



## Cysticercosis: A Neglected And Endemic Public Health Problem In Brazil

  <https://doi.org/10.56238/colleinternhealthscienv1-108>

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### **ABSTRACT**

Human cysticercosis is an endemic zoonosis caused by the ingestion of *Taenia solium* eggs, a flat-bodied worm of the cestode group capable of lodging in various types of tissue such as muscles, heart, eyes and, above all, brain, which can cause serious consequences to the health of the host. Therefore, this literature review aims to highlight the general aspects of cysticercosis and present the epidemiological evidence published on the subject. This parasitic disease most prevalently affects residents of rural areas due to their proximity to pig farming. Despite the extensive knowledge about the relationship between this parasite and its hosts, there is a notable lack of recent epidemiological studies and prophylactic programs regarding this pathology, making it an important and neglected public health problem for all endemic areas. Currently, there is no national *T. solium* control program established in the affected areas, which highlights the need to identify strategies appropriate to the epidemiological scenario.

**Keywords:** *Taenia solium*, Public health, Prophylaxis, Endemic Diseases.

## **1 INTRODUCTION**

Cysticercosis is a zoonosis caused by the larval stage of *Taenia solium* and is part of the teniasis-cysticercosis complex. The larvae have the ability to lodge in various tissues of the host triggering clinical syndromes that include neurocysticercosis and extraneural cysticercosis. Brain infection, neurocysticercosis, can cause severe symptoms due to the mass effect and inflammation induced by the degeneration of the cysticercus and release of antigens in the affected tissue, and is an important cause of late onset epilepsy and a range of disorders such as headache, meningitis, cognitive changes, focal neurological deficits. Epileptic seizures tend to be the most commonly encountered symptom (Dixon et al., 2021).

The Brazilian territory presents environmental and social factors that contribute to the formation of

endemic areas for neurocysticercosis, such as tropical climate, practice of pig farming, and poor sanitary conditions. Therefore, in Brazil, neurocysticercosis is considered the most common isolated cause of epilepsy. In other countries, a considerable number of people who acquired cysticercosis outside endemic areas where there are significant numbers of immigrants seek medical attention. In Latin America, it is highlighted by several authors that it is an area of high prevalence of neurocysticercosis, in 18 Latin American countries, with an estimated 350,000 patients. Although swine cysticercosis in the region is not well documented, the clandestine slaughter of pigs, without inspection and sanitary control, is considerable in most countries of Latin America and the Caribbean when compared to other countries, the fundamental cause being the lack of notification, it is estimated that with proper surveillance the amount would be much higher than the current figure (Brazil, 2010).

## 2 METHODOLOGY

For the development of the study, searches were performed in SciELO, UpToDate, and PubMed databases, and in Google Scholar, in addition to consultations in Ministry of Health manuals. The descriptors used for the *online* search were "cysticercosis", "neurocysticercosis", "pathophysiology", "clinical aspects", "transmission", "prophylaxis", "epidemiology", and "social impact". Inclusion criteria were: complete articles, published in Portuguese, English or Spanish. Articles that did not fit these criteria were discarded. Initially, we tried to review only recent publications, from 2017 to date, but not many epidemiological studies were found in this period, especially with regard to Brazil, so we included studies prior to 2017.

## 3 DEVELOPMENT

### 3.1 TRANSMISSION AND DISSEMINATION OF THE PARASITE IN THE HOST

Cysticercosis is an infection that affects humans and pigs. It is caused by the presence of the larval form of *Taenia solium*, acquired by ingesting contaminated eggs eliminated in the feces of a tapeworm carrier. It is part of the Teniasis-Cysticercosis complex, caused by the same species of the cestode parasite, at different stages of its life cycle (Brazil, 2010).

Pigs and humans are infected by ingesting eggs or proglottids, segments of tapeworms. Humans are usually exposed to *Taenia solium* eggs by ingestion of contaminated food or water or by spread from person to person. Self-contamination of the individual with teniasis can also occur, since the eggs can be found on the hands of the host, in the perianal and perineal region, on clothing, and even on household furniture. Cysticercosis due to ingestion of *Taenia saginata* eggs practically does not occur, being extremely rare (Brazil, 2010).

Once the eggs or proglottids are ingested, the oncospheres, the immature form of the parasite embedded in an embryonic envelope, hatch in the intestine, invade the intestinal wall, enter the bloodstream, and migrate to various tissues and organs, where they mature into cysticercuses over 60 to 70

days, and can lodge, for example, in the muscles, eyes, heart, and above all, the brain. Cysticercosis, unlike teniasis, is a somatic disease, since it is characterized by the presence of *Taenia solium* larvae in the tissues (Brazil, 2010).

### 3.2 PATHOPHYSIOLOGY

The *Cysticercus cellulosae* larva becomes infective to humans after 60 to 75 days in the tissue and may remain viable in the muscles of the pig for several years or for its entire life (Guimarães et al., 2010). When man ingests raw or insufficiently cooked pork, it is digested and under the action of bile and the larva is released, the scolices develop and the suckers attach to the intestinal mucosa, with the rostrum insinuating itself between the villi or inside the Luberkühn crypts in the jejunum, where the acuculae are attached. The posterior vesicle undergoes atrophy and the process of strobilus growth begins (Guimarães et al., 2010). In 60 to 70 days pregnant proglottids are already found and are eliminated in the feces. Adults live an average of three years, and may live up to 25 years housed in the human digestive tract (Guimarães et al., 2010).

The penetration of oncospheres into the human body does not trigger clinical manifestations, and their migration happens through the intestinal wall. Once the parasite reaches the point of attachment, the pathogenic process begins, attributable to two main factors that account for the varied symptomatology: the mechanical compression and consequent displacement of tissues or structures resulting from the location and growth of the cysticercus, which may obstruct, for example, the normal flow of organic fluids such as cerebrospinal fluid, and the inflammatory process that involves the parasite and may eventually extend to neighboring structures. The inflammation is usually of the chronic cellular type, with numerous lymphocytes and plasma cells. It depends on several factors, such as the location, number and evolutionary phase of the cysticercus, and the reaction of the parasitized tissue (Rey, 2002).

### 3.3 CLINICAL MANIFESTATIONS

The clinical manifestations of cysticercosis range from asymptomatic, milder forms, such as muscle pain and fatigue, to more severe forms, which trigger epilepsy, intracranial hypertension, and stroke. The main and most serious manifestations occur due to the preference of the cysticercus to invade tissues of high metabolism, which have high glucose consumption, a high production of ATP and high oxidation, such as brain, eyes and muscles (Leite and Takayanagui, 2000).

Muscle manifestation can occur when there are cysticercus interfering with the muscle dynamics of the sarcomeres and muscle fibers, or when they are affecting the muscle metabolism itself, which can cause muscle pain, fatigue, and can look like a sebaceous cyst or a nodule (Pfuentzenreiter and Ávila-Pires, 2000).

Neurocysticercosis, a condition caused by the involvement of cysticercus anywhere in the central nervous system of humans, has its manifestations depending on factors such as the morphological type, quantity, location, and stage of development of the cysticercus, in addition to issues of the host's own

immunological reaction. The incubation period of neurocysticercosis lasts from 4 to 5 years, and symptoms commonly appear when the cysts cause an inflammatory response in the host. The main symptoms include convulsions, neurological damage (paralysis or numbness in one segment of the body), compressive signs such as increased intracranial pressure (headache, vomiting, and torpor), altered behavior, meningitis (fever, headache, and neck stiffness), among others (Pfuentzenreiter and Ávila-Pires, 2000).

In relation to epileptic seizures, the nervous system reacts with the formation of degenerative phenomena in neurons, demyelination of the white matter that carries neuronal signals from subcortical regions to the cortex and from the cortex to subcortical regions. As a result of the multiple cortical locations, focal or generalized epileptic symptoms, motor, sensory, and sensory alterations may occur (Pfuentzenreiter and Ávila-Pires, 2000).

Direct exposure or toxic substances cause the cysticercus to localize in the ventricles, causing irritation of the choroid plexus and hypertension, and may also cause hydrocephalus. Epilepsy is the most common syndrome of neurocysticercosis and the leading cause of onset in adulthood in developing regions, accounting for more than 50% of cases. Psychiatric disorders vary, but are usually behavioral changes, mild cognitive impairment, and eventually dementia (Pfuentzenreiter and Ávila-Pires, 2000).

### 3.4 PROPHYLAXIS

The prophylaxis of cysticercosis includes basic hygiene measures, such as washing hands, especially after going to the bathroom and before meals, not using feces as fertilizer, using only treated, boiled and/or filtered water, inspecting products of vegetable and animal origin, and basic sanitation. Moreover, it is extremely important the sanitary education of man and the detection and treatment of the parasitized individual, because he is the disseminator of cysticercosis; the use of sanitary facilities with cesspools or sewage networks; the ingestion of well-cooked or roasted meat or meat products. It is also relevant in endemic areas to clarify the population about the risks and combat the practice of clandestine slaughter of cattle; ensure parasitic sterilization of wastewater at the outflow of effluents from urban areas and the use of cesspools in rural areas; track animals slaughtered and positive for bovine cysticercosis, with subsequent treatment by health authorities (Toledo et al., 2018).

### 3.5 EPIDEMIOLOGY

Cysticercosis is an endemic disease in several regions of Asia, India, South Africa, and Central and South America, including Brazil. Because it is a parasitic disease acquired through the ingestion of *Taenia solium* parasite eggs eliminated in the feces of individuals with teniasis, it is especially prevalent in areas of high population density and in rural areas where pig farming is practiced under suboptimal hygienic conditions (White, 2023).

Neurocysticercosis (NCC) is one of the main identifiable causes of epilepsy in endemic areas. Arruda (1991), in a prospective study in the state of Paraná, reports a prevalence of 27.1% of NCC as an

etiology of epilepsy. Similarly, Trevisol-Bittencourt, Silva and Figueiredo (1998) showed a prevalence of 24% of NCC in patients hospitalized for epilepsy in a service in the city of Chapecó, Santa Catarina. As in Brazil, other Latin American countries also have studies relating epilepsy to NCC. In an endemic community in Peru, there is evidence that 39% of individuals with epilepsy present images compatible with NCC on brain CT scans (Moyano et al., 2014). Available works about the epidemiology of cysticercosis in Brazil and other endemic regions are scarce and existing publications are outdated, lacking new epidemiological studies for the proper mapping of the cysticercosis landscape.

#### **4 CONCLUSION**

Cysticercosis is directly related to the lack of basic sanitation and the practice of pig farming, since it is caused by the direct ingestion of food/water contaminated with feces containing *Taenia solium* eggs. Its main complication is neurocysticercosis, which is the cause of approximately 30% of cases of epilepsy. Epidemiological data on cysticercosis is still scarce, exposing the neglect of this disease. Therefore, exploring the epidemiology of cysticercosis in known endemic areas is fundamental, in order to know the real prevalence and clinical repercussions of the disease, and to effectively allow the implementation of prophylactic measures in the most affected regions.

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