# We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

4,500
Open access books available

118,000
International authors and editors

130M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities


WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

## Interested in publishing with us?
## Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

Chapter 5

# Control of *Taenia Solium* Transmission of Taeniosis and Cysticercosis in Endemic Countries: The Roles of Continental Networks of Specialists and of Local Health Authorities

Agnès Fleury, Edda Sciutto, Aline S. de Aluja, Carlos Larralde, Sonia Agudelo, Gisela Maria Garcia, Jaime Fandiño, Randy Guerra, Cáris Nunes, Samuel Carvalho de Aragão, Marcello Sato, Ronaldo Abraham, Arturo Carpio, Franklin Santillan, Maria Milagros Cortez A., Glenda Rojas, Elizabeth Ferrer, Cruz Manuel Aguilar, Juan Carlos Durán and R. Michael E. Parkhouse

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/51286

## 1. Introduction

Neurocysticercosis (NCC) is still an endemic disease in most of the countries of Asia, Africa and Latin America, despite the important progress made in the development of effective tools for its prevention, diagnosis and treatment. Although the infection disappeared in many European countries during the nineteenth century, in some Eastern European countries control was not achieved until the beginning of the twentieth century, mainly due to the improvement of their political, social and economic status. Alarming recent reports show the persistence of the endemia in Africa [1-3] **(Table 1)**, as well as in the Americas [25] **(Table 2)** and in Asia **(Table 3).** None of the endemic countries has been able to eradicate *Taenia solium´s* Taeniosis/Cysticercosis (T/C). Similarly, the frequency of human cases of NCC is increasing in some industrialized countries, such as the United States, Canada and Spain, due mostly to migrant workers, although some autochthonous cases have also occurred [92-97].

In this paper, we will try to understand the reasons behind such failures and propose strategies that can improve the control of the T/C.

## 2. Actual tools for diagnosis and treatment

It is clear that there are efficient tools for diagnosis and treatment, although investigations must surely go on and progress will be made.

INTECH
open science | open minds

© 2013 Fleury et al., licensee InTech. This is an open access chapter distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/3.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

| Country | Reference | Type of study | Subject included | Diagnosis based on | Seroprevalence Cysticercosis | Prevalence NCC |
|---|---|---|---|---|---|---|
| Burkina Faso | [4] | Population-based | 763 | Ag-ELISA | 10,3%; 1.4%; 0% | |
| | [5] | Population-based | 734 | Ag-ELISA | 4.5% | |
| Burundi | [6] | Case-control | 324 PWE 648 controls | Ab-ELISA | 59.6 % PWE 31,5% controls | |
| | [7] | PWE | 250 | Ab-ELISA | 61% | |
| | [8] | Case-control | 303 PWE 606 Controls | Ab/Ag - ELISA | Ab 58,7% ; Ag 38,3 PWE Ab 31, 4% Ag 20 % controls | |
| | [9, 10] | Population-based | 168 | Ab-ELISA | 1,2% | |
| | [11] | Population-based | 500 | EITB | 25,8% | |
| Cameroon | [12] | Population-based | 137 Butchers 198 Controls | Ag-ELISA | Butchers 3,6% Controls: 4,5% | |
| | [13] | Population-based | 504 PWE | Ab/Ag ELISA | 1,2% Ag 44,6% Ab | |
| | [14] | Population-based | 4993 | Ag-ELISA CT scan | 0,4% 1,0 % 3,0% | 59.1% of sero+ |
| | [15] | Population-based | 93 PWE 81Controls | Ab-ELISA | 18,3% PWE 14,8% Controls | |
| Democratic Republic of Congo | [16] | Population-based | 943 | Ag-ELISA | 21.6% | |
| Madagascar | [17] | Population-based | 4375 | Ab-ELISA EITB | 7-21% | |
| | [18] | US Peace Corps | 73 | EITB | 8,2% | |
| Mozambique | [19] | Urban children | 269 | Abs | 20,8% | |
| Senegal | [20] | Population-based | 403 | Ag-ELISA EITB CT scan | 11,9% | 23,3% of sero+ |
| South Africa | [21] | PWE (Hospital) | 92 | CT scan | | 37% |
| Tanzania | [22, 23] | Hospital-based | 212 PWE | CT scan | | 16.5% |
| Zambia | [24] | Population-based | 708 | Ag-ELISA | 5,8% | |

**Table 1.** Prevalence (sero prevalence) of human neurocysticercosis in Africa.
Only 2002-2012 articles were considered.

Improvement of neuroimaging techniques permits a sensitive and accurate diagnosis of NCC in the great majority of cases, the problem being its limited accessibility to the principal rural population. Immunodiagnosis based on serum antibody detection is an efficient marker of contact with the parasite, permitting the identification of endemic areas in which control and preventive measures must be intensified. Detection of parasite antigens in serum and cerebrospinal fluid permits a confident diagnosis of severe neurocysticercosis forms, allowing opportune and adequate treatment and reducing the morbidity [98]. Regarding NCC treatment, two cestocidal drugs (Praziquantel and

Albendazole) have been used for at least 30 years. Although different studies evaluating their efficacy have shown that these drugs are not efficient in all patients, they also revealed that they eliminate the parasites and diminish the symptomatology significantly more than placebo [99-101]. As a consequence, investigation in this area must continue.

| Country | Reference | Type of study | Subject included | Diagnosis based on | Seroprevalence Cysticercosis (%) | Prevalence NCC |
|---|---|---|---|---|---|---|
| Bolivia | [26] | Population-based | 10124 (124 PWE) | EITB CT-scan | | 27.4% PWE |
| Brazil | [27] | Blood donors | 1133 | Ab-ELISA | 5.6 | |
| | [28] | Population-based | 694 | EITB | 1.6 | |
| | [29] | Hospital-based | 36379 | CT-scan | | 0.20% |
| | [30] | Population-based | 110 PWE | EITB, Ag-ELISA | 8.2 (EITB) 3.6 (ELISA) | |
| | [31] | Hospital-based | 5 105 259 | Admission | | 0.01% |
| | [32] | Population-based | 354 | Ab-ELISA, EITB | 11.3 | |
| | [33] | Population-based | 84 | Ab-ELISA | 5.9 | |
| | [34] | Population-based | Deaths Sao Paulo state | Death certificate | | 0.55/1000,000** |
| | [35] | Hospital-based | 1501 | Autopsies | | 4.80** |
| | [36] | Hospital-based | 1009 | CT-scan | | 9.02 |
| | [37] | Hospital- based | 6500 | Autopsies | | 0.80 |
| Colombia | [38] | Hospital based | Psychiatric patients with neurological signs (98) Primary psychiatric patients (153) Controls (246) | EITB | Group 1: 5.1 Group 2: 2.6 Group 3: 2 | |
| | [39] | Population-based | 399 | Ab- ELISA | 52.9 | |
| | [40] | Patients with neurological symptoms | 1890 sera 989 CSF 52 sera + CSF | Ab-ELISA CTscan/MRI | 14.9 | 82.2 |
| | [41] | Population-based | 157 | Ab-ELISA | 28.7 | |
| | [42] | Pig-breeders | 46 | EITB | 8,7 | |
| | [43] | Population-based | 665 | Ab-ELISA | 28.4 | |
| | [44] | PWE | 111 | Ab- ELISA | 17,1 | |
| | [45] | PWE | 223 | Ab-ELISA | 35,9 | |
| | [46] | Population-based | 29360 | Ab-ELISA | 8.55 | |
| Ecuador | [47] | Population-based | 4306 | Ag-ELISA | 4.99 | |
| | [48] | Population-based | 2415 (24 PWE) | CT scan | | 33% PWE |

| Country | Reference | Type of study | Subject included | Diagnosis based on | Seroprevalence Cysticercosis (%) | Prevalence NCC |
|---|---|---|---|---|---|---|
| | [49] | Population-based | 800 | Ag-ELISA, EITB | 2.25 | |
| | [50] | Hospital-based | 194 PWE (late-onset) | CT scan/MRI | | 19.6* |
| Haiti | [51] | Medical visits | 216 | EITB | 2.8 | |
| Honduras | [52] | Population-based | 6473 (151 PWE) | EITB CT scan | | 37 (PWE) |
| | [53] | Population-based | 5609 (33 PWE) | EITB CT scan | | 13.9 (PWE) |
| Mexico | [54] | Population-based | 154 | CT scan | | 9.1 |
| | [55] | Population-based | 649 | CT scan | | 9.1 |
| | [56] | Psychiatric patients | 105 | Ab-ELISA EITB | 7.6 (ELISA) 0.9 (EITB) | |
| | [57] | PWE (late-onset) | 455 | CT scan | | 21.1 |
| | [58] | All NC patients diagnosed at INNN in 2004 | 4706 | CT scan/ MRI | | 2.5 |
| Nicaragua | [59] | PWE | 88 | Ab-ELISA EITB | 8.0 (ELISA) 14.8 (EITB) | |
| Peru | [60] | Population-based | 2583 | EITB | 13.9 | |
| | [61] | Population-based | 316 | EITB | 21 | |
| | [62] | Population-based | 903 | EITB (825) CTscan (150) | 24.2 | 27.3 |
| | [63] | Housemaids | 1178 | EITB CT-scan | 14.6 | 50 (of sero+) |
| | [64] | Population-based | 803 | EITB CT-scan | 24.4 | 3 |
| | [65] | Population-based | 817 (8 PWE) | EITB CT-scan | | 50 (PWE) |
| | [66] | Population-based | 368 | Ab-ELISA, EITB | 3.3 | |
| Venezuela | [67] | Population-based | 68 | Ag/Ab ELISA | Ag: 64.7, Ab: 79 | |
| | [68] | Population-based (3) | 1254 | Ag/Ab ELISA | Ag: 9.1; 6.1; 5.7 Ab: 36.5;36.5; 4 | |
| | [69] | Hospital-based | 158 psychiatric patients 127 controls | EITB | Patients:18.3 Controls:1.6 | |

EITB: Electro immune transfer blot; PWE: people with epilepsy. Ag: Circulating antigens of *T. solium* metacestodes, Ab: Antibodies anti-cysticercal. * Only patients diagnosed between 2000 and 2009 were included. ** Cases of cysticercosis in general were reported

**Table 2.** Prevalence (sero prevalence) of human neurocysticercosis in Latin America.
Only 2002-2012 articles were considered.

| Country | Reference | Type of Study | Subject included | Diagnosis Based on | seroprevalence | Prevalence NCC |
|---|---|---|---|---|---|---|
| China | [70] | Population-based | 202 | Ab-ELISA | 2.97%. | |
| India | [71] | Population-based | 72 | CT-scan | | 26% |
| | [72] | Hospital study | 1026 PWE | CT-scan | | 34.6% |
| | [73] | Population-based | 1063 | EITB | 15.9% | |
| | [74] | Population-based | 450 | Ab-ELISA | 22.4% | |
| | [75] | Population-based | 595 | CT-scan | | 15.1% |
| | [76] | Population-based | 141 PWE | CT-scan | | 24.8% |
| | [77] | Population-based | 1064 (sera) | Ab / Ag-ELISA CT-scan | 15.9% (Ac) / 4.5% (Ag) | |
| | [78] | Neurological patients | 103 | Ac-ELISA | 33 (32%) | |
| | [79] | Population-based | 1442 controls 91 suspected cases of NCC 100 healthy students | Indirect haemagglutination (IHA) | 6.1% controls 21.97% suspected cases 0% healthy students | |
| | [80] | Blood donors | 216 | Ab-ELISA / Ag-Co-agglutination | 14 (6.48 %) | |
| Indonésia | [81] | Population-based (1539 people) | 1120 cases of burns, 293 PWE (Papua) / 74 PWE, 746 controls (Bali) | Ab-ELISA | 67% PWE, 65% SCN (Papua) 13.5% PWE 12.5% controls (Bali) | |
| | [82] | Population-based | 17 PWE 32 SCN 47 control | Ab-ELISA | 70.6% PWE 62.5% SCN 25.5% control | |
| | [83] | Population-based | 96 | Ab-ELISA | 45.8% | |
| | [84] | Population-based | 311 | Ab-ELISA | 0.3% | |
| Korea | [85] | Population-based | 74,448 | Ab-ELISA | 8.3% (1993) 2.2% (2006) | |
| Malasya | [86] | Population-based | 135 | Ab-ELISA | 2.2%. | |
| Nepal | [87] | Hospital study | 300 PWE | MRI | | 47% |
| Philippines | [88] | Population-based | 497 | Ab-ELISA | 24.6% | |
| Thailand | [89] | Population-based | 159 | Ab-ELISA | 5.70% | |
| Viet Nam | [90] | Population-based | 210 | Ag-ELISA | 5.7% | |
| | [91] | Population-based | 707 (303 mountain, 175 coast 229 urban) | Ag-ELISA, CT scan | 5.3% (mountain) 0.6% (coast) 0% (urban) | |
| PWE: people with epilepsy / SCN: subcutaneous nodules | | | | | | |

**Table 3.** Prevalence (seroprevalence) of human neurocysticercosis in Asia
only 2002-2012 articles were considered.

Regarding porcine cysticercosis, diagnosis based on tongue inspection has been conventionally used, but does not detect all affected pigs. Serology permits, although not with ideal sensibility and specificity, identification of the areas where the life-cycle of the parasite persists. Echography (ultrasound) has recently been introduced as a sensitive (95%) and specific (97%) method of diagnosis (Kappa coefficient of 90%) [102]. Treatment of cysticercotic pigs with oxfendazole has shown a good efficiency [103].

Diagnosis of the adult form of *T. solium* is perhaps the topic where more efforts must be made. Although a species-specific coproantigen ELISA was developed, reaching very good performance [104], further studies are required to evaluate it in field conditions. And this is not so easy, as prevalence of taeniosis seems to be much lower than that of cysticercosis, a fact understandable as one tapeworm carrier can infect hundreds of people and thousands of pigs. Treatment of taeniosis with niclosamide or praziquantel has shown to be very efficient [105].

In conclusion, although efforts must continue in some areas, today we have tools that allow the detection of endemic areas and the effective diagnosis and treatment of patients in most circumstances. This situation, adding to the existence of specific tools for prevention (vaccine), allows the design of extensive and effective preventive and control programs.

## 3. Strategies to eradicate the disease

Cysticercosis is considered a neglected "tools-ready disease" according to WHO [106] and as a potentially eradicable disease since 1993 [107].This is feasible because there are no animal reservoirs besides humans and pigs, the only source of *T. solium* infection for pigs being humans (the definitive host), interrupting the parasite´s life cycle seems an easy task by intervention strategies acting upon different stages of the parasite´s development.

Different strategies have been proposed and tested, generally experimental and at small scale, to eradicate the (T/C) complex, the most notable being:

1. Massive cestocidal treatment to humans in order to reduce the number of tapeworm carriers [108-110].
2. Health education programs aiming to promote the understanding of the mechanisms of transmission of the parasite and to improve hygienic behavior, pig-management and sanitary conditions which fosters transmission [111-113].
3. Treatment of infected pigs [103, 114-116].
4. Vaccination of rural pigs: different vaccines have been tested in field conditions and have demonstrated their efficacy in preventing swine cysticercosis [117-120].
5. Combinations of different strategies: pig vaccination and treatment [121], massive human cestocidal treatment associated with pig vaccination and treatment [122,123].

Almost all these strategies have shown some degree of efficacy, this fact contrasting with the persistence of the parasite in all the endemic countries in the 1950's. It should be noted that, to our knowledge, programs promoting letrinization of rural communities and construction

of pig housing have not been tested (probably due to economic and logistic costs) although it seems to be a very efficient strategy for many parasitic and infectious disease transmitted by faeces.

## 4. What must be done?

This is a truly kafkian situation: we are in the presence of a parasite that causes a potentially severe human disease, as well as important economic losses; paradoxically, it is clear that the disease is potentially eradicable and, in fact, scientists and health authorities know how to eradicate it and have strategies to reach this goal. Despite all these resources, and their demonstrated effectiveness, the signs of a decrease of the transmission rate in the endemic countries are inconclusive or doubtful and, worse yet, in some non-endemic countries, an increase in the number of neurocysticercosis cases is occurring.

Faced with this perspective, it becomes evident that we will not attain the eradication of *T. solium* without:

### 4.1. The intervention of the national and international health authorities in control programs

International initiatives have been concerned with the problem of cysticercosis for many years and several meetings were organised, the most important being: WHO Technical Consultation (Geneva, 1983), Pan American Health Organization (PAHO) Informal Consultation on Taeniasis/Cysticercosis (Porto Allegre, 1990), International Task Force for Disease Eradication (ITFDE, Atlanta, 1993), PAHO/WHO Informal Consultation on the Taeniasis/Cysticercosis Complex (Brasilia, 1995), North Atlantic Treaty Organization (NATO) Seminar on Emergent Helminth Zoonoses, (Pozna, 2000), Fifty-Fifth World Health Assembly, (Geneva, 2002), ITFDE II (Atlanta, 2003), WHO Expert Consultation on Foodborne Trematode Infections (Ventiane, 2009). In most of them, strategies for prevention and control of T/C were analyzed and recommendations were made. Since 2008, the WHO has included T/C in its Global Plan to combat Neglected Tropical diseases [124].

Regarding national health authorities, not much has been done. In very few countries, specific norms have been recommended. Such is the case of Latin America where only Mexico has an official norm for the vigilance, the prevention and the control of T/C in the first level of attention which was published in 1994 (modified in 2004) [125]. The Mexican norm includes the implementation of education and information programs, the identification and treatment of tapeworm carriers, the referral of subjects with suspected of NCC to a second level of attention, the confiscation of infected pigs, and the obligation to notify the diagnosed cases of NCC, taeniosis and swine cysticercosis to the corresponding authorities. The effort must be applauded, and has surely contributed to the awareness of the general population and of the medical personnel about the problem. Unfortunately, still, 15 years after its promulgation, cases of swine and human cysticercosis are still being diagnosed and not notified in Mexico. Probably, this is due to the fact that this norm did not

reach the rural zones where the life-cycle of *T. solium* is still active and notification is not equally honored by all professionals (or because there are no health facilities in these areas).

It is important to promote the confiscation of infected pigs, but who is going to pay the owners, and who will go to the endemic communities (for example >2500 municipalities in Mexico) and make the diagnosis in more than six million rural pigs that get renewed every year? Clearly, pig owners must be included in a control program, for the obvious reason that they are the most interested in not having infected pigs.

It is highly relevant to promote the notification of infected individuals, but who will make this notification? Hospitals with an efficient epidemiologic department are scarce and medical doctors in public institutions are generally over loaded by the clinical workload. The comparison of the official statistics and the statistics published from only one hospital center can demonstrate the problem: in 2004, in the Instituto Nacional de Neurología y Neurocirugía, located in Mexico City, an institution that treats only patients lacking social security, 120 new cases of NCC were diagnosed [58], while in the official statistics, in this same year, approximately 400 new NCC cases were reported throughout Mexico [126]. It is very improbable that a sole institution accounts for a quarter of all the Mexican NCC cases, and probably this is due to a significant under-reporting of cases. Faced with this undesirable practice, what actions can the governments take? It is probably necessary: 1) to maintain a continuing health education program available to the population and the medical personnel, insisting on their obligation to notify the cases and promoting the establishment of epidemiological departments and surveillance system in all the hospitals, 2) to actively lobby for the implementation of a National Control Program that could be started as a priority in the areas from where most cases are referred. In relation to this point, the critical question is, who can organize a preventive program? The scientists probably not, as the logistics of such programs require an established structure supported by a recognized local authority. Since 2009, in Mexico, an extensive pilot control program is under way, in certain areas of the poorest states, based on health and sanitary education and associated with vaccination of pigs. Local authorities are part of the efforts, helping with the identification of the endemic areas, by furnishing sera collected from the pigs, and by funding the program. The results so far are encouraging. People in the remote areas accept suggestions for improvement in their pig raising methods and for their personal hygiene, including the indispensable installation of latrines [127]. What has become clear is that programs must be of long duration, at least 5 years. It is of little use to visit communities, give talks, vaccinate pigs and leave. People in theses "forgotten" areas need long-lasting help, advice and supervision. Therefore, without the active participation of the governments, failure of any control program is predictable because scientists cannot apply it at large enough scales and sufficient time. Finally, the presence of cysticercosis is an objective indicator of unacceptable conditions in a rural community, and their improvement will not only contribute to the eradication of cysticercosis, but will also bring collateral benefits, such as the control of other soil transmitted diseases and increased public awareness of respect for adequate simple public health measures.

### 4.2. Implementation of regional networks

As *T. solium* does not respect frontiers, it is necessary to organize multidisciplinary regional networks of specialists that must be the interlocutors of the local government and international organizations, and that must participate in the decision of where the preventive measures must be applied, and what type of measures are the most adequate regarding the individual characteristics of the country affected. Such efforts are currently established:

- In Asia, the Regional Network for Asian Schistosomiasis and other important zoonoses (RNAS+) was created in 2006 (extension of the RNA created in 2000) and since this date has published several papers and has maintained discussions on preventive measures to be applied to effectively combat zoonoses.
- In Africa: the Cysticercosis Working Group in Eastern and Southern Africa (CWGESA) was established in 2002 to promote communication, collaboration and coordination of integrated research and control activities to combat cysticercosis.
- In Europe, The European Cysticercosis Working Group, inaugurated in 2008 and receiving organizational support from the World Health Organization (WHO)/Food and Agricultural Organization of the United Nations (FAO) Collaborating Centre for Parasitic Zoonoses in Denmark and the University of Edinburgh, Scotland, and aimed at finding ways to achieve a more effective, concerted approach to combat cysticercosis in Europe, as well as in the main cysticercosis-endemic areas of Africa, Asia, and Latin America [128].
- In Latin America, since 1987, the Cysticercosis Working Group in Peru has made several epidemiological, diagnostic and control studies in this country [129] and recently a new Ibero-Latinamerican network was created to promote the investigation and the implementation of preventive measures in the entire continent.

At the moment, although some objectives have been reached, their scope is still limited. To improve the situation, it is necessary: 1) to expand exchanges between the different networks; 2) to open ways of communication between these networks and the national and international authorities.

In conclusion, to reach the control of *T.solium* infections it is very important to open new ways of communication between the scientists, grouped in networks, and with the international and the national health authorities. Agreements must be made in which the role and responsibilities of each of them are clearly defined. If one of these conditions fails, we are afraid that in 50 years, today's T/C epidemiological situation will persist.

## Author details

Agnès Fleury*
*For the Ibero Latinamerican Cysticercosis Network*
*Peripheral Unit of the Institute of Biomedical Research in the National Neurology Institute,*
*National Autonomous University of Mexico, Mexico DF*

* Corresponding Author

Edda Sciutto and Carlos Larralde
*Immunology Department, Institute of Biomedical Research, National Autonomous University of Mexico, Mexico DF*

Aline S. de Aluja
*Department of Pathology, School of Veterinary Medicine and Zootecnies, National Autonomous University of Mexico, Mexico DF*

Sonia Agudelo and Maria Garcia Gisela
*Department of Parasitology, Academic Corporation for the Study of Tropical Pathologies, School of Medicine, Antioquia University, Medellin, Colombia*

Jaime Fandiño and Randy Guerra
*Latin America Research Center in Epilepsy, Cartagena, Colombia*

Cáris Nunes and Samuel Carvalho de Aragão
*School of Veterinary Medicine, University Estadual Paulista Julio de Mesquita Filho, Brazil*

Marcello Sato
*University Federal Do Tocantins, Brazil*

Ronaldo Abraham
*Medicine Department, Taubaté University, Brazil*

Arturo Carpio
*University of Cuenca, Ecuador*

Franklin Santillan
*Santa Ana Clinic, Cuenca, Ecuador*

Maria Milagros Cortez A., Glenda Rojas and Elizabeth Ferrer
*Biomedical Research Institute "Dr. Francisco J. Triana Alonso", Faculty of Health Sciences, University of Carabobo, Maracay, Venezuela*

Cruz Manuel Aguilar
*Tropical Diseases Research Center, University of Carabobo, San Carlos, Cjedes state, Venezuela*

Juan Carlos Durán
*Higher University of San Andrés, La Paz, Bolivia*

Teresa Garate
*Carlos III Institute of Health, National Center of Microbiology, Majadahonda, Madrid, Spain*

R. Michael E. Parkhouse
*Instituto Gulbenkian de Ciencias, Oeiras, Portugal*

## Acknowledgement

The authors acknowledge the CYTED program (Ibero-American Programme for Science, Technology and Development) that has founded partially the network.

## 5. References

[1] Pondja A, Neves L, Mlangwa J, Afonso S, Fafetine J, Willingham AL 3rd, Thamsborg SM, Johansen MV. Prevalence and risk factors of porcine cysticercosis in Angónia District, Mozambique. PLoSNegl Trop Dis. 2010;4(2):e594

[2] Assana E, Amadou F, Thys E, Lightowlers MW, Zoli AP, Dorny P, Geerts S. Pig-farming systems and porcine cysticercosis in the north of Cameroon. J Helminthol. 2010;84(4):441-6.

[3] Praet N, Kanobana K, Kabwe C, Maketa V, Lukanu P, Lutumba P, Polman K, Matondo P, Speybroeck N, Dorny P, Sumbu J. *Taenia solium* cysticercosis in the Democratic Republic of Congo: how does pork trade affect the transmission of the parasite? PLoS Negl Trop Dis. 2010;4(9).

[4] Carabin H, Millogo A, Praet N, Hounton S, Tarnagda Z, Ganaba R, Dorny P, Nitiéma P, Cowan LD. Evaluation du Fardeau Economique de la Cysticercose Au Burkina Faso (EFECAB)- Seroprevalence to the antigens of *Taenia solium* cysticercosis among residents of three villages in Burkina Faso: a cross-sectional study. PLoS Negl Trop Dis. 2009;3(11):e555.

[5] Nitiéma P, Carabin H, Hounton S, Praet N, Cowan LD, Ganaba R, Kompaoré C, Tarnagda Z, Dorny P, Millogo A. Prevalence case-control study of epilepsy in three Burkina Faso villages. Acta Neurol Scand. 2012 Jan 31. doi: 10.1111/j.1600-0404.2011.01639.x.

[6] Nsengiyumva G, Druet-Cabanac M, Ramanankandrasana B, Bouteille B, Nsizabira L, Preux PM. Cysticercosis as a major risk factor for epilepsy in Burundi, east Africa. Epilepsia. 2003;44(7):950-5.

[7] Diagana M, Nsengiyumva G, Tuillas M, Druet-Cabanac M, Bouteille B, Preux PM, Tapie P. Electroencephalograms (EEG) in 250 patients with epilepsy in a cysticercosis endemic area in Burundi. Neurophysiol Clin. 2005;35(1):1-10.

[8] Prado-Jean A, Kanobana K, Druet-Cabanac M, Nsengyiumva G, Dorny P, Preux PM, Geerts S. Combined use of an antigen and antibody detection enzyme-linked immunosorbent assay for cysticercosis as tools in an epidemiological study of epilepsy in Burundi. Trop Med Int Health. 2007;12(7):895-901.

[9] Nkouawa A, Sako Y, Itoh S, Kouojip-Mabou A, Nganou CN, Saijo Y, Knapp J, Yamasaki H, Nakao M, Nakaya K, Moyou-Somo R, Ito A. Serologica studies of neurologic helminthic infections in rural areas of southwest cameroon: toxocariasis, cysticercosis and paragonimiasis. PLoS Negl Trop Dis. 2010;4(7):e732.

[10] Nkouawa A, Sako Y, Moyou-Somo R, Ito A. Serological and molecular tools to detect neurologic parasitic zoonoses in rural Cameroon. Southeast Asian J Trop Med Public Health. 2011;42(6):1365-74.

[11] O'Neal SE, Townes JM, Wilkins PP, Noh JC, Lee D, Rodriguez S, Garcia HH, Stauffer WM. Seroprevalence of antibodies against *Taenia solium* cysticerci among refugees resettled in United States. Emerg Infect Dis. 2012;18(3):431-8.

[12] Vondou L, Zoli AP, Nguekam, Pouedet S, Assana E, Kamga Tokam AC, Dorny P, Brandt J, Geerts S. *Taenia solium* taeniasis/cysticercosis in the Menoua division (West Cameroon). Parasite. 2002;9(3):271-4.

[13] Zoli AP, Nguekam, Shey-Njila O, Nsame Nforninwe D, Speybroeck N, Ito A, Sato MO, Dorny P, Brandt J, Geerts S. Neurocysticercosis and epilepsy in Cameroon. Trans R Soc Trop Med Hyg. 2003;97(6):683-6.

[14] Nguekam JP, Zoli AP, Zogo PO, Kamga AC, Speybroeck N, Dorny P, Brandt J, Losson B, Geerts S. A seroepidemiological study of human cysticercosis in West Cameroon. Trop Med Int Health. 2003;8(2):144-9.

[15] Dongmo L, Druet-Cabanac M, Moyou SR, Zebaze DR, Njamnshi AK, Sini V, Mapoure N, Echouffo TJ, Djeumen WC, Ndumbe PM. Cysticercosis and epilepsy: a case-control study in Mbam Valley, Cameroon. Bull Soc Pathol Exot. 2004;97(2):105-8.

[16] Kanobana K, Praet N, Kabwe C, Dorny P, Lukanu P, Madinga J, Mitashi P, Verwijs M, Lutumba P, Polman K. High prevalence of *Taenia solium* cysticercosis in a village community of Bas-Congo, Democratic Republic of Congo. Int J Parasitol. 2011;41(10):1015-8.

[17] Andriantsimahavandy A, Ravaoalimalala VE, Rajaonarison P, Ravoniarimbinina P, Rakotondrazaka M, Raharilaza N, Rakotoarivelo D, Ratsitorahina M, Rabarijaona LP, Ramarokoto CE, Leutscher P, Migliani R. The current epidemiological situation of cysticercosis in Madagascar. Arch Inst Pasteur Madagascar. 2003;69(1-2):46-51.

[18] Leutscher P, Andriantsimahavandy A. Cysticercosis in Peace Corps volunteers in Madagascar. N Engl J Med. 2004;350(3):311-2.

[19] Noormahomed EV, Pividal JG, Azzouz S, Mascaró C, Delgado-Rodríguez M, Osuna A. Seroprevalence of anti-cysticercus antibodies among the children living in the urban environs of Maputo, Mozambique. Ann Trop Med Parasitol. 2003;97(1):31-5.

[20] Secka A, Grimm F, Marcotty T, Geysen D, Niang AM, Ngale V, Boutche L, Van Marck E, Geerts S. Old focus of cysticercosis in a senegalese village revisited after half a century. Acta Trop. 2011;119(2-3):199-202.

[21] Foyaca-Sibat H, Cowan LD, Carabin H, Targonska I, Anwary MA, Serrano-Ocaña G, Krecek RC, Willingham AL 3rd. Accuracy of serological testing for the diagnosis of prevalent neurocysticercosis in outpatients with epilepsy, Eastern Cape Province, South Africa. PLoS Negl Trop Dis. 2009;3(12):e562.

[22] Winkler AS, Blocher J, Auer H, Gotwald T, Matuja W, Schmutzhard E. Epilepsy and neurocysticercosis in rural Tanzania-An imaging study. Epilepsia. 2009;50(5):987-93.

[23] Blocher J, Schmutzhard E, Wilkins PP, Gupton PN, Schaffert M, Auer H, Gotwald T, Matuja W, Winkler AS. A cross-sectional study of people with epilepsy and neurocysticercosis in Tanzania: clinical characteristics and diagnostic approaches. PLoS Negl Trop Dis. 2011;5(6):e1185.

[24] Mwape KE, Phiri IK, Praet N, Muma JB, Zulu G, Van den Bossche P, de Deken R, Speybroeck N, Dorny P, Gabriël S. *Taenia solium* Infections in a rural area of Eastern Zambia-A community based study. PLoS Negl Trop Dis. 2012; 6(3): e1594.

[25] Morales J, Martínez JJ, Rosetti M, Fleury A, Maza V, Hernandez M, Villalobos N, Fragoso G, de Aluja AS, Larralde C, Sciutto E. Spatial distribution of *Taenia solium* porcine cysticercosis within a rural area of Mexico. PLoS Negl Trop Dis. 2008;2(9):e284.

[26] Nicoletti A, Bartoloni A, Sofia V, Bartalesi F, Chavez JR, Osinaga R, Paradisi F, Dumas JL, Tsang VC, Reggio A, Hall AJ. Epilepsy and neurocysticercosis in rural Bolivia: a population-based survey. Epilepsia. 2005;46(7):1127-32.

[27] Silveira-Lacerda Ede P, Machado ER, Arantes SC, Costa-Cruz JM. Anti-*Taenia solium* metacestodes antibodies in serum from blood donors from four cities of Triângulo Mineiro area, Minas Gerais, Brazil, 1995. Rev Inst Med Trop Sao Paulo. 2002;44(4):229-31.

[28] Gomes I, Veiga M, Embirucu EK, Rabelo R, Mota B, Meza-Lucas A, Tapia-Romero R, Carrillo-Becerril BL, Alcantara-Anguiano I, Correa D, Melo A. Taeniasis and cysticercosis prevalence in a small village from Northeastern Brazil. Arq Neuropsiquiatr. 2002;60(2-A):219-23.

[29] Mendes EC, da Silva SS, Fonseca EA, de Souza HR, de Carvalho RW. Human neurocysticercosis in Baixada Fluminense, Rio de Janeiro State, Brazil. Arq Neuropsiquiatr. 2005;63(4):1058-62.

[30] Freitas FI, Meza-Lucas A, Lima CB, Costa W, Melo A. Cysticercosis research in epileptic patients dwelling in towns of the western Cariri in the State of Paraíba, Brazil. Arq Neuropsiquiatr. 2005;63(3A):656-60.

[31] Façanha MC. Cysticercosis' admissions in public health hospitals: Ceará State distribuition. Rev Soc Bras Med Trop. 2006;39(5):484-7.

[32] Oliveira HB, Rodrigues RM, Barcelos IS, Silva LP, Costa-Cruz JM. Anti-*Taenia solium* metacestode IgG antibodies in serum samples from inhabitants of a central-western region of Brazil. Rev Inst Med Trop Sao Paulo. 2006;48(1):49-52.

[33] Prestes-Carneiro LE, Freitas Sde B, Zago SC, Miguel NA, Primo OB, Iha AH, Espíndola NM, Vaz AJ. Taeniosis-cysticercosis complex in individuals of a peasants' settlement (Teodoro Sampaio, Pontal of Paranapanema, SP, Brazil). Mem Inst Oswaldo Cruz. 2006 ;101(1):15-20.

[34] Santo AH. Cysticercosis-related mortality in the State of São Paulo, Brazil, 1985-2004: a study using multiple causes of death. Cad Saude Publica. 2007;23(12):2917-27.

[35] Faleiros AC, Lino-Junior R, Lima V, Cavellani C, Corrêa RR, Llaguno M, Reis M, Teixeira V. Epidemiological analysis of patients coinfected with Chagas disease and cysticercosis. Biomedica. 2009;29(1):127-32.

[36] Grazziotin AL, Fontalvo MC, Santos MB, Monego F, Grazziotin AL, Kolinski VH, Bordignon RH, Biondo AW, Antoniuk A. Epidemiologic pattern of patients with neurocysticercosis diagnosed by computed tomography in Curitiba, Brazil. Arq Neuropsiquiatr. 2010;68(2):269-72.

[37] de Almeida SM, Torres LF. Neurocysticercosis--retrospective study of autopsy reports, a 17-year experience. J Community Health. 2011;36(5):698-702.

[38] Sanzón F, Osorio AM, Morales JP, Isaza R, Cardona E, Moncayo LC, Villota GE, Zapata OT, Palacio CA, Arbeláez MP, Restrepo BI. Serological screening for cysticercosis in mentally altered individuals. Trop Med Int Health. 2002;7(6):532-8

[39] Torres F, Vásquez R, Gonzales F, Vergara D, Alvarado E, Giraldo J, Medina G, Zamora T. Cisticercosis en el departamento de Cauca. Revista de la Asociación Colombiana de Ciencias Biológicas. Ibagué (Colombia). 2004; 16(2).

[40] Montero Y, Rojas R. Estudio retrospectivo de la seroprevalencia de neurocisticercosis en Colombia. Dentro del Periodo de enero de 1995 a diciembre de 2005. Programa de Vigilancia por el Laboratorio. Instituto Nacional de Salud. Tesis de pregrado Bacteriología Pontifica Universidad Javeriana. Colombia. 2005

[41] Caldera O, Acuña E, Guzman E, Giraldo J, Yanine H. Prevalencia de anticuerpos frente a las fracciones polipeptídicas 53 y 92 kDa del metacéstodo de *Taenia solium* en habitantes del corregimiento Sabanas de Pedro, Sucre. Biomédica. 2005; 25(1): 188.

[42] Agudelo-Flórez P, Restrepo B, Palacio G. Knowledge and practices concerning taeniasis-cysticercosis in Colombian pig-breeders. Rev. salud pública. Colombia. 2009;11 (2): 191-199.

[43] Vásquez L, Agudelo-Florez P, Giraldo J, Vergara D , Samper D, Nieto-S D, Ramos O, Bonilla L, Campo V. Prevalencia de cisticercosis humana en el área rural de mercaderes, cauca. Revista de la Asociación Colombiana de Ciencias Biológicas. 2010;22(1): 68

[44] Vergara J, Ortega M, Vásquez L, Casas J, Giraldo J. Cisticercosis humana en pacientes con diagnóstico de epilepsia en un centro de salud de Popayán, Cauca Introducción. Biomédica 2011. 31(3):83.

[45] Giraldo J, Franco C, Vásquez L. Detección de anticuerpos anti-cisticerco en pacientes que asistieron a consulta médica durante el período 2009-2010 a la Liga contra la Epilepsia, Capítulo Cauca. Biomédica. 2011;31(3):159.

[46] Flórez A, Pastrán S, Vargas N, Enríquez Y, Peña A, Benavides A, Villarreal A, Rincón C, Garzón I, Muñoz L, Guasmayan L, Valencia C, Parra S, Hernández N. Seroprevalencia de la cisticercosis en 23 departamentos de Colombia, 2010. Biomédica. 2011; 31(3): 29-32.

[47] Rodríguez-Hidalgo R, Benítez-Ortiz W, Dorny P, Geerts S, Geysen D, Ron-Román J, Proaño-Pérez F, Chávez-Larrea MA, Barrionuevo-Samaniego M, Celi-Erazo M, Vizcaíno-Ordóñez L, Brandt J. Taeniosis-cysticercosis in man and animals in the Sierra of Northern Ecuador. Vet Parasitol. 2003;118(1-2):51-60.

[48] Del Brutto OH, Santibáñez R, Idrovo L, Rodrìguez S, Díaz-Calderón E, Navas C, Gilman RH, Cuesta F, Mosquera A, Gonzalez AE, Tsang VC, García HH. Epilepsy and neurocysticercosis in Atahualpa: a door-to-door survey in rural coastal Ecuador. Epilepsia. 2005;46(4):583-7.

[49] Rodriguez-Hidalgo R, Benitez-Ortiz W, Praet N, Saa LR, Vercruysse J, Brandt J, Dorny P. Taeniasis-cysticercosis in Southern Ecuador: assessment of infection status using multiple laboratory diagnostic tools. Mem Inst Oswaldo Cruz. 2006;101(7):779-82.

[50] Del Brutto OH, Del Brutto VJ. Reduced percentage of neurocysticercosis cases among patients with late-onset epilepsy in the new millennium. Clin Neurol Neurosurg. 2012 Apr 11.

[51] Raccurt CP, Agnamey P, Boncy J, Henrys JH, Totet A. Seroprevalence of human *Taenia solium* cysticercosis in Haiti. J Helminthol. 2009;83(2):113-6.

[52] Medina MT, Durón RM, Martínez L, Osorio JR, Estrada AL, Zúniga C, Cartagena D, Collins JS, Holden KR. Prevalence, incidence, and etiology of epilepsies in rural Honduras: the Salamá Study. Epilepsia. 2005;46(1):124-31.

[53] Medina MT, Aguilar-Estrada RL, Alvarez A, Durón RM, Martínez L, Dubón S, Estrada AL, Zúniga C, Cartagena D, Thompson A, Ramirez E, Banegas L, Osorio JR, Delgado-Escueta AV, Collins JS, Holden KR. Reduction in rate of epilepsy from neurocysticercosis by community interventions: the Salamá, Honduras study. Epilepsia. 2011;52(6):1177-85.

[54] Fleury A, Gómez T, Alvarez I, Meza D, Huerta M, Chavarria A . High prevalence of calcified silent neurocysticercosis in a rural village of Mexico. Neuroepidemiology 2003;22:139-145.

[55] Fleury A, Morales J, Bobes RJ, Dumas M, Yánez O, Piña J, . An Epidemiological study of familial neurocysticercosis in an endemic Mexican community. Trans R Soc Trop Med Hyg 2006;100: 551-558.

[56] Alvarado-Esquivel C, Arreola-Valenzuela MA, Rodríguez-Briones A, Alanís-Quiñones OP, Estrada-Martínez S, Luevanos-Becerra C, . Seroprevalence of selected viral, bacterial and parasitic infections among inpatients of a public psychiatric hospital of Mexico. Rev Inst Med Trop Sao Paulo 2008;50:161-164.

[57] Suástegui R, Gutiérrez J, Ramos R, Bouchan S, Navarrete H, Ruiz J, . Clinical characteristics of the late-onset epilepsy in Mexico to the beginning of the new millennium: 455 cases. Rev Invest Clin 2009;61:354-363.

[58] Fleury A, Moreno García J, Valdez Aguerrebere P, de SayveDurán M, Becerril Rodríguez P, Larralde C, Sciutto E. Neurocysticercosis, a persisting health problem in Mexico. PLoS Negl Trop Dis. 2010;4(8):e805.

[59] Bucardo F, Meza-Lucas A, Espinoza F, García-Jerónimo RC, García-Rodea R, Correa D. The seroprevalence of *Taenia solium* cysticercosis among epileptic patients in León, Nicaragua, as evaluated by ELISA and western blotting. Ann Trop Med Parasitol. 2005 Jan;99(1):41-5.

[60] García HH, Gilman RH, Gonzalez AE, Verastegui M, Rodriguez S, Gavidia C, Tsang VC, Falcon N, Lescano AG, Moulton LH, Bernal T, Tovar M; Cysticercosis Working Group in Perú. Hyperendemic human and porcine *Taenia solium* infection in Perú. Am J Trop Med Hyg. 2003;68(3):268-75.

[61] Moro PL, Lopera L, Bonifacio N, Gilman RH, Silva B, Verastegui M, Gonzales A, Garcia HH, Cabrera L; Cysticercosis Working Group in Peru. *Taenia solium* infection in a rural community in the Peruvian Andes. Ann Trop Med Parasitol. 2003;97(4):373-9.

[62] Montano SM, Villaran MV, Ylquimiche L, Figueroa JJ, Rodriguez S, Bautista CT, Gonzalez AE, Tsang VC, Gilman RH, Garcia HH; Cysticercosis Working Group in Peru. Neurocysticercosis: association between seizures, serology, and brain CT in rural Peru. Neurology. 2005;65(2):229-33.

[63] Huisa BN, Menacho LA, Rodriguez S, Bustos JA, Gilman RH, Tsang VC, Gonzalez AE, García HH; Cysticercosis Working Group in Perú. Taeniasis and cysticercosis in housemaids working in affluent neighborhoods in Lima, Peru. Am J Trop Med Hyg. 2005;73(3):496-500.

[64] Lescano AG, Garcia HH, Gilman RH, Gavidia CM, Tsang VC, Rodriguez S, Moulton LH, Villaran MV, Montano SM, Gonzalez AE; Cysticercosis Working Group in Peru. *Taenia solium* cysticercosis hotspots surrounding tapeworm carriers: clustering on human seroprevalence but not on seizures. PLoS Negl Trop Dis. 2009;3(1):e371.

[65] Villarán MV, Montano SM, Gonzalvez G, Moyano LM, Chero JC, Rodriguez S, Gonzalez AE, Pan W, Tsang VC, Gilman RH, Garcia HH; Cysticercosis Working Group in Peru. Epilepsy and neurocysticercosis: an incidence study in a Peruvian rural population. Neuroepidemiology. 2009;33(1):25-31.

[66] Cordero A, Miranda E, Segovia G, Cantoral V, Huarcaya I. Taeniosis prevalence and human cysticercosis seroprevalence in Pampa Cangallo, Ayacucho, Peru 2008. Rev Peru Med Exp Salud Publica. 2010;27(4):562-8.

[67] Ferrer E, Cortez MM, Perez H, De la Rosa M, de Noya BA, D'Avila I, Harrison LJ, Foster-Cuevas M, Parkhouse RM, Cabrera A. Serological evidence for recent exposure to *Taenia solium* in Venezuelan Amerindians. Am J Trop Med Hyg. 2002;66(2):170-4.

[68] Ferrer E, Cabrera Z, Rojas G, Lares M, Vera A, de Noya BA, Fernandez I, Romero HU, Harrison LJ, Parkhouse RM, Cortez MM. Evidence for high seroprevalence of *Taenia solium* cysticercosis in individuals from three rural communities in Venezuela. Trans R Soc Trop Med Hyg. 2003;97(5):522-6.

[69] Meza NW, Rossi NE, Galeazzi TN, Sánchez NM, Colmenares FI, Medina OD, Uzcategui NL, Alfonzo N, Arango C, Urdaneta H. Cysticercosis in chronic psychiatric inpatients from a Venezuelan community. Am J Trop Med Hyg. 2005;73(3):504-9.

[70] Chung JY, Eom KS, Yang Y, Li X, Feng Z, Rim HJ, Cho SY, Kong Y. A seroepidemiological survey of *Taenia solium* cysticercosis in Nabo, Guangxi Zhuang Autonomous Region, China. Korean J Parasitol. 2005;43(4):135-9.

[71] Prasad KN, Chawla S, Jain D, Pandey CM, Pal L, Pradhan S, Gupta RK. Human and porcine *Taenia solium* infection in rural north India. Trans R Soc Trop Med Hyg. 2002;96(5):515-6.

[72] Singh G, Singh P, Singh I, Rani A, Kaushal S, Avasthi G. Epidemiologic classification of seizures associated with neurocysticercosis: observations from a sample of seizure disorders in neurologic care in India. Acta Neurol Scand. 2006;113(4):233-40.

[73] Prabhakaran V, Raghava MV, Rajshekhar V, Muliyil J, Oommen A. Seroprevalence of *Taenia solium* antibodies in Vellore district, south India. Trans R Soc Trop Med Hyg. 2008;102(3):246-50.

[74] Vora SH, Motghare DD, Ferreira AM, Kulkarni MS, Vaz FS. Prevalence of human cysticercosis and taeniasis in rural Goa, India. J Commun Dis. 2008;40(2):147-50.

[75] Prasad KN, Verma A, Srivastava S, Gupta RK, Pandey CM, Paliwal VK. An epidemiological study of asymptomatic neurocysticercosis in a pig farming community in northern India. Trans R Soc Trop Med Hyg. 2011;105(9):531-6.

[76] Goel D, Dhanai JS, Agarwal A, Mehlotra V, Saxena V. Neurocysticercosis and its impact on crude prevalence rate of epilepsy in an Indian community. Neurol India. 2011;59(1):37-40.

[77] Jayaraman T, Prabhakaran V, Babu P, Raghava MV, Rajshekhar V, Dorny P, Muliyil J, Oommen A. Relative seroprevalence of cysticercus antigens and antibodies and

antibodies to Taenia ova in a population sample in south India suggests immunity against neurocysticercosis. Trans R Soc Trop Med Hyg. 2011;105(3):153-9.

[78] Kumar A, Khan SA, Khan S, Das S, Anurag, Negi KS. A study of neurocysticercosis in the foothills of the Himalayas. Int J Infect Dis. 2006;10(1):79-82.

[79] Parija SC, Sahu PS. A serological study of human cysticercosis in Pondicherry, South India. J Commun Dis. 2003;35(4):283-9.

[80] Parija SC, Balamurungan N, Sahu PS, Subbaiah SP. Cysticercus antibodies and antigens in serum from blood donors from Pondicherry, India. Rev Inst Med Trop Sao Paulo. 2005;47(4):227-30.

[81] Margono SS, Subahar R, Hamid A, Wandra T, Sudewi SS, Sutisna P, Ito A. Cysticercosis in Indonesia: epidemiological aspects. Southeast Asian J Trop Med Public Health. 2001;32 Suppl 2:79-84.

[82] Wandra T, Ito A, Yamasaki H, Suroso T, Margono SS. *Taenia solium* Cysticercosis, Irian Jaya, Indonesia. Emerg Infect Dis. 2003;9(7):884-5.

[83] Suroso T, Margono SS, Wandra T, Ito A. Challenges for control of taeniasis/cysticercosis in Indonesia. Parasitol Int. 2006;55 Suppl:S161-5.

[84] Wandra T, Sutisna P, Dharmawan NS, Margono SS, Sudewi R, Suroso T, Craig PS, Ito A. High prevalence of *Taenia saginata* taeniasis and status of *Taenia solium* cysticercosis in Bali, Indonesia, 2002-2004. Trans R Soc Trop Med Hyg. 2006;100(4):346-53.

[85] Lee MK, Hong SJ, Kim HR. Seroprevalence of tissue invading parasitic infections diagnosed by ELISA in Korea. J Korean Med Sci. 2010;25(9):1272-6.

[86] Noor Azian MY, Hakim SL, Sumiati A, Norhafizah M. Seroprevalence of cysticercosis in a rural village of Ranau, Sabah, Malaysia. Southeast Asian J Trop Med Public Health. 2006;37(1):58-61.

[87] Rajbhandari KC. Epilepsy in Nepal. Can J Neurol Sci. 2004;31(2):257-60.

[88] Xu JM, Acosta LP, Hou M, Manalo DL, Jiz M, Jarilla B, Pablo AO, Ovleda RM, Langdon G, McGarveyST,Kurtis JD, Friedman JF, Wu HW. Seroprevalence of cysticercosis in children and young adults living in a helminth endemic community in leyte, the Philippines. J Trop Med. 2010;2010:603174

[89] Anantaphruti MT, Okamoto M, Yoonuan T, Saguankiat S, Kusolsuk T, Sato M, Sato MO, Sako Y, Waikagul J, Ito A. Molecular and serological survey on taeniasis and cysticercosis in Kanchanaburi Province, Thailand. Parasitol Int. 2010;59(3):326-30.

[90] Erhart A, Dorny P, Van De N, Vien HV, Thach DC, Toan ND, Cong le D, Geerts S, Speybroeck N, Berkvens D, Brandt J. Taenia solium cysticercosis in a village in northern Viet Nam: seroprevalence study using an ELISA for detecting circulating antigen. Trans R Soc Trop Med Hyg. 2002;96(3):270-2.

[91] Somers R, Dorny P, Nguyen VK, Dang TC, Goddeeris B, Craig PS, Vercruysse J. Taenia solium taeniasis and cysticercosis in three communities in north Vietnam. Trop Med Int Health. 2006;11(1):65-72.

[92] Esquivel A, Diaz-Otero F, Gimenez-Roldan S. Growing frequency of neurocysticercosis in Madrid (Spain).Neurologia. 2005;20(3):116-20.

[93] O'Neal S, Noh J, Wilkins P, Keene W, Lambert W, Anderson J, Compton Luman J, Townes J. *Taenia solium* Tapeworm Infection, Oregon, 2006-2009. Emerg Infect Dis. 2011;17(6):1030-6.

[94] Sorvillo F, Wilkins P, Shafir S, Eberhard M. Public health implications of cysticercosis acquired in the United States. Emerg Infect Dis. 2011;17(1):1-6.

[95] Del Brutto OH. Neurocysticercosis among international travelers to disease-endemic areas. J Travel Med. 2012a;19(2):112-7.

[96] Del Brutto OH. Neurocysticercosis in Western Europe: a re-emerging disease? Acta Neurol Belg. 2012b, Apr 18.

[97] Del Brutto OH. A review of cases of human cysticercosis in Canada. Can J Neurol Sci. 2012c;39(3):319-22.

[98] Fleury A, Hernández M, Avila M, Cárdenas G, Bobes RJ, Huerta M, Fragoso G, Uribe-Campero L, Harrison LJ, Parkhouse RM, Sciutto E. Detection of HP10 antigen in serum for diagnosis and follow-up of subarachnoidal and intraventricular human neurocysticercosis. J Neurol Neurosurg Psychiatry. 2007;78(9):970-4.

[99] Garcia HH, Pretell EJ, Gilman RH, Martinez SM, Moulton LH, Del Brutto OH, Herrera G, Evans CA, Gonzalez AE; Cysticercosis Working Group in Peru. A trial of antiparasitic treatment to reduce the rate of seizures due to cerebral cysticercosis. N Engl J Med. 2004;350 (3):249–58.

[100] Del Brutto O, Roos K, Coffey C, Garcia HH. Meta-analysis: Cysticidal drugs for neurocysticercosis: albendazole and praziquantel. Ann Intern Med. 2006;145(1):43-51.

[101] Carpio A, Kelvin EA, Bagiella E, Leslie D, Leon P, Andrews H, Hauser WA; Ecuadorian Neurocysticercosis Group. The effects of albendazole treatment on neurocysticercosis: a randomized controlled trial. J Neurol Neurosurg Psychiatry. 2008; 79(9):1050-5.

[102] Herrera-García SC, de Aluja AS, Méndez Aguilar RE. El uso de la ultrasonografía para el diagnóstico de la cisticercosis porcina. Vet Mex. 2007;38(1):125-133.

[103] Pondja A, Neves L, Mlangwa J, Afonso S, Fafetine J, Willingham AL 3rd, Thamsborg SM, Johansen MV. Use of oxfendazole to control porcine cysticercosis in a high-endemic area of mozambique. PLoS Negl Trop Dis. 2012;6(5):e1651.

[104] Guezala MC, Rodriguez S, Zamora H, Garcia HH, Gonzalez AE, Tembo A, Allan JC, Craig PS. Development of a species-specific coproantigen ELISA for human *Taenia solium* taeniasis. Am J Trop Med Hyg. 2009;81(3):433-7.

[105] Pawlowski ZS. Role of chemotherapy of taeniasis in prevention of neurocysticercosis. Parasitol Int. 2006; 55 Suppl:S105-9.

[106] WHO, "Global Plan to Combat Neglected Tropical Diseases 2008-2015. World Health Organization 2007.

[107] Recommendations of the International Task Force for Disease Eradication. MMWR Recomm Rep. 1993;42:1–38.

[108] Cruz M, Davis A, Dixon H, Pawlowski ZS, Proano J. Operational studies on the control of *Taenia solium* taeniasis/cysticercosis in Ecuador. Bull World Health Organ. 1989;67(4):401-7.

[109] Allan JC, Velasquez-Tohom M, Fletes C, Torres-Alvarez R, Lopez-Virula G, Yurrita P, Soto de Alfaro H, Rivera A, Garcia-Noval J. Mass chemotherapy for intestinal *Taenia solium* infection: effect on prevalence in humans and pigs. Trans R Soc Trop Med Hyg. 1997;91(5):595-8.

[110] Sarti E, Schantz PM, Avila G, Ambrosio J, Medina-Santillán R, Flisser A. Mass treatment against human taeniasis for the control of cysticercosis: a population-based intervention study. Trans R Soc Trop Med Hyg. 2000;94(1):85-9.

[111] Keilbach NM, de Aluja AS, Sarti GE. Programme to control Taeniasis-cysticercosis (*T.solium*): Experiences in a Mexican village. Acta Leidensia, 1989;57(2): 181-9.

[112] Sarti E, Flisser A, Schantz PM, Gleizer M, Loya M, Plancarte A, Avila G, Allan J, Craig P, Bronfman M, Wijeyaratne P. Development and evaluation of a health education intervention against *Taenia solium* in a rural community in Mexico. Am J Trop Med Hyg. 1997;56(2):127-32.

[113] Ngowi HA, Carabin H, Kassuku AA, MloziMR,Mlangwa JE, Willingham AL 3rd.A health-education intervention trial to reduce porcine cysticercosis in Mbulu District, Tanzania. Prev Vet Med. 2008;85(1-2):52-67.

[114] Gonzales AE, Garcia HH, Gilman RH, Gavidia CM, Tsang VC, Bernal T, Falcon N, Romero M, Lopez-Urbina MT. Effective, single-dose treatment or porcine cysticercosis with oxfendazole. Am J Trop Med Hyg. 1996;54(4):391-4.

[115] Gonzalez AE, Gavidia C, Falcon N, Bernal T, Verastegui M, Garcia HH, Gilman RH, Tsang VC; Cysticercosis Working Group in Peru. Protection of pigs with cysticercosis from further infections after treatment with oxfendazole. Am J Trop Med Hyg. 2001;65(1):15-8

[116] Sikasunge CS, Johansen MV, Willingham AL 3rd, Leifsson PS, Phiri IK. *Taenia solium* porcine cysticercosis: viability of cysticerci and persistency of antibodies and cysticercal antigens after treatment with oxfendazole. Vet Parasitol. 2008;158(1-2):57-66.

[117] Molinari JL, Rodríguez D, Tato P, Soto R, Arechavaleta F, Solano S. Field trial for reducing porcine *Taenia solium* cysticercosis in Mexico by systematic vaccination of pigs. Vet Parasitol. 1997;69(1-2):55-63.

[118] Huerta M, de Aluja AS, Fragoso G, Toledo A, Villalobos N, Hernández M, Gevorkian G, Acero G, Díaz A, Alvarez I, Avila R, Beltrán C, Garcia G, Martinez JJ, Larralde C, Sciutto E. Synthetic peptide vaccine against *Taenia solium* pig cysticercosis: successful vaccination in a controlled field trial in rural Mexico. Vaccine. 2001;20(1-2):262-6.

[119] Sciutto E, Rosas G, Hernández M, Morales J, Cruz-Revilla C, Toledo A, Manoutcharian K, Gevorkian G, Blancas A, Acero G, Hernández B, Cervantes J, Bobes RJ, Goldbaum FA, Huerta M, Diaz-Orea A, Fleury A, de Aluja AS, Cabrera-Ponce JL, Herrera-Estrella L, Fragoso G, Larralde C. Improvement of the synthetic tri-peptide vaccine (S3Pvac) against porcine *Taenia solium* cysticercosis in search of a more effective, inexpensive and manageable vaccine. Vaccine. 2007;25(8):1368-78.

[120] Morales J, Martínez JJ, Manoutcharian K, Hernández M, Fleury A, Gevorkian G, Acero G, Blancas A, Toledo A, Cervantes J, Maza V, Quet F, Bonnabau H, de Aluja AS, Fragoso G, Larralde C, Sciutto E. Inexpensive anti-cysticercosis vaccine: S3Pvac

expressed in heat inactivated M13 filamentous phage proves effective against naturally acquired *Taenia solium* porcine cysticercosis. Vaccine. 2008;26(23):2899-905.

[121] Assana E, Kyngdon CT, Gauci CG, Geerts S, Dorny P, De Deken R, Anderson GA, Zoli AP, Lightowlers MW. Elimination of *Taenia solium* transmission to pigs in a field trial of the TSOL18 vaccine in Cameroon. Int J Parasitol. 2010;40(5):515-9.

[122] Garcia HH, Gonzalez AE, Gilman RH, Moulton LH, Verastegui M, Rodriguez S, Gavidia C, Tsang VC; Cysticercosis Working Group in Peru. Combined human and porcine mass chemotherapy for the control of *Taenia solium*. Am J Trop Med Hyg. 2006;74(5):850-5.

[123] Garcia HH, Gonzalez AE, Rodriguez S, Gonzalvez G, Llanos-Zavalaga F, Tsang VC, Gilman RH; Grupo de Trabajo en Cisticercosis en Perú. Epidemiology and control of cysticercosis in Peru. Rev Peru Med Exp Salud Publica. 2010;27(4):592-7.

[124] Prichard RK, Basáñez MG, Boatin BA, McCarthy JS, García HH, Yang GJ, Sripa B, Lustigman S. A research agenda for helminth diseases of humans: intervention for control and elimination. PLoS Negl Trop Dis. 2012;6(4):e1549.

[125] Mexican Health Secretary. Modificación a la Norma Oficial Mexicana NOM-021-SSA2-1994, para la prevención y control del complejo taeniosis/cisticercosis en el primer nivel de atención médica. Diario Oficial de la Federación, 2004. http://www.salud.gob.mx/unidades/cdi/nom/m021ssa294.html. (accessed 12 June 2012)

[126] Flisser A, Correa D. Neurocysticercosis may no longer be a public health problem in Mexico. PLoS Negl Trop Dis 2010;4: e831

[127] de Aluja A, Morales Soto J, Sciutto E. A Programme to Control Taeniosis-Cysticercosis (*Taenia solium*) in Mexico, Current Topics in Tropical Medicine, Dr. Alfonso Rodriguez-Morales (Ed.), ISBN: 978-953-51-0274-8, InTech, 2012. Available from: http://www.intechopen.com/books/current-topics-in-tropical-medicine/a-program-to-control-taeniosis-cysticercosis-taenia-solium-in-mexico

[128] Willingham AL 3rd, Harrison LJ, Fèvre EM, Parkhouse ME; Cysticercosis Working Group in Europe. Inaugural meeting of the Cysticercosis Working Group in Europe. Emerg Infect Dis. 2008;14(12):e2.

[129] Garcia HH, Gonzalez AE, Rodriguez S, Gonzalvez G, Llanos-Zavalaga F, Tsang VC, Gilman RH; Grupo de Trabajo en Cisticercosis en Perú. Epidemiology and control of cysticercosis in Peru. Rev Peru Med Exp Salud Publica. 2010;27(4):592-7.