

THE CURRENT *TAENIA SOLIUM* TAENIASIS/CYSTICERCOSIS SITUATION IN INDONESIA

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Abstract. The first *Taenia solium* taeniasis/cysticercosis case in Indonesia has not been clearly recognized or recorded. There has been no regular report of this disease. On a very few occasions, cysticercosis cellulosa cases were reported among post-mortem examinations of slaughtered pigs, particularly in Medan, North Sumatra Province, and Denpasar, Bali Province. Since 1972, the Directorate General of Communicable Disease Control and Environmental Health, Ministry of Health, collaborating with the Directorate General of Livestock, Ministry of Agriculture, conducted some surveillance work through data collection from hospitals and animal slaughterhouses, and collected data from surveys. During the period 1987-2002, 11/30 Indonesian provinces were found endemic. Christian and Hindu groups populate some areas of all 11 endemic provinces. These groups used to breed pigs with small-scale backyard farming, and there were very few large-scale breeding farms. In 10/11 endemic areas where stool surveys were conducted and worms examined after treatment, it was found that the positive rates were around 0.0-3.1%, except in Papua Province, where the positive rate was 10.5%. The positive rate for cysticercosis/brain cysticercosis cases, which is confirmed by isolation of the nodule by counter-immunoelectrophoresis (CIEP) test, and by recognition of epileptic symptoms, was around 0.0-1.8%, except in Papua Province (about 25.0%). During the early 1970s, atebine and yomesan were used to de-worm humans, and praziquantel was used for victims of cysticercosis/brain cysticercosis. Since 1998, praziquantel with albendazole and mebendazole have been used to treat *Taenia solium* taeniasis/cysticercosis. The *T. solium* taeniasis/cysticercosis situation in Papua Province, particularly among the 120,000 population of Baliem Valley, in Jayawijaya district, has become the worst, especially when the cysticercosis rate of 25.0% is projected onto the 120,000 population at risk. Control measures have been conducted with very minimal success.

INTRODUCTION

The Indonesian archipelago has a population of 220 million, and consists of about 21,000 islands, of which about 17,600 are named, while only about 8,000 are inhabited. About 85.0% of the Indonesian population is Moslem while another 15% are Christians, Hindu, Buddhists and animists, and these communities can be found predominantly in some locations. Wild boar can be found on every island of Indonesia. Some Christian, Hindu, Buddhist and animist communities breed pigs, but mostly by small-scale backyard farming. This type of traditional farming can be found in the provinces of Aceh, North Sumatra, Riau, Bangka Belitung, Lampung, Central Java, Bali, East Nusatenggara, Central Kalimantan, East Kalimantan, South Sulawesi, Central Sulawesi, North Sulawesi, Maluku, and Papua. Industrial pig farms, where the number of pigs may be up to 700,000 head, are small in number and can be found in North

Sumatra, Riau, Bangka Belitung, Central Java, and Bali provinces. The problem of *Taenia solium* taeniasis/cysticercosis used to be found around traditional pig farms. Some factors are related to the *T. solium* taeniasis/cysticercosis problem, such as the way farmers take care of their pigs, whether the pigs are kept inside a fence all day or just let roam around freely outside the fence, the availability of a family latrine, how the pork is cooked, and how the farmers take care of their personal hygiene to prevent *T. solium* taeniasis/cysticercosis.

The first *Taenia solium* taeniasis/cysticercosis case in Indonesia is not clearly recognized or recorded. Before 1972, this disease was not included among the notifiable diseases, since reported cases were very rare and were received from a few hospitals in North Sumatra, West Kalimantan, and Bali. Porcine cysticercosis cases were recorded frequently and reported annually from 1952 from slaughterhouses in Bali and North Sumatra. All of these infected pig carcasses, according to veterinary policy, were discarded. The first human cysticercosis cellulosa case was reported in Bali in 1963, where the cyst was taken from subcutaneous nodules in the upper arm and the larvae were confirmed by clinical laboratory examination. From then until 1972, there were nine

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other confirmed subcutaneous cases of human cysticercosis in Bali, together with cases in northern Sumatra provinces. Almost all of these cysticercosis nodules were found predominantly subcutaneously on the upper arms and medial thighs.

MATERIALS AND METHODS

Stool examinations were performed to determine *Taenia* eggs. On some occasions, *Taenia* segments emerged from the rectum. All positive segments and eggs were treated with de-worming drugs. Species were then determined by segment specifications.

Physical examinations were also conducted; subcutaneous nodules were palpated in the area of the medial thighs, upper arms, lateral neck, and upper shoulders. Biopsies of subcutaneous nodules were conducted and the cyst walls were destroyed using bile liquid. The *Taenia* worm can be identified by its juvenile form. Neurocysticercosis can be recognized by epileptic seizures. Serological examination can be performed to determine patients suffering from unseen cysticercosis, which is not apparent by subcutaneous nodule or by lack of epileptic seizure.

The *Taenia solium* taeniasis/cysticercosis transmission cycle can be determined by interview and observation of the population's daily life. Questions were addressed to the respondents about their personal hygiene, environmental sanitation, and how they processed pork and vegetables for food, how they kept their pigs, and whether they had family latrines. Enumerators recorded all answers in the questionnaire form sheets.

The taeniasis patients were treated, and praziquantel was administered. During the treatment trials, some patients with cysticercosis and neurocysticercosis were given praziquantel tablets, while some other groups of patients were treated with albendazole. During the treatment period, all of them had to be hospitalized.

Porcine cysticercosis can be detected by examination of nodules in the pig's tongue, but mostly cysticercosis *cellulosae* can be seen during post-mortem examination. Serological tests have been done among pigs and dogs in Baliem Valley.

RESULTS

Human *T. solium* taeniasis/cysticercosis surveys from 1972-2000 in Indonesia are presented in Table 1. Four taeniasis surveys were conducted in Sumatra during three decades, twice in 1972 in North Sumatra

Province, once in 1981 in Lampung Province, and another in 1987 in Riau Province. In 1972, surveys were conducted in North Sumatra Province in two different places, once in Samosir Island in Lake Toba district in North Tapanuli, and another in Tanah Karo district. During the first survey, 8 (2.8%) out of 285 stool samples were found positive for *Taenia* eggs, and after yomesan de-worming drugs were given, the adult *Taenia* from all patients were collected and confirmed as *T. solium*. Of the 283 serum specimens collected, 3 (1.1%) were found antibody-positive against *C. cellulosae*. During the second survey in North Sumatra in 1972, 350 stool samples were collected and 7 (2.0%) were found positive for *Taenia* eggs. After they were treated with yomesan de-worming medicine, adult *T. saginata* was confirmed from one person, while adult *T. solium* were found from another six persons. During that survey period, 350 serum specimens were also collected and 2 (0.6%) were antibody-positive for *C. cellulosae*.

Another survey on Sumatra Island was conducted in Lampung Province, in 1981, where 476 stool specimens were examined and 5 (1.0%) were found positive for *Taenia* eggs. After praziquantel de-worming medicine was given, it was confirmed that they suffered from *T. solium* taeniasis. Of 473 serum specimens examined, 8 (1.7%) were antibody-positive for *C. cellulosae*. In 1987, a survey was performed in Riau Province, where 202 stool specimens were collected and 2 (0.9%) were positive for *Taenia* eggs, all of which were confirmed as *T. solium* taeniasis. From 201 serum-collected specimens, no antibody positive against *C. cellulosae* was found.

From 1973 to 2003, surveys were conducted five times in Irian Jaya Province (now known as Papua Province), twice in 1973, and once each in 1979, 1994 and 2000. The surveys in 1973, 1979, and 1994 were conducted among the populations of some villages located around Lake Wissel in the sub-district of Enarotali, district of Paniai, while the survey in 2000 was conducted in the Baliem Valley in Jayawijaya district. For the four surveys in Enarotali sub-district, the positive rates for *Taenia* eggs were about 2.2 to 10.5%. During the last survey in Enarotali, in 1994, the positive rate had increased to 10.4%. During the four survey times in Enarotali, it was found also that the rate of antibody-positive to *C. cellulosae* was between 17.4-25.0%, while in 1994, the antibody-positive against *C. cellulosae* by serological test was found to have increased to 21.6%. During the fifth survey in the Baliem Valley, in Jayawijaya district, in 2000, it was found that 60.0% of serum specimens were antibody-positive to *C. cellulosae*.

In Bali, surveys were conducted three times, once in each of the years 1977, 1981, and 1990. In 1977, 12/548 (2.2%) stool specimens were found positive for *Taenia* eggs, in 1981 4/351 (1.1%), and in 1990 14/515 (2.7%) of stool specimens. In 1977, yomesan de-worming medicine was administered, but since 1981 praziquantel has been used. In all three surveys in Bali, all infections were confirmed as *T. solium*. During the survey in 1977 which was conducted in Bali, it was found that 7 (1.3%) out of 546 sera were antibody positive against *C. cellulosae*, in 1981, 5 (1.4%) out of 352 serum specimens were positive of antibody against *C. cellulosae*, and in 1990 it was found that 9 (1.8%) out of 511 serum sample were antibody positive against *C. cellulosae*.

In 1975, a survey was conducted on Flores Island, in East Nusatenggara Province, where 12/445 (2.8%) stool specimens were found positive for *Taenia* eggs. When yomesan was given, it was confirmed that 2/12 patients suffered from *T. saginata* taeniasis, while another 10 suffered from *T. solium* taeniasis. Of 440 serum specimens examined, 4 (0.9%) were found positive for *T. solium* cysticercosis antibody.

On Lombok Island, in West Nusatenggara Province, a survey was conducted in 1998. Of 260 stool specimens examined, 8 (3.1%) were positive for *Taenia* eggs. Praziquantel was administered, and it was found that all patients suffered from *T. solium* taeniasis. Serum specimens from 260 survey participants were collected and examined; 2 (0.8%) sera were found positive for *C. cellulosae* antibody.

On Sulawesi Island, a survey was conducted in three provinces; in 1981 in North Sulawesi Province, in 1985 in Southeast Sulawesi Province, and in 1989 in South Sulawesi Province. During the 1981 survey in North Sulawesi Province, 245 stool specimens were collected but none were found positive for *Taenia* eggs; however, 2/245 (0.8%) serologically examined serum specimens were found antibody-positive for *C. cellulosae*. During the survey conducted in Southeast Sulawesi in 1985, 1/243 (0.4%) stool specimens were positive for *Taenia* eggs, and when praziquantel de-worming medicine was given, it was confirmed that the case suffered from *T. solium*, but from 243 collected sera, not one was found positive for *C. cellulosae* antibody. During the 1989 survey in South Sulawesi

Table 1
Human *Taenia solium* taeniasis/cysticercosis surveys from 1972-2000 in Indonesia.

Province	Year	Stool sample for <i>T. solium</i>		Serum sample for <i>C. cellulosae</i>	
		No. exam	No. pos (%)	No. exam	No. pos (%)
North Sumatra (1)	1972	285	8 (2.8)	283	3 (1.1)
North Sumatra (2)	1972	350	7 (2.0)	350	2 (0.6)
Irian Jaya (1)	1973	170	18 (10.5)	170	43 (25.0)
Irian Jaya (2)	1973	74	6 (8.1)	74	21 (18.4)
East Nusatenggara	1975	445	12 (2.8)	440	4 (0.9)
Bali (1)	1977	548	12 (2.2)	546	7 (1.3)
Irian Jaya (3)	1979	350	7 (2.2)	350	61 (17.4)
Bali (2)	1981	351	4 (1.1)	352	5 (1.4)
North Sulawesi	1981	245	0 (0.0)	245	2 (0.8)
Lampung	1981	476	5 (1.0)	473	8 (1.7)
Southeast Sulawesi	1985	243	1 (0.4)	243	0 (0.0)
Riau	1987	202	2 (0.9)	201	0 (0.0)
West Nusatenggara	1988	260	8 (3.1)	260	2 (0.8)
South Sulawesi	1989	288	14 (4.9)	283	1 (0.4)
Central Kalimantan	1990	144	4 (2.8)	144	1 (0.7)
Bali (3)	1990	515	14 (2.7)	511	9 (1.8)
Irian Jaya (4)	1994	537	56 (10.4)	537	116 (21.6)
Irian Jaya (5)	2000	0	0 (0.0)	70	42 (60.0)

Sources of data: Directorate General of CDC-EH, MOH; NIHR&D, MOH; Parasitology Department, FOM-UOI

Province, it was found that 14/288 (2.7%) stool specimens collected were positive for *Taenia* eggs, and after de-worming with praziquantel, all patients were confirmed as suffering from *T. solium* taeniasis. When 283 serum specimens were examined, it was confirmed that one person (0.4%) suffered from *T. solium* cysticercosis.

A survey was done on Kalimantan Island in Central Kalimantan Province, in 1990. Of 144 stool specimens examined, 4 (2.8%) were found positive for *Taenia* eggs. After praziquantel de-worming, it was confirmed that all suffered from *T. solium* taeniasis. One person (0.7%), through serum specimen examination, was confirmed as suffering from *T. solium* cysticercosis.

A cross-sectional study regarding population behavior related to *Taenia solium* taeniasis/cysticercosis was conducted in the Baliem Valley, Jayawijaya District, Papua Province, in 2000; the results of this study is shown in Table 2. This survey was done almost four years after an outbreak of *T. solium* cysticercosis, in 1996, which occasioned epileptic seizures in about 3,600 persons. The *T. solium* taeniasis/cysticercosis problem was distributed geographically in six sub-districts, with a population of about 60,000 persons. Physical examination was also performed in order to determine subcutaneous *T. solium* cysticercosis. It was known that *T. solium* taeniasis/cysticercosis was the only taeniasis problem in the highlands of Papua Province, since only pigs can be found, and there are no cattle or buffalo in that area. One hundred and sixty respondents were questioned and their daily lives were also observed.

It was found from that survey that about 42/160 (26.3%) respondents suffered from subcutaneous cysts

and about 23 (14.4%) with epileptic seizures. About 28 (17.5%) were treated against *T. solium* taeniasis/cysticercosis. Epileptic seizures occurred among 30/160 (18.6%) respondents, even though subcutaneous cysts were unable to be recognized. Nine (5.6%) persons showed epileptic seizures without any palpated subcutaneous cyst.

About 154/160 (96.3%) respondents, representing each household, had no family latrine. Consequently, 151 (94.4%) of them confessed to defecating in the surrounding house yards. Of 160 respondents, 87 (54.4%) used to eat raw and unwashed sweet potatoes, while of 160 respondents, 159 (99.4%) used to eat improperly roasted sweet potatoes and pork.

A number of 70 serum specimens were collected from 160 respondents and found that 42(60.0%) were found that they were suffered from *T. solium* cysticercosis. Biopsies among 22 persons with subcutaneous nodule were done. The cysts were isolated from 22 persons with palpated subcutaneous nodules and 21(90.9%) of the cysts were confirmed as *C. cellulosae*.

During the last three decades, 13 porcine cysticercosis serological surveys were conducted in 13 places in Indonesia (Table 3). On the island of Sumatra, surveys were conducted in three provinces. One survey was conducted in 1973 in North Sumatra Province; in 1981, in Lampung Province, and in 1987 in Riau Province. Serological examination was performed and 14/191 (7.2%) pig blood sera from North Sumatra Province (1973) were antibody-positive against porcine *C. cellulosae*; 40/325 (12.3%) pig sera in 1981 from Lampung Province were antibody-positive for porcine *C. cellulosae*, while 4/182 (2.2%)

Table 2
Of 160 respondent subjects related to the *Taenia solium* taeniasis/cysticercosis status among the population of Baliem Valley, District of Jayawijaya, Papua Province, in 2000.

Subject	Total	%
Treated taeniasis/cysticercosis	28	17.5
Suffered from subcutaneous cysts	42	26.3
Epilepsy with subcutaneous cyst	30	18.6
Epilepsy without subcutaneous cyst	9	5.6
Family latrine not available	154	96.3
Defecate around the house	151	94.4
Eat sweet potatoes without cooking	87	54.4
Eat improperly roasted sweet potatoes and pork	159	99.4
Positive antibody against <i>C. cellulosae</i> , of 70 sera	42	60.0
Positive <i>C. cellulosae</i> from 22 subcutaneous cysts	21	90.9

pig sera, collected from Riau Province, in 1987, were found antibody-positive for porcine *C. cellulosae*.

In 1973, surveys were conducted twice in Irian Jaya (Papua) Province, the first in 1973 and the second in 1974. Both surveys were done in Enarotali Sub-district, District of Paniai. From the survey in 1973, 46/274 (16.9%) pig sera were found positive for porcine antibody to *C. cellulosae*, while from the survey in 1974, 76/311 (24.3%) pig sera were antibody-positive for porcine *C. cellulosae*. On the island of Bali, Bali Province, the same surveys were conducted twice, once in 1973, and another in 1975. During the 1973 survey, 324 pig sera were collected and 71 (22.0%) were porcine antibody-positive for *C. cellulosae*. From the survey in 1975, 284 pig sera were collected and 69 (24.2%) were porcine antibody-positive for *C. cellulosae*.

Porcine cysticercosis surveys were conducted three times on Sulawesi Island; in North Sulawesi Province (1981), in Southeast Sulawesi Province (1985), and in South Sulawesi Province (1989). During the survey in North Sulawesi Province, 17/266 (6.3%) pig sera collected were antibody-positive for porcine *C. cellulosae*. From the survey in Southeast Sulawesi, 34/250 (13.4%) pig sera were antibody-positive for porcine *C. cellulosae*, while from South Sulawesi Province, 11/230 (4.8%) pig sera were antibody-positive for porcine *C. cellulosae*.

A survey conducted on Kalimantan Island, in

Central Kalimantan Province (1990), found 6/202 (2.9%) pig sera specimens antibody-positive for porcine *C. cellulosae*. In East Nusatenggara Province, a survey conducted on Flores Island (1975) found 45/251 (18.1%) pig sera were antibody-positive for porcine *C. cellulosae*. The same type of survey was conducted on Lombok Island, West Nusatenggara Province (1988), and found that 12/218 (5.5%) pig sera specimens were antibody-positive for porcine *C. cellulosae*.

Besides palpation of subcutaneous cysticercus nodules, serological tests were also performed among suspected *T. solium* cysticercosis patients, including patients with epileptic seizure. It was found that 42/70 (60%) sera taken randomly among 160 respondents were positive for *T. solium* cysticercus antibody. Biopsies of 22 patients for subcutaneous nodules were done. Histopathological examinations were performed and found that 21/22 (90.9%) isolated cysts from subcutaneous nodules were confirmed as *T. solium* cysticercus.

After some clinical trials of some de-worming medicines, it was decided to use praziquantel for taeniasis cases and praziquantel or albendazole for cysticercosis and neurocysticercosis patients. Mass treatment for taeniasis cases can be given with a single dose of 100 mg/kg body weight. The patients were told to eat soft food for 24 hours and fast 12 hours before treatment. The medicine was given on an empty

Table 3
Porcine cysticercosis cellulosae serological survey in Indonesia, 1973-1990^a.

Province	Year	No. of serum samples	
		Examined	Pos. (%)
North Sumatra	1973	191	14 (7.2)
Irian Jaya (1)	1973	274	46 (16.9)
Bali (1)	1973	324	71 (22.0)
Irian Jaya (2)	1974	311	76 (24.3)
Bali (2)	1975	284	69 (24.2)
East Nusatenggara	1975	251	45 (18.1)
Lampung	1981	325	40 (12.3)
North Sulawesi	1981	266	17 (6.3)
Southeast Sulawesi	1985	250	34 (13.4)
Riau	1987	182	4 (2.2)
West Nusatenggara	1988	218	12 (5.5)
South Sulawesi	1989	230	11 (4.8)
Central Kalimantan	1990	202	6 (2.9)

^a Sources of data: Directorate General of CDC & EH, MOH and NIHR&D, M.

stomach, followed by 30 g of magnesium sulfate laxative for adults, and 7.5-15 g for children. The *Taenia* scolex must be collected and identified to ensure that the worm was completely removed. About 100% of the taeniasis patients were successfully treated.

Neurocysticercosis patients with epileptic symptom and / or patients found antibody-positive for *T. solium* cysticercus with serological test, followed by x-ray confirmation, were treated with praziquantel or albendazole. All patients were treated in hospital. Similar results were found with praziquantel and albendazole treatments. Patients were treated with a single dose of 50 mg/kg body weight of praziquantel, divided into three doses for 15 days. Albendazole can be given as a single dose of 15 mg/kg body weight divided into three doses *per os* for 7 days. To avoid allergic reaction, corticosteroids were given to the patients during treatment of *T. solium* cysticercosis and neurocysticercosis using praziquantel and albendazole. Successful treatment was indicated by a reduction in epileptic seizure frequencies followed by their total disappearance.

DISCUSSION

From all 13 conducted surveys in various places in Indonesia, 5,262 stool specimens were collected and only 3 persons (0.06%) were found with *T. saginata* taeniasis, or 6 per 1,000 population in Indonesia. It seems that taeniasis *saginata* is not a public health problem in Indonesia, since *T. saginata* cysticercosis has never been found in man, while *C. bovis* can only be found in cows.

The positive percentage of *Taenia solium* taeniasis on Sumatra Island ranged from 0.9-2.29%, especially in North Sumatra Province, where it was more than 2.0%. On the island of Bali, the percentage-positive for *Taenia solium* taeniasis ranged from 1.1-2.7% and in two survey areas, over 2.0%. On Sulawesi Island, the highest percentage-positive for *Taenia solium* taeniasis (4.9%) was found in South Sulawesi, while in North and Southeast Sulawesi the rates were < 2.0%. In East and West Nusatenggara, the rates were > 2.0%, while in Central Kalimantan it was 2.8%. In Papua Province, the lowest percentage-positive for *Taenia solium* taeniasis was about 2.2%, while from another three surveys in Enarotali Sub-district, the positive percentage of *Taenia solium* taeniasis were 8.1-8.5%, more than fourfold 2.0%. It seems that, relatively, *Taenia solium* taeniasis was the greatest public health problem in the province of Papua, followed by Bali, North Sumatra, West Nusatenggara, South Sulawesi, Central Kalimantan, and East Nusatenggara, since the

percentages-positive for *Taenia solium* taeniasis were > 2.0%. In Papua Province, *Taenia solium* taeniasis is a particular problem among the population, especially in districts of Paniai and Jayawijaya. This situation has come about because the people in almost all of those two districts, and in some surrounding districts follow the tradition of eating roasted pork, but unfortunately, *T. solium*-larva-infected pork is improperly roasted and the larvae are not killed. In some special parties, such as New Year's Eve celebrations, the people in some villages slaughter some tens of pigs, which are not inspected properly by a meat inspector.

A single case of human *T. solium* neurocysticercosis used to be an individual health problem. Intensive, complicated, high-risk treatment must be undertaken. This individual problem may be projected onto the current situation among the 120,000 Baliem Valley population in District of Jayawijaya, where about 28.3% or 33.96/120,000 persons suffer from subcutaneous nodules. If 90.9% of them suffer from *T. solium* cysticercosis, that means an estimated 30.87 persons per 120,000 population, which is thus a serious public health problem. This situation might be categorized as a national disaster for Indonesia. This may be seen from the last survey data from Baliem Valley, in Jayawijaya District (2000), where 60.0% of subcutaneous nodules were confirmed as *T. solium* cysticercosis. If these data are reliable and trustworthy there must be $(28.3\% : 100\%) \times 30.870 = 5,742$ persons with epileptic seizures from *T. solium* subcutaneous cysticercosis.

All of these problems have arisen from very poor personal hygiene among the majority of the population, eating improperly roasted pork and sweet potatoes, defecation around the house yard, and letting pigs roam freely outside their fences.

Conclusion

1. *T. solium* taeniasis was found in some provinces populated by non-Moslem communities. Its prevalence was between 0.0% in North Sulawesi Province, up to 4.9% in South Sulawesi. The highest was 10.5% in Papua Province.

2. A 0.0% prevalence of *T. solium* cysticercosis could be found in Southeast Sulawesi and Riau provinces, with a maximum of 1.8% in Bali, except for Papua Province, which was the highest, at 60%.

3. About 96.3% of households in Baliem Valley, Jayawijaya district, Papua Province had no family latrine and 94.4% of the family members defecated around the house yard, while 99.4% of them ate improperly roasted pork and sweet potatoes.

4. The minimum porcine *C. cellulosae* prevalence (2.2%) was found in Riau Province and the maximum (24.2%) was found in Bali Province, but the highest prevalence was 24.3% in Papua Province. The prevalences in Bali and Papua provinces were not significantly different.

Suggestions

1. *Taenia solium* taeniasis/cysticercosis control programs in some provinces of Indonesia must be developed, particularly Papua Province must be highly prioritized, since taeniasis and *T. solium* cysticercosis/neurocysticercosis were significantly high.

2. A *Taenia solium* taeniasis/cysticercosis control program must be set up as a long-term program because it is directed at changing human behavior, which will require an intensive effort of at least 5-10 years.

3. A short-term control program must be set up for at least one year, to treat taeniasis and cysticercosis/neurocysticercosis cases, but re-infection must be prevented by public health education and intensive surveillance for human and porcine *T. solium* taeniasis/cysticercosis.

4. The interdepartmental cross-coordination control program, especially between the Department of Health and the Department of Agriculture, must be maintained to cut the human-pig disease transmission cycle.

5. The possibility of mass porcine cysticercosis cellulosae treatment must be considered among other interventions in terms of food safety policy and discontinuing humans being infected with taeniasis solium from pork.

REFERENCES

Benenson A, ed. Control of communicable diseases in man. 15th ed. Washington, DC: American Public Health Association, 1990.

Desowitz R, Simanjuntak G. Observation of the application of CIEP for sero-epidemiology of the cysticercosis. *Southeast Asian J Trop Med Public Health* 1977;8:73-7.

Desowitz RS, Margono S, Sutjahyo, Simanjuntak G. Observations on the application of counterimmunoelectrophoresis for the seroepidemiology of human cysticercosis. *Southeast Asian J Trop Med Public Health* 1977;8:303-7.

Desowitz RS. New Guinea tapeworms and Jewish grandmothers: tales of parasites and people. New York: Norton, 1981.

Hilleboe HE, Larimore GW, eds. Preventive medicine, principles of prevention in the occurrence and progression of disease. 2nd ed. Philadelphia: WB Saunders, 1965.

Margono SS, Simanjuntak GM, Sahlan R. Geographical distribution of taeniasis solium and cysticercosis cellulosae in man and swine in Paniai District. *Southeast Asian J Trop Med Public Health* 1974;7:133-7.

Margono SS, Subianto DB. Taeniasis and cysticercosis among Enarotali population. *Southeast Asian J Trop Med Public Health* 1972;5:211-4.

Sigmund OH. The Merck veterinary manual. 5th ed. Rahway, NJ: Merck; 1979.

Simanjuntak G, Ito A. Taeniasis/cysticercosis in Indonesia as an emerging disease. *Parasitol Today* 1977;12:321-3.

Simanjuntak GM, Margono SS, Sahlan R. An investigation on taeniasis and cysticercosis in Bali. *Southeast Asian J Trop Med Public Health* 1977;8:494-7.

Subianto DB, Margono SS. Burnt outbreak related to the brain cysticercosis among Enarotali population, District of Paniai, Irian Jaya. *Southeast Asian J Trop Med Public Health* 1974;4:73-6.

Sutoto, Margono SS, Indrijono Tantoro. "Sejarah dan Perkembangan P4I dari Masa ke Masa" Dwi Windu P4I, Buku Peringatan 16 tahun Perkumpulan Pemberantasan Penyakit Parasit di Indonesia (P4I), Jakarta, Indonesia, 1992.