 37.7% were aged between 21 and 30 years, 53.1 % were of the female gender, 41.7 % had no formal school education and 77.2% had kept pigs for a period of 6 to 10 years. Among the 26 butcher-owners interviewed, 53.9% were between 11-20 years old, 92.3% were males, and 57.7% had attained primary level education, while 46.2% had 1-5 years of experience in pork butcher trade. Of the 92 consumers interviewed, 48.9% were between 31-40 years of age, 83.7% were females and 46.7% had not acquired formal education.

**Farmer’s awareness of risk of Porcine Cysticercosis**

Table 1 shows the frequency distribution of farmers by their awareness about the pig management systems, *Taenia solium* parasite and the possible risks factors of its transmission. The estimated frequencies among those interviewed showed that only about two-in-ten farmers declared being aware of the link between pig management system and PC compared (p<0.0001) to eight-in-ten (17.3% vs. 82.7%) who declared that they were not aware. Furthermore, results revealed that two-in-ten farmers declared that they were aware of the *Taenia solium* parasite compared (p<0.0001) to eight-in-ten (24.1% vs. 75.9%) who claimed not being aware ($\chi^2$ 43.556, $p$ value 0.0001).
Regarding awareness about risk factors in the transmission of porcine cysticercosis, only two-in-ten farmers were aware compared (p<0.0001) to eight-in-ten (21.6% vs 78.4%) who claimed not being aware.

**Table 1:** Frequency distribution of farmers by their awareness of transmission factors for *T. solium* cysticercosis

| Awareness of: | Response | Frequency | Percent | Chi-Square ($\chi^2$) | P-value |
|---------------|----------|-----------|---------|-----------------------|---------|
| Knowledge about *Taenia solium* parasite | Aware | 39 | 24.1 | 43.5565 | 0.0001 |
| | Not aware | 123 | 75.9 | | |
| Knowledge about the link between pigs management systems and PC | Aware | 28 | 17.3 | 69.3580 | 0.0001 |
| | Not aware | 134 | 82.7 | | |
| Knowledge about risks for PC transmission | Aware | 35 | 21.6 | 52.2469 | 0.0001 |
| | Not aware | 127 | 78.4 | | |

**Butcher-owners and consumers’ attitudes towards safety of pork in the market**

Table 2 presents the frequency distribution of butcher-owners’ attitudes to issues of safety of pork sold at different retail outlets along the value chain. While more (p<0.01) of the butcher owners interviewed had the perception that pork from slaughter slabs and home slaughters has high risks and pork from the butcheries has no risks, they could not (p>0.05) split on the safety of the pork from the eateries. For pork from slaughter slabs, about eight-in-ten of the butcher owners interviewed had the perception that risk was high compared to two-in-ten (76.9% vs. 23.1%) that had the perception that there are no risks. For pork from home slaughters, about seven-in-ten of the butcher owners interviewed had the perception that risk was high compared to three-in-ten (73.1% vs. 26.91%) that had the perception that there were no risks. In contrast, pork from the butcheries had about three-in-ten perceiving that risk was high compared to seven-in-ten (30.8% vs. 69.2%) that had the perception that there were no risks. Though the perception of risk being high or no risk was not statistically different (p>0.05) for pork from the eateries, fewer had the perception that risk is high (38.5% vs. 61.5%).

**Table 2:** Frequency distribution of Butcher-owners’ attitudes to safety of pork at different retail outlets

| Pork sale point | Risk perception | Frequency | Percent | Chi-Square ($\chi^2$) | P-value |
|-----------------|----------------|-----------|---------|-----------------------|---------|
| Home slaughter  | High risk      | 19        | 73.1    | 5.5385                | 0.0186  |
| | No risk        | 7           | 26.9     | | |
| Slaughter Slabs| High risk      | 20        | 76.9    | 7.5385                | 0.0060  |
| | No risk        | 6           | 23.1     | | |
| Butchery        | High risk      | 8         | 30.8    | 3.8462                | 0.0499  |
| | No risk        | 18          | 69.2     | | |
| Eateries        | High risk      | 10        | 38.5    | 1.3846                | 0.2393  |
| | No risk        | 16          | 61.5     | | |

Table 3 presents the frequency distribution of consumer perception to safety of pork in the market in response to whether they strongly agreed or disagreed with the specific statements put to them. More of the consumers interviewed strongly agreed (p<0.05) that pork was generally safe (85.9% vs. 14.1%), that pork from the
slaughter slab was safer than pork from the farm (92.4% vs. 7.6%) and that pork from butcheries is generally safer than pork from the eateries (81.5% vs. 18.5%). However, more of the consumers (p<0.05) interviewed strongly disagreed that pork from the eateries exposed humans to cysticercosis (64.1% vs. 35.9%). On the other hand, consumers could not split (p>0.05) on whether undercooked pork was more likely to transmit cysticercosis to humans and whether they always cooked pork well before eating.

Table 3: Frequency distribution of consumer perception on safety of pork in the market

| Perception                                      | Agreement          | Frequency | Percent | Chi-Square (χ²) | P-value |
|------------------------------------------------|--------------------|-----------|---------|----------------|---------|
| Pork sold is generally safe                     | Strongly agree     | 79        | 85.9    | 47.3478        | 0.0001  |
|                                                 | Strongly disagree  | 13        | 14.1    |                |         |
| I always cook well the pork before eating      | Strongly agree     | 55        | 59.8    | 3.5217         | 0.0606  |
|                                                 | Strongly disagree  | 37        | 40.2    |                |         |
| Undercooked pork is more likely to transmit cysticercosis to human | Strongly agree | 52 | 56.5 | 1.5652 | 0.2109 |
|                                                 | Strongly disagree  | 40        | 43.5    |                |         |
| Pork from the slaughter slab is safer than pork from farm | Strongly agree | 85 | 92.4 | 66.1304 | 0.0001 |
|                                                 | Strongly disagree  | 7         | 7.6     |                |         |
| Pork from butchers is generally safer than pork from the eateries | Strongly agree | 75 | 81.5 | 36.5652 | 0.0001 |
|                                                 | Strongly disagree  | 17        | 18.5    |                |         |
| Pork from the eateries expose human to cysticercosis | Strongly agree | 33 | 35.9 | 7.3478 | 0.0067 |
|                                                 | Strongly disagree  | 59        | 64.1    |                |         |

Discussion

This study investigated awareness, attitudes and perceptions on safety practices among farmers, butcher-owners and consumers about the risk factors for PC in Western Kenya. Results showed only two-in-ten farmers had knowledge of Taenia solium parasite, risk factors in PC transmission and could associate pig management system with PC. These findings differed with those of Adenuga et al., (2018) who found high level of awareness among farmers, with seven-in-ten (70.5%) being aware of porcine cysticercosis and about half (47.8%) knowing about its transmission as a zoonotic disease. Mishra et al., 2007 reported high level of awareness among farmers (59.1%) but with low awareness about pork tapeworm transmission (35.0%). Results of the present study may have differed from those others because it was carried out in the rural area of Western Kenya where pig keeping had become a popular small-holder activity for low-income families where over half (57.6%) lived in poverty. These resource-poor families engage in pig production using the traditional scavenging feeding system because of inability to invest in modern housing, commercial feeds and herd health programme. Pig production is a diversification livelihood strategy and not a major source of income streams for these farmers. About half (50%) of the farmers were without formal school education to enable them be trained by extension staff on modern pig husbandry (Nantima et al., 2015a, Kithinji et al., 2017) as compared to pig farmers in Botswana and Tanzania where 15 to 25% of farmers had secondary education (Nsoso et al., 2006; Karimuribo et al., 2011).

The results of this study concur with the findings of Sibongiseni et al., (2016) and Mwendia et al., (2018) which reported an association between poor knowledge of T. solium infections and poor hygiene by farmers. This practice was common in Western Kenya where farmers owned and used dilapidated, unhygienic latrines for human waste disposal. Therefore, this study suggests the need for farmers to be trained on the three variables namely, pig management systems, T. solium, porcine cysticercosis as important tools for control in the two areas.

Results of this study showed that the risks of pork in the market was perceived to be high at slaughter slabs and home slaughters, and no risks at the butchery and eateries. Findings elsewhere (Ocaido et al., 2013; Fahrion et
al., 2014; Fogang et al., 2015), reported that pork from informal market was riskier to human health exposing consumers to zoonotic diseases. The findings of this study are in agreement with reports of Ngasala et al., (2015) and Gayatri et al., (2017) who reported that butcher-owners as knowledgeable people able to protect human beings through disease prevention and control. These results suggested the need for creation of awareness of the risk of disease transmission to butcher-owners along the pork value chain in the study area.

Results revealed that the majority of consumers agree with the perceptions, all except for the eateries where consumers were less likely to agree in strong agreement about exposure to cysticercosis in the eateries. The present results confirm the findings by Kagira et al., (2010) and FAO, (2012) who reported that most butcheries in Western Kenya had restaurants/eateries attached where pork was sold cooked (41%). The butcheries sold also raw pork (59%). Studies in Burkina Faso (Ngowi et al., 2017), reported that, boiling was the common traditional method for cooking pork. Boiling of pork products exposes consumers to Taenia solium (Thomas, 2014; Cook, 2015) due to undercooking since consumers do enjoy and prefer the juiciness of the meat (Levy et al., 2014). A study by Nguiu et al., (2020) in Thika sub-County of Kiambu County of Kenya, reported the frying as the preference method by consumers. This method may expose humans as it cannot kill all cysts. This expresses how consumers ignored the fact that pork from the eateries could expose humans to cysticercosis due to the practice of eating undercooked pork. It is also suggesting that health education could significantly increase knowledge and awareness of the disease, and can inspire behavioral change that will reduce disease transmission through thorough cooking practices. Consumers were not sure of the safety aspect of the meat consumed in the vibandas because of doubts of health inspection and meat source. Our findings confirmed those by Mutua et al., (2019) on the traceability approach for consumers along the traditional pork value chain in western Kenya. Hence, our results suggest the need for consumers to be educated on the pork eating habits as it predisposes humans to the utter risk of T. solium infection in the study area.

Conclusion

The study concluded that farmers from Western Kenya had little knowledge of pig management. Taenia parasite or its transmission. Results also indicate that butcher-owners and consumers hold different views about where safe pork is found in the market. Therefore, public education about PC risks and pork safety is necessary among all stakeholders in the pork value chain in Western Kenya. This should involve training pig farmers, pork consumers, butcheries to create awareness on transmission risk factors and strategies for the control of porcine cysticercosis. It should be possible to complement training with public education to stop consumer habits of eating undercooked pork from untraceable slaughter sources along the pork value chain, especially so in the local eateries. This predisposes humans to the risk of T. solium infection resulting in intestinal tapeworm when the pork eaten contains larval cysts. The stakeholders need to embrace multi-sector one health approach to break the T. solium life cycle. The main components of this campaign are recruitment of qualified pork inspectors and enforcement of meat inspection practices as requisite to the control of PC in Busia and Kakamega Counties.

Conflicts of interest: The authors declare that they have no conflicts of interest.

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