Published in final edited form as:

Am J Epidemiol. 1992 April 15; 135(8): 875–882.

Epidemiology of Taeniasis and Cysticercosis in a Peruvian Village

F. Diaz¹, H. H. Garcia¹, R. H. Gilman², A. E. Gonzales³, M. Castro³, V. C. W. Tsang⁴, J. B. Pilcher⁴, L. E. Vasquez⁵, M. Lescano⁵, C. Carcamo¹, G. Madico¹, E. Miranda¹, and The Cysticercosis Working Group in Peru

¹Universidad Peruana Cayetano Heredia, Lima, Peru

²Department of International Health, School of Hygiene and Public Health, The Johns Hopkins University, Baltimore, MD

³Facultad de Medicina Veterinaria, Universidad Nacional Mayor de San Marcos, Lima, Peru

⁴Division of Parasitic Diseases, Center for Infectious Diseases, Centers for Disease Control, Atlanta, GA

⁵Instituto de Medicina Tropical de San Martin, Tarapoto, Peru

Abstract

To determine the prevalence of cysticercosis in a rural area where the disease is endemic, the authors studied the seroepidemiology of human and porcine cysticercosis in a Peruvian jungle community (Maceda, Peru) in 1988 using an enzyme-linked immunoelectrotransfer blot (EITB) assay. Of the 371 sampled inhabitants, 30 (8%) were seropositive, most of whom were asymptomatic. After niclosamide therapy, four *Taenia* species worms were identified in the seropositive group, compared with one in the control group ($p = 0.06$). Pigs were frequently infected: 44 of 133 (33%) were found positive for *Taenia* by tongue examination and 57 of 133 (43%) were positive by EITB. In 69% of the sampled households that had pigs, there was at least one seropositive pig. The number of pigs diagnosed positive by the tongue examination was significantly greater in households that had latrines than in those that did not. Cysticercosis is a common but usually asymptomatic infection that affects both humans and pigs in the high jungle areas of Peru.

Keywords

cysticercosis; environmental monitoring; immunoblotting; swine; *Taenia*; toilet facilities; transfer blot

Cysticercosis is a disease endemic in most developing countries where pigs are raised (1). In both Mexico and Peru, more than 10 percent of neurologic patients receiving acute care have serologic evidence of *Taenia solium* infection (2, 3). Humans acquire cysticercosis by ingesting *T. solium* eggs from human feces either directly or indirectly, through contaminated food or water. The eggs mature into larvae, which invade the intestinal wall,

Copyright © 1992 by The Johns Hopkins University School of Hygiene and Public Health All rights reserved

Reprint requests to Dr V. C W Tsang, Department of Parasitology, The Centers for Disease Control, Atlanta, GA 30333..

Other members of the Cysticercosis Working Group in Peru include the following *Universidad Peruana Cayetano Heredia, Lima, Peru*: J. Naranjo, M. Verastegui, T. Montenegro, C Gallo, P. Torres, A. Guevara, R Castillo; *Instituto de Medicina Tropical de San Martin, Tarapoto, Peru*: J. Matsuoka, L. Samaniego, N. Riva; *Hospital Hipolito Unanue, Lima, Peru*: G. Alban, and *Cambridge University, Cambridge, England*: C. Evans.

muscle, brain, and other tissues. Pigs also acquire cysticercosis in the same manner. Humans develop taeniasis after ingesting raw or poorly cooked pork or beef that contains the larval form of *T. solium* or *Taenia saginata*. Larvae invaginate the small intestine of humans and develop into adult tapeworms. The tapeworm produces eggs after 3 months and may survive for years, thus spreading cysticercosis in both humans and pigs (4, pages 609–25).

Rational programs to control cysticercosis cannot be developed until the epidemiology of the disease is better understood. The true incidence of cysticercosis in both human and pig populations is unknown. The prevalence of porcine infection, based on meat inspections in Mexican slaughterhouses, has been estimated at 0.005–10 percent (5). However, many infected pigs are raised by small farmers, who often sell their pigs in informal markets where meat inspection is not performed. Since governmental and international agencies base their statistics for porcine cysticercosis on slaughterhouse statistics (6, 7), clandestine sale of meat results in a considerable underestimation of the true prevalence rates of porcine cysticercosis. For example, in Huancayo, a city of 500,000 inhabitants in the highlands of Peru, no pigs were registered as infected with cysticercosis (8), yet field surveys revealed that more than 30 percent of the pigs were infected with *T. solium* (9).

A reliable serologic test to determine the true prevalence of infection in both humans and pigs was lacking until the enzyme-linked immunoelectrotransfer blot assay (EITB) was developed for the detection of antibodies to *T. solium* in sera (10, 11, 12). We used this highly sensitive (98 percent) and specific (100 percent) assay (11) to study the epidemiology of human and porcine cysticercosis in a community in the high jungle of Peru where the disease is endemic. We also compared seropositive inhabitants with an age- and sex-matched group of seronegative subjects to determine whether seropositivity was associated with an increased risk of neurologic symptoms.

MATERIALS AND METHODS

Study site

Case reports from the hospital and slaughterhouse of the city of Tarapoto in the division of San Martin in the Peruvian jungle have shown that cysticercosis is endemic in this area (13). The nearby (20 km) rural village of Maceda (population, 421) was selected for this study because of its accessibility by an all-weather road and its convenient size. Maceda is typical of villages populated by descendants of the Chanca tribes, who until recently spoke only Quechua. Most of the Chanca villages are located along tributaries of the Huallaga river, such as the Mayo river where Maceda is located. Maceda, based on its size, agricultural economy, and riverside location, is a representative village of the high jungle area. Temperatures in the zone vary from 23 to 27°C, and the rainy season extends from November through May. Maceda contains simple adobe houses built on hillsides along the river. Pigs and other animals wander freely in the houses, which all have dirt floors. There are three natural geographic strata in the village: near the river basin, on the slope of the hills, and at the top of the hillside near the road.

Like other villages in the zone, Maceda does not have electricity or piped water. Water is obtained from the river. A number of the residences have borehole latrines in the backyard; other households use the fields for defecation. Pigs eat human feces deposited in the fields and at the sides of the latrines. Pigs are rarely corralled, and the majority are permitted to feed freely throughout the village. Most pigs are raised for sale in Tarapoto, but some are consumed by villagers on festival days.

Study design

The study was performed in two stages. First, we conducted an epidemiologic survey to determine prevalence rates and clustering in humans and pigs. A study was then conducted to compare the prevalence of neurologic disease in seropositive versus seronegative individuals. Studies were approved by the Committee on Human Volunteers and the Animal Experimentation Committee of the Universidad Peruana Cayetano Heredia and the Johns Hopkins University, and by the village council of Maceda. Informed consent was obtained from all participants.

Epidemiologic survey

Village meetings were held to explain the purpose of the study. After constructing a map of the village, we visited each household, counted the number of humans and pigs, and noted the presence of latrines. Two teams performed the survey. The first team collected stool and serum samples from villagers. A second team of veterinarians captured pigs and examined their tongues for cysts, and obtained blood from their jugular veins for the EITB test. Pigs under 4 months of age were excluded from the study, in order to exclude the presence of maternal antibody and because of difficulty in sampling.

Examination of stool specimens

Stool specimens were collected, and a sample was examined for the presence of parasites by microscopy, both directly and after formalin ether concentration and sedimentation (4, pages 1124–79). Stool examination detects less than 20 percent of infected individuals (14).

Soil samples

A core of soil was taken from five areas considered most likely to be contaminated with *T. solium* eggs. These included the sides of dirty latrines or boreholes as well as open household areas used for open-air defecation. Soil was transported to the laboratory and processed as follows: Soil samples were diluted and strained through gauze; after 20 minutes, the sediment in the filtrate was examined by microscope for the presence of eggs. When used to examine stool specimens, this method is tenfold more sensitive than direct microscopic examination (15).

Water studies

Five samples of river water obtained at different points were pumped through a 0.10- μ m nylon filter. The quantity of water sampled ranged from 50 to 100 gallons, depending on the amount of sediment present in the water. Filters were placed in a small amount of 10 percent formalin and backwashed with pressurized nitrogen, and the sediment was examined for the presence of *Taenia* species eggs. This method has been used primarily for the recovery of oocysts of cryptosporidium (16).

EITB analysis

Antibodies to *T. solium* species in blood samples from humans and pigs were examined using the method developed by Tsang et al. (11, 12). Briefly, the assay uses purified glycoprotein antigens (LL-GP) in an immunoblot format to detect infection-specific antibodies. Peroxidase-labeled goat anti-human antibody (KPL, Gaithersburg, MD) was used at a molar ratio of 1:2 (immunoglobulin G:peroxidase) diluted at 1/100. Bound antibodies were visualized using a hydrogen peroxide/3' 3-diaminobenzidine hydrochloride substrate system. The sensitivity of this assay varied from 94 to 98 percent, and the specificity was 100 percent (11, 12).

Diagnostic criteria

There are seven glycoprotein bands commonly recognized by antibodies from serum of human cases of cysticercosis (9). These bands are GP50, GP42–39, GP24, GP21, GP18, GPU, and GP13. Quality control of the EITB assay was performed in collaboration with the laboratory at the Centers for Disease Control, Atlanta, Georgia.

Cross-sectional comparison of the prevalence of neurologic disease

The second study was initiated 2 months after the initial survey. Using the census data, each individual whose EITB test was positive ($n = 30$) was matched by age and sex with a seronegative individual. A neurologist who was unaware of the participants' serologic status examined each pair and took detailed clinical histories, including the history of seizures, headaches, and subcutaneous nodules. In addition, all individuals were given niclosamide (2 g, by mouth) followed by a magnesium sulfate purge. Stools were collected and examined for the presence of *Taenia* species eggs. Villagers found to be infected with other helminths were treated whenever possible.

Data analysis

Either the chi-square or the McNemar test was used to test categorical variables. Clustering was measured using Smith and Pike's test (17). This test was performed to determine whether there was an increased rate of seropositivity among individuals living in the same house, in households located within 15 meters of each other, and in different topographic locations.

RESULTS

EITB results in humans

At the time of our survey, Maceda had 421 inhabitants living in 73 separate households (mean $\pm$ standard deviation (SD), 5.76 ± 2). Serum was obtained from 371 villagers (88 percent) (table 1) and stool specimens were obtained from 305 (72 percent). Children aged less than 1 year were significantly ($p < 0.05$) underrepresented in our sampling. Many parents would not allow us to take blood from their small children. Thirty inhabitants (8 percent)—18 females and 12 males—were seropositive. None of the 62 children younger than 6 years of age were seropositive. Children 6–15 years of age had significantly lower rates of seropositivity in comparison with older individuals (table 1).

In two houses, more than one inhabitant was seropositive. The rate of human seropositivity was not increased by the presence of another infected household member, proximity to a household with an infected individual, or the topographic location of the house. The presence of a latrine and the size of the family also were not significantly associated with a positive EITB result. Families owning infected pigs did not have a higher risk of seropositivity than families who either did not own pigs or owned non-infected pigs.

Only one of the stool samples (0.3 percent) from the 305 individuals who were examined before being treated with niclosamide contained *Taenia* species eggs. Serum from this inhabitant was EITB positive.

Results from tongue and EITB tests in pigs

Nearly 90 percent (64/73) of the Maceda households owned pigs (mean number of pigs per household, 3.7 ± 3.7 (SD); range, 1–11 per household). More than 80 percent of the pigs aged 4 months or more (133/151) were sampled; 43 percent (57/133) were seropositive for *Taenia* by the EITB, and 33 percent (44/133) were found positive by the tongue examination

(table 2). We examined pigs at 52 of the 64 households (81 percent) that had pigs. Of these 52 households, 36 (69 percent) had at least one seropositive pig, and 28 (54 percent) had a pig positive by the tongue examination. Of the houses with latrines, 76 percent had at least one pig positive by the tongue examination, as compared with 33 percent of the houses without latrines. This difference was statistically significant ($p < 0.05$) (table 3). However, there was no difference in the total number of pigs found positive for *Taenia* by each method in households with latrines and those without latrines: Of the 76 pigs tested from households with latrines, 27 were found positive by tongue examination and 29 were found positive by the EITB; of the 56 pigs tested from households without latrines, 16 were found positive by tongue examination and 27 were found positive by the EITB. (Note: The household status of one of the 133 pigs examined could not be identified.)

Environmental samples

No *Taenia* eggs were found in either the five water or the five soil samples.

Cross-sectional comparison of the prevalence of neurologic disease

We compared signs and symptoms of neurologic disease in 28 of the seropositive persons and 29 of the seronegative controls. Two of the seropositive subjects and one of the controls were not available for the neurologic examination. No difference was found between the two groups (table 4). Headaches were common in both groups, and except for one seronegative patient with seizures, neurologic symptoms were limited to signs of peripheral neuropathy (table 4).

As part of the study of the prevalence of neurologic disease, 21 stool samples from the 30 subjects seropositive for *Taenia* by the EITB and from 22 of the 29 seronegative controls were examined for *Taenia* species eggs after niclosamide treatment. *Taenia* species eggs were observed in stools from 4 of 21 infected persons (19 percent) and from 1 of the 22 controls (5 percent) ($p = 0.06$). We were unable to distinguish the eggs of *T. solium* from those of *T. saginata*. *T. saginata* infection occurs in Peru, but the finding for cysticercosis by the EITB in individuals infected with this cestode is negative (12). The eggs observed in the stool of the single control person are probably from a beef tape worm.

DISCUSSION

The EITB test utilizes glycoprotein antigens purified by lectin affinity chromatography. This test is highly sensitive (98 percent) and specific (100 percent), with a positive predictive value greater than 90 percent (11, 12). It does not cross-react with other parasites, including other cestodes such as *T. saginata*, *Hymenolepis nana* and *Echinococcus granulosus* (11, 12).

This study utilized the EITB test to detect antibodies to *T. solium* in persons and pigs in communities where *T. solium* is endemic. Infection was common; 8 percent of the inhabitants and 43 percent of the pigs were seropositive. Cysts were detected on the tongues of 33 percent of the pigs, confirming the high prevalence rates found serologically.

The seroprevalence rates for infection with *Taenia* species in Maceda are among the highest in the world. They are surpassed only by those in New Guinea, where seroprevalence in villages endemic for this disease is about 20 percent (18). In Mexico, serosurveys using the enzyme-linked immunosorbent assay (ELISA), a less sensitive method (12), have found that 5 percent of the population had positive results (19).

In our studies, clustering of infected humans or pigs was not evident, but in similar studies in Mexico, infected individuals tended to be clustered by household (19). The considerable

difference in patterns of village transmission and presentation are probably due to differences in cultural behavior. The discrepancy between low rates of tapeworm infection and high rates of cyst infections in humans has also been noted in India (20), New Guinea (18), and Mexico (19).

The high prevalence of pigs that were seropositive and/or positive by tongue examination strongly suggests that these animals often eat human feces containing *T. solium* eggs. Infection can be severe; some pigs have as many as 2,500 cysts per kilogram of meat (21). Large numbers of eggs must be ingested for pigs to acquire this degree of infection, since at least one egg must be ingested to get one cyst (4, pages 609–25). In areas where pigs are so heavily infected, environmental contamination must be intense, yet environmental surveys rarely demonstrate *Taenia* species eggs (19).

In pigs, agreement between the results of the EITB and of tongue examination has previously been shown to be good (9). The sensitivity of tongue examination is generally lower than that of the EITB. However, in the present study, seven pigs found positive for *Taenia* infection by the tongue examination were negative by the EITB. In pigs, the discrepancy between the findings of the tongue examination and the EITB may be the result of a lack of antibody production in lightly infected animals. Another possible explanation is that the pigs in this study were allowed to range and graze freely about the surrounding thickets, where thorns abound in the vegetation. Some of the palpated “cysts” may actually have been scar tissue from old injuries acquired during feeding.

In this study in a tropical hillside village, the only identifiable risk factor associated with *T. solium* infection in humans was age; in pigs, the presence of a latrine was a risk factor. Antibodies in pigs appear to develop within several months of infection (9, 22). In our study, seropositivity in humans did not begin until after school age. Reasons for the delay in seropositivity may include social factors and dose- and exposure-related variables. Perhaps infection occurs primarily outside the household, or young children are less susceptible to *T. solium* infection.

Our finding that latrines were associated with increased positivity on the tongue examination in pigs suggests that a poorly designed latrine may be more of a hazard than a help in controlling cysticercosis. The lack of an association between latrines and seropositivity in both humans and pigs, however, indicates generalized exposure to *T. solium*.

None of the seropositive villagers had symptoms that were clearly due to cysticercosis or that required therapy or hospitalization. No difference in the rate of headache was noted between infected persons and controls. Signs and symptoms of peripheral neuropathy (hypesthesia, hyporeflexia and/or paresthesia) were present in five subjects. Tropical peripheral neuropathy is usually secondary to toxins such as organophosphorus compounds (23) rather than to space-occupying lesions such as cysticercosis (3).

The high rate of asymptomatic infection is consistent with previous reports of prevalence rates of 0.2 percent found in autopsies of presumably asymptomatic individuals killed by trauma (24). The percentage of asymptomatic seropositive individuals who will eventually develop symptomatic disease is unknown. Some British soldiers stationed in India first developed symptoms 30 years after returning home (25).

Stool examination was not an efficient method for diagnosing *T. solium* infection. Only one of six individuals with taeniasis was detected when a routine single stool examination was performed. This poor result is consistent with that of another study, in which routine microscopy examination of stool detected less than 20 percent of infected individuals (14).

While the EITB test is a useful marker for exposure to *T. solium* antigen, it cannot distinguish between the tapeworm and cyst stages of *T. solium*.

Serologic studies in humans and pigs are useful for 1) determining areas where the disease is endemic, 2) defining and targeting high-risk families by *T. solium* antigen contact, and 3) monitoring the success of control programs by determining the incidence of new cysticercosis infections. Needed however are assays for the detection of carriers of tapeworm and detailed local studies concerning the consumption and sale of pork in zones where the disease is endemic. In addition, studies examining the effect of specific interventions on infections in pigs and humans are required. Such studies will assist in the construction of a rational control program for the prevention of *T. solium* infection.

We have shown the EITB to be a useful tool for defining the epidemiology of cysticercosis in both humans and pigs. In areas where *T. solium* infection is endemic, it is present in 5–10 percent of individuals, most of whom are usually asymptomatic. *T. solium* infection was also seen in 10 percent of Peruvian neurologic patients (3). What is not known is the proportion of infected individuals who will eventually develop symptoms. Even when this proportion is lower than 1 percent, the number of cases of neurologic disease may be high because of the high prevalence of *T. solium* infection in the population. Cysticercosis is a significant public health problem that will require intervention programs that are culturally acceptable and within the economic reach of third world countries.

Acknowledgments

This study was supported by grants from the International Development Research Centre, Ottawa, Canada; the Agency for International Development Peer Science Technology Coordination (7208), Washington, DC; the International Foundation for Science; the Consejo Nacional de Ciencia y Tecnología–Peru, and the RG-ER Fund, Baltimore, MD.

The authors thank Dr. T. Rodriguez, J. B. Phu, and D. Sara for editorial help, A. B. Prisma for aid in data analysis, Gloria D. Cromwell for manuscript preparation, and the population of Maceda for their cooperation.

Abbreviations

EITB enzyme-linked immunoelectrotransfer blot

REFERENCES

1. Mahajan, RC. Geographical distribution of human cysticercosis. In: Flisser, A.; Willms, K.; Laclette, JP., et al., editors. Cysticercosis: present state of knowledge and perspectives. Academic Press; New York: 1982. p. 39-46.
2. Flisser A. Neurocysticercosis in Mexico. Parasitol Today. 1988; 4:131–7. [PubMed: 15463066]
3. Garcia HH, Martinez M, Gilman RH, et al. Diagnosis of cysticercosis in endemic zones. Lancet. 1991; 338:549–51. [PubMed: 1678809]
4. Belding, DL. Textbook of parasitology. 3rd ed.. Appleton Century Crofts; New York: 1965. p. 609-25.
5. Aluja, A. Frequency of porcine cysticercosis in Mexico. In: Flisser, A.; Willms, K.; Laclette, JP., et al., editors. Cysticercosis: present state of knowledge and perspectives. Academic Press; New York: 1982. p. 53-62.
6. Benson, AJ. Publicacion cientifica. Pan American Health Organization; Washington, DC: 1983. El control de las enfermedades Transmisibles; p. 442Spanish
7. Matyas, Z.; Pawlowski, Z.; Soulsby, E.J.L., et al. Guidelines for surveillance, prevention and control of cysticercosis/taeniasis. World Health Organization; Geneva, Switzerland: 1983. p. 71-2.WHO/VPH 83.49

8. Ministerio de Agricultura. Unidad de Servicio Pecuario. Ministerio de Agricultura; Lima, Peru: 1986. Spanish
9. Gonzalez AE, Cama V, Gilman RH, et al. Prevalence and comparison of serologic assays, necropsy, and tongue examination for the diagnosis of porcine cysticercosis in Peru. *Am J Trop Med Hyg.* 1990; 43:194–9. [PubMed: 2389823]
10. Tsang VCW, Peralta JM, Simons AR. Enzyme-linked immunoelectrotransfer blot techniques (EITB) for studying the specificities of antigens and antibodies separated by gel electrophoresis. *Methods Enzymol.* 1983; 92:377–91. [PubMed: 6855619]
11. Tsang VCW, Brand J, Boyer AE. Enzyme-linked immunoelectrotransfer blot assay and glycoprotein antigens for diagnosing human cysticercosis (*Taenia solium*). *J Infect Dis.* 1989; 159:50–9. [PubMed: 2909643]
12. Diaz F, Garcia H, Gilman RH, et al. Immunodiagnosis of human cysticercosis (*Taenia solium*): a comparison of ELISA and EITB assays. *Am J Trop Med Hyg.* In press.
13. Llontop, R.; Nolte, C.; Urbina, R. Cisticercosis encerdos beneficiados en el camal frigorifico No 37 de Tarapoto. Ministerio de Agricultura y Alimentacion RA XI, Laboratorio de Sanidad Animal y Zoonosis; Tarapoto, Peru: 1980. Spanish
14. Pawlowski Z, Schultz MG. Taeniasis and cysticercosis (*Taenia saginata*). *Adv Parasitol.* 1972; 10:270–343.
15. Lumberas H, Cantella R, Burga R. Acerca de un procedimiento de sedimentacion rapida para investigar huevos de *Fasciola hepatica* en heces. Su evaluacion y uso en el campo. *Revista Medica Peruana.* 1962; 31:167–74. Spanish.
16. Musial CE, Arrowood MJ, Sterling CR, et al. Detection of *Cryptosporidium* in water by using polypropylene cartridge filters. *Appl Environ Microbiol.* 1987; 53:687–92. [PubMed: 3579277]
17. Smith PG, Pike MC. Generalizations of two tests for detection of household aggregation of disease. *Biometrics.* 1976; 32:817–28. [PubMed: 827316]
18. Muller R, Lillywhite J, Bending J, et al. Human cysticercosis and intestinal parasitism amongst the Ekari people of Irian Jaya. *J Trop Med Hyg.* 1987; 90:291–6. [PubMed: 3430662]
19. Sarti-Gutierrez EJ. *Taenia solium* taeniasis and cysticercosis in a Mexican village. *Trop Med Parasitol.* 1988; 39:194–8. [PubMed: 3194663]
20. Tandon PN. Cerebral cysticercosis. *Neurosurg Rev.* 1983; 6:119–27. [PubMed: 6371590]
21. Chavera, A.; Gonzales, AE.; Cama, V., et al. Cisticercosis porcina: Aspectos clinicos y patologicos en la Sierra Central del Peru; Anales XII Congreso Panamericano de Ciencias Veterinarias; May 1988; p. 27Spanish
22. Tsang VC, Brand JA, Zhou W, et al. Efficacy of the immunoblot assay for cysticercosis in pigs and modulated expression of distinct IgM/IgG activities to *Taenia solium* antigens in experimental infections. *Vet Immunol Immunopathol.* 1991; 29:69–78. [PubMed: 1949584]
23. Senanayake N, Roman GC. Toxic neuropathies in the tropics. *J Trop Geogr Neurol.* 1991; 1:3–15.
24. Escalante, S. Neurocisticercosis. Universidad Peruana Cayetano Heredia; Lima, Peru: 1973. p. 16(Spanish). Unpublished doctoral dissertation
25. Dixon HBF, Hargreaves WH. Cysticercosis (*Taenia solium*): A further ten years' clinical study, covering 284 cases. *Q J Med.* 1944; 13:107–21.

TABLE 1
**Age-stratified rates of seropositivity for antibodies to *Taenia solium* detected by the enzyme-linked immunoelectrotransfer blot (EITB):
Maceda, Peru, 1988**

Age (years)	Total no. of subjects	Sampled subjects		Seropositive subjects	
		No	%	No.	%
<1	18	10	55	0	0
1-5	72	62	86	0	0
6-10*	67	64	96	4	6
11-15*	58	56	97	3	5
16-30	79	66	84	7	11
31-40	45	39	87	5	13
41-50	29	26	90	2	8
>50	53	48	91	9	19
Total	421	371	88	30	8

* There were significantly fewer seropositive results among children aged 6-15 years than among older villagers (7/120 vs. 23/179; $p < 0.05$ by the chi-square test).

TABLE 2
Comparison of results of enzyme-linked immunoelectrotransfer blot (EITB) tongue
examination for *Taenia solium* infection in pigs^{*}: Maceda, Peru, 1988

Results of tests for <i>T. solium</i> (EITB/tongue examination) [†]	NO. of pigs	%
+/+	37	28
-/+	7	5
+/-	20	15
-/-	69	52
Total	133	100

^{*} McNemar's test shows a significant ($p < 0.01$) difference between the results of the EITB and the tongue examination.

[†] +, positive for *T. solium*; -, negative for *T. solium*.

TABLE 3
Association between household latrine status and detection of *Taenia solium* in pigs by two methods*: Maceda, Peru, 1988

Household latrine status	No. of households	No. of households with pigs	Households with pigs positive for <i>T. solium</i>			
			By EITB		By tongue examination	
			No.	%	No.	%
With latrine	31	25	20	80	19 [†]	76
Without latrine	42	27	16	59	9	33
Total	73	52	36	69	28	54

* Enzyme-linked immunoelectrotransfer blot (EITB) and tongue examination, both performed by veterinarians.

[†] Significantly associated with latrines, $p < 0.05$ by the chi-square test.

TABLE 4
Comparison of neurologic symptoms in villagers seropositive for antibodies to *Taenia solium* by the enzyme-linked immunoelectrotransfer blot and seronegative villagers matched for age and sex: Maceda, Peru, 1988

Symptoms	Seropositive villagers (n = 28)		Seronegative villagers (n = 29)		p value
	No.	%	No.	%	
Headache	16	57	12	41	>0.05
Seizures	0	0*	1	3	>0.05
Hyporeflexia or areflexia	2	7	0	0	>0.05
Hypesthesia	1	4	1	3	>0.05
Paresthesia	2	7	1	3	>0.05

* One patient in the seropositive group had a history of episodes of loss of consciousness.