Provisional Agenda Item 14

RIMSA9/20 (Eng.)
14 April 1995
ORIGINAL: SPANISH

TAENIASIS/CYSTICERCOSIS:
SOCIOCULTURAL AND ECONOMIC DETERMINANTS
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1. Introduction

The taeniasis-cysticercosis complex has been recognized as an important problem in public and animal health and has attracted sanitary, economic, and cultural interest for several decades now, it has not been sufficiently studied nor have intervention measures been devised to assist in controlling the disease in the Region (1).

It is common knowledge that neurocysticercosis affects millions of people in the underdeveloped countries, causing disease and death. This pathology consequently reinforces the importance assigned to the parasitic diseases in all the tropical zones in Latin America, Africa, and Asia (2,3). Cysticercosis, furthermore, is responsible for considerable economic losses derived from the confiscation of infected carcasses and loss of the commercial value of meat. In 1963, porcine cysticercosis in six slaughterhouses in Central America and Panama was the cause of 68% of all confiscations, producing losses estimated at US$ 500,000 (4).

In Mexico, 264,000 dressed pigs were confiscated for cysticercosis in 1980, with total losses estimated at $43 million. It must be borne in mind that the most affected pigs are those raised in non-technicalized settings on small farms close to the owner's dwellings, and therefore the proportion of pigs taken to slaughterhouses with official inspections is very low. As a result, such losses may actually be considerably higher because of the limited reliability of slaughterhouse records for estimating the severity of the economic problem represented by cysticercosis in these animals.

Although economic losses for livestock production are considered to be high, they are no less important than those deriving from the medical care that must be provided to persons who develop cerebral cysticercosis. In countries such as Mexico, it has been estimated that the medical care of a single patient with neurocysticercosis costs more than $2,000, including diagnosis, treatment, days of work lost, and hospitalization (1).

The presence of this parasitic complex in the populations of the Region must be viewed from a perspective that takes into account the environmental, social, cultural, and economic aspects of the surrounding environment, which interacts decisively in maintaining the cycle of the causative agents involved. Hence, any intervention to interrupt the cycle must be founded on a multisectoral approach and community participation so as to be able to act on all fronts that represent risks for the appearance of the disease in the population.
2. Taeniasis/Cysticercosis Complex

2.1 Biology and Ecology in the Americas

The causative agents of these kinds of parasitoses, classified as Cestodiasis, are *Taenia solium* and *Taenia saginata*, and their respective larval states *Cysticercus cellulosae* and *Cysticercus bovis*. The two species of *Taenia* are distributed throughout the world, *T. solium* found much more frequently in the underdeveloped countries.

The Taeniae, whitish, tape-form, hermaphrodite helminths, populate the intestine of the man, who serves as the sole definitive host. The intermediate hosts in the larval stages are, in the case of *T. solium*, the domestic pig and wild boar, and in the case of *T. saginata*, bovines, especially domestic bovines. Both types of host may be infected by ingesting intestinal *Taenia* eggs contained in human feces; they are eliminated separately, contained in gravid proglottids, or in mature fragments of the worm itself (figures 1 and 2). This explains the wider distribution of cysticercosis, due to the coprophagous habits of the intermediate hosts (1,5).

**Figure 1**

*Taenia saginata* and *Cysticercus cellulosae*

Transmission Cycle

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The eggs of the tapeworms are highly resistant to the external environment, which means that once expelled by the human host, within or outside the proglottids, they remain viable for weeks or months in moist, shaded soils. This occurs in places where man defecates in the open air, a circumstance that facilitates the access of cattle and pigs to the eggs. In certain circumstances, man may also come into contact with these eggs and thus contract cysticercosis.

Of the two species of Taenia, the most important for public health is T. solium, since man can develop cysticerci in his tissues upon ingesting taenia eggs when his hands have been contaminated by contact with feces in the perianal region or through the ingestion of raw, undercooked, or badly handled food (6) (figure 1).

After the eggs have been ingested by man, the oncospheres or hexacanth embryos contained inside the eggs are liberated, penetrate the intestinal wall, reach the lymphatic and blood capillaries, and lodge in various tissues and organs, especially the central
nervous system, eyes, and subcutaneous and muscle tissue. In approximately 10 weeks, the embryos evolve into cysticerci, which may survive for several years until they finally die or become calcified.

The cysticercus observed most frequently is a round or oval-shaped vesicle some five millimeters in diameter, surrounded by a translucent membrane containing a transparent liquid; held against the light a uniform white mass or invaginated scolex may be observed, indicating a stage traditionally known as Cysticercus cellulosae, a scientific term considered to be incorrect, since it does not denote an independent parasitic species; hence, some prefer to call it a vesicular cysticercus of T. solium (5).

Another, less frequent form, described in Mexico, is the multilobular cysticercus without scolex, designated Cysticercus racemosus, which is of great importance by virtue of its clinical and pathological implications for human beings, since it appears to be a degenerative state of the vesicular cysticercus and is generally found in soft cisternal meninges and in the ventricular system. This form, as well as other intermediate lobulated forms without a scolex, has been described only in the human brain, and its size depends on the space in which it is lodged.

Although both forms of taeniasis and cysticercosis are distributed throughout the world, their prevalence is greater in the rural areas of Latin America and in urban fringe settlements in cities in which rural inhabitants have settled, bringing their customs with them and giving rise to environments in which inadequate means for the disposal of human excreta and rudimentary methods of pig-raising lead to the infection of both humans and animals.

2.2 Mode of Transmission and Incubation

The life cycle of the tapeworm should be divided into two kinds of populations: one, the rural areas involved in zoonotic transmission of the infection, in which the cycle is complete and humans are affected by taeniasis and cysticercosis and pigs by cysticercosis; and the other, the urban areas, where fecal-oral transmission of cysticercosis is most common (7).

Individuals residing in urban areas may sporadically travel to rural areas and acquire taeniasis or cysticercosis through the consumption of unsafe local food. Another possibility concerns individuals who work as drivers of vehicles who are accustomed to eating in roadside restaurants where the food is prepared under unhygienic conditions, thereby increasing their risk of acquiring the infection and serving as carriers to other geographical regions.
In the case of *T. solium*, development of cysticercus, from ingestion up to the adult stage and expulsion of the first proglottids in the feces, takes place in from 60 to 70 days, and persistence of the parasite in the human intestine may be prolonged for years, with consequent elimination of eggs and proglottids; in the case of taeniasis by *T. saginata*, development takes place between 10 and 12 weeks after infection with the cysticercus.

The incubation period of cysticercosis is very variable, both in man and in animals, so that symptoms may appear anywhere from 15 days to many years after infection.

2.3 *Susceptibility and Resistance*

Virtually nothing is known about the factors that might influence the susceptibility and resistance to infection by *T. solium* in human hosts, such as the age of the host and the number of parasites. In infections of this type, most definitive hosts can be infected repeatedly, with only a slight increase in resistance.

There have been no reports of the formation of antibodies against *T. solium* in human hosts, and nothing is known about the way this phenomenon could influence the susceptibility of the host to infection by large numbers of larvae.

Attempts to immunize definitive hosts with extracts or secretions of scolex, cysticercus fluids, membranes, adult worms, or oncospheres do not produce consistent immunity to reinfection (8).

2.4 *Symptoms*

Intestinal infections by *Taeniae* are usually asymptomatic. The symptoms of human cysticercosis from *T. solium* depend on its location. Most of the clinical manifestations are related to the presence of cysticerci in the central nervous system (neurocysticercosis), causing convulsions, hydrocephaly, psychiatric disorders, disability, and even death. In the eye, the cysticerci may be located in the anterior or posterior chamber and can be detected by examination of the fundus. Cysticercosis in the intermediate host rarely causes disturbances in growth or reproduction. Moreover, the life of the pig prior to slaughter is too short to permit the appearance of symptoms deriving from the invasion of nerve tissue. Consequently, the presence of cysticerci occurs especially in striate muscles and occasionally in viscera, such as the liver or the heart, locations that do not give rise to symptoms in the animal (13).
2.5 Diagnosis

The diagnosis of taeniasis is based on the background provided by the host and by observation of the expulsion of gravid proglottids in the feces, or detection of tapeworm eggs. Since these are intermittent, they must be subjected to coprologic analyses. Distinction of species is not possible.

In addition to direct coproparasitoscopy, other methods are employed at the present time—the Kato-Katz thick smear, concentration with formalin-ether, and perianal smear with gummed transparent cellophane tape—whose advantages and limitations depend on the biological phase of the parasitic disease, the method employed, and its standardization.

The diagnosis of cysticercosis involves the microscopic observation of possible cysticerci of *T. solium* isolated or lodged in the parasitized tissues during eye examination, surgery, or necropsy, when they can be found in their vesicular or racemose forms, described above. Background information on patients as to their sociocultural surroundings and habits is useful in this type of diagnosis.

At the present time, diagnosis by imaging, such as computerized axial tomography (CAT) and magnetic resonance imaging (MRI), is considered to be the most suitable procedure, not only for diagnosis, but also for prognosis, the prescription of therapy, and the monitoring of its results. The high cost and consequently limited access by patients to these technologies constitutes a limitation for their more extended use (9).

The use of immunological methods for the diagnosis and detection of taeniasis/ cysticercosis has been limited and has met with little success in the Region. The ELISA test is perhaps the most commonly employed, although its limited sensitivity and specificity, coupled with the possibility of crossed reactions with other parasites, diminishes its usefulness for diagnosis (10,11). Even less useful are other tests, such as indirect hemagglutination (IHA). In general, immunodiagnosis is used on a very small scale and is more associated with the activities of research institutions (5).

For routine diagnosis of pigs and cattle, postmortem observation of cysticerci is used during inspection in the slaughterhouse, a method that additionally offers the possibility of tracking the origin of the pig and pinpointing a focus of infection. According to some authors, examination of the tongues of live pigs has a sensitivity of 70% and a specificity of 100% (12). It is also a laborious process, which despite its widespread use among pig dealers, does not rule out the presence of cysticerci in other organs, such as the eye, the muscles, or the brain.
2.6 Control Methods

The biological aspects of taeniasis/cysticercosis suggest that strategies for their control must be based on interruption of the transmission chain at the level of the definitive host (man) and the intermediate hosts (animals). The characteristics of the infection make it susceptible to control measures. Since man is the sole definitive host and the only source of infection for the intermediate hosts, he should be the target of elimination efforts, bearing in mind that the modification of his own habits and lifestyles are crucial for the elimination of this zoonosis.

PAHO/WHO (5) has formulated two alternative strategies for control of taeniasis/cysticercosis by *T. solium*:

- short-term interventions, based on community action against taeniasis at the foci of transmission of the disease by identifying such foci in order to interrupt the cycle of transmission;

- long-term comprehensive intervention programs, which include appropriate legislation, detection and treatment of individual *Taeniae* carriers, health education, the improvement of technologies in pig-raising, expansion of the coverage and efficiency in meat inspection, and improvement of the sanitary infrastructure.

2.6.1 Short-term Intervention Programs

Given the current conditions in the Region, the most logical approach is to promote the modernization of the sanitary infrastructure and the application of other long-term control measures. Yet there is also a need to implement actions that will yield results in the immediate future, based on identification and treatment of taeniasis in both the infected populations and those at risk in a given geographical area so as to achieve an immediate reduction in morbidity and mortality due to neurocysticercosis.

The idea of interventions of this nature has been supported by the experiences of countries such as Ecuador, where they have been applied in endemic areas (6). One study showed that the administration of a single dose of praziquantel to more than 10,000 people resulted in the expulsion of tapeworms in 1.6% of this population group. A year after this intervention, cysticercosis in slaughtered pigs showed a decline from 11.4% to 2.6%, suggesting rapid success in the reduction of environmental contamination by *T. solium* eggs. Participation by the community and several public and private entities notably reduced the costs of the intervention, since treatment of a single case of taeniasis with praziquantel at a cost of around $0.20 turned out to be 150 times cheaper than treating a case of neurocysticercosis with the same medication.
An immediate intervention model of this nature can also be applied to urban communities in which, as previously noted, transmission takes place essentially through the fecal-oral cycle that involves only humans, and thus makes them carriers in this environment and ultimately spreaders of the infection. The strategies in this case include the ability to carry out parasitologic diagnosis at the local care levels to support diagnostic studies of wider coverage, community participation, and community education to improve knowledge of the disease and promote self-care as a preventive measure and, of course, the ability to provide medical treatment for the population.

These kinds of interventions should be complemented by solutions using technologies appropriate to the basic sanitation problems of the affected communities.

2.6.2 Long-term Intervention Programs

It has been recognized that the presence of the taeniasis/cysticercosis complex in a given population and the options for controlling it must emanate from the principle that the disease does not limit itself to purely biological phenomena, but extends to include risk factors that originate in social, economic, and cultural phenomena. Strategies in this case should attempt to bring about the improvement of basic sanitation in committed communities through better drinking water supply systems; adequate elimination of excreta, wastewater and solid wastes; pest control; improved technologies for livestock-raising; improvement in the infrastructure to benefit and promote sanitary inspection of animals; and intensified community activities.

The high costs of modernizing the sanitary infrastructure indicates that it is not a viable medium-term strategy for the countries of the Region, but it is nevertheless the only one that will eventually attack the problem at its core. In this regard, the countries of the Region are facing a situation similar to that of the European countries a century ago. In that case it was necessary to make great strides in the population's general sanitation, economic, and cultural levels in order to overcome the situation and bring it to its present state in which only a few scattered foci of the disease continue to exist.

3. Social and Economic Importance of Taeniasis/Cysticercosis

The broad distribution of this complex in the Region of the Americas and the magnitude it reaches in some countries make it possible to estimate the impact of taeniasis/cysticercosis on the general health status and on agricultural and livestock production. The impact on health, for example, should be viewed not only from the perspective of the harm to health, but also as regards the repercussions on the social costs for communities and the economic costs for the health sector and social security systems. The economic impact is not only seen in the economic losses deriving from the fall in the market prices of animals and meat, confiscation of dressed animals, and a decline in livestock development, but also in its impact on food security for the population.
As may be seen, these problems overlap one another, and their impact must necessarily be considered from that perspective.

3.1  Situation of Human Taeniasis and Neurocysticercosis

The situation of this pathology in the Region is not precisely known. Nevertheless, the available information indicates broad distribution in at least 15 countries, some of which have foci scattered across their territories, others in which the foci are sporadic or localized, and still others in which the situation is unknown.

Table 1 shows the preliminary classification of transmission of taeniasis/ cysticercosis in the Region.

Since taeniasis/cysticercosis is a disease that does not usually present apparent symptoms, and since there is limited epidemiological surveillance of the presence of active foci and the disease is not reportable, knowledge about its true prevalence is limited. The available information suggests that infection by T. solium is endemic in the Americas, with a greater frequency in countries such as Bolivia, Brazil, Ecuador, Guatemala, and Mexico, and a truly low prevalence in Costa Rica.

This information bears a relation to the sociosanitary situation of the countries, and is expressed in the greater or lesser frequency of the disease in their territories.

Table 2 presents available information on taeniasis in the Region. In the case of Guatemala, recent information indicates that the presence of taeniasis was 2.9% for 1993 and 0.67 for 1994; Honduras registered percentages of infection that ranged between 0.4% and 6.0% between 1986 and 1989.

In Mexico, one of the countries most affected by the problem, the frequency ranged between 0.1% and 7%.

The problem of underregistration also extends to neurocysticercosis in humans, making it difficult to learn the real incidence of the disease in the population. Table 3 shows the information available on the situation in some countries of the Region.

As is known, cysticerci in humans may lodge in several organs: subcutaneous and muscle tissue, the eye, and nerve tissue. The greatest concern is for the latter location, since it has the greatest impact on the health of the people and perhaps on the economics of the health services.
Table 1
Preliminary Classification of the Transmission of Taeniasis/Cysticercosis in Countries of the Americas

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>CHARACTERISTICS</th>
<th>COUNTRIES</th>
<th>ACTIVE FOCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Taeniasis and Cysticercosis are prevalent and the problem is disseminated</td>
<td>Bolivia, Brazil, Colombia, Ecuador,</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Guatemala, Honduras, Mexico, Peru</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>The problem exists but transmission is sporadic</td>
<td>Argentina, Chile, Costa Rica,</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dominican Republic, Haiti, Panama,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Venezuela</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Only imported cases exist</td>
<td>Canada, Cuba, Guyana, French Guiana,</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jamaica, Paraguay, Suriname, Trinidad,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tobago, USA*</td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>No information available</td>
<td>Belize, El Salvador, Nicaragua,</td>
<td>?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uruguay</td>
<td></td>
</tr>
</tbody>
</table>
### Table 2

Frequency of Taeniasis in Humans by Country and Year

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>YEAR</th>
<th>PERCENTAGE OF INFECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Taenia spp.</strong></td>
</tr>
<tr>
<td>Bolivia</td>
<td>1977-1986</td>
<td>2.6(0.1-8.7)</td>
</tr>
<tr>
<td>Brazil</td>
<td>1965-1968</td>
<td>1.0(0.2-2.7)</td>
</tr>
<tr>
<td></td>
<td>1986-1989</td>
<td></td>
</tr>
<tr>
<td>Chile</td>
<td>1958-1980</td>
<td>0.2(0.1-1.7)</td>
</tr>
<tr>
<td>Colombia</td>
<td>1968</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>1986</td>
<td>8.36*</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1978-1987</td>
<td>0.02-0.09</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1974</td>
<td>1.0(0.3-1.0)</td>
</tr>
<tr>
<td></td>
<td>1985-1986**</td>
<td></td>
</tr>
<tr>
<td>El Salvador</td>
<td>1987-1988</td>
<td>0.18-0.28</td>
</tr>
<tr>
<td>Guatemala</td>
<td>1914-1953</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1986</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>1993*****</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>1994****</td>
<td>0.67</td>
</tr>
<tr>
<td>Haiti</td>
<td>1964</td>
<td>0.10</td>
</tr>
<tr>
<td>Honduras</td>
<td>1961-1966</td>
<td>6.7</td>
</tr>
<tr>
<td></td>
<td>1986-1989**</td>
<td>0.4-6.0</td>
</tr>
<tr>
<td>Mexico</td>
<td>1970-1971</td>
<td>0.6(0.2-1.1)</td>
</tr>
<tr>
<td></td>
<td>1984-1989</td>
<td>2.2(1.0-3.4)</td>
</tr>
<tr>
<td>Panama</td>
<td>1960</td>
<td>0.2</td>
</tr>
<tr>
<td>Venezuela</td>
<td>1961</td>
<td>0.2(0.1-0.6)</td>
</tr>
</tbody>
</table>

* Expulsion background.
** Epidemiological studies.
*** Proportion of cases of *T. solium* compared with *T. saginata* 3:1.
**** Central Laboratories of the DGSS of the Ministry of Health.

**SOURCE:** Epidemiology and control of the taeniasis/cysticercosis in Latin America. PAHO/WHO, 1990.
Table 3
Frequency of Cases of Neurocysticercosis Registered by Country and Year, in Neurology and Neurosurgery Hospitals

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>YEAR</th>
<th>NEOUROCYSTICERCOSIS (PERCENTAGE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>1947-1955</td>
<td>2.9</td>
</tr>
<tr>
<td></td>
<td>1945-1965</td>
<td>3.39</td>
</tr>
<tr>
<td></td>
<td>1969-1988</td>
<td>3.15</td>
</tr>
<tr>
<td>Colombia</td>
<td>1955-1970</td>
<td>0.9</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1976-1988</td>
<td>0.006*</td>
</tr>
<tr>
<td>Chile</td>
<td>1950-1979</td>
<td>0.4</td>
</tr>
<tr>
<td>Ecuador</td>
<td>1978-1980</td>
<td>2.6</td>
</tr>
<tr>
<td>Mexico</td>
<td>1959-1963</td>
<td>8.6</td>
</tr>
<tr>
<td></td>
<td>1973</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>1988</td>
<td>10.0**</td>
</tr>
<tr>
<td>Peru</td>
<td>1974-1985</td>
<td>0.5</td>
</tr>
</tbody>
</table>

* Percentage of positive biopsies.
** Percentage of positive computerized tomographies.


A case study of cysticercosis in Guatemala between 1940 and 1988 revealed that of 1,454 registries of this disease, 1,184 (81.5%) were cases of neurocysticercosis and 18% (1.2%) were of the eye (14).

In Mexico, neurocysticercosis has been responsible for close to 5% of admissions to neurology and neurosurgery services, and was the definitive diagnosis in 11.25% of the patients operated on for removal of cerebral tumors. Moreover, cerebral cysticercosis was found in 2.8% to 3.6% of all autopsies in hospitals in Mexico City and was reported as the cause of death in 0.6% to 1.5% of hospitalized patients (2).
In Ecuador, between 1978 and 1984, it was found that the diagnosis rate of neurocysticercosis in hospitals was between 0.3 and 2.62 per 1,000 patients (16). The result of a prior study carried out in Cuenca (17) indicated 1.3% of diagnoses of this cause between 1963 and 1981.

In Peru, a cysticercosis rate was reported of 212 per 100,000 autopsies between 1963 and 1973, according to information supplied by the central morgue in Lima, and between 1961 and 1970 a rate was reported of 1,136 per 100,000 autopsies carried out in hospitals (18).

Another factor to be evaluated in order to understand the social and economic impact of the disease is related to the population groups it affects. Various studies have shown that as many as 75% of the patients are in the age group that corresponds to the economically active population (2,16).

The disease, viewed from the perspective of social cost, thus has double significance: the spending on health required for care systems and for patients, on the one hand, and the decrease in the work force brought on by the lost work days of those affected by the disease, their total disability, or even their deaths.

Spending on health involves major expenditures on diagnosis, drug treatment, and surgery, and, on occasion, rehabilitation. It must be borne in mind that neurocysticercosis, by reason of its sociocultural repercussions, is more frequent in low-income rural or marginalized urban populations.

Patients often choose to ignore initial symptoms of the disease, such as headaches, convulsions, and epileptiform attacks, and fail to seek specialized medical care. When the symptoms become more apparent or physicians suspect neurocysticercosis, the expenditures involved in diagnosis by imaging are high and most often must covered by the health or social security organizations. It is necessary to bear in mind that the cost of a tomography at the present time is approximately $400 in some countries in the Region.

It was also mentioned previously that drug treatment costs approximately $300 per patient. Thus, it was estimated that in Mexico the cost of medical care, including hospitalization, chemotherapy, neurosurgery, and tomography for a total of only 2,700 patients amounted to $14.5 million (2).

To these costs must be added the costs of lost work days, which in cases of neurocysticercosis involves an average of 42 days, although some patients take much more time to recover and others never recover. In addition, it may happen that secondary reactions to the drugs occur in some patients, thereby leading to additional expenditures.
Finally, thought must be given to the inestimable costs stemming from patients with severe cases of neurocysticercosis who never recover, the possible loss of sight in the case of ocular neurocysticercosis, or even death, which sometimes occurs during the course of the disease or after surgery (19).

Nevertheless, the impact on health may be even greater if it is considered that some of those affected by the disease never have access to medical care, seek treatment in first-level services lacking in diagnostic resources, die without confirmation of the disease, or are diagnosed with some other pathology.

Mention must also be made of the impact on health and the social costs that arise in countries in which the disease is not endemic and in which foci are created by immigrants from countries where it is endemic. This is the case of recent reports of neurocysticercosis among the members of an Orthodox Jewish community in New York and the cases registered in the State of California, United States of America, that resulted from contacts by residents with immigrants from endemic countries. Such cases indicate the possibility that taenia infections may be imported into the United States by immigrants, refugees, and travelers from endemic countries as a source of neurocysticercosis for local residents (20,21).

3.2 Animal Cysticercosis

The situation of this disease in animals is not well documented in the Region. The data available on swine cysticercosis is based on that provided by the inspection services, whose coverage is limited in the countries. It is sufficient to observe that in Colombia, for example, there are some 1,300 slaughterhouses and packing plants, and inspection is carried out in only 5% of them.

Swine breeding and marketing in many of the countries is often non-technicalized. Marketing is carried out in regional markets, and the animals are butchered by their owners on small farms out of the reach of sanitary inspection.

Despite the general imprecision of the available information, the economic importance of this unfortunate situation is evident if it is taken into account, for example, that losses of more than $43 million were estimated in Mexico in 1980, which amounted to 68.5% of the total investment in swine production (2).

In Peru, where according to estimates 83% of the swine population is raised on family farms, information indicates an average prevalence of cysticercosis of 5%. With an annual extraction rate of 57%, the economic losses caused by the disease by reason of confiscation of swine carcasses may be estimated at $2.5 million (18).
In reality, this probably does not occur, since the percentage of swine taken to official slaughterhouses is limited, as are the coverage of inspection and the deficiencies in the techniques employed where this is effectively practiced. What is certain is that these figures may represent a potential economic loss, to which must be added the fact that swine thus become the most important spreaders of taeniasis and, consequently, the source of unestimated social costs (6,22).

The direct effects of animal disease on the economy are of unquestionable significance, just as they are for human health, since they translate into disease and a loss of sources of food, which doubtless only aggravates the situation in countries where infections and malnutrition abound in the population.

4. Social and Cultural Factors Related to the Prevalence of Taeniasis/Cysticercosis

As mentioned previously, taeniasis/cysticercosis, as well as other diseases, occurs as the result of the interaction of several factors associated with lifestyle and the social and cultural conditions of the communities it affects, which must not be ignored in proposing interventions to solve the problem.

In the case of this parasitic complex, the connotation is more obvious, since the association between precarious living conditions and greater incidence of the disease is clear. In fact, taeniasis and cysticercosis have profound roots in the social and economic conditions in which the Region’s population lives.

4.1 Population

Demographic change points to a growing increase in the economically active population, which may, in turn, indicate an increase in the proportion of the population exposed to the risk of the taeniasis/cysticercosis.

The accelerated processes of urbanization have deteriorated living conditions in the Region’s large urban conglomerates, since an significant proportion of the urban population is made up of people who migrate from rural areas and small population settlements, thereby contributing to the absolute growth of the poor population, which is now larger at the urban level than at the rural level.

The marginalized conditions common to these communities result in overcrowding and unhealthy conditions that lead to the establishment and spread of active taeniasis/cysticercosis foci as the conditions conducive to transmission are reproduced in urban areas.
Migration of this nature creates unemployment and underemployment, obliging the migrants to remedy their situation by engaging in activities in the informal sector of the economy, one of whose principal manifestations is the sale of food in the streets. It is obvious that taenia carriers can spread the infection if the procedures employed in the preparation of food they sell are not the most adequate.

As regards migration, it is also important to emphasize the role played in the transmission of the disease by migratory patterns both within and between countries. Mention has already been made of the magnitude of such migration from the Spanish-speaking countries to North America and those that frequently take place in other countries along the border areas when rural dwellers temporarily migrate to perform farm work in another country, as occurs, for example, between Colombia and Ecuador, and from Bolivia and Paraguay to Argentina.

4.2 Poverty

Social inequities are evident in most of the countries, and some studies indicate that the Region of the Americas is the region of the world demonstrating the greatest contrasts in this regard. In 1990 almost 50% of the population of Latin America was living below the poverty line, and it must not be forgotten that average values in a country often conceal substantial extremes in this regard between various sectors of its population (23).

This phenomenon is most acute in rural areas. In some countries, life in the countryside is one of extreme poverty. To make matters worse, the conditions are such that the taeniasis/cysticercosis is easily transmitted.

4.3 Basic Sanitation

The phenomena referred to above go hand-in-hand with a social factor of great weight in the epidemiology of taeniasis/cysticercosis—access of the population to drinking water and excreta disposal systems. In 1992 drinking water supply in the countries of Latin America and the Caribbean was available to only 57% of the population in the rural sector and 78% in the urban sector. These figures do not take into account that some systems function irregularly or are interrupted, which makes it technically impossible to maintain the quality of the water provided to the population, a constant concern of the governments since the cholera epidemic was unleashed in 1991 (24).
With regard to excreta disposal, of the population provided with this service, either by sewerage systems, septic tanks, or latrines, 80% resides in urban areas and only 34% in rural areas. Those countries with the most serious deficiencies in this regard are those where the disease is most prevalent.

Accelerated migration and disordered urbanization aggravate the problem further by increasing the spread of marginalized conglomerates in the cities, which are deprived of the basic services infrastructure the governments are unable to provide and are subjected to the consequent risk of taeniasis/cysticercosis, which finds its most fertile terrain in such surroundings.

The serious problem of the discharge of untreated wastewater into watercourses must also be mentioned. It must be borne in mind that this water is very often used domestically by populations that have no other source, or for the irrigation of crops, vegetable gardens, and animal pasture lands, thereby creating still another risk factor for the consumption of taenia eggs and the appearance of cases of neurocysticercosis.

4.4 Educational Levels

An important phenomenon is taking place in improving the educational levels of the population in Latin America. Although there are significant differences between one country and another, and even in those at the same level of economic development, progress has been made that may be considered conducive to opening the way to one of the principal intervention strategies for the prevention of taeniasis/cysticercosis. The impact of literacy on attitudes and behavior toward health is well known.

However, between one-third and one-fourth of the populations of some countries, such as Guatemala, Haiti, Honduras, and Nicaragua, are illiterate; but more worrisome still is the deterioration of the free and public educational systems resulting from the Region’s economic crisis, a deterioration that precisely affects the poorest sectors in both urban and rural areas.

4.5 Raising, Marketing, and Consumption of Pigs

The raising of pigs in most of the countries of Latin America is a non-technicalized primary activity that provides a major source of income for the sustenance of the rural economy and the marginalized areas of the cities. With the exception of countries such as Brazil, where it is estimated that slightly more than 60% of all the pigs in the Region are found, industrial exploitation of these animals has only taken off in recent years, and consequently the predominant breeding place remains the family farm.
In Chile, on the other hand, 90% of the pig farmers use modern techniques. Therefore, porcine cysticercosis has practically disappeared within its borders.

The practices mentioned above are also reflected in animal and meat marketing systems. Usually, the animals are sold at live fairs or at the farmer's home, and the meat is sold after the animal has been slaughtered at home without any sanitary control. The same thing happens with the production of by-products such as home-made sausage.

Traders avoid taking pigs with cysticercosis to slaughterhouses in urban centers, since in the course of sales transactions they run the risk of having their pigs inspected by palpation of their tongues to detect the disease. This causes a drop in the price paid for the animals and commonly encourages clandestine slaughter and sale, which suggests that the information on cysticercosis obtained in official slaughterhouses is not the best indicator of the real incidence of the disease in a particular region.

There are also other cultural factors that relate to the marketing of meat. It is known that in most of the countries in the Region, pigs from technicalized operations represent a low percentage of all the meat marketed, a market that is based on refrigerated meat from slaughterhouses. Popular meat consumption culture indicates that broad segments of the population prefer non-refrigerated meat from domestic animals, which they consider not only tastier, but also cheaper, all of which provides support to the clandestine market.

5. Intersectoral Control Actions and Community Participation

The problem of taeniasis/cysticercosis poses a clear challenge in order to control the disease and to improve the health of the population. There are also a number of factors in nature that lead to the persistence of the disease. This demands that the control strategies be based on the implementation of integrated programs in which there is cooperation among the various sectors that share responsibility for solving the problem.

Another very important factor is obtaining active community participation in all phases of the interventions and creating a sense of belonging on the part of the community with regard to solving the problem.

Inasmuch as this problem involves other sectors, such as health, agriculture, education, public works, planning, economy, finance, and communications, it is necessary to establish adequate coordination and to define the responsibility of each sector both at the local operational level and the national level.
The implementation of a program for the control of any disease requires the political decision to mobilize the required resources. For this reason, effective promotion efforts are needed in order to sensitize the authorities and enlist their support. The principal stages in achieving this are the following.

5.1 **Implementation Strategies**

Depending on prevalence criteria, the existence of resources, viability, the degree of interest manifested in the various sectors involved, and acceptance by the community, broad-coverage programs can be implemented from the outset or in a more gradual manner.

Development of the activities requires a minimum structure for the operational phase and sufficient leadership to coordinate the actions in accordance with the responsibilities of each sector. Leadership should be understood as operational capability, which will most likely be established in a health sector entity.
REFERENCES


