Prevalence of *Clonorchis sinensis* Infections Along the Five Major Rivers in Republic of Korea, 2007

Hyun-Kyung Kim, MS¹, Hyeng-Il Cheun, PhD¹, Byung-Suk Cheun, PhD¹, Ki-Yeon Lee, MS¹, Tong-Soo Kim, PhD², Sang-Eun Lee, PhD¹, Won-ja Lee, PhD¹, Shin-Hyeong Cho, PhD¹,*

¹Division of Malaria and Parasitic Diseases, Korea National Institute of Health, Seoul, Korea
²Department of Parasitology, Inha University School of Medicine, Incheon, Korea

Abstract

Objectives

The prevalence of *Clonorchis sinensis* infection was investigated among residents of the five major river basins, that is, Hangang, Nakdonggang, Seomjingang, Yeongsangang, and Geumgang River basins in Korea.

Methods

From January to December 2007, a total of 31,268 stool samples were collected from 29 localities and examined by the formalin-ether sedimentation technique.

Results

Intestinal parasite eggs and/or protozoan cysts were detected from 2957 (9.5%) inhabitants. Number of residents harbouring helminth eggs in the faeces was 2542 (8.1%) for *C. sinensis*, 255 (0.8%) for *Heterophyes* spp., 36 (0.1%) for *Echinostoma* spp., 30 (0.1%) for *Trichuris trichiura*, 8 (0.03%) for *Ascaris lumbricoides*, 7 (0.02%) for *Gymnophalloide seoi*, and 50 (0.02%) for *Trichostrongylus orientalis*. Number of residents harbouring protozoan cysts in the faeces was 133 (1.3%) for *Entamoeba* spp. and 50 (0.2%) for *Giardia lamblia*. The positive rates of *C. sinensis* in Nakdonggang, Seomjingang, Yeongsangang, Geumgang, and Hangang River basins were 12.2%, 9.5%, 3.3%, 3.0%, and 1.0%, respectively. The egg positive rate of *C. sinensis* was higher in male (10.6%) than in female (6.1%), and the age group of 50s had the highest positive rate (10.4%).

Conclusion

The result of this study revealed little decrease in positive rate of *C. sinensis* compared with the result of southern endemic areas of Korea in 2006.

*Corresponding author. Department of Malaria and Parasitic Diseases, Korea National Institute of Health, 194, Tongil-ro, Eunpyeong-gu, Seoul 122-701, Korea.
E-mail: jo4u@cdc.go.kr

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/3.0) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

© 2010, Korea Centers for Disease Control and Prevention. Published by Elsevier. All rights reserved.
1. Introduction

Intestinal parasitic infections were highly prevalent until 1970s in Korea, especially among residents of major river basins of the country. During the past decade, a rapid decrease in the overall prevalence of intestinal parasites has been observed and is attributed mainly by nationwide control programs and health education undertaken by the Korean government along with increases in living conditions and quality of life among people living in Korea. Despite the remarkable decrease in soil-transmitted nematode infections, however, the prevalence of fish-borne trematode infections such as with *Clonorchis sinensis* and *Metagonimus yokogawai* has been maintained at relatively high level.

The liver fluke, *C. sinensis*, is currently the most important parasite infecting humans in Korea. Egg positive rates of *C. sinensis* in general population were 4.6% in 1971, 1.8% in 1976, 2.6% in 1981, 2.7% in 1986, 2.2% in 1992, 1.4% in 1997, and 2.4% in 2004. In 1981, the egg positive rates of people living in those river basins differed considerably; 40.2% in Nakdonggang, 30.8% in Yeongsangang, 17.3% in Seomjingang, 15.7% in Hangang, 15.9% in Tamjungang, 12.0% in Geumgang, and 8.0% in Mangyeonggang Rivers.

2. Materials and Methods

2.1. Surveyed area

Twenty-nine counties (Figure 1 and Table 1) were selected in five major river basins, which were located near or alongside the major rivers of Korea with reference...
to the nationwide survey in 2004. The study was undertaken for 1 year from January to December 2007.

2.2. Stool collection and examination

Stool specimens were collected in plastic containers and transferred to the laboratory of Korea National Institute of Health. A total of 31,268 subjects were recruited from villages for stool collection by a random household sampling method to assess the prevalence of parasitic infection. The formalin-ether sedimentation technique was used to examine helminth eggs, larvae, and protozoan cysts. One gram of each faecal sample was fixed with 10% neutral formalin in a 10-mL test tube. The formalin-fixed stool specimen was further processed by the formalin-ether concentration technique and examined for parasites in the laboratory. Parasite-positive individuals were treated with praziquantel and other appropriate anti-parasitic drugs at the end of the study.

3. Results

3.1. Number of positive cases of total intestinal parasites

Of 31,268 stool samples examined, 2957 (9.5%) were found to contain various intestinal parasite eggs, cysts, or larvae. Eggs of *C. sinensis*, *Heterophyes* spp., *Echinostoma* spp., *Trichuris trichiura*, *Ascaris lumbricoides*, Gymnophalloide seoi, and *Trichostrongylus orientalis* were detected from 2542 (8.1%), 255 (0.8%), 36 (0.1%), 30 (0.1%), 8 (0.03%), 7 (0.02%), and 5 (0.02%) individuals, respectively. Protozoan cysts were detected from 133 (1.3%) individuals for *Entamoeba* spp. and 50 (0.2%) for *Giardia lamblia* (Table 2).

3.2. Egg positive cases of *C. sinensis* by river basin and gender

Infection rates of *C. sinensis* by river basin, locality, and gender are summarized in Table 3. The overall egg positive rate of *C. sinensis* was 8.1%. The highest rate was observed in the Nakdonggang River basin, which showed an average infection rate of 12.2%, ranging from 2.8% to 23.1% by counties. Yecheon-gun showed the highest rate at 23.1%, followed by Sangju-si (20.8%). The next highest rate was observed in the Seomjingang River basin with an average infection rate of 9.5%, ranging from 6.8% to 14.4%. The lowest infection rate was observed in the Hangang River basin, which showed an average of 1.0%.

The egg positive rate of *C. sinensis* was higher in male (10.6%) than in female (6.1%). The highest male egg positive rate was also observed in the Nakdonggang River basin with an average of 15.3%, ranging from 3.6% to 28.5%. Male residents living in Yecheon-gun showed the highest infection rate at 23.1%, followed by Sangju-si (22.9%). The next highest rate was observed in the Seomjingang River basin with an average infection rate of 9.5%, ranging from 6.8% to 14.4%. The lowest infection rate was observed in the Hangang River basin, which showed an average of 1.0%.
3.3. Egg positive cases of *C. sinensis* by age group

Among the 31,268 cases examined by age group, the positive rate of *C. sinensis* was highest in the age group between 50 and 59 years (10.4%), followed by the order of 40—49 (8.7%), 60—69 (8.3%), and 70—79 (7.7%) years (Table 4).

4. Discussion

The present study indicated that the overall prevalence of intestinal parasites was 9.5% and 2957 individuals were infected with 13 species of intestinal parasites. This result, however, is considerably lower than that of 2006, which was observed a 14.3% positive rate in southern endemic areas. The positive rate of *C. sinensis* was the highest, covering 85.6% of all positive cases. The egg positive rate of *C. sinensis* (8.1%) decreased slightly compared with the result of 2006 investigation. In the nationwide surveys in 1997 and 2004, *C. sinensis* positive rates were 1.4% and 2.4%, respectively, and these results suggested that *C. sinensis* are prevalent along major river basins. The present study was mainly focused on residents of villages where clonorchiasis has been endemic or suspected. Thus, it is the main reason for the current investigation.

| Locality (river basin) | No. of Examined | No. of Positive (%) | Cs (%) | Het | Ech | Gs | Al | Tt | To | Am | Gl |
|------------------------|-----------------|---------------------|--------|-----|-----|----|----|----|----|----|----|
| Hangang                |                 |                     |        |     |     |    |    |    |    |    |    |
| 1                      | 1,029           | 21 (2.0)            | 19 (1.8)| 1  | 0  | 0  | 0  | 0  | 0  | 2  | 0  |
| 2                      | 988             | 12 (1.2)            | 2 (0.2)| 1  | 0  | 0  | 1  | 0  | 0  | 4  | 1  |
| Subtotal               | 2,017           | 33 (1.6)            | 21 (1.0)| 2  | 0  | 0  | 1  | 0  | 0  | 4  | 3  |
| Geumgang               |                 |                     |        |     |     |    |    |    |    |    |    |
| 3                      | 1,038           | 9 (0.9)             | 3 (0.3)| 0  | 0  | 0  | 1  | 0  | 3  | 3  |
| 4                      | 868             | 45 (5.2)            | 41 (4.7)| 0  | 0  | 0  | 0  | 0  | 2  | 0  |
| 5                      | 1,120           | 37 (3.3)            | 30 (2.7)| 0  | 0  | 0  | 0  | 3  | 0  | 4  | 1  |
| 6                      | 1,056           | 58 (5.5)            | 48 (4.5)| 0  | 0  | 0  | 0  | 0  | 4  | 3  | 3  |
| 7                      | 1,076           | 45 (4.2)            | 37 (3.4)| 5  | 0  | 0  | 1  | 0  | 0  | 0  | 1  |
| Subtotal               | 5,158           | 194 (3.8)           | 159 (3.1)| 5  | 0  | 0  | 1  | 11 | 0  | 11 | 6  |
| Seomjingang            |                 |                     |        |     |     |    |    |    |    |    |    |
| 8                      | 1,213           | 96 (7.9)            | 83 (6.8)| 5  | 0  | 0  | 0  | 0  | 7  | 2  |
| 9                      | 2,424           | 284 (11.7)          | 247 (10.2)| 43 | 1  | 0  | 0  | 0  | 11 | 3  |
| 10                     | 1,193           | 124 (10.4)          | 111 (9.3)| 4  | 0  | 0  | 0  | 1  | 2  | 7  | 2  |
| 11                     | 1,072           | 109 (10.2)          | 77 (7.2)| 16 | 0  | 1  | 2  | 0  | 14 | 5  |
| 12                     | 922             | 182 (19.7)          | 133 (14.4)| 50 | 0  | 0  | 0  | 0  | 11 | 2  |
| Subtotal               | 6,824           | 795 (11.7)          | 651 (9.5)| 118| 1  | 1  | 2  | 1  | 2  | 50 | 14 |
| Youngsangang           |                 |                     |        |     |     |    |    |    |    |    |    |
| 13                     | 1,256           | 101 (8.0)           | 40 (3.2)| 37 | 33 | 0  | 0  | 0  | 7  | 1  |
| 14                     | 1,098           | 58 (5.3)            | 44 (4.0)| 3  | 1  | 2  | 0  | 1  | 8  | 2  |
| 15                     | 1,009           | 41 (4.1)            | 30 (3.0)| 10 | 0  | 1  | 0  | 0  | 5  | 1  |
| 16                     | 1,049           | 56 (5.3)            | 31 (3.0)| 7  | 0  | 1  | 0  | 3  | 12 | 3  |
| Subtotal               | 4,412           | 256 (5.8)           | 145 (3.3)| 57 | 34 | 4  | 0  | 5  | 32 | 7  |
| Nakdonggang            |                 |                     |        |     |     |    |    |    |    |    |    |
| 17                     | 836             | 109 (13.0)          | 99 (11.8)| 10 | 0  | 0  | 0  | 0  | 0  | 0  |
| 18                     | 919             | 141 (15.3)          | 141 (15.3)| 5  | 0  | 0  | 0  | 0  | 0  | 0  |
| 19                     | 1,001           | 63 (6.3)            | 59 (5.9)| 4  | 0  | 0  | 0  | 0  | 0  | 0  |
| 20                     | 1,002           | 80 (8.0)            | 73 (7.3)| 5  | 0  | 0  | 0  | 2  | 0  | 0  |
| 21                     | 936             | 149 (15.9)          | 142 (15.2)| 1  | 0  | 1  | 0  | 2  | 0  | 2  |
| 22                     | 1,175           | 150 (12.8)          | 138 (11.7)| 4  | 0  | 0  | 0  | 1  | 1  | 4  |
| 23                     | 1,165           | 154 (13.2)          | 145 (12.4)| 6  | 0  | 0  | 0  | 1  | 2  | 6  |
| 24                     | 880             | 101 (11.5)          | 98 (11.1)| 3  | 0  | 0  | 0  | 0  | 0  | 0  |
| 25                     | 1,172           | 57 (4.9)            | 33 (2.8)| 0  | 0  | 1  | 2  | 1  | 0  | 19 | 0  |
| 26                     | 695             | 103 (14.8)          | 94 (13.5)| 14 | 0  | 0  | 0  | 2  | 0  | 0  |
| 27                     | 953             | 211 (22.1)          | 198 (20.8)| 3  | 1  | 0  | 3  | 1  | 2  | 7  |
| 28                     | 1,163           | 131 (11.3)          | 124 (10.7)| 10 | 0  | 0  | 0  | 1  | 0  | 3  | 0  |
| 29                     | 960             | 230 (24.0)          | 222 (23.1)| 8  | 0  | 0  | 2  | 0  | 4  | 2  |
| Subtotal               | 12,857          | 1,679 (13.1)        | 1,566 (12.2)| 73 | 1  | 2  | 4  | 13 | 2  | 36 | 20 |
| Total                  | 31,268          | 2,957 (9.5)         | 2,542 (8.1)| 255| 36 | 7  | 8  | 30 | 133| 50 |
Cs, *Clonorchis sinensis*; Het, *Heterophyes* spp.; Ech, *Echinostoma* spp.; Gs, *Gymnophalloides seoi*; Al, *Ascaris lumbricoides*; Tt, *Trichuris trichiura*; To, *Trichostrongylus orientalis*; Am, *Entamoeba* spp.; Gl, *Giardia lamblia*. *Hook worm, *Diphyllobothrium latum*, *Enterobius vermicularis*, *Paragonimus westermani.*

Table 2: Positive cases of intestinal helminths and protozoa according to locality and parasites species
higher egg positive rate of \textit{C. sinensis} of the present study (8.1%) than that (2.4%) of 2004.

Clonorchiasis has been regarded as a persisting helminthiasis and has largely disappeared throughout the country.\textsuperscript{1} In 2006, the total egg positive rate of \textit{C. sinensis} was 11.1% among residents living in the river basins of South Korea. The egg positive rates observed in the river basins of Nakdonggang, Seomjingang, Yeongsangang, Geumgang, and Hangang were 17.1%, 11.2%, 5.5%, and 4.6%, respectively.\textsuperscript{2} In 2007, the total egg positive rate of \textit{C. sinensis} was 8.1% (Table 3). The positive rates observed in the river basins of Nakdonggang, Seomjingang, Yeongsangang, Geumgang, and Hangang were 12.2%, 9.5%, 3.3%, 3.1% and 1.0%, respectively (Table 3). Especially, the river basins of Nakdonggang and Seomjingang Rivers still appear to be endemic.

The average egg positive rate of \textit{C. sinensis} among male was 10.6%, which ranged from 0.2% to 28.5% by river basin areas, whereas the average positive rate among female was 6.1% with a range from 0.2% to 19.2% (Table 3). Infection rates of male and female residents showed between 3.0% and 2.8% decrease compared with results of 2006.

The egg positive rate increased as age increased, reaching a maximum of 10.4% in the age group of 50–59 years (Table 3), followed by 40–49 (8.4%), 60–69 (8.3%), 70–79 (7.7%), and older than 80 (6.5%) years. The infection status of \textit{C. sinensis} among Koreans by age in this study showed the same peak at the 50- to 59-year-old group as compared with the result in 2006.\textsuperscript{3} This result appears to be the typical pattern of \textit{C. sinensis} infection, showing a peak at the age group of

### Table 3 Positive rates of \textit{C. sinensis} according to localities and gender

| Locality (river basin) | Total* | Male | Female |
|------------------------|--------|------|--------|
|                        | No. of Examined | No. of Positive (%) | No. of Examined | No. of Positive (%) | No. of Examined | No. of Positive (%) |
| Hangang                | 2,017   | 21 (1.0) | 930   | 14 (1.5) | 1,085 | 7 (0.6) |
| Guemgang               | 1,056   | 48 (4.5) | 528   | 33 (6.3) | 528   | 15 (2.8) |
| Subtotal               | 5,158   | 159 (3.1) | 2,397 | 110 (4.6) | 2,761 | 49 (1.8) |
| Seomjingang            | 6,824   | 651 (9.5) | 3,131 | 398 (12.7) | 3,692 | 252 (6.8) |
| Youngsangang           | 4,412   | 145 (3.3) | 1,794 | 91 (5.1) | 2,618 | 54 (2.1) |
| Nakdonggang            | 12,857  | 1,566 (12.2) | 5,677 | 868 (15.3) | 7,178 | 1,060 (6.1) |

*Sex unidentified: five.
40–49 or 50–59 years,7 which is then rapidly decreased afterwards. Because the life span of *C. sinensis* is known to be up to 30 years, the infection peak in the age group of 50s is comprehended as an accumulation effect of reinfection or superinfection with age because epidemiologic studies indicate that humans do not develop any resistance to reinfection or superinfection by the parasites.4 However, the egg positive rate decreased after the peak, in spite of the cumulative effect in the age group of 60s or more. This decreasing phenomenon in senior groups has been commonly observed in previous investigations4,7 and may suggest the possibility of shorter lifespan of residents with clonorchiasis than those of uninfected ones at the endemic areas.10 This decrease of 27% compared with the previous year appears to be an outcome of low endemicity by praziquantel medication. The clonorchiasis in the endemic area of South Korea is under continuous anthelminthic intervention, and the intervention makes the decrease in positive rate.11 Our data have been updated the status of clonorchiasis in endemic area of Korea as reduced egg positive rate and lower intensity of infection compared with previous reports.3,8,9,11,12

**Table 4** Positive rates of *C. sinensis* according to localities and age groups

| Locality (river basin) | Age group (yr) | Total | 1–19 | 20–29 | 30–39 |
|------------------------|----------------|-------|------|-------|-------|
|                        | No. of Examined | No. of Exposed (%) | No. of Examined | No. of Exposed (%) | No. of Examined | No. of Exposed (%) |
| Hangang                | 1,029 (1.8)     | 65 (0.0)     | 18 (0.0) | 44 (0.0) |       |
|                        | 988 (0.2)       | 39 (0.0)     | 19 (0.0) | 46 (0.0) |       |
| Subtotal               | 2,017 (1.0)     | 104 (0.0)    | 37 (0.0) | 90 (0.0) |       |
| Guemgang               | 1,038 (3.0)     | 10 (0.0)     | 15 (0.0) | 42 (0.0) |       |
|                        | 868 (4.7)       | 91 (0.0)     | 39 (2.6) | 46 (2.3) |       |
|                        | 1,120 (2.7)     | 0 (0.0)      | 33 (1.0) | 62 (2.3) |       |
|                        | 1,056 (4.5)     | 78 (0.0)     | 24 (0.0) | 55 (0.0) |       |
|                        | 1,076 (3.4)     | 94 (0.0)     | 14 (0.0) | 38 (3.9) |       |
| Subtotal               | 5,158 (3.1)     | 273 (0.0)    | 125 (1.6) | 243 (7.2) |       |
| Seomjingang            | 1,213 (6.8)     | 48 (2.1)     | 13 (7.7) | 50 (2.0) |       |
|                        | 2,424 (10.2)    | 37 (1.2)     | 31 (3.2) | 81 (6.4) |       |
|                        | 1,193 (9.3)     | 2 (0.0)      | 9 (11.1) | 31 (2.5) |       |
|                        | 1,072 (7.2)     | 74 (1.4)     | 44 (2.3) | 56 (10.7) |       |
|                        | 922 (14.4)      | 26 (15.4)    | 12 (2.2) | 36 (16.7) |       |
| Subtotal               | 6,824 (9.5)     | 187 (3.7)    | 109 (5.5) | 254 (8.3) |       |
| Younsgangang           | 1,256 (4.2)     | 36 (0.0)     | 28 (0.0) | 28 (1.6) |       |
|                        | 1,098 (4.0)     | 11 (0.0)     | 14 (0.0) | 25 (1.4) |       |
|                        | 1,009 (3.0)     | 4 (0.0)      | 14 (0.0) | 39 (0.0) |       |
|                        | 1,049 (3.0)     | 9 (0.0)      | 9 (0.0)  | 38 (2.6) |       |
| Subtotal               | 4,412 (3.3)     | 60 (0.0)     | 65 (0.0) | 130 (3.3) |       |
| Nakdonggang            | 836 (10.6)      | 1 (0.0)      | 4 (0.0)  | 23 (13.0) |       |
|                        | 919 (15.3)      | 69 (1.4)     | 4 (0.0)  | 24 (16.7) |       |
|                        | 1,001 (5.9)     | 0 (0.0)      | 0 (0.0)  | 5 (0.0)  |       |
|                        | 1,002 (7.3)     | 0 (0.0)      | 2 (0.0)  | 14 (0.0) |       |
|                        | 936 (15.2)      | 18 (5.6)     | 11 (0.0) | 34 (11.1) |       |
|                        | 1,175 (11.7)    | 9 (0.0)      | 8 (25.0) | 18 (0.0) |       |
|                        | 1,165 (12.4)    | 24 (8.3)     | 22 (9.1) | 37 (2.7) |       |
|                        | 880 (11.1)      | 15 (0.0)     | 9 (0.0)  | 41 (3.7) |       |
|                        | 1,172 (2.8)     | 0 (0.0)      | 15 (0.0) | 85 (0.0) |       |
|                        | 695 (13.5)      | 17 (0.0)     | 29 (17.2) | 40 (10.0) |       |
|                        | 953 (20.8)      | 62 (6.5)     | 25 (12.0) | 31 (9.7) |       |
|                        | 1,163 (10.7)    | 12 (0.0)     | 27 (0.0) | 43 (2.4) |       |
|                        | 960 (23.1)      | 3 (0.0)      | 6 (16.7) | 20 (5.0) |       |
| Subtotal               | 12,857 (12.1)   | 230 (3.5)    | 162 (8.0) | 415 (6.0) |       |
| Total                  | 31,268 (8.1)    | 854 (1.8)    | 498 (4.2) | 1,132 (5.6) |       |

In conclusion, the result of this study revealed little decrease in positive rate of *C. sinensis* compared with the result of southern endemic areas of Korea in 2006. Therefore, continuous and repeated praziquantel medication is necessary in the endemic in Korea.
References

1. Hong ST, Chai JY, Choi MH, et al. A successful experience of soil-transmitted helminth control in the Republic of Korea. *Korean J Parasitol* 2006;44:177–85.

2. Korea Centers for Disease Control and Prevention, Korean Association of Health Promotion. *Prevalence of Intestinal Parasitic Infections in Korea. The 7th Report.* Seoul, South Korea; 2004.

3. Seo BS, Lee SH, Cho SY, et al. An epidemiologic study on clonorchiasis and metagonimiasis in riverside areas in Korea. *Korean J Parasitol* 1981;19:137–50.

4. Lee JH, Yang HM, Bak UB, Rim HJ. Promoting role of *Clonorchis sinensis* infection on induction of cholangiocarcinoma during two-step carcinogenesis. *Korean J Parasitol* 1994;32:13–8.

5. Shim HS, Lim BJ, Kim MJ, et al. Mucinous cholangiocarcinoma associated with *Clonorchis sinensis* infestation: a case report. *Korean J Hepatol* 2004;10:223–7.

6. Choi D, Lim JH, Lee KT, et al. Cholangiocarcinoma and *Clonorchis sinensis* infection: a case-control study in Korea. *J Hepatol* 2006;44:1066–73.

7. Cho SH, Lee KY, Lee BC, et al. Prevalence of clonorchiasis in southern endemic areas of Korea in 2006. *Korean J Parasitol* 2008;46:133–7.

8. Kim BJ, Ock MS, Kim IS, Yeo UB. Infection status of *Clonorchis sinensis* in residents of Hamyang-gun, Gyeongsangnam-do, Korea. *Korean J Parasitol* 2002;40:191–3.

9. Lee GS, Cho IS, Lee YH, et al. Epidemiological study of clonorchiasis and metagonimiasis along the Geum-gang (river) in Okcheon-gun (county), Korea. *Korean J Parasitol* 2002;40:9–16.

10. Hong ST. *Clonorchis sinensis* (Chapter 35). In: Miliotis MD, Bier JW, editors. *International Handbook of Foodborne Pathogens.* USA: Marcel Dekker, Inc.; 2003. p. 581–92.

11. Hong ST, Rim HJ, Min DY, et al. Control of clonorchiasis by repeated treatments with praziquantel. *Korean J Parasitol* 2001;39:285–92.

12. Rim HJ. Cholangiocarcinoma: an update. *J Helminthol* 2007;79:269–81.