
Abstracts and Reports



Potential Eradicability of Taeniasis and Cysticercosis¹

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THE PROBLEM

Taeniasis and cysticercosis, respectively, are infections with the adult and larval stages of tapeworm parasites belonging to the genus *Taenia*. The two taeniid species that commonly infect humans, *T. solium* and *T. saginata*, both require two hosts to complete their life cycles. Human beings are the obligatory final hosts of both species' adult-stage tapeworms, while swine and cattle are the natural intermediate hosts for the larval-stage parasites (cysticerci) of *T. solium* and *T. saginata*, respectively. In many regions of the world *T. solium* taeniasis/cysticercosis is an important health problem of man. In addition, both tapeworm species cause livestock infections responsible for serious economic losses.

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Biology and Transmission

Humans acquire intestinal tapeworm infections (taeniasis) by ingesting cysticerci in raw or inadequately cooked meat (pork or beef) of infected intermediate hosts. Two to three months later, mature tapeworms that have grown to a length of several meters make daily releases of gravid segments containing many thousands of infective eggs into the human host's stools. The intermediate animal hosts acquire cysticercosis by ingesting taeniid eggs passed in stools of the human tapeworm carriers. These eggs hatch into embryonic parasites within the animals' intestines and develop into larval cysticerci in their muscles and other tissues. The egg stages of *T. solium* (but not *T. saginata*) can also infect humans, and in this way can give people potentially life-threatening neurocysticercosis. For that reason, the medical importance of infection with *T. solium* is much greater than infection with *T. saginata*.

Medical and Veterinary Impact

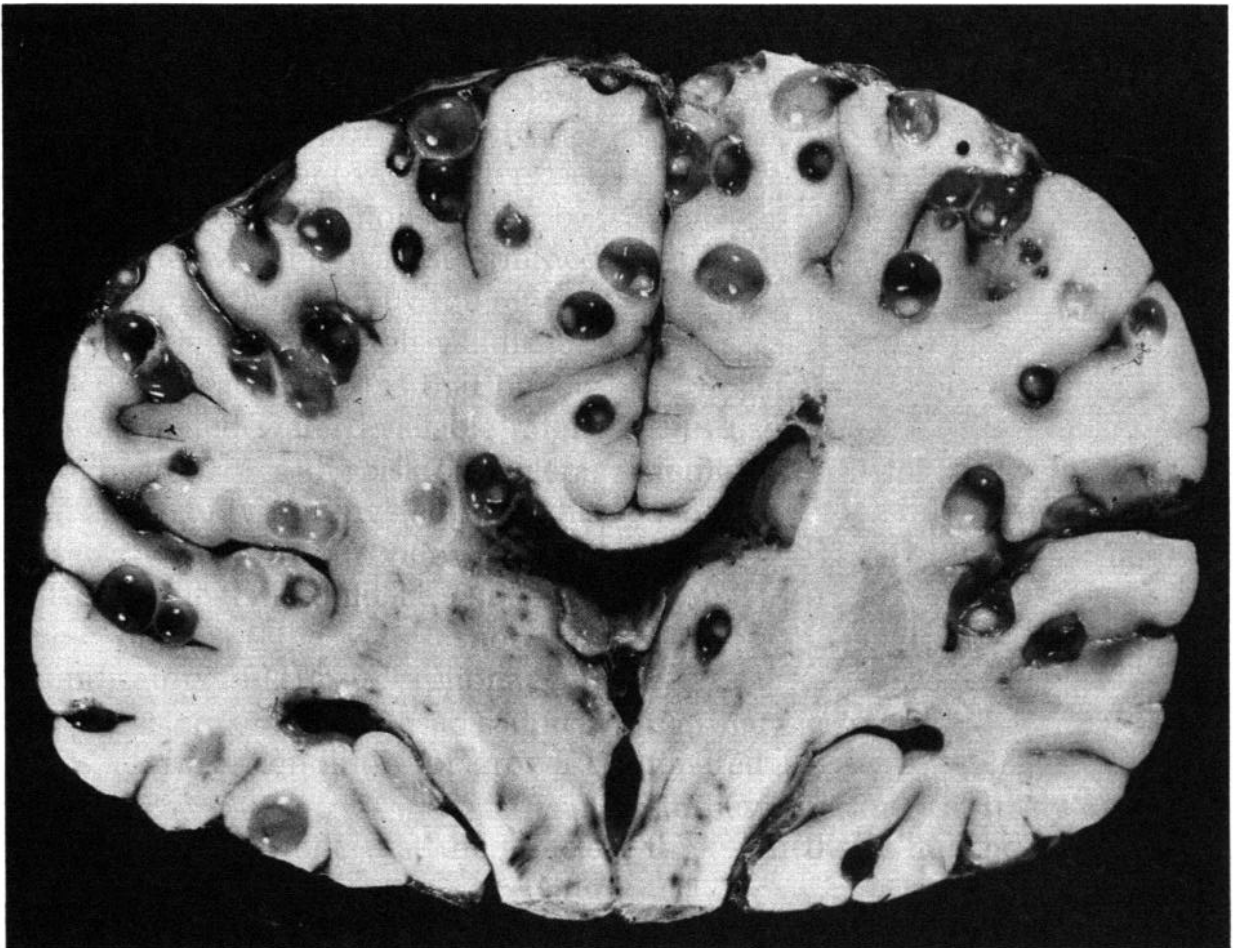
Tapeworm infection of the human intestine by either *T. solium* or *T. saginata* may cause abdominal pain, anorexia, and other gastrointestinal symptoms but is

rarely of serious medical consequence. In contrast, *T. solium* cysticercosis in humans, which is often symptomatic, can produce severe or fatal results. Although larval parasites may localize throughout the human body, most clinical manifestations are related to the presence of cysticerci in the central nervous system (neurocysticercosis), where they may invade the parenchyma, subarachnoid spaces, and ventricular system and cause seizures, hydrocephalus, focal neurologic signs, and psychiatric disorders involving physical and/or mental disability with a high risk of death (see photo, below). Cysticercosis in animal intermediate hosts rarely causes clinical impairment of growth and production; however, the market value of infected meat is greatly reduced.

Prevalence and Distribution

Although *T. solium* and *T. saginata* infections occur throughout the world, the prevalence of both species is highest in rural areas of Latin America, Asia, and Africa. Environmental conditions common to most communities where taeniasis and cysticercosis are endemic include inadequate mechanisms for disposing of human feces together with swine and cattle husbandry practices that give those livestock access to such feces (see photo, p. 399).

Taenia infections are generally underdiagnosed and underreported. However, the World Health Organization has estimated that these infections afflict some 50 million people and kill roughly 50 000 human beings a year. The total numbers



Cross-section of the brain of a 9-year-old Mexican girl who died of complications associated with massive cerebral cysticercosis. (Photo courtesy of Dr. Ana Flisser.)

do not distinguish between *T. solium* and *T. saginata* infections, but it may be assumed that virtually all the deaths are due to *T. solium* neurocysticercosis.

Most statistics on morbidity and mortality caused by neurocysticercosis are clinic-based. In Mexico, South Africa, and other countries where such data have been recorded, it has been found that neurocysticercosis is a common cause of death in neurosurgical services, the usual cause of late-onset epilepsy, and the cause of death or an incidental finding in 2% to 4% of all autopsies.

Rural community-based surveys, carried out recently in Mexico and Togo, indicate that rates of epilepsy are three

to four times higher in the survey areas than in industrialized countries, and serologic evidence implicates neurocysticercosis as the cause of at least 25% to 33% of the cases.

During the 1980s, the incidence of infection indicated by clinical diagnoses increased markedly as a result of improvements in radiologic and serologic diagnostic methods. Besides being observed in developing areas, this apparent increase was also found in industrialized countries—including the United States, where most cases are imported.

Economic losses caused by swine and cattle cysticercosis, although estimated for only a few countries, impose significant



The outside commons area of a household in a region of Mexico where *Taenia solium* is endemic. The unrestrained sow and piglets have access to human fecal wastes deposited on the open ground or in shallow pit latrines.

burdens on livestock industries. In Mexico, porcine cysticercosis is responsible for loss of more than half the national investment in swine production, and in Latin America generally it has been estimated to impose an annual economic loss of roughly US\$ 164 million. In Africa, losses of US\$ 1 000–2 000 million have been attributed to bovine cysticercosis. The near impossibility of keeping livestock free of infection under prevailing conditions continues to frustrate the development of a profitable cattle industry in many developing countries.

THE CASE FOR ERADICATION

The following characteristics of *T. solium* and *T. saginata* infections make them vulnerable to eradication: (1) the life cycles require humans as definitive hosts; (2) tapeworm infection in humans is the only source of infection for intermediate hosts; (3) domestic animal intermediate-host populations can be managed; (4) no significant wildlife reservoirs exist; and (5) practical intervention is available in the form of mass chemotherapy of human taeniasis with safe and effective drugs.

Because of marked differences in the population stability of the two species, however, *T. saginata* appears much harder to eradicate than *T. solium*. Indeed, the prevalence of *T. saginata* has increased in Europe over the past 40 years. For example, the prevalence of bovine cysticercosis in Germany before 1950 was reported at around 0.3%, while at present it is reported around 2% and may be higher in some regions. This increasing bovine cysticercosis incidence appears associated with intensification of cattle-rearing operations, limited ability to detect infected carcasses through meat inspection, increased movement of people from *T. saginata*-endemic areas for reasons of tourism and immigration, in-

creased popularity of raw beef dishes, and sewage treatment facilities' inability to destroy taeniid eggs. For all these reasons, new knowledge, tools, and intervention strategies are needed to effectively control bovine (*T. saginata*) taeniasis and cysticercosis.

In contrast, *T. solium* taeniasis/cysticercosis appears to be a good candidate for eradication because it has gradually disappeared from most European countries even in the absence of specifically targeted control measures. At the end of the last century, the prevalence of *T. solium* in swine and humans in Germany was similar to that found today in Mexico and other endemic regions. However, the occurrence of *T. solium* in Europe is now limited to scattered foci in eastern and southern Europe. Factors credited with the elimination of *T. solium* include improvements in general sanitation and economic status, the introduction of indoor swine husbandry, and rigorous meat inspection. The reasons why the first and third of these factors have not also reduced or eliminated the transmission of *T. saginata* may be related to different characteristics of the cattle and swine husbandry systems and different feed sources for these animals.

Current Strategies

WHO and PAHO have formulated two alternate strategies for controlling *T. solium* taeniasis/cysticercosis. These are (1) comprehensive long-term intervention and (2) short-term intervention based on mass treatment of taeniasis in existing transmission foci.

Ideally, a complete comprehensive program of long-term intervention would include appropriate legislation, health education, modernization of swine husbandry practices, improvement of meat inspection efficiency and coverage, pro-

vision of adequate sanitary facilities, and adoption of measures to detect and treat human tapeworm carriers. This comprehensive approach to control should be advocated and implemented wherever possible; such integrated measures would have additional benefits beyond the control of taeniasis and cysticercosis, reducing the occurrence of other diseases in the communities involved.

However, appropriate modernization of the sanitary infrastructure is both expensive and beyond the current capabilities of most rural populations. Also, even if those affected understand the situation, long-term programs of community health education are needed because traditional attitudes, beliefs, and behavior patterns are hard to change. In sum, the social, political, and economic realities in many communities where *T. solium* is endemic provide little hope that all of these comprehensive long-term measures can be implemented soon.

In the meantime, to promote more rapid progress toward eradication and substantial reduction of the sickness and death caused by neurocysticercosis, WHO and PAHO have proposed short-term control programs directed at identifying foci and treating all diagnosed or suspected human cases of taeniasis. The immediate goal of these programs is to interrupt transmission from humans to pigs and to other humans. Thereafter, following one or more rounds of mass chemotherapy, progress can be maintained by integrating education and control activities into primary health care systems in a manner aimed at detecting and targeting new or reemerging foci.

Remaining Barriers

Among the obstacles to short-term control that still exist in many areas are the following:

- There is commonly a lack of national surveillance and control programs capable of encouraging, promoting, supervising, and evaluating *Taenia* control activities and/or a lack of funds to support such activities.
- Cooperation between veterinary and medical services in rural areas is often insufficient.
- Effective taeniocidal drugs are often not available in rural endemic communities where the disease is endemic.
- To be effective over the long run, control measures based on chemotherapy have to be supported by aggressive education campaigns and by significant improvements in personal hygiene and general sanitation within the disease-endemic area, steps whose success generally depends at the local level upon community desire for action.
- In many cases local awareness of the problem is lacking. While people in endemic rural communities usually recognize cysticerci in local pigs and are aware that the infection reduces the value of pork, they usually do not understand the relationship between taeniasis in humans and cysticercosis in pigs and humans. Rarely do villagers know there is an easy way to control the infection by treating taeniasis in humans.

New Tools and Knowledge

On a more positive note, a number of recent experiences and research findings have significantly enhanced the potential for eradication. These developments, which stand a chance of encouraging national authorities to adopt programs based on the approach proposed by WHO and PAHO, are as follows:

- Intervention technology has improved. Safe, effective, and inexpensive taeniocides are now available (praziquantel and niclosamide are on the WHO essential drug list). Better education services are possible via the mass media. More effective primary health care service infrastructures have been organized. And a shift toward industrialized pig production in some regions seems likely to reduce the small-scale breeding of pigs by individuals under unsanitary conditions that is the major source of cysticercosis.
- Improved methods of radiologic and immunologic diagnosis for both cysticercosis and taeniasis are now available and are being applied in epidemiologic studies and surveillance systems.
- Community-based epidemiologic studies have shown that the distribution of cases of cysticercosis in humans and pigs is largely focal, being associated with people having active or recent taeniasis.
- Surveillance of cysticercosis in local pigs is a practical, inexpensive, and sensitive method for monitoring and evaluating the effectiveness of community-based control programs (1-3).
- A WHO-supported study in Ecuador has shown that short-term mass taeniocidal chemotherapy is feasible. The cost of the intervention was acceptable because it used existing veterinary and medical services and inexpensive medication. (It should be noted that the cost of treating one case of taeniasis with a low dose of praziquantel, about US\$ 0.20 at retail prices, was about 150 times less than the cost of using the same medication to treat a case of neurocysticercosis.)

RESEARCH AND PLANNING NEEDS

Within this context, operational research and national programs are needed to implement and validate the proposed strategies for eradicating *T. solium* in a variety of geographic and socioeconomic settings. Available diagnostic and therapeutic technology is adequate to support eradication programs. Even here, however, progress could be accelerated by development of better, faster, and more field-applicable methods for detecting human taeniasis and swine cysticercosis.

Beyond that, as a first step toward achieving prevention and control of taeniasis and cysticercosis, it will be necessary to promote operational research, with the assistance of WHO and PAHO, aimed at verifying the effectiveness, costs, and benefits of alternative short-term and long-term control strategies directed against *T. solium* and *T. saginata*. At the same time, WHO and PAHO should promote development of national action plans that provide evaluation components and adequate funding for surveillance and control of *T. solium* infection. Finally, in order to increase the cost-benefit ratio of interventions, it will be important to promote trials that evaluate the possibilities for combining interventions against *Taenia* with measures aimed at other intestinal helminths by using single broad-spectrum anthelmintics or anthelmintic combinations. Together, these research and planning measures can provide an important complement to activities now capable of eradicating *T. solium*, and perhaps *T. saginata*, from a broadening array of developing areas in this hemisphere and around the world.

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De Madres a Madres: A Community Partnership to Increase Access to Prenatal Care¹

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INTRODUCTION

Early and regular prenatal care is essential for optimum health of both mother and infant and can dramatically lower the rate of maternal mortality. However, access to prenatal care is directly linked to economic status: poor women are less likely to receive such care—both in developing countries and in the United States of America (1).

In Houston, Texas, the fourth largest city in the United States, many women in the sizable Hispanic population receive no prenatal care at all. Barriers to obtaining care include lack of transportation to a clinic, inadequate insurance,

personal fears, stress, and ambivalence surrounding the pregnancy. Many Hispanic women face additional barriers such as undocumented immigration status, ineligibility for financial assistance, and inability to speak English.

To decrease barriers and increase access to prenatal care in one Hispanic neighborhood, a program called *de Madres a Madres* ("from mothers to mothers") was initiated in 1989. The area in which it operates, Houston's Northside community, is an inner-city neighborhood with high-density housing. Median family income is US\$ 12 782. All the women of childbearing age, who make up 34% of the community's population of 13 555, are considered to be "at-risk" for not receiving early prenatal care.

De Madres a Madres is a community coalition effort that includes a group of volunteer mothers working in partnership with community services, including schools, businesses, churches, health and social service agencies, and the media. The coalition seeks to increase community awareness about the importance of

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