

## NEUROCYSTICERCOSIS

### AN EPIDEMIOLOGICAL SURVEY IN TWO SMALL RURAL COMMUNITIES

WALTER O. ARRUDA \* — NATAL J. CAMARGO \*\* — ROSANA C. COELHO \*

---

**SUMMARY** — The authors describe the epidemiological findings related to human taeniasis and cysticercosis, and swine cysticercosis in two small rural communities, Postinho (P) and Tigre (T), of South Brazil. The prevalence of epilepsy was 2.04% (P) and 2.25% (T). The prevalence of neurocysticercosis was 0.47% (P) and 0.93% (T), and prevalence of swine cysticercosis was 12.8% (P) and 27.8% (T). *Taenia* sp. infestation was detected in 4.3% (P) and 4.6% (T) of stool examinations. The hyperendemic human taeniasis and cysticercosis and swine cysticercosis seems to be related to poor hygienic habits of the population, and the free access to human excreta by the pigs.

#### **Neurocisticercose: um estudo epidemiológico em duas pequenas comunidades rurais.**

**RESUMO** — Os autores relatam os resultados de estudo epidemiológico sobre cisticercose humana e suína em duas pequenas comunidades rurais do Paraná: Postinho (P) e Tigre (T). A prevalência de epilepsia foi de 2,04% (P) e 2,25% (T). Neurocisticercose foi diagnosticada em 0,47% (P) e 0,93% (T) da população. Cisticercose foi observada em 12,8% (P) e 27,8% (T) no rebanho suíno. Exames parasitológicos foram positivos para *Taenia* sp. em 4,3% (P) e 4,6% (T). A infestação humana e suína hiperendêmica nessas comunidades parece estar relacionada aos precários hábitos higiênicos e às condições sanitárias da população, além do regime de criação solto dos suínos, permitindo seu livre acesso aos dejetos humanos.

---

Cerebral cysticercosis is a complex and heterogeneous infestation of the central nervous system (CNS) due to *Cysticercus cellulosae*, the larval stage of *Taenia solium*. It is the most common parasitic infestation of the CNS in man and represents a serious health problem in many developing countries<sup>6,7</sup>. In countries of high prevalence, cerebral cysticercosis may be a major cause of epilepsy<sup>2,9,11,22</sup>. This disease is acquired through the ingestion of *Taenia solium* eggs. Autoinfestation although controversial, is another postulated mechanism of cysticercosis. The prevalence of neurocysticercosis is reportedly high in countries where the consume of infested pork is high, with a consequent high prevalence of taeniasis. Poor hygienic habits seems to be an essential factor for further contamination of water and/or food<sup>11,27,28</sup>.

In this report, the authors present the results of the first part (Diagnosis of the Situation) of a Pilot Program for the Control of Human Taeniasis and Cysticercosis in two small rural communities of South Brazil.

---

\* Serviço de Neurologia, Centro de Saúde Metropolitano, Secretaria de Estado da Saúde do Paraná, Fundação Caetano Munhoz da Rocha; \*\* Centro de Epidemiologia, Diretoria de Vigilância e Pesquisa, Secretaria de Estado da Saúde do Paraná.

## MATERIAL AND METHODS

A Pilot Program for the Control of Human Taeniasis and Cysticercosis in the State of Paraná was planned by the Secretaria de Estado da Saúde, Estado do Paraná, Fundação Caetano Munhoz da Rocha, in July 1987 and put into action the next month. Two small rural communities, Tigre (Rio Branco do Sul, PR) and Postinho (Tijucas do Sul, PR) (Fig. 1), were elected for this Program due to the following criteria: (1) creation of pigs in complete freedom; (2) average population of 500 inhabitants; (3) basic sanitary deficiencies; (4) high prevalence of pork cysticercosis (more than 5%); (5) high prevalence of human taeniasis (more than 1%). An explanation about the goals of the Project was given to the population. The physical and sanitary characteristics of each community were thoroughly evaluated by sanitary technicians. The prevalence of swine cysticercosis was evaluated through the slaughter and necroscopic examination of 5% of the total swine population of the communities. Positive stool examinations include the presence of eggs of plathelminths and helminths, and the finding and identification of protozoa. Environmental contamination by *Taenia* sp. eggs and enteric parasites were evaluated through parasitological examination of soil and vegetable samples, collected around the houses.

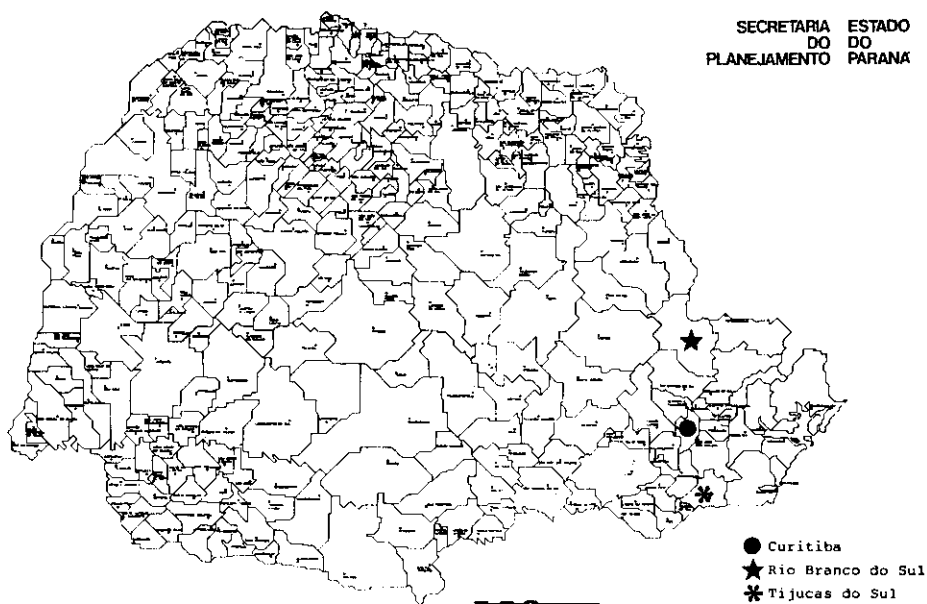


Fig. 1 — Localization in the State of Paraná of the two rural communities studied.

All members of the communities with complaints of headache, epilepsy and/or related neurologic symptoms/signs were referred by a general physician to the Serviço de Neurologia, Centro de Saúde Metropolitano, in Curitiba. These patients were submitted to anamnesis, complete physical and neurological examination (W.O.A.). The diagnosis of epilepsy was given to patients with generalized or partial seizures and who had two or more seizures. Febrile convulsions were excluded. All the epileptic patients and other patients with a specific indication were submitted to CT scan examination. CT scan examinations were performed in two services of computerized tomography with recognized experience in the neuroradiological diagnosis of cysticercosis<sup>14,15</sup>. All patients with tomographic diagnosis of cysticercosis were submitted to spinal tap. Cerebrospinal fluid (CSF) examination included immunofluorescence test for cysticercosis (Mrs. Elvira Doi, Laboratório Clínico do Hospital de Clínicas da Universidade Federal do Paraná). Electroencephalograms (EEG) were performed in all epileptic patients and in other patients with some specific indication. The EEG were recorded for at least 30 min and included the response to hyperventilation. The results were computed as normal or abnormal. The last term included any abnormal electroencephalographic activity, epileptiform or not.

## RESULTS

Characteristics of the two rural communities are given in table 1, including the results of stool examinations. In table 2 are showed data related to pig creation and consume of pork.

A total of seventy patients were thoroughly evaluated, 30(4.7%) from Postinho and 40(7.5%) from Tigre (Table 3). Of 36 CT scans, 9 (25%) were abnormal. In 8 patients the CT scan disclosed the presence of multiple calcifications compatible to neurocysticercosis. Arachnoid cyst of the sylvian fissure was found in one patient. Viable cysticercotic cysts or hydrocephalus were not observed in any patient. Spinal tap was performed in these 9 patients. CSF examination was normal in all of them. Only one patient, with multiple

	Postinho	Tigre
Population	636	532
Properties	130	104
Pig creation	103 (79.2 %)	76 (73.1 %)
Stool examinations	509	522
Positive examinations	460 (90.3 %)	463 (88.7 %)*
Taenia sp.	22 (4.3 %)	24 (4.6 %)*

Table 1 — General characteristics of the rural communities. \* Yates chi square test, nonsignificant.

	Postinho	Tigre
Properties	130	104
Free creation	90 (87.4 %)	72 (94.7 %)
Goal of creation		
1) Consume	62 (60.2 %)	52 (68.4 %)
2) Commerce	1 (1.0 %)	2 (2.6 %)
3) 1 + 2	40 (38.8 %)	22 (29.0 %)
Number of pigs	766	704
Number autopsied	39 (5.0 %)	36 (5.1 %)
Number with cysticercosis	5 (12.8 %)	10 (27.8 %)*

Table 2 — Pigs creations charaterises. \* Yates chi square test, nonsignificant.

	Postinho	Tigre
Population	636	532
Number of patients	30 (4.7 %)	40 (7.5 %)
Male/female	15/15	12/28
Age (years)	25.8 ± 22.0	25.5 ± 17.0
Range	2-76	3-70
Number epileptics	13 (2.04 %)	12 (2.25 %)*
Number CT scans	14	22 *
Number neurocysticercosis	3 (0.47 %)	5 (0.94 %)*

Table 3 — Examined patients of the two communities. \* Yates chi square test, nonsignificant.

nodular calcifications, had a positive CSF indirect immunofluorescent reaction for cysticercosis (1/40). EEG were performed in 35 patients. In 7 patients, epileptiform activity was found. Five patients suffered epilepsy and the other two complained only of headache and denied any convulsive episode. Neurologic examination was normal in all patients with the exception of one, with severe mental retardation.

In around half of the properties, pigs with cysticercosis were slaughtered: Tigre 39(51.3%); Postinho 66(56.4%). Most of this meat was consumed by the communities: Tigre 25(64.1%); Postinho 41(62.1%). The properties have a latrine in a different proportion in the two communities (Postinho 77.9%; Tigre 44.6%) ( $p < 0.05$ ), but in both communities the habit to defecate outside the latrines was equally and highly prevalent (Postinho 66.2%; Tigre 77.0%). For this reason, and due to the system of free creation of animals, the pigs frequently have access to the human dejects in the properties and/or in the neighbourhood (Postinho 95.2%; Tigre 94.7%). The provision of water for human use and for the pigs was not protected in any property (100%).

A good part of the properties have a vegetable garden for its own use (Postinho 84.6%, Tigre 69.2%), and here again the source of water for irrigation was not protected. In table 4 is showed the degree of contamination of the soil and vegetables in both communities. Only the most important species of enteric parasites and protozoa are depicted. A higher proportion of positive parasitological examinations in the soil is observed in Postinho, due the more frequently detection of other enteric parasites eggs (e.g., *Strongyloides stercoralis*) and protozoa. *Taenia* sp. eggs occurred with the same frequency in both communities.

	Postinho		Tigre	
	Soil	Vegetable	Soil	Vegetable
Nr. of samples	101	52	97	37
Nr. positive	41 (40.5 %) *	29 (55.7 %)	65 (67.0 %) *	19 (51.3 %)
<i>Taenia</i> sp.	4 (3.9 %)	1 (1.9 %)	5 (5.1 %)	1 (2.7 %)
<i>Ascaris</i>	25 (24.7 %)	5 (9.5 %)	31 (31.9 %)	3 (8.1 %)
<i>Ancylostoma</i>	2 (1.9 %)	2 (3.8 %)	4 (4.1 %)	1 (2.7 %)
<i>S. stercoralis</i>	3 (3.0 %) *	3 (5.7 %)	17 (17.5 %) *	3 (8.1 %)
<i>Giardia lamblia</i>	1 (0.9 %)	3 (5.7 %)	4 (4.1 %)	1 (2.7 %)
<i>E. histolytica</i>	2 (1.9 %)	2 (3.8 %)		

Table 4 — Parasitological examination of the soil and vegetables. \* Yates chi square test,  $p < 0.01$ .

#### COMMENTS

Most reports about prevalence of neurocysticercosis are based either on pathological data or on the experience of Departments of Neurology and Neurosurgery of general hospitals 4,9,22. Some idea of the real prevalence in different populations are given by sero-epidemiological studies 9,10,13,28. In Mexico, the prevalence of cysticercosis was estimated to be 1.0%, based on the detection of anti-cysticercus antibodies by indirect immunofluorescence (IF) in 18,417 sera 9. Vianna et al. 28 conducted a study in 1,122 patients, and observed a positive IF test or a positive ELISA (enzyme-linked immunosorbent assay) test for *Cysticercus cellulosae* in 5.2%. However, both works emphasize the regional variations of the prevalence of cysticercosis. Neurocysticercosis has been observed to be more prevalent in Southeast and South Brazil, while it is relatively rare in the states of North and Northeast 18,19. Serological tests (complement fixation test, indirect immunofluorescence test) are much less sensitive in inactive forms of neurocysticercosis, in special with normal CSF analysis 13,24. This fact could explain the very low rate of positive CSF serological tests in our cases (one in nine).

Neurocysticercosis, human teniasis and porcine cysticercosis are hyperendemic in these two communities. The actual prevalence of neurocysticercosis may be even higher, for a good number of cases of cerebral cysticercosis are asymptomatic 7,9,16. Epilepsy is the commonest clinical manifestation of neurocysticercosis 4,11,26. Although

control population data are not available, the prevalence of epilepsy seems to be rather high in both studied communities. In fact, high prevalence rates of epilepsy in some Latin America countries may be related to the high local prevalence rates of cerebral cysticercosis<sup>21</sup>. The potential etiologic role of neurocysticercosis in epilepsy can be illustrated by our personal experience with 130 epileptic outpatients, prospectively evaluated by CT scan. Neurocysticercosis was diagnosed in 33 (25.4%).

By the fecal contamination of food and water anybody in the community, irrespective of food preference, may be infected by the ingestion of *T. solium* eggs<sup>27</sup>. This mode of infestation possibly accounts for the cases which history of eating pork is not elicited. The high percentage of soil and vegetable contamination observed in these communities undoubtedly contributes to the continuous swine and human infestation with *Taenia solium* and other enteric parasites.

In conclusion, the data of our study corroborates with the notion that hyperendemic swine cysticercosis, human teniasis and cysticercosis are associated with low standards of living and poor hygienic habits<sup>10,27,28</sup>. A combination of changes in animal husbandry practices, application of meat inspection, sanitary education of the population and improvement of sanitation and living standards may be crucial to the eradication of *Taenia solium*, as occurred in some countries of Europe<sup>8</sup>. In spite of the advent of potent drugs (praziquantel, albendazol)<sup>1,23,25</sup> for the treatment of cysticercosis and taeniasis, its real usefulness is still debatable<sup>16</sup>. Neurosurgical treatment is indicated only in very selected cases<sup>5,20</sup>. Moreover, the morbidity of cysticercosis remains high. The economic effects of high hospital costs, the patient's inactivity and illness during a productive period of life, make the social cost of cysticercosis unbearable in our country. Therefore, all efforts for eradication of this disease are warranted.

Acknowledgments — Participants of the Pilot Program for the Control of Cysticercosis/Taeniasis in Paraná — Lineu R. Silva, Eglé Terezinha Busetti, Vanete Thomaz Soccol, Edilene Alcântara de Castro, Enio Celso Heller, Jamil Kalacne, Rubens Gusso, Nilse Brandalise, José Francisco Konolsaisen, Ederaldo Conceição Telles Filho, Celso Luiz Rúbio.

#### REFERENCES

1. Agapejev S, Meira DA, Barraviera B, Machado JM, Pereira PCM, Mendes RP, Kamegasawa A, Curi PR — Neurocysticercosis: treatment with albendazole and dextrochloropheniramine (preliminary report). *Rev Inst Med trop São Paulo* 30:387, 1988.
2. Arseni C, Cristescu A — Epilepsy due to cerebral cysticercosis. *Epilepsia* 13:253, 1972.
3. Benicio G, Travassos F — Considerações sobre neurocisticercose e epilepsia no nordeste do Brasil. *Neurobiologia* 35:115, 1972.
4. Canelas HM — Neurocisticercose: incidência, diagnóstico e formas clínicas. *Arq Neuro-Psiquiat (São Paulo)* 20:1, 1962.
5. Colli BO, Martelli N, Assirati JA, Machado HR, Forjaz SV — Results of surgical treatment of neurocysticercosis in 69 cases. *J Neurosurg* 65:309, 1986.
6. Del Brutto OH, Sotelo J — Neurocysticercosis: an update. *Rev Infect Dis* 10:1075, 1988.
7. Estanol B, Corona T, Abad P — A prognostic classification of cerebral cysticercosis: therapeutic implications. *J Neurol Neurosurg Psychiat* 49:1121, 1986.
8. Gemmell MA — A critical approach to the concepts of control and eradication of echinococcosis/hydatidosis and taeniasis/cysticercosis. *Parasitology* 17:465, 1987.
9. Gutierrez EJS, Ospina IG — La taeniasis y cisticercosis en México. *Salude Publ Mex* 28:556, 1986.
10. Heinz HJ, Macnab GM — Cysticercosis in the Bantu of Southern Africa. *South Afr J Med Sci* 30:19, 1965.
11. Heinz HJ, Klintworth GK — Cysticercosis in the etiology of epilepsy. *South Afr J Med Sci* 30:32, 1965.
12. Machado LR — Líquido cefalorraqueano e neurocisticercose: aspectos evolutivos da resposta inflamatória celular. *Arq Neuro-Psiquiat (São Paulo)* 45:353, 1987.
13. Marty P, Mary C, Pagliardini G, Quilici M, Le Fichoux Y — Courte enquête sur la cisticercose et la taeniasis à *Taenia solium* dans un village de l'ouest Cameroun. *Méd Trop* 46:181, 1986.
14. Mazer S, Antoniuk A, Ditzel LFS, Araujo JC — The computed tomographic spectrum of cerebral cysticercosis. *Comput Radiol* 7:373, 1983.
15. Mingueti G, Ferreira MV — Computed tomography in neurocysticercosis. *J Neurol Neurosurg Psychiat* 46:936, 1983.

16. Monteiro I, Coelho T, Stocker A — La neurocisticercose, une parasitose fréquente au Portugal. *Presse Méd* 16:964, 1987
17. Moodley M, Moosa A — Treatment of neurocysticercosis: is praziquantel the new hope? *Lancet* 1:262, 1989.
18. Peregrino AJP, Porto SO — Neurocisticercose no sudeste da Bahia. *Arq Neuro-Psiquiat (São Paulo)* 43:55, 1985.
19. Queiroz AC, Martinez AMB — Envolvimento do sistema nervoso central na cisticercose. *Arq Neuro-Psiquiat (São Paulo)* 37:34, 1979.
20. Ramina R, Arruda WO, Parolin MKF, Prestes ACF — When and on what to operate in multiple cysticercosis cysts? *J Neurol Neurosurg Psychiat* 51:1006, 1988.
21. Sander JWAS, Shorvon SD — Incidence and prevalence studies in epilepsy and their methodological problems: a review. *J Neurol Neurosurg Psychiat* 50:829, 1987.
22. Schenone H, Ramirez R, Rojas A — Aspectos epidemiológicos de la neurocisticercosis en America Latina. *Rev Chil Parasit* 28:61, 1973.
23. Sotelo J, Escobedo F, Carbajal JR, Torres R, Rubio-Dennadieu F — Therapy of parenchymal brain cysticercosis with praziquantel. *N Engl J Med* 310:1001, 1984.
24. Sotelo J, Guerrero V, Rubio F — Neurocysticercosis: a new classification based on active and inactive forms. A study of 753 cases. *Arch Intern Med* 145:442, 1985.
25. Spina-França A, Nóbrega JPS, Machado LR, Livramento JA — Neurocisticercose e praziquantel: evolução a longo prazo de 100 pacientes. *Arq Neuro-Psiquiat (São Paulo)* 47:444, 1989.
26. Takayanagui OM, Jardim E — Aspectos clínicos na neurocisticercose: Análise de 500 casos. *Arq Neuro-Psiquiat (São Paulo)* 41:50, 1983.
27. Veliath AJ, Ratnakar C, Thakur LC — Cysticercosis in South India. *J Trop Med Hyg* 88:25, 1985.
28. Vianna LG, Macedo V, Costa JM, Mello P, Souza D — Estudo soropidemiológico da cisticercose humana em Brasília, Distrito Federal. *Rev Soc Bras Méd Trop* 19:149, 1986.