Taenia solium cysticercosis

An emerging food-borne zoonosis in sub-Saharan Africa

The tapeworm *Taenia solium*, transmitted between humans and pigs, affects millions of people in sub-Saharan Africa. Epilepsy and headache are common symptoms leading to human suffering, stigmatization, and death. In addition, infected pigs lead to considerable economic losses (1).

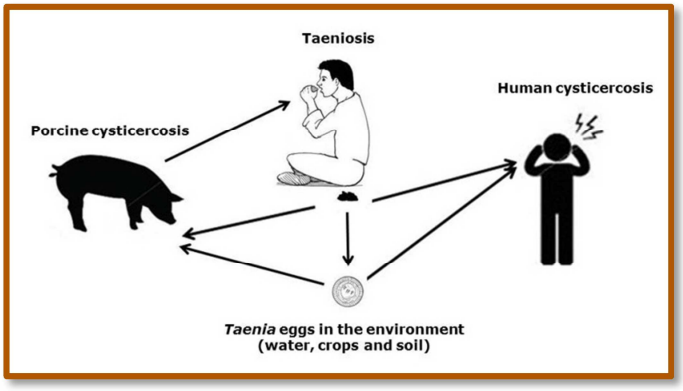
People can get infected with *Taenia solium* even if they do not eat pork!

***Taenia solium* cysticercosis is emerging because:** The demand for pork is increasing in sub-Saharan Africa while knowledge regarding *T. solium* cysticercosis is almost non-existent, free roaming pigs are the norm, meat inspection is either non-existent or inappropriate, open defecation is highly prevalent, and personal- and meat hygiene are poor.

***Taenia solium* is a significant health and economic burden in sub-Saharan Africa**
Since 1970, *T. solium* has been found in 29 African countries. However, the true prevalence of *T. solium* in humans and pigs in sub-Saharan Africa remains unknown. Prevalence studies are few but it has been found to be up to 6% for human taeniosis (2), up to 17% for human cysticercosis (3) and up to 64% for porcine cysticercosis (2).

Health cost
The prevalence of epilepsy in sub-Saharan Africa is estimated at 15/1000 people (4). A third of these cases are estimated to be caused by *T. solium* (5). This means that approximately 4 million people in sub-Saharan Africa suffer from epilepsy due to *T. solium*. Few studies have assessed the cost of *T. solium*. In west Cameroon the total annual health cost in 2009 was estimated to be 10.3 million Euro (6).

Agricultural losses
Taenia solium is suspected to be present in all sub-Saharan countries. It causes considerable economic losses in the agricultural sector due to the reduced value of pork and carcass condemnation. In Eastern Cape Province, South Africa the cost was estimated to be 5 million USD in 2004 for the agricultural sector alone (7).



Life cycle: Humans become infected with the *T. solium* tapeworm (taeniosis) by eating raw or undercooked infected pork.

Tapeworm eggs (too small to be seen by the naked eye) pass with an infected person's stool. Millions of eggs are excreted into the environment. Pigs get infected by eating human stool containing eggs or by ingesting eggs from the environment. Eggs develop into small cysts throughout the pig's body.

Humans can also become infected with *T. solium* eggs by ingesting contaminated food or water (human cysticercosis) or as a result of poor hygiene. Cysts often develop in the human brain causing a condition called neurocysticercosis. Symptoms include epilepsy, severe headache and blindness. Neurocysticercosis can lead to death.

Diagnosis in humans: Tapeworm eggs can be detected in the human stool by microscopy or by molecular analysis. Antibodies and antigens from both adult worms and cysts can be measured in the blood. Cysts in the brain may be detected using computed tomography (CT) scanning.

Diagnosis in pigs: Cysts can be detected in live pigs by tongue examination. However, this will only identify the more severely infected pigs. Antibodies and antigens from cysts can be measured in the blood. Post mortem, pork can be inspected for cysts in the meat.

Control of *Taenia solium*

Internationally, five strategies have been suggested for elimination of *T. solium*: 1) Treatment of humans and pigs, 2) Vaccination of pigs, 3) Improved pig management and pork production, 4) Improved sanitation, 5) Improved knowledge through health education. As *T. solium* infects both humans and pigs, control requires an integrated approach. For national control inter-sectorial collaboration between the government and the public is vital. Health and veterinary professionals need to collaborate in order to combine key solutions. Treatment and vaccination against *T. solium* in pigs are yet unavailable in sub-Saharan Africa. Therefore control strategies must include several (if not all) of the following control options.

1. Health education – With specific emphasis on sanitation and hygiene (personal and meat hygiene). This may reduce a number of faecal and meat borne diseases, but even if successfully implemented, some practices, like open defecation, are difficult to change.

2. Treatment of humans (taeniosis) – Highly efficacious and cheap drugs (praziquantel and niclosamide) with a high potential to reduce transmission have been developed. However, the drugs are not always locally available, infected people do not recognise they are infected, and confirmative diagnosis by routine microscopy is not possible.

3. Pig confinement – Increases profit and provides pig manure as fertilizer for crops. Additionally confining pigs prevents African swine fever and other diseases. However, it requires increased input of time and resources as well as pig management knowledge.

4. Pork inspection – Improves general food safety, but if farmers are not compensated for their infected pork, clandestine slaughter and trade will be the result.

Taenia solium is considered eradicable because of its simple life cycle, with humans as the only tapeworm carrier. Elimination of the parasite in Europe and North America was facilitated through industrialization including pig confinement and improved hygiene and sanitation. Whereas porcine cysticercosis is a notifiable disease in most countries, human taeniosis and cysticercosis have not been declared notifiable diseases by the World Health Organization.

Key solutions to control

- ✓ Stop open defecation
- ✓ Treat human taeniosis cases
- ✓ Confine all pigs and piglets at all times
- ✓ Ensure proper meat inspection
- ✓ Condemn infected pork
- ✓ Cook pork properly
- ✓ Wash hands before food preparation
- ✓ Educate all stakeholders
- ✓ Provide clean drinking water to pigs and people

References: 1: Phiri *et al*. 2003, Acta Tropica 87, 13-23. 2: Mwape *et al*. 2012, PLoS NTD 6, e1594. 3: Mwanjali *et al*. 2013, PLoS NTD 7, e2102. 4: Ngugi *et al*. 2010, Epilepsia 51, 883-890. 5: Ndimubanzi *et al*. 2010, PLoS NTD 4, e870. 6: Praet *et al*. 2009, PLoS NTD 3, e406. 7: Carabin *et al*. 2006, Trop. Med. Int. Health 11, 906-16.
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