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Taeniasis/cysticercosis

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Key facts

- The term taeniasis refers to intestinal infection with tapeworms. Three parasite species cause taeniasis in humans, *Taenia solium*, *Taenia saginata* and *Taenia asiatica*. Only *T. solium* causes major health problems.
- *T. solium* taeniasis is acquired by humans through the ingestion of the parasite's larval cysts (cysticerci) in undercooked and infected pork.
- Human tapeworm carriers excrete tapeworm eggs in their faeces and contaminate the environment when they defecate in open areas.
- Humans can also become infected with *T. solium* eggs due to poor hygiene (via the fecal-oral route) or ingesting contaminated food or water.
- Ingested *T. solium* eggs develop to larvae (called cysticerci) in various organs of the human body. When they enter the central nervous system, they can cause neurological symptoms (neurocysticercosis), including epileptic seizures.
- *T. solium* is the cause of 30% of epilepsy cases in many endemic areas where people and roaming pigs live in close proximity. In high-risk communities it can be associated with as many as 70% of epilepsy cases.
- More than 80% of the world's 50 million people who are affected by epilepsy live in low and lower-middle income countries.

Transmission and burden

Taeniasis is an intestinal infection caused by 3 species of tapeworm: *Taenia solium* (pork tapeworm), *Taenia saginata* (beef tapeworm) and *Taenia asiatica*.

Humans can become infected with *T. saginata* or *T. asiatica* when they consume infected beef meat or pig liver tissue, respectively, which has not been adequately cooked, but taeniasis due to *T. saginata* or *T. asiatica* has no major impact on human health. Therefore, this fact sheet refers to the transmission and health impacts of *T. solium* only.

Infection with the *T. solium* tapeworm occurs when a person eats raw or undercooked, infected pork. Infection with the tapeworm causes few clinical symptoms. Tapeworm eggs passed in the faeces with the tapeworm carrier are infective for pigs. *T. solium* eggs may also infect humans if they are ingested by a person (via the fecal-oral route, or by ingesting contaminated food or water), causing infection with the larval parasite in the tissues (human cysticercosis).

Human cysticercosis can result in devastating effects on human health. The larvae (cysticerci) may develop in the muscles, skin, eyes and the central nervous system. When cysts develop in the brain, the condition is referred to as neurocysticercosis (NCC). Symptoms include severe headache, blindness, convulsions and epileptic seizures and can be fatal.

Neurocysticercosis is the most frequent preventable cause of epilepsy worldwide and is estimated to cause 30% of all epilepsy cases in countries where the parasite is endemic. In specific communities the association between NCC and epilepsy can be up to 70%. In poor remote settings where the disease is present, epilepsy is difficult to diagnose and treat, and causes major stigma, especially in girls and women (where it is commonly associated to witchcraft).

Cysticercosis mainly affects the health and livelihoods of subsistence farming communities in developing countries of Africa, Asia and Latin America. It also reduces the market value of pigs and makes pork unsafe to eat. In 2015, the WHO Foodborne Disease Burden Epidemiology Reference Group identified *T. solium* as a leading cause of deaths from food-borne diseases, resulting in a considerable total of 2.8 million disability-adjusted life-years (DALYs). The total number of people suffering from NCC, including symptomatic and asymptomatic cases, is estimated to be between 2.56–8.30 million, based on the range of epilepsy prevalence data available. Although 70% of patients with epilepsy could lead a normal life if treated correctly, poverty, ignorance of the disease, inadequate infrastructure in health or lack of access to medication, cause 75% people with this condition to be treated poorly, if treated at all.

Symptoms

Taeniasis due to *T. solium*, *T. saginata* or *T. asiatica* is usually characterized by mild and non-specific symptoms. Abdominal pain, nausea, diarrhoea or constipation may arise when the tapeworms become fully developed in the intestine, approximately 8 weeks after ingestion of meat containing cysticerci.

These symptoms may continue until the tapeworm dies following treatment, otherwise it may live for several years. It is considered that untreated infections with *T. solium* tapeworms generally persist for 2–3 years.

In the case of cysticercosis due to *T. solium*, the incubation period prior to the appearance of clinical symptoms is variable, and infected people may remain asymptomatic for many years.

In some endemic regions (particularly in Asia), infected people may develop visible or palpable subcutaneous nodules. Neurocysticercosis is associated with a variety of signs and symptoms depending on the number, size, stage, and location of the pathological changes as well as the host's immune response but can also be clinically asymptomatic. Symptoms may include chronic headaches, blindness, seizures (epilepsy if they are recurrent), hydrocephalus, meningitis, and symptoms caused by lesions occupying spaces of the central nervous system.

Treatment

to assist in controlling or stopping the parasite transmission cycle. The treatment can be done on an individual basis, or as preventive chemotherapy depending on the local circumstances and the control approaches being implemented. Taeniasis can be treated with single doses of praziquantel (10 mg/kg) or niclosamide (adults and children over 6 years: 2 g, children aged 2–6 years: 1 g). Albendazole at 400 mg for 3 consecutive days has also been used. Recommendations and important considerations for the use of these drugs for preventive chemotherapy for taeniasis, are described in the PAHO/WHO Guideline for preventive chemotherapy for the control of *T. solium* taeniasis.

In NCC, since the destruction of cysts may lead to an inflammatory response, specialised treatment is required and may include long courses with high doses of praziquantel and/or albendazole, as well as supporting therapy with corticosteroids and/or anti-epileptic drugs, and possibly surgery. The dosage and the duration of treatment can vary greatly and depend mainly on the number, size, location and developmental stage of the cysts, their

surrounding inflammatory edema, acuteness and severity of clinical symptoms or signs. The WHO guidelines on management of *T. solium* neurocysticercosis provide more details to assist health care-providers.

Prevention and control

To prevent, control and possibly eliminate *T. solium*, public health interventions including veterinary, human health and environmental sectors are required.

There are several interventions for the control of *T. solium* that can be used in different combinations. In a meeting of experts in 2009, they were identified as:

Core “rapid impact” interventions:

- **treatment of human taeniasis;**
- **intervention in pigs (vaccination plus anthelmintic treatment);**

Supporting measures:

- **community health education, including hygiene and food safety;**
- **improved sanitation - ending open defecation;**

Measures requiring more fundamental societal changes:

- **improved pig husbandry - no free-roaming pigs; and**
- **improved meat inspection and processing of meat products.**

Mathematical models have been used to determine the probability of success of the different strategies’ combinations and the implementation period required to achieve sustained control, but they are still based in many assumptions and unknowns. However, they usually coincide in that integrated One-Health interventions, are the ones more likely to achieve a faster sustainable control.

WHO's response

Promoting better clinical management of neurocysticercosis

Epilepsy is one of the most common clinical signs in patients with NCC. WHO recognizes that people with epilepsy frequently suffer stigmatization and discrimination. WHO urges the Member States to support the establishment and implementation of strategies for the management of epilepsy, and promote actions to prevent the causes of epilepsy ([Resolution WHA 68.20 of 2015](#)). WHO has published the [WHO guidelines on management of *Taenia solium* NCC](#) to promote better clinical management.

Providing guidance for improved diagnostics and supporting countries diagnostic capacity

Faecal screening tests such as Kato-Katz, can be used to identify *Taenia* eggs and hence areas in which the parasite may be endemic, but the test is not species specific, so the positive samples must be confirmed as *T. solium*.

The gold standard for the diagnostic of NCC is imaging.

Improved, simple, cost-effective diagnostic tools for *Taenia solium* are still needed.

WHO has developed Target Product Profiles (TPPs) for the diagnosis of NCC, taeniasis and porcine cysticercosis and they were [published in 2017](#).

Supporting countries in their cysticercosis control efforts

WHO has been asked by countries affected with cysticercosis, to support their efforts to control the disease. Here are some of the actions taken:

Identification of endemic areas (mapping): One of the first steps to control the disease is to identify those communities or endemic areas where control measures need to be implemented. WHO has developed a mapping protocol which includes an Excel mapping tool, to evaluate the level of risk and assist the countries in identify high risk areas for endemicity to *T. solium*.

Donation of taenicides: Under the umbrella of universal health coverage, and with the aim of providing access to quality medicines, WHO has negotiated with Bayer the donation of taenicides and they are now available for the control of *T. solium* through the WHO.

Supporting the validation of control programs Several countries are mounting pilot programmes while conducting operational research to measure impact and refine strategies such as the pilot project in Madagascar

Guidance to implement control programs: In the Americas, PAHO has released a manual on the "Practical considerations for the control of taeniasis and cysticercosis caused by *Taenia solium* – contribution to the control of *T. solium* in Latin America and the Caribbean"

Strengthening prevention and control through a One-Health approach

The transmission cycle of *T. solium* involves pigs as intermediate hosts. As part of an integrated control strategy to break the transmission cycle of the parasite it is important to implement control measures in pigs.

Advocating a multi-sectorial approach with key partners: WHO is working closely with partner agencies such as the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) (known as the Tripartite) to promote animal interventions and meet the needs for interdisciplinary collaboration to control *T. solium*, with the final goal to prevent human suffering due to NCC.

Promoting pig interventions: Specific control measures in the pig population include the implementation of good farming practices, vaccination of pigs with the TSOL18 vaccine and the treatment with oxfendazole. Vaccination prevents the pigs getting infected; oxfendazole cures the pigs already infected at the time of vaccination, and both can be given simultaneously. Working with veterinary authorities as well as key partners in the animal sector, WHO is supporting pilot projects incorporating pig interventions, essential to attain long-term outcomes.

Improving data on *T. solium*

Robust surveillance data is fundamental to assess disease burden, take action and to evaluate progress. As for other neglected diseases, data is especially scarce. WHO is active in counters this situation by collecting and mapping data on *T. solium* distribution and risk factors associated with the occurrence of the parasite, such as information on pig keeping, food safety and sanitation. This information has been incorporated into the WHO Global Health Observatory.