

REVIEW

TAENIASIS/CYSTICERCOSIS IN INDONESIA, 1996-2006

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Abstract. Three human taeniid species, *Taenia solium*, *Taenia saginata*, and *Taenia asiatica* are distributed in Indonesia. This brief review summarizes the present situation of taeniasis/cysticercosis, distribution of the three human taeniid species, and the risk factors/transmission of this parasitic disease in Bali, Papua, and North Sumatra, Indonesia.

INTRODUCTION

Taenia saginata or *Taenia asiatica* is a tapeworm parasite that causes taeniasis, the presence of adult worms in the human small intestine. *Taenia solium* can cause two distinct clinical presentations: taeniasis, and cysticercosis, the presence of larval stages in tissues. By consuming raw or undercooked beef/pork contaminated with metacestodes (cysticercus/cysticerci) of *T. saginata*, *T. asiatica*, or *T. solium*, humans get infected with the metacestodes, which become adult tapeworms within a few months. The intermediate host becomes infected by ingesting eggs or gravid segments of one of the three taeniid species released from tapeworm carriers. In humans, the ingestion of eggs of *T. solium* happens through contaminated food, vegetable, water, etc. It is also due to autoinfection, directly through

anal-oral route, or by internal autoinfection, reflux of the proglottid or eggs from the intestine into the stomach (Subianto *et al*, 1978; Bakta, 1987; Sanchez, 2003). Cysticercosis can affect many anatomical areas, but it becomes more prominent in the central nervous system (CNS), causing neurocysticercosis (NCC). NCC is the most common parasitic disease of the CNS and one of the most important causes of epilepsy (Sanchez, 2003; Takayanagui and Odashima, 2006).

Taeniasis/cysticercosis is still a very important health problem in certain areas of Indonesia. The disease in this country is caused by three cestodes, that is, *T. solium*, *T. saginata*, and *T. asiatica* (Margono *et al*, 2006; Suroso *et al*, 2006; Wandra *et al*, 2006a). These three cestodes were reported from three known endemic provinces for taeniasis/cysticercosis: Bali (*T. solium* and *T. saginata*), Papua (*T. solium*), and North Sumatra (*T. asiatica*).

Historically, *T. saginata* taeniasis in Indonesia was reported in East Java in 1867 (Oemijati, 1977), and *T. solium* taeniasis in East Kalimantan in 1940 (Bonne, 1940, cited in Suroso *et al*, 2006). Cases with taeniasis and/or cysticercosis have also been reported sporadically from several other provinces (Simanjuntak *et al*, 1997; Suroso *et al*, 2006).

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GEOGRAPHICAL DISTRIBUTION

Bali

A recent survey for human taeniasis and cysticercosis in four villages in four districts of Bali (Gianyar, Badung, Denpasar, Karang Asem Districts) in 2002-2005, indicated that among 540 local people, the prevalence rates of *T. saginata* taeniasis were found to range from 1.1% in Badung in 2004 and in Karang Asem in 2006, to 27.5% in Gianyar (Ketewel village) in 2004. The prevalence rates of *T. saginata* taeniasis increased dramatically in Gianyar, including in 2002 (25.6%) and 2005 (23.8%), compared to previous surveys in 1977 (2.1%) and in 1999 (1.3%), respectively (Simanjuntak *et al*, 1977; Sutisna *et al*, 2000). It is possibly due to the increase in the number of families who consume raw beef (beef *lawar*) (Wandra *et al*, 2006a). However, when 48 taeniasis patients in Gianyar, who expelled tapeworm after treatment with praziquantel in 2002-2005, were re-examined in 2003-2006, there were no cases of re-infections with *T. saginata*. All of them reported that they stopped eating beef *lawar* after they recognized that they harbored tapeworms. However, a few people could not stop eating beef *lawar*, and, after a few months, they expelled tapeworms again.

In another village of Gianyar (Pagesangan) in 2006, only 2 (3.6%) of *T. saginata* taeniasis patients among 56 local people were found. Based on mitochondrial DNA analysis, all 66 tapeworms expelled from 66 worm carriers during 2002-2006 were confirmed to be *T. saginata*. There is no evidence for the existence of *T. asiatica* in humans in Bali (Wandra *et al*, 2006a; Wandra *et al*, unpublished data). The source of infection with *T. saginata* taeniasis was related to the consumption of a local raw-beef dish (beef *lawar*) with inadequate meat and food (*lawar*) inspection. The risk factors for *T. saginata* taeniasis are age, gender, level of education, consumption of beef *lawar*, and source of *lawar* (Wandra *et al*, 2006a).

By contrast, *T. solium* taeniasis/cysticercosis is now rather rare in Bali, probably due to improvements in sanitation and pig husbandry. Among 596 local people in five villages in 4 districts of Bali in 2002-2006, there was no

indication of *T. solium* taeniasis, history of epileptic seizures (suspected neurocysticercosis), and subcutaneous nodules (suspected subcutaneous cysticercosis) except for 2 seropositive out of 451 serum samples, including 0.8% (1/125) in Gianyar in 2002, and 2.8% (1/36) in Karang Asem in 2006, respectively (Wandra *et al*, 2006a, Wandra *et al*, unpublished data).

Papua

An epidemiological study on taeniasis/cysticercosis was carried out in 11 sub-districts in 5 districts of Papua (Jayawijaya, Merauke, Manokwari, Paniai, and Nabire) for ten years (1996-2005). A total of 1,474 persons were diagnosed by anamnesis (questionnaire) and physical examinations; 146 stools samples for detection of *Taenia* spp by copro-ELISA test. The serum samples of human (1,444), pigs (272) and dogs (125) were available for detection of antibodies against *T. solium* cysticercosis.

A total prevalence of 13.0% (19/146) for taeniasis was found in Jayawijaya, including 14/88 (15.9%) in 1999, and 5/58 (8.6%) in 2001. The seroprevalence of cysticercosis in humans by sub-district in Papua was detected to range from 0.0% (0/60) in a non-endemic area, Merauke Sub-District, Merauke in 1998, to 45.8% (44/96) in a highly endemic area, Assologaima Sub-District, Jayawijaya in 1996 (Wandra *et al*, 2000, 2003; Ito *et al*, 2003, 2004; Wandra *et al*, unpublished data).

The seroprevalence of cysticercosis in pigs and dogs in Jayawijaya ranged from 8.5% to 70.4% (1998-1999), and from 4.9% to 33.3% (2000-2002), respectively. Necropsy of 4 seropositive dogs found cysticerci of *T. solium* in the brain and heart (4 all) and in the muscle (2) as well. Mitochondrial DNA (mtDNA) analysis of proglottids and cysts obtained either from human, pigs, or dogs and metacestodes grown in NOD/shi-*scid* mice were confirmed to be *T. solium* Asian genotypes (Wandra *et al*, 2000; Ito *et al*, 2002, 2003, 2004). There were no *T. saginata* or *T. asiatica* human cases in Papua.

Bivariate analysis of available data for age, sex, levels of education, and the habit of hand washing before eating in a group with seropositive cysticercosis (n = 102-158) and a

control in a group with seronegative cysticercosis (n = 355-576) in Jayawijaya showed that the factors associated with cysticercosis for local people were age ($p < 0.01$), levels of education ($p < 0.01$), and washing hand before eating ($p < 0.05$). It is suggested that the 18 years or older group, low level of education, and the habit of not washing hands before eating were the important factors associated with cysticercosis, particularly in Jajawijaya, Papua (Wandra *et al*, unpublished data).

A study in four Sub-districts of Jayawijaya (Assologaima, Wamena Kota, Kurulu, and Hubikosi) among 506 families in 1996-2005 showed that only 17% (86/506) defecated in a toilet, 6.3% (32/506) in the backyard, 1.8% (9/506) in the river, 64.6% (327/506) in the garden, and 10.3% (52/506) in the forest (Wandra *et al*, unpublished data).

The number of contaminated districts in Papua has increased from one district (Pania) in the 1970s (Margono *et al*, 2006) to 4 districts (Paniai, Jayawijaya, Manokwari and Nabire) in the past 10 years, due to the local people in Papua moving from one district to another district, sometimes bringing their pigs with them, so that the disease appears to have spread from endemic areas to other districts, particularly where the ethnic groups such as Akari, Dani, Lani, and Yale are predominant, as related to their life style and socio-cultural characteristics (Suroso *et al*, 2006; Wandra *et al*, unpublished data).

There was no evidence that Merauke had already been contaminated, because a woman showing a high antibody titer in 1997 was a transmigrant from another province of Indonesia (Wandra *et al*, 2000, 2003; Ito *et al*, 2003, 2004). There is no data available on taeniasis/cysticercosis from other districts of Papua.

North Sumatra

In Samosir Island in Lake Toba, North Sumatra the prevalence rates of taeniasis during 1972-1990 were reported to range from 1.9% to 20.7% (Kosin *et al*, 1972; Cross *et al*, 1976; Koeshardjono *et al*, 1987; Kosman *et al*, 1990 cited in Depary, 2003). Repeated epidemiological surveys of taeniasis/cysticercosis during 2003-2006 on 240 local people showed that 6/240

(2.5%) were infected with *T. asiatica*, including 2/58 (3.4%) in 2003 and 4/182 (2.2%) in 2005 (Wandra *et al*, 2006b).

Mitochondrial DNA analysis of proglottid samples isolated from patients showed that all 6 expelled tapeworms were confirmed to be *T. asiatica*. There is no evidence for the existence of *T. solium* or *T. saginata* in Samosir Island. The main risk factor of *T. asiatica* taeniasis for the people is due to preparation of a local traditional dish (*sang-sang*) at home, in local restaurants, and during traditional or religious celebrations. While cutting pork into small pieces, the people sometimes try to eat the uncooked viscera (liver). This is completely different from the Bali people who do not like the taste of uncooked viscera (Wandra *et al*, 2006b).

CONCLUSION

The recent survey for human taeniasis and cysticercosis in Bali indicated that the increase in the number of cases of *T. saginata* taeniasis might be due to the increasing number of families who consume raw beef (beef *lawar*). *T. solium* taeniasis/cysticercosis is now rather rare, probably due to the improvement in sanitation and pig husbandry. Both *T. solium* and *T. saginata* are distributed in Bali. There is no evidence for the existence of *T. asiatica* in humans in Bali, probably due to the local people liking uncooked meat with blood (pork *lawar*), but not liking uncooked viscera. *T. solium* is distributed in Papua. The population aged 18 years or older group, low level of education, and the habit of not washing hands before eating were the important factors associated with cysticercosis, particularly in Jajawijaya. The number of contaminated districts with taeniasis/cysticercosis has increased. Mitochondrial DNA (mtDNA) analysis of parasite was confirmed to be *T. solium* Asian genotypes. In Samosir Island, North Sumatra, where *T. asiatica* taeniasis is still found, it was possibly related to the consumption of the uncooked viscera of local pigs. Considering the differences in religions, cultures, socio-economic characteristics, and levels of education, control programs of taeniasis/cysticercosis should be adapted to the specific local area and be evidence based.

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