

Taenia solium taeniosis/cysticercosis in Asia: epidemiology, impact and issues

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Abstract

Several reports of patients with cysticercosis from many countries in Asia such as India, China, Indonesia, Thailand, Korea, Taiwan and Nepal are a clear indicator of the wide prevalence of *Taenia solium* cysticercosis and taeniosis in these and other Asian countries. However, epidemiological data from community based studies are sparse and available only for a few countries in Asia. Cysticercosis is the cause of epilepsy in up to 50% of Indian patients presenting with partial seizures. It is also a major cause of epilepsy in Bali (Indonesia), Vietnam and possibly China and Nepal. Seroprevalence studies indicate high rates of exposure to the parasite in several countries (Vietnam, China, Korea and Bali (Indonesia)) with rates ranging from 0.02 to 12.6%. Rates of taeniosis, as determined by stool examination for ova, have also been reported to range between 0.1 and 6% in the community in India, Vietnam, China, and Bali (Indonesia). An astonishingly high rate of taeniosis of 50% was reported from an area in Nepal populated by pig rearing farmers. In addition to poor sanitation, unhealthy pig rearing practices, low hygienic standards, unusual customs such as consumption of raw pork is an additional factor contributing to the spread of the disease in some communities of Asia. Undoubtedly, cysticercosis is a major public health problem in several Asian countries effecting several million people by not only causing neurological morbidity but also imposing economic hardship on impoverished populations. However, there are wide variations in the prevalence rates in different regions and different socio-economic groups in the same country. It is important to press for the recognition of cysticercosis as one of the major public health problems in Asia that needs to be tackled vigorously by the governments and public health authorities of the region.

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Keywords: Zoonoses; Pigs; Epilepsy; Parasite; Cysticercosis

1. Introduction

Asia, the largest continent on earth, occupies one-third of the land mass but is home to more than three-fifths of humanity. It is a continent that

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is highly varied in its geography, economic development of its countries, its population's religious and social beliefs and types of government. *Taenia solium* taeniosis and cysticercosis are diseases associated with poverty, pork consumption and poor pig husbandry practices. It is, therefore, not surprising that the prevalence of the disease in Asia is highly varied depending on the presence or absence of these risk factors in different countries of the region. While in some countries such as Japan and Singapore, increasing economic prosperity and accompanying infrastructure, have made the disease almost non-existent, while in others, such as the Islamic countries of the middle east and west Asia, religious proscription of the consumption of pork has had a similar result. In other regions of Asia, however, the disease is known to occur with varying prevalence. The disease has been known to exist in Asia for several hundreds of years. A seminal paper on the subject was published more than 40 years ago by Dixon and Lipscomb (1961). They carefully studied the disease in 450 British soldiers who served in India and clarified the latency and other features of the disease in this group of patients. Unfortunately, the disease did not receive the attention due to it in Asia, and it did not gain prominence as a major cause of neurological morbidity and economic loss. Therefore, unlike in Latin America, the disease was ignored in most parts of Asia and only over the last two decades has there been interest in the disease in Asia. Consequently, the epidemiological aspects of the disease are poorly worked out in most countries of Asia. Data on the prevalence of taeniosis, human cysticercosis and porcine cysticercosis in most countries of Asia are not easily available or are of questionable reliability.

2. Methods

2.1. Data acquisition

The following tools were employed to obtain the epidemiological data on *T. solium* taeniosis and cysticercosis in Asia:

- 1) Medline search using the search words 'cysticercosis' and the name of the Asian country
- 2) Personal knowledge of published articles on the disease from Asia; and
- 3) Unpublished contributions on the disease based on the work done by one of authors.

Non-english language publications and non-indexed articles have possibly been overlooked with the above methodology.

2.2. Data presentation

The epidemiological data will be presented under the following categories:

- Hospital based data on human cysticercosis.
- Community based data on human cysticercosis.
- Community or hospital based data on taeniosis.
- Data on porcine cysticercosis.

The above data are summarized in Table 1. A more detailed discussion of these data is presented below.

3. Hospital based data on human cysticercosis in Asian countries

Evidence for the occurrence of cysticercosis in a particular country is derived from publications of clinical data on patients from that country. The largest number of such publications has come from India (>100 publications). Publications on cysticercosis are available from several other countries in Asia, namely, Indonesia (island of Bali and Irian Jaya province), Thailand, Korea, Taiwan, Hong Kong, Vietnam, Philippines and Nepal.

3.1. India

There are several publications, from India, on the clinical aspects of neurocysticercosis (NCC) and ocular cysticercosis. This is ample evidence for the widespread occurrence of the disease in India. The disease is prevalent in virtually all states of the country although it varies significantly between

Table 1
Prevalence data on *T. solium* taeniosis and cysticercosis in some Asian countries

Country	Human cysticercosis (%)	Taeniasis (%)	Porcine cysticercosis (%)
China	3–4	0.112 (0.06–19)	5.4 (0.8–40)
Indonesia	1.7–13	0.8–23	0.02–2.63
Vietnam	5–7	0.5–6	0.04–0.9
India	NA	2	9.3
Nepal	NA	10–50	32.5
Korea	3	NA	NA

See text for details on methodologies used to arrive at the prevalence data in different countries; NA, not available.

different states (Rajshekhar and Chandy, 2000). There are few reports of patients with cysticercosis from Jammu and Kashmir, a predominantly Muslim state, and Kerala where educational levels and hygienic standards are probably the highest in the country.

There are certain unique features of the disease in India. The solitary form of the disease (solitary cysticercus granuloma, SCG) is the commonest presentation of the disease and is seen in nearly two-thirds of all patients with NCC. Anywhere between 26 and 50% of all Indian patients presenting with partial seizures are diagnosed with a SCG on the CT scan (Wadia et al., 1987; Misra et al., 1994). The other unusual feature of the disease is the low proportion of pork eaters amongst Indian patients with NCC. Less than 1–2% of patients with NCC admit to eating pork. More than 95% of Indian patients with NCC are vegetarians or do not consume pork. Serological assays using the enzyme linked immunotransfer blot (EITB) revealed exposure to the disease in 21.5% of 107 neurological patients attending a hospital in Mumbai (Tsang and Garcia, 1999).

3.2. Vietnam

In a study of patients attending the National Institute of Malariology, Parasitology and Entomology (NIMPE) in Hanoi, Vietnam, 633 cases of NCC were diagnosed out of 4017 patients (15.8%) managed there between 1996 and 1997 (Van De, 2002, unpublished data). These cases were diagnosed with CT scan of the brain. A large number of patients with NCC had live cysts in the brain and 30% of patients with NCC were found to have

taeniosis. Several patients were reported to have subcutaneous cysts.

3.3. Indonesia

Evidence for the existence of cysticercosis in Bali and in Paniai District, Irian Jaya were provided in the early 1970s, by the dramatic increase in the incidence of patients suffering burns due to falls into open fires during epileptic attacks (Bending and Catford, 1983). Based on a positive serological test using ELISA, 10 of 74 (13.5%) patients with epilepsy in Bali were diagnosed to have NCC (Margono et al., 2001).

3.4. South Korea

A serological assay of 2667 randomly selected patients with epilepsy was performed using enzyme linked immunosorbent assay (ELISA) (Kong et al., 1993). Overall a positive rate of 4% was noted with patients from Cheju Do having the highest rate of 8.4%. Furthermore, 2.1% of normal people who were undergoing a routine medical check up were found to be serologically positive for exposure to cysticercosis. This study performed between 1987 and 1990 and published in 1993 revealed for the first time the prevalence of the disease both in the epileptic and normal population of Korea.

3.5. Nepal

Often patients from Nepal seek neurological and neurosurgical treatment outside their country, especially in India. Data from the Christian

Medical College Hospital, Vellore showed that 14 Nepalese patients were diagnosed with SCG form of NCC in the 5 years between 1991 and 1995 (Rajshekhar and Chandy, 2000). However, a diagnosis of cysticercosis was made in only 0.01% (4/25 033) of pathological specimens examined at Bir Hospital, Kathmandu between 1995 and 1997. In Patan Hospital, Lalitpur District, 62 of 23 402 pathological specimens were diagnostic of cysticercosis (Joshi et al., 2002, unpublished data). These low figures are due to the fact that most patients with cysticercosis do not need surgical confirmation. The fact that seven of eight epileptic Gurkha soldiers (Nepalese) serving with the British Army in Hongkong were diagnosed to have NCC indicates the prevalence of the disease in parts of Nepal (Heap, 1990).

3.6. Hongkong

Presence of cysticercosis in Hongkong is well recognized in clinical articles (Heap, 1990, 1991).

3.7. Thailand

In a report on CT findings in 132 patients with NCC in 1989, 45 were found to have a SCG (Bhoopat et al., 1989). More recently Yodnopak-low and Mahuntussangapong (2000) found a SCG in 20 of 972 patients presenting with epilepsy.

3.8. China

There are few clinical articles in the English language literature on NCC from China with most of the published literature on the subject appearing in local Chinese language journals. In the Shang-dong province 38 of 35 512 patients (0.2%) examined in 2000, were diagnosed with NCC (Xiaonong, 2002, personal communication).

3.9. Other countries in Asia

Reports of patients with NCC have been presented from other countries in Asia such as Japan and Oman (Morioka et al., 1996; Chandy et al., 1989). But most of these patients are expatriates or have had history of travel to endemic regions.

4. Community based cysticercosis data

Some of the best data on the prevalence of cysticercosis in the community is available from Bali and Irian Jaya in Indonesia. In the other regions of Asia prevalence data are just emerging or are not available. Community based studies on the prevalence (seroprevalence) of the disease are generally performed by testing the sera of a defined population group using either the ELISA or EITB. This indicates the degree of exposure of a given population to the disease but does not of itself indicate active disease in an individual.

4.1. Indonesia

In one of the earliest seroprevalence studies on cysticercosis, Coker-Vann et al. (1981) reported their results in 1981 using ELISA to test sera from a population in several regions of south-east Asia. On the island of Bali, Indonesia, 21% of sera were positive from one village where pigs are especially numerous, whereas in Sumatra, Indonesia, only 3–4% of sera were positive (Coker-Vann et al., 1981). The seroprevalence of cysticercosis has been reported to range from 2% in northern Sumatra to 48% in Irian Jaya (Simanjuntak et al., 1997). However, a more recent survey performed in three villages of Bali, using the immunoblot, has revealed a seroprevalence of 1.65% (6/363) (Sutisna et al., 1999). Another survey of 746 residents in four ecological groups of Bali found that 94 (13%) persons were positive by the immunoblot (Theis et al., 1994).

In a survey of 160 human sera samples from 18 villages in Jaywijaya District of Irian Jaya, 81 (50.6%) were found to be positive by the immunoblot (Subahar et al., 2001). Thus, there seems to be considerable variability in the seroprevalence of the disease in different parts Indonesia.

4.2. Vietnam

Coker-Vann et al. (1981) reported that from 3 to 13% of sera from populations in Micronesia, Burma, Vietnam, and the Philippines were found to react with cysticercus antigen. Van De (2002, personal communication) reported that the pre-

valence of cysticercosis in Bac Ninh province of Vietnam was 5–7%. The methodology used to arrive at this figure was not clarified.

4.3. China

The following data are summarized from a report on the epidemiology of taeniosis and cysticercosis in China by Xiaonong (2002, personal communication). He obtained data from the Chinese language literature on the subject. There are five zones of high endemicity within China, namely: (1) the Northeast provinces; (2) north China; (3) northwest China; (4) fourth zone comprising Shandong, Henan, Anhui and Hubei; and (5) fifth zone comprising Guanddong, Guangxi, Hainan, Yunnan and Sichuan. Most epidemiological studies on cysticercosis have, however, focused on the prevailing situation in Shandong province of China. A seroprevalence of 2.2% was noted using the ELISA and in another study using the indirect fluorescent antibody assay, a seroprevalence of 3.2% was found (Cao et al., 1996). The seroprevalence was found to be low in other provinces ranging from 0.02 to 4.3%. However, higher rates have been reported from Pumi nation area of Yunnan province (11.2%) and Guxi (9.5%). It was estimated that there were 3 million patients with cysticercosis in China.

4.4. Other countries

Coker-Vann et al. (1981) analysed sera, for cysticercal antibodies, from residents of Singapore and found, that there was a higher proportion of positive sera among the Chinese (13%) than among the Indian (5%) or Malay muslims (3%). These data, reported in 1981, are probably not reflective of the present situation as the lack of clinical cases from Singapore in recent years suggests lack of local transmission of the disease or very low levels of endemicity.

Unfortunately, there is no community based prevalence data on cysticercosis from India or other endemic countries in the region.

5. Data on taeniosis

Data on the prevalence of taeniosis was obtained till the early 1990s with examination of stools for ova of *T. solium*, a method known to underdiagnose the problem as it has a low sensitivity. This method also cannot distinguish between the ova of *T. solium* and *Taenia saginata* and can lead to an overestimation of the prevalence of *T. solium* taeniosis in regions where pork and beef tapeworms are prevalent. More recently, estimation of community prevalence of taeniosis has been done using the coproantigen test on stools. Taeniosis data are available for some countries in Asia and these are described below.

5.1. China

The following data are summarized from a report by Xiaonong (2002, personal communication). A nationwide survey of human parasites was conducted between 1998 and 1992 covering 30 provinces in China and involving 1.48 million people. The average prevalence rate for taeniosis was 0.112% but it ranged from 0.66 to 6.0% in different provinces (Yu et al., 1994). In an earlier survey, examination of the stool from 34 million individuals in Henan province, conducted between 1975 and 1987 yielded a taeniosis rate of 0.55%.

5.2. Bali, Indonesia

Surveys in Bali have identified taeniosis rates of 0.4–23.0% (Suweta, 1991). These surveys were done using the stool examination for ova of the parasite. A more recent survey, using the coproantigen method, however, reported a lower prevalence figure of 0.72% (Sutisna et al., 1999); it was suggested that the higher figures in the earlier surveys might have been due to the inability to distinguish between *Taenia* species and some of the cases might have been due to *T. saginata* which is also prevalent in this region.

5.3. Nepal

Taeniosis rates range from 10 to 50% amongst different ethnic groups in the Syangja and Tana-

hunan districts of Nepal (Joshi et al., 2002, unpublished data). These are amongst the highest taeniosis rates reported from anywhere in the world. It is possible that these high numbers are due to the prevalence of *T. saginata* infestation.

5.4. Vietnam

Van De (2002, unpublished data) reported that taeniosis rates in different regions of Vietnam were as follows: 0.5–2% in the plains; 3.8% in the highlands and 2–6% in the mountainous regions.

5.5. India

Examination of stools from patients attending a hospital in northern India revealed that 2% of patients had taeniosis (Mahajan and Malla, 1992). In a community based study, 600 stool samples were examined for the presence of ova of *Taenia* and again a prevalence of taeniosis of 2% was noted (Pathak and Gaur, 1989). All these patients probably had *T. solium* infestation as most Indians, being Hindus, do not consume beef and therefore, were unlikely to be harbouring *T. saginata*.

5.6. Korea

Several surveys for intestinal parasites have been conducted in Korea since 1915 (Eom and Rim, 2001). The more recent data on the prevalence of intestinal parasitic infections published by the Korean Ministry of Health and Welfare reported taeniosis prevalence rates of 0.06% in 1992 and 0.02% in 1997 (Eom and Rim, 2001).

5.7. Philippines

Arambulo et al. (1976), from the Philippines, reported a taeniosis prevalence rate of less than 1%. They commented that, in the Philippines, *T. saginata* infections were, however, commoner than *T. solium* infections.

6. Data on porcine cysticercosis

Data on porcine cysticercosis is usually obtained from examination of pork in official slaughterhouses but this probably underestimates the degree of the problem. Since most pigs in developing countries in Asia, as in other regions of the world, are not slaughtered in officially sanctioned slaughterhouses, but in informal places, including homes. The infected pigs are more likely to be slaughtered in these surroundings than in slaughterhouses for the fear of economic loss. Prevalence of porcine cysticercosis can also be roughly estimated by palpation of the tongue or inspection of the conjunctiva of live pigs for cysts. More recently, prevalences have been estimated using serological tests (ELISA or EITB).

6.1. Vietnam

Porcine cysticercosis rates as determined from slaughterhouse meat inspection, was reported to be between 0.04% in Hanoi and 0.9% from five provinces in Southern Vietnam (Van De, 2002, unpublished data). Doanh et al. (2002, unpublished data) reported that the rate of porcine cysticercosis in the mountainous regions was 0.03–0.31% and in the midland provinces was 0.02%. But these rates are likely to be lower than the true prevalence rates due to the factors discussed above, especially the use of insensitive detection techniques.

6.2. China

The infection rates of pigs in China is highly variable ranging from 0.84 to 15% and in some areas was found to be as high as 40% (Xiangong, 2002, personal communication).

6.3. Indonesia

Suweta (1991) reported a prevalence rate of 0.15% for cysticercosis in pigs in Bali. However, no cases of porcine cysticercosis have been reported from Bali since 1986 (Suweta, 1991). The latter data can be challenged as local transmission of cysticercosis persists. In a recent survey using the

immunoblot on pig sera, 50 of 71 pigs (70.4%) from Irian Jaya were found to be positive and hence considered to have been exposed to the metacestodes of *T. solium* (Subahar et al., 2001).

6.4. Nepal

Joshi et al. (2002, unpublished data) estimated the prevalence of porcine cysticercosis to be 14% (34/250) by examination of carcasses in Kathmandu and Dharan. They performed lingual examination of live pigs in Syangja district which yielded a rate of 32% (136 positive out of 419 pigs examined).

6.5. India

In a study performed in the northern Indian state of Uttar Pradesh between 1980 and 1985, 3550 pig carcasses were screened for cysticercosis and 9.3% were found to be positive for the infection (Pathak and Gaur, 1989).

6.6. Philippines

Arambulo et al. (1976) reported a prevalence rate of 1.67% for porcine cysticercosis based on the examination of slaughtered pigs between 1971 and 1974.

7. Economic impact

Fan and Chung (1997) estimated that the annual economic loss due to taeniasis (all species including *Taenia asiatica*) in the mountainous regions of Taiwan, Cheju island of Korea and Samosir island of Indonesia amounted to US\$ 18 million, US\$ 13 million and US\$ 2.4 million, respectively.

8. Conclusions

From the data presented above, it is evident that *T. solium* taeniosis and cysticercosis are major public health problems in several Asian countries and also result in loss of revenue to pig rearers. However, good prevalence data for most countries

except Indonesia, is unavailable (India, Nepal, Philippines), incomplete or is outdated (Taiwan, Korea, China). Some of the methods utilized to obtain the prevalence data are also unreliable or have been superseded by more robust and specific tests. There is, therefore, a need to obtain reliable and current data on the prevalence of the zoonoses in several Asian countries.

Local customs and food habits play a major role in the persistence and spread of the disease in several endemic regions. Some of the beliefs and practices pertain to the use of latrines (or lack thereof) and others to the cooking of pork. In several communities of Indonesia, Vietnam, Nepal, Taiwan and Korea, consumption of raw pork is customary during festivals. Practices such as these ensure continuing transmission of the disease.

References

- Arambulo, P.V., Cagera, B.D., Tongson, M.S., 1976. Studies on the zoonotic cycle of *Taenia saginata* taeniasis and cysticercosis in the Philippines. *Int. J. Zoonoses* 3, 77–104.
- Bending, J.J., Catford, J.C., 1983. Epidemic of burns in New Guinea due to cerebral cysticercosis. *Lancet* 23, 1(8330), 922.
- Bhoopat, W., Pongwarin, N., Issaragrisil, R., Suthiponchai, S., Khanyasthiti, P., 1989. CT diagnosis of cerebral cysticercosis. *J. Med. Assoc. Thai.* 72, 673–681.
- Cao, W.C., Van der Ploeg, C.P., Gao, C.L., Xu, J.F., Cao, X.C., Cui, Z.H., Ren, Z.X., Habbema, J.D., 1996. Seroprevalence and risk factors of human cysticercosis in a community of Shandong, China. *Southeast Asian J. Trop. Med. Public Health* 27, 279–285.
- Chandy, M.J., Sharma, R.R., Lad, S.D., Manchanda, A., 1989. Focal epilepsy and a single small enhancing cortical ring lesion on computed tomography in Asians (letter). *Emirates Med. J.* 7, 190–197.
- Coker-Vann, M.R., Subianto, D.B., Brown, P., Diwan, A.R., Desowitz, R., Garruto, R.M., Gibbs, C.J., Jr., Gajdusek, D.C., 1981. ELISA antibodies to cysticerci of *Taenia solium* in human populations in New Guinea, Oceania and Southeast Asia. *Southeast Asian J. Trop. Med. Public Health* 12, 499–505.
- Dixon, H.B.F., Lipscomb, F.M., 1961. Cysticercosis: an analysis and follow up of 450 cases. Medical Research Council Special Report Series, No. 299. Her Majesty's Stationery, London, pp. 1–58.
- Eom, K.S., Rim, H-J, 2001. Epidemiological understanding of *Taenia* tapeworm infections with special reference to *Taenia asiatica* in Korea. *Korean J. Parasitol.* 4, 267–283.

- Fan, P.C., Chung, W.C., 1997. Sociocultural factors and local customs related to taeniasis in east Asia. *Kaohsiung J. Med. Sci.* 13, 647–652.
- Heap, B.J., 1990. Cerebral cysticercosis as a common cause of epilepsy in Gurkhas in Hong Kong. *J. R. Army Med. Corps.* 136, 146–149.
- Heap, B.J., 1991. False positive tuberculostearic acid test in cysticercosis (letter). *Lancet* 337, 498–499.
- Kong, Y., Cho, S.Y., Cho, M.S., Kwon, O.S., Kang, W.S., 1993. Seroepidemiological observation of *Taenia solium* cysticercosis in epileptic patients in Korea. *J. Korean Med. Sci.* 8, 145–152.
- Mahajan, R.C., Malla, N., 1992. Parasitic infections of the central nervous system. In: Abraham, J. (Ed.), *Progress in Clinical Neurosciences*, vol. 8. Neurological Society of India, Chennai, pp. 82–91.
- Margono, S.S., Subahar, R., Hamid, A., Wandra, T., Sudewi, S.S., Sutisna, P., Ito, A., 2001. Cysticercosis in Indonesia: epidemiological aspects. *Southeast Asian J. Trop. Med. Public Health* 2 (Suppl. 32), 79–84.
- Misra, S., Verma, R., Lekhra, O.P., Misra, N.K., 1994. CT observations in partial seizures. *Neurol. India* 42, 24–27.
- Morioka, T., Yamamoto, T., Nishio, S., Takeshita, I., et al., 1996. Magnetoencephalographic features in neurocysticercosis. *Surg. Neurol.* 45, 176–182.
- Pathak, K.M., Gaur, S.N., 1989. Prevalence and economic implications of *Taenia solium* taeniasis and cysticercosis in Uttar Pradesh State of India. *Acta Leiden.* 57, 197–200.
- Rajshekhar, V., Chandy, M.J., 2000. Incidence of solitary cysticercus granulomas. In: Rajshekhar, V., Chandy, M.J. (Eds.), *Solitary Cysticercus Granuloma: The Disappearing Lesion*. Orient Longman, Chennai, pp. 12–28.
- Simanjuntak, G.M., Margono, S.S., Okamoto, M., Ito, A., 1997. Taeniasis/cysticercosis in Indonesia as an emergent disease. *Parasitol. Today* 13, 321–323.
- Subahar, R., Hamid, A., Purba, W., Wandra, T., Karma, C., Sako, Y., Margono, S.S., Craig, P.S., Ito, A., 2001. *Taenia solium* infection in Irian Jaya (west Papua), Indonesia: a pilot serological survey of human and porcine cysticercosis in Jayawijaya district. *Trans. R. Soc. Trop. Med. Hyg.* 95, 388–390.
- Sutisna, I.P., Fraser, A., Kapti, I.N., Rodriguez-Canul, R., Puta Widjana, D., Craig, P.S., Allan, J.C., 1999. Community prevalence study of taeniasis and cysticercosis in Bali, Indonesia. *Trop. Med. Int. Health* 4, 288–294.
- Suweta, I.G., 1991. The situation of cysticercosis/taeniasis in animals/man in Bali. *Southeast Asian J. Trop. Med. Public Health* 22 (Suppl.), 236–238.
- Theis, J.H., Goldsmith, R.S., Flisser, A., Koss, J., Chionino, C., Plancarte, A., Segura, A., Widjana, D., Sutisna, P., 1994. Detection by immunoblot assay of antibodies to *Taenia solium* cysticerci in sera from residents of rural communities and from epileptic patients in Bali, Indonesia. *Southeast Asian J. Trop. Med. Public Health* 25, 464–468.
- Tsang, V.C.W., Garcia, H.H., 1999. Immunoblot diagnostic test (EITB) for *Taenia solium* cysticercosis and its contribution to the definition of this under-recognized but serious public health problem. In: Garcia, H.H., Martinez, S.M.M. (Eds.), *Taenia solium Taeniasis/Cysticercosis*. Editorial Universo, Lima, Peru, pp. 245–254.
- Wadia, R.S., Makhale, C.N., Kelkar, A.V., Grant, K.B., 1987. Focal epilepsy in India with special reference to lesions showing ring or disc-like enhancement on contrast computed tomography. *J. Neurol. Neurosurg. Psychiatry* 50, 1298–1301.
- Yodnopaklow, P., Mahuntussangapong, A., 2000. Single small enhancing CT lesion in Thai patients with acute symptomatic seizures: a clinico-radiological study. *Trop. Med. Int. Health* 5, 250–255.
- Yu, S.H., Xu, L.Q., Jiang, Z.X., Xu, S.H., Han, J.J., Zhu, Y.G., Chang, J., Lin, J.X., Xu, F.N., 1994. Nationwide survey of human parasites in China. *Southeast Asian J. Trop. Med. Public Health* 25, 2–3.