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Taeniosis-cysticercosis in man and pigs in Ecuador

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The Andean region (Sierra) of Ecuador is considered as hyper-endemic for taeniosis/cysticercosis. Neurocysticercosis is a significant cause of epilepsy at the community level in Andean villages in Ecuador (Cruz et al., 1999). Nevertheless, even though improved techniques of immunodiagnosis have become available, prevalence data in the region are still fragmentary, not only concerning the metacestodes in man and pigs but equally about intestinal *Taenia*. As a result, the impact of cysticercosis on public health and on the economy have not yet been documented.

Factors favouring transmission of *T. solium* are commonly present in the Sierra. Like in most developing countries sanitary conditions in Ecuador are poor with limited access to clean water. Ecuador has a pig population of 2.7 million among which 57% are raised in the Sierra. Local breeds (adult live weight 35–40 kg) are kept mainly (90%) in traditional farming conditions, characterised by free roaming and scavenging behaviour. Only about 48% of the pigs are slaughtered in abattoirs. Meat inspection is routinely performed in only 50% of these abattoirs (Ruiz, 1986). Consequently, the majority of the pork is marketed and consumed without veterinary inspection. An adult pig is sold at US$ 100–150. No measures are taken to prevent infected meat from being consumed. Tongue inspection by private professionals is common practice in livestock markets but it is merely an assessment of the quality and, by proof of absence, a means of price fixing rather than a preventive measure, since cysticercotic pigs are diverted to parallel illegal slaughter circuits. Although rarely detected in slaughterhouses, positive carcasses are condemned without any form of compensation. Pork is the main source of animal protein and is an important feast dish. It is consumed mainly as *fritada* (fried in its own fat) or *cecina* (raw, dried strips), both of which can contain invasive cysticerci if not prepared properly. The awareness of the rural population on taeniosis/cysticercosis is lacking. While people in endemic rural communities usually recognise cysticerci in local pigs and are aware that the infection reduces the value of the pork, they usually do not understand the relationship between taeniosis in humans and cysticercosis in pigs and humans. Oddly enough, in the Northern Sierra cysticerci in meat are nicknamed *triquina* by the local population, yet *Trichinella* spp. have never been reported.

It is difficult to get a clear picture on the prevalence of taeniosis/cysticercosis in the country. Official reports indicate low and moderate incidences of taeniosis and cysticercosis in humans, respectively, in some provinces in the Sierra, like Bolivar, Cañar and Imbabura (taeniosis/cysticercosis of 0/1.60, 0/1.36 and 0/3.57, per 100,000 habitants, respectively). In contrast, the prevalence of human cysticercosis, based on autopsy studies was estimated at 3% (Guerrero, 1965) and community-based surveys indicated an even higher prevalence: taeniosis between 1.02 and 1.60% (Jiménez, 1976; Cruzc et al., 1989) and cysticercosis between 10% (based on EITB) and 14.4% (based on CT-scan) in the northern Sierra (Cruz et al., 1999). *Taenia* specimens were considered to be *T. solium* in all cases since *Taenia saginata* was not known to occur in the study areas (Cruz et al., 1989). In pigs, a similar disagreement between official reports and results of surveys was found: slaughterhouses report a prevalence of <0.1%, while in surveys in the Southern Sierra between 5.9 and 12% of the pigs were found infected (Jiménez, 1976; Benítez, 1995).

While in the Sierra the so called taeniosis/cysticercosis paradox prevails, i.e. low prevalence of taeniosis and high prevalence of cysticercosis, this is not the case in the coastal provinces of Esmeraldas, Los Rios and Manabi, where the presence of adult *Taenia* has been demonstrated with no or hardly any cases of human cysticercosis, i.e. 1.36/0, 11.11/0.30 and 1.01/0 per 100,000 habitants, respectively, according to the Ecuadorian Ministry of Public Health.

With the aim of better documenting the epidemiology of taeniosis/cysticercosis Rodríguez-Hidalgo et al. (2003) conducted comprehensive surveys in man, pigs and cattle in the Pichincha and Imbabura provinces in the Andean region, north of Quito. In humans, 215 out of 4306 (4.99%) were positive in a monoclonal-based sandwich ELISA for the detection of circulating antigen (Ag-ELISA), whereas coprological examination of 1935 stools revealed 30 (1.55%) tapeworm carriers. Twenty-nine tapeworms were collected and identified by morphology and PCR. Twenty-one specimens were identified as *T. saginata* and only 8 as *T. solium*. Porcine cysticercosis was demonstrated in 15 out of 2896 (0.52%) carcasses, and 93 out of 1032 serum samples (9.01%) were positive by Ag-ELISA. In cattle on post-mortem inspection 3 out of 806 (0.37%) carcasses had *T. saginata* metacestodes, however 35 sera out of 869 (4.03%) showed circulating antigen by the Ag-ELISA.

These results are unexpected because from 1985 to 2001, according to FAO, WHO and OIE reports, no data on *Cysticercus bovis* in Ecuador are available in spite of bovine cysticercosis being notifiable (Welte, 1997, Handistatus II, 2002). Before 1985, it was listed as exceptional. Furthermore, a report specifying adult *T. saginata* has never been made in Ecuador where usually prevalence of *Taenia* is given without reference to the species (López, 1969). All references to adult *Taenia* were assumed to be *T. solium*, presumably because of the higher impact of this parasite on public health. These results show that when taeniosis is diagnosed the possibility of *T. saginata* has to be considered since this species is co-existing in a *T. solium* endemic region.

Neurological disorders are well documented in Ecuador. The overall epilepsy rate in Ecuador is estimated at 12.7/1000 (Cruz, 1994). In rural areas that are socioeconomically deprived this rate is even higher. In a door-to-door study, Basch et al. (1997) found a prevalence ratio for epilepsy of 22.6/1000 in a rural migrant community near Quito. This high epilepsy rate led to the establishment of a CT-centre in Quito, only 5 years after the first introduction of this neuro-imaging technology in the US. The major causes

of epilepsy in Ecuador are calorie-protein malnutrition, chronic iodine deficiency and neurocysticercosis (Cruz, 1994). From the records of the CT-centre, it was estimated that approximately 10% of the neurology cases presented had evidence of NCC.

In conclusion, while taeniosis/cysticercosis is known to be endemic in Ecuador, especially in the Sierra, the economic burden remains difficult to assess because infected pork escapes official inspection in most cases. The impact on human health appears to be important given the high rate of neurological disorders in which neurocysticercosis makes a substantial contribution.

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The burden and impact of echincoccosis/hydatidosis in Australia

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E. granulosus is the only member of the Genus *Echinococcus* currently occurring in Australia and was introduced with domestic animals (sheep and domestic dogs) during European settlement. Native wildlife (macropodid marsupials and dingoes), having evolved in isolation to *E. granulosus* proved highly susceptible to infection. Today, wildlife populations maintain the major reservoir of *E. granulosus* in Australia, through a prey/predator interaction (Jenkins and Morris, 2003) between dingoes and macropodid marsupials. The geographical distribution of *E. granulosus* in Australia is influenced by rainfall (Gemmell, 1958) with the highest prevalences of the parasite occurring in wildlife, domestic animals