Prevalence and Reinfection of Ascaris lumbricoides and Trichuris trichiura among Elementary School Children in Rural Villages of Bali

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ABSTRACT
A study was carried out on the prevalence of infection and reinfection of A. The study objective was to assess the prevalence of the two worm species and reinfection that occurred after treatment. The elementary schools of SD1 Taman, SD3 Mambal, and SD3 Sibang Kaja were selected as the study sites by random sampling. Fecal samples from school children of the three selected elementary schools were collected and examined by Kato-Katz thick smear technique. Interview was done to assess the children’s habits and risk factors for reinfection. The results showed an overall prevalence of intestinal worm infection of 72.8%, the highest was found at SD1 Taman (92.4%). The prevalence in male school children was higher (75.7%) than in female children (69.3%), but the difference was not statistically significant (p>0.05). Infection intensity of A. lumbricoides was mostly (77.7%) light and that of T. trichiura was mostly (84.8%) very light. Treatment of ascariasis with Pyrantel 10 mg/kg BW in a single dose, and the trichuriasis with Mebendazole 100 mg twice a day for three days, and of mixed infection of the two species with Pyrantel 125 mg and Mebendazole 100 mg in single dose for three days gave an overall cure rate of 95.5%. Reinfection rates were of A. lumbricoides at second and third month after treatment were 1.3% and 11.9%, respectively. Reinfection rates of T. trichiura at first, second and third month after treatment were 4.7%, 7.6% and 20.9%, respectively. School children whose families routinely covered their meals at home had a lower reinfection rate than those whose families did not cover their meals (p<0.05).

Keywords: A. lumbricoides; T. trichiura; Prevalence; Risk factors; Reinfection

INTRODUCTION
Soil-Transmitted Helminths (STHs) are the most common cause of helminthic infections in humans. More than a quarter of the world’s population is infected with one or more of these parasites. The highest infection prevalence of Ascaris lumbricoides and Trichuris trichiura is usually found in school-age children and that of hookworm in adults. In Indonesia, the prevalence of STH infections especially A. lumbricoides and T. trichiura in school-age children in rural areas is still high hence imposes a significant public health problem [1]. A study done on school children at seven elementary schools in Badung district, Bali has shown 95.9% prevalence of A. lumbricoides and 60.5% prevalence of T. trichiura. Mixed infections of two STH species were more prevalent than single infections [2]. Another study done on school children of 26 elementary schools in Denpasar (the capital city of Bali) has found a prevalence of STH of 3-10% in the central area and 29% - 33% in the periphery of the city. The objective of our present study is to observe the infection prevalence A. lumbricoides and T. trichiura and their reinfection rates after treatment among elementary school children in the Subdistrict of Abiansemal, Bali [3]. Considering the high prevalence of STH infection in elementary school children in Abiansemal sub-district and several places in Bali with a portion of the children having heavy infection intensity, thus it is important to carry out prevention and control program to reduce infection transmission. The recommended prevention and control strategies comprise drug treatment, health education, and sanitation improvement. Regular drug treatment aims to reduce prevalence and level of soil contamination with worm eggs, especially in areas where sanitation and health facilities are inadequate.

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10,000-40,000) and heavy (EPG>40,000). Intensity of infection was assessed based on the number of worm eggs per gram of feces (EPG), according to the criteria as follows: Intensity of *A. lumbricoides* infection: light (EPG<10,000), moderate (EPG 10,000-40,000) and heavy (EPG>40,000). Intensity of *T. trichiura*: very light (EPG<1000), light (EPG 1000-4000), moderate (EPG 4000-10,000) and heavy (EPG>10,000) (Khan, 1982).

### MATERIALS AND METHODS

#### Location, population, samples, and time of study

This study was carried out in the Subdistrict of Abiansemal, Badung District, Bali, Abiansemal is a rural sub-district of 69.01 km² in area (Figure 1). The nearest part of the Subdistrict is around 8 km north of Denpasar, the capital city of Bali Province, and the farthest part is around 30 km north of Denpasar. Its total population is 65,420 people who are mostly farmers (Center for Statistical Data of Bali Province, 2015, unpublished data). Population of this study was all elementary schools located within the service areas of Health Center 1, Health Center 2 and Health Center 3 of Abiansemal Subdistrict [4]. From each health center area, one elementary school was chosen as the study sample by simple random sampling technique. By this method, elementary schools of SD1 Taman, SD3 Mambal and SD3 Sibang Kaja were selected as the study samples [5]. The distance of the villages of Mambal is about 8 km, Sibang Kaja 12 km and Taman 15 km, respectively, north of Denpasar city, the capital of Bali Province. The total number of school children of the three selected elementary schools was 391 comprising 101 persons at SD1 Taman, 100 persons at SD3 Mambal, and 190 persons at SD3 Sibang Kaja. From the total 391 school children, 356 fecal samples could be collected and examined (91.05% coverage). Oral informed consent was obtained from each of the study samples. This study was carried out from March to June 2010 [6].

#### Technique of examination

The 356 fecal samples collected from school children of the three selected elementary schools were examined by modified Kato-Katz thick smear technique to detect infection by finding worm eggs as well as to evaluate the intensity of infection, which was assessed based on the number of worm eggs per gram of feces (EPG), according to the criteria as follows: Intensity of *A. lumbricoides* infection: light (EPG<10,000), moderate (EPG 10,000-40,000) and heavy (EPG>40,000). Intensity of *T. trichiura*: very light (EPG<1000), light (EPG 1000-4000), moderate (EPG 4000-10,000) and heavy (EPG>10,000) (Khan, 1982).

#### RESULTS

Of 391 school children of the three selected elementary schools, 356 children submitted their fecal samples (91.05% coverage), consisted of 193 males and 163 females. Those who did not give their fecal samples were subsequently treated [7]. Those who had *ascariasis* were treated with pyrantel 10 mg/kg body weight single dose; children who had *trichuriasis* were treated with mebendazole 100 mg twice a day for three consecutive days, and those with mixed infection of the two worms were treated with pyrantel tablet (125 mg single dose for one day) combined with mebendazole 1 tablet (100 mg) as a single dose for three consecutive days. Fourteen days after treatment, were re-collected from the treated school children and reexamined [8]. The treated school children who were found cured (no more worm eggs found in the stool) were followed-up by reexamining their stools each following month for three consecutive months, to see if reinfection with *A. lumbricoides* and *T. trichiura* occurred (indicated by finding of worm eggs of one or both of the two species). For *A. lumbricoides*, reinfection was assessed beginning at the second month after cure in accordance with the nature of its life cycle, so we must take into account that if *Ascaris* eggs are still found in the stool samples at the first month after cure, it should not be regarded as reinfection.

#### Interview on study subjects

An interview using a pre-designed questionnaire was done to all of the involved school children to study their knowledge about the two worms and their health-related habits such as use of latrine for defecation, washing hands before eating, boiling drinking water, protecting or covering their prepared meal at home. Direct observation was done to evaluate the cleanliness of the children’s fingernails [9].

#### Data analysis

The data related to prevalence of infection were analyzed statistically by chi-square test to assess any significant difference at p<0.05. Data related to reinfection and those obtained from interview to the school children were analyzed descriptively.

### Treatment and reinfection rate assessment

Out of 356 school children who were found positive for worm eggs in their stools were subsequently treated [7]. Those who had *ascariasis* were treated with pyrantel 10 mg/kg body weight single dose; children who had *trichuriasis* were treated with mebendazole 100 mg twice a day for three consecutive days, and those with mixed infection of the two worms were treated with pyrantel tablet (125 mg single dose for one day) combined with mebendazole 1 tablet (100 mg) as a single dose for three consecutive days. Fourteen days after treatment, were re-collected from the treated school children and reexamined [8]. The treated school children who were found cured (no more worm eggs found in the stool) were followed-up by reexamining their stools each following month for three consecutive months, to see if reinfection with *A. lumbricoides* and *T. trichiura* occurred (indicated by finding of worm eggs of one or both of the two species). For *A. lumbricoides*, reinfection was assessed beginning at the second month after cure in accordance with the nature of its life cycle, so we must take into account that if *Ascaris* eggs are still found in the stool samples at the first month after cure, it should not be regarded as reinfection.

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the examination found an overall prevalence of intestinal infection of 72.8%. The highest prevalence was found in school children of SD1 Taman (92.4%), followed by SD3 Mambal (80.9%) and SD3 Sibang Kaja (58.3%). (Table 1) SD1 in Taman village with the highest prevalence rate is located farthest from Denpasar, SD3 Sibang Kaja with the lowest prevalence rate is located nearest from Denpasar, and SD3 Mambal is located in between the two villages. A study done previously on 4858 fecal samples of school children of 24 elementary schools in Denpasar found a lower overall prevalence rate of 10.3% (PKBI Bali, 2005). Another study done in 2003 on school children of five elementary schools in Punggul and Jagapati villages in Badung district found a lower prevalence rate in elementary schools in Jagapati village, which is located closer to Denpasar city than in Punggul village which is more distant from Denpasar. Those lower prevalence rates may be associated with better hygiene - sanitation in the villages within the close vicinity of Denpasar city due to higher possession of latrine used for defecation in households. It may also be due to provision of clean water (piped water) supply for drinking and sanitary use in the city and villages close from Denpasar as compared with the more remote villages.

The prevalence rate among male school children (75.7%) was higher than in females (69.5%), but this difference was statistically not significant (x2 test, p>0.05) (Table 2). In a study carried out on elementary school children at Punggul and Jagapati villages, Bali, a similar result was found where the prevalence of intestinal worm infection in male elementary school children was higher (91.5%) than in female children (90.0%). Similar result was also found at Belok Sidan village, Badung district, Bali where the prevalence rate among male elementary school children was 80% and among female school children 77%, although the difference was not significant (p>0.05). In contrast, a study in China has found the prevalence of A. lumbricoides and T. trichiura infection was higher in females than in males. Similar finding was also found in Iran where the prevalence of infection in females was significantly higher than in males.

The high prevalence of infection with A. lumbricoides and T. trichiura (Table 3) might be due to continuous infection transmission of the two species caused by persistent soil pollution with the worm eggs by infected people who defecate outside latrines, because they do not have latrines at home. This may also relate to poor knowledge of the school children about intestinal worm infections, as shown by results of the interview that most (76.0% and 98.1%) of the school children had low level of knowledge about hookworm infections were found only among school children of SD1 Taman, with a prevalence of 14.1%.

DISCUSSION

Three hundred fifty-six (356) fecal samples were collected from school children of three randomly selected elementary schools and examined by Kato-Katz thin smear method [11]. Results of
found 60% and 33.9% mixed infections with the two worm species at Punggul Jagapati and Belok Sidan village, respectively. For development of their eggs, the two worm species need the same moist and shaded soil condition, which is usually found on house yards where children often defecate and play with earth. A study in the province of Yang Tse, China has found that 62.6% of the population were infected with one or more intestinal nematodes. *A. lumbricoides* and *T. trichiura* infections considered as reemerging diseases in this province were thought to be associated with the use of untreated manure for fertilizing soil and accidental ingestion of Ascaris eggs due to people’s habit of chewing sugar cane. A somewhat similar situation was encountered in Iran where poor sanitation existed as a result of indiscriminate defecation and the use of human excreta as fertilizer for farming. In Bali, however, there is no practice of using human excreta as fertilizer for farming, hence worm eggs pollution of the soil and water is solely associated with people’s habit of indiscriminate defecation.

Result of our present study shows that treatment of *A. lumbricoides* with pyrantel and *T. trichiura* with mebendazole and mixed infection of the two worms with pyrantel plus mebendazole as a single dose for three consecutive days had cured 95.5% of the infections. Mild side effects were encountered during treatment such as nausea, heartburn, and dizziness. A longitudinal study in Iran showed that a 2-year treatment program with the same drug regimens significantly decreased the prevalence rate of *A. lumbricoides* from 53.3% to 6%, and 32% of *A. lumbricoides* eggs expelled became unfertilized after treatment.

Reinfection of *A. lumbricoides* was assessed at the second month of observation, on the consideration that during treatment some *A. lumbricoides* larvae might still be circulating in the pulmonary blood circulation which eventually will reach into the small intestine to become adults and produce eggs. Therefore, if *A. lumbricoides* eggs were found in the fecal examination at the first month after cure, it should not be regarded as reinfection. This study showed at the second and third month of observation reinfection rates of *A. lumbricoides* were 1.3% and 11.9%, respectively. A study in 1990 at Jembatan Besi, Jakarta found that reinfection rate of *A. lumbricoides* was 58.8% three months after treatment in individuals who got both treatment and health promotion, while reinfection rate was 40% in those who got only treatment with no health promotion. Reinfection rates of *A. lumbricoides* and *T. trichiura* in those who had adequate knowledge about the two worm species did not differ significantly from the group who had inadequate knowledge about the two worm species. Health promotion could raise people’s knowledge about worm infection but it did not have any influence on reinfection. In Iran, a study has shown that children with parents having higher level of education, especially of the mothers, have lower infection rate of intestinal worms. This study has also found that there was a significant correlation between the number of siblings in the families and the increased rate of intestinal worm infection. A study in rural Kwa Zulu Natal/South Africa showed that 16 weeks after cure, reinfection of hookworm was low (10%), reinfection of *A. lumbricoides* was moderate and reinfection of *T. trichiura* was low. A second treatment was done 6 months later and 18 weeks after treatment reinfection of hookworm was relatively high, reinfection of *A. lumbricoides* was moderate and that of *T. trichiura* was low. Differences of reinfection after the first and the second treatment may be due to slightly longer reinfection period and seasons (cool and dry during the first treatment and hot and humid during the second treatment) that influence the life cycles of the worms. Reinfection with *A. lumbricoides* can occur when children play on house yard densely contaminated with worm eggs by which they may accidentally ingest the embryonated eggs through their soiled hands. Reinfection of *A. lumbricoides* and *T. trichiura* after treatment is correlated with the level of infection intensity in children before treatment.

Considering the high prevalence of STH infection in elementary school children in Abiansemal sub-district and several places in Bali with a portion of the children having heavy infection intensity, thus it is important to carry out prevention and control program to reduce infection transmission. The recommended prevention and control strategies comprise drug treatment, health education, and sanitation improvement. Regular drug treatment aims to reduce prevalence and level of soil contamination with worm eggs, especially in areas where sanitation and health facilities are inadequate. Health education aims mainly to reduce transmission of infection by promoting the school children’s knowledge and health-related habits such as defecating in latrine, washing hands before eating and after defecation, drinking only boiled or save water, always having clean fingernails, and covering or hygienic handling of food at home. In our opinion, improvement of sanitation condition particularly in rural villages and slum areas in the cities by providing latrines and water supply for households imposes the biggest challenge due to people’s poverty and budget limitation on the part of the government, however, it is crucially worth implementing in the perspective towards having a healthy and bright future generation, free from helminth infection.

**CONCLUSION**

In conclusion, according to our present study, the overall prevalence rate of soil-transmitted helminths among elementary school children in Abiansemal subdistrict, Badung district, Bali was quite high. In order to reduce or eliminate soil-transmitted helminth infection among elementary school children it is recommended that a preventive and control program be implemented by means of regular anthelmintic treatment, health education, and improvement of hygiene-sanitation.

**REFERENCES**


