

## Original Article

# DETERMINATION OF DEFINITIVE AND INTERMEDIATE HOSTS OF CERCARIAL DERMATITIS-PRODUCING AGENTS IN NORTHERN IRAN

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**Background:** The study concerns the prevalence of avian schistosomes in intermediate and definite hosts in Mazandaran Province, northern Iran.

**Methods:** A total of 14190 fresh-water snails belonging to various genera were sampled and tested for cercarial emission by lighting and then crushing. During the same period, the nasal blood vessels and mesenteric veins of aquatic birds, mainly belonging to the Anatidae family, were examined under dissecting microscope for detecting adult worms.

**Results:** Forty-seven (0.33%) of examined snails mainly *Lymnaea gedrosiana*, *L. palustris*, *L. stagnalis*, and *Planorbis planorbis* were found to be infected with larval stages of *Trichobilharzia* spp. Adult schistosomes were observed in 25 (18.1%) wild waterfowls. The most infected birds were *Anas platyrhynchos*, *A. clypeata*, and *Aythya ferina*, respectively.

**Conclusion:** Annually migration of various species of aquatic birds toward the northern parts of Iran and the simultaneous presence of intermediate snails in the water resources of this area, combined with long hours of sunshine in the summer months, suggest that cercarial dermatitis could be a prominent health problem, especially among paddy field workers in this area.

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**Keywords:** Anatidae • avian schistosome • cercarial dermatitis • *Lymnaea* • *Trichobilharzia*

## Introduction

Cercarial dermatitis is an annoying inflammatory response to penetration of skin by nonhuman schistosome parasites, mostly avian Schistosomatidae. Other synonyms for this condition are swimmer's itch and clam-digger's disease. Schistosomes are worms belonging to Trematoda that are adopted to live in circulatory blood vessels. From a medical viewpoint, these worms could be divided into two main groups: the first group is genus *Schistosoma*

that induces disease in human and the second group comprises animal (mammals, birds, and reptiles) pathogens exclusively.

The life cycle in both groups is similar. The first stage larvae—miracidia—will be released and migrate to the body of snail, after the eggs drop into water. Then miracidia transform to multiinfective larvae—cercariae—through asexual multiplication. If cercariae come into contact with the skin of their normal host, they could transform into adult worms; but if they penetrate the skin of nonspecific hosts, migration will continue and result in variable degrees of inflammation and hypersensitivity reactions. Although the disease is self-curing, it could cause a highly itchy skin rash with secondary infection that result in absenteeism from daily work; this is particularly the case in those who accidentally or repeatedly have had exposure to water sources (such as paddy fields, recreational lakes, and man-made ponds).

Thousands of birds migrate to Iran's natural

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habitats annually. Additionally, the presence of intermediate snails in these areas potentially complete the life cycle of the parasite. The continuous contact of rice cultivators in northern Iran with agricultural bodies of water that come from man-made ponds has made cercarial dermatitis an endemic disease in this area<sup>1,2</sup> and in southern Iran.<sup>3</sup> Although cercarial dermatitis has been reported from most areas in the world,<sup>4-9</sup> definite bird hosts and intermediate snails have not been fully recognized.<sup>10</sup> This study was designed to determine these two important aspects of the epidemiology of cercarial dermatitis.

### Area of study

Located in the north of Iran (53°6' E, 36°23' N), Sari is the capital of Mazandaran Province. Sari is bordered by the Caspian Sea to the North, the chain of Alborz mountains in the South and South-East, Neka District to the East, and by Joibar and Ghaem Shaher Districts to the West. Sari's geography could be divided into two sections: plains and mountains. The mountainous part is covered with jungles and is suitable for animal husbandry and beekeeping, while, the sea-level plains are temperate with a wet climate. The main occupation in the plains is rice cultivation. Agricultural water is supplied by 152 small and large man-made ponds. Seyed Mahale, the specific area of study, is about 5 – 22 meters lower than sea level and 20 kilometers far from Sari. Nearly, 85% of the earth in this area is rice paddy fields, which are supplied by 14 man-made ponds. The distance between these dams and the Caspian Sea is 8 kilometers. These dams have water year-round and, therefore, this place is suitable for migrant and sedentary birds.

## Materials and Methods

### Assessment of definite hosts

According to the results of a previous study in northern Iran, the prevalence rate of infection has been around 10%.<sup>2</sup> The Iranian Department of the Environment (IDE) estimates the number of migrating birds in this region to be about 2,800. Under the supervision of IDE, a total of 138 migrating ducks were hunted for species determination. Mesenteric vessels were examined under the light and if a suspect worm was found, that segment of vessel was checked for the presence of adult worms under the dissecting



**Figure 1.** A typical egg belonging to Schistosomatidae with unilateral terminal spine (original magnification  $\times 400$ ).

microscope. Because the main location for bird schistosomes is the nasal mucosa, the following route of dissection was also performed<sup>11</sup>:

Two deep incisions in each side of the beak (at the site of the jaw joint) were made and then the palate bone and adjacent tissue were dissected. In such a situation, two pieces of nasal mucosa were completely exposed and removed. To have enough time for laboratory tests, the mucosa of one side was laid in a separate Petri dish containing 10 mL of free chloride water. Vessel dissection was performed with fine needles under a microscope.

The presence of typical eggs of *Trichobilharzia* (Figure 1) that were going to hatch and miracidium coming out of them were taken as signs of infection.

### Assessment of intermediate hosts

A total of 14,189 snails were collected from man-made ponds and paddy fields. After species identification, every 10 snails were placed in a separated water container. The cercarial emergence was stimulated by 30 to 60 minutes of lighting in the laboratory. Snails from positive batches were



**Figure 2.** *Ocellata furcocercariae*; characteristic of avian schistosomes. Note the two eye spots and the prominent ventral sucker (original magnification  $\times 400$ ).

**Table 1.** The prevalence of ducks (Anatidae) infected by Schistosomatidae in northern Iran.

Duck species	Number examined	Infected number	Prevalence
<i>Anas platyrhynchos</i>	34	12	35/3
<i>Anas strepera</i>	15	—	—
<i>Anas platyrhynchos</i>	15	—	—
<i>Anas creca</i>	6	—	—
<i>Anas ovata</i>	1	—	—
<i>Anas clypeata</i>	13	10	76/92
<i>Aythya ferina</i>	16	3	18/75
<i>Aythya fuligula</i>	21	—	—
<i>Aythya nyroca</i>	4	—	—
<i>Netta rufina</i>	10	—	—
<i>Bucephala clangula</i>	3	—	—

separated into individual Petri dishes for a second assay. If no cercariae shedding were observed, the snails were pressed and crushed between two square pieces of 15×15 glasses and studied. Findings of ocellata furcocercariae (Figure 2), which are characteristic for bird schistosomes, were taken as evidence of infection.

## Results

The prevalence rate of infection with schistosomes among the total of 138 aquatic birds was 18.1% (Table 1). The most infected birds were *Anas clypeata* (76.9%) followed by *A. platyrhynchos* (35.3%) and *Aythya ferina* (18.7%).

Evaluation of 130 mesenteric vessels of the aforementioned birds detected the parasite in merely 3 cases (2.3%). Ironically, nasal blood vessels concurrently contained the same parasites in this group. Due to fragility and length of worm dwelling in nasal blood vessels, removal of the intact worms was not possible (Figure 3).

Out of the 14,190 snails that were examined by both methods of cercariae shedding and crushing, 47 (0.33%) were infected with furcocercariae causing cercarial dermatitis, and 8 (0.056%) had

cercariae belonging to avian schistosomes (Table 2). The cercariae belonging to the other Trematoda were found in 25 (0.18%) snails.

The most frequently infected snail was *Lymnae gedrosiana*. Out of 1,794 examined snails of this species, 8 (0.045%) cases were infected. In our study, the other intermediate hosts were *L. palustris*, *L. stagnalis*, and *Planorbis planorbis*. None of the 3,560 snails belonging to the genus *Physa* were infected with causative agents of cercarial dermatitis.

## Discussion

There are some published reports of cercarial dermatitis due to bovine schistosomes including *Schistosoma spindale* in Thailand and India<sup>12, 13</sup> and *Orientobilharzia turkestanicum* in Iran.<sup>1</sup> However, in recent studies, it has been substantiated that cercariae of bird schistosomes are the main and most common agents producing this condition. Similar to two previous studies in Iran,<sup>2, 3</sup> the present study indicates that the genus *Trichobilharzia* is responsible for the majority of swimmer's itch cases.

The base of this study was the examination of 138 birds resulting in an 18.1% prevalence of infection. This demonstrates a noticeable increase in comparison with the previous study by Athari,<sup>2</sup> performed on 188 birds with an estimated 8.5% prevalence. The main reason for this difference might be attributed to the fact that in the prior study the samples included 80 *Fulica atra*. *Fulica atra* do not belong to the duck family and the tested birds were free of infection. Therefore, to confirm previous studies both in Iran and other parts of the world, this investigation only focused on the family of Anatidae.

In this study, the most frequently infected definitive host was *Anas clypeata*. Out of 13



**Figure 3.** Adult male worm (*Trichobilharzia* spp.) with gynecophoric canal (original magnification ×400).

**Table 2.** The prevalence of snails infected by cercarial dermatitis-producing agents in northern Iran.

Snail species	Number examined	Infected by avian cercariae	Prevalence	Infected by other furcocercariae	Prevalence
<i>L.gedrosiana</i>	1794	3	0.17	5	0.27
<i>L.palustris</i>	4934	3	0.06	10	0.2
<i>L.stagnalis</i>	2350	1	0.04	7	0.29
<i>P.planorbis</i>	1552	1	0.06	9	0.59
<i>Physa gyrina spp</i>	3560	—	—	8	0.22
<b>Total</b>	<b>14190</b>	<b>8</b>	<b>0.05</b>	<b>39</b>	<b>0.27</b>

examined ducks belonging to this species, 10 (76.9%) were infected. This type of duck lives in shallow parts of water and by nutritional behavior is a surface feeder. Cercariae, due to their needs of air, come to surface layers of water and, therefore, the chance of exposure to infection increases.<sup>11</sup> In Europe, the most common definitive host of avian schistosomes is the duck *A. platyrhynchos*.<sup>4</sup> In the present study, the prevalence of infection in this species was 35.3%. This finding confirms Beer et al<sup>14</sup> who found that the proportion of ducks *A. platyrhynchos* infected with *T.ocellata* accounted for 30% in Byelarus.

The prevalence of infection in *Aythya ferina*, both wild (immigrant) and domestic, which is one of the most prevalent species in northern Iran, were 22.9% and 35.2% in previous and present studies, respectively. Domestic duck husbandry in northern Iran accompanied by the co-existence of this species and intermediate snails in water resources, provide a continuous risk of exposure to cercarial dermatitis for farmers in this area.

The lack of infection in *A.creca* could be attributed to the low number of examined cases of this type in our samples, while in a previous study, 2 out of 10 were infected.<sup>2</sup>

Concerning these findings, we recommend that further epidemiological studies are needed to focus on the above-mentioned species and *A.nyroca*. Additionally, finding only 3 cases of infection in the mesenteric vessels confirmed that, contrary to mammalian schistosomes, the selective location for avian schistosomes is vessels of the nasal mucosa. This finding is consistent with other reports.<sup>6-9</sup>

We found *L.gedrosiana* as the most frequently infected intermediate host for bird schistosomes. The infection rate of this species in previous<sup>2</sup> and present studies were 0.08% and 0.17%, respectively. These results are analogous, but the results of the Farahnak and Essalat in 2003, which evaluated 2000 of this species in southern Iran, showed a prevalence of 2.4%.<sup>3</sup> Many researchers agree that Pulmonata are the main intermediate hosts for bird schistosomes<sup>4-11</sup> and, among them,

fresh water snails are the main intermediate hosts. Beer et al in Minsk State found that 18.8% of snails were infected with cercariae of *Trichobilharzia* and that *L.stagnalis* and *L.ovata* were the most frequently infected hosts.<sup>14</sup> To determine the intermediate hosts of *T.ocellata* in Germany, Kock also found that *L.stagnalis* and *Stagnicola palustris* had been infected.<sup>15</sup> On the other hand, a few authors in other parts of the world disagree with this and refer to the Prosobranchia snails of salt water as the suitable intermediate hosts, especially in beach areas.<sup>16, 17</sup>

Whereas Scott and Burt in Canada<sup>18</sup> and Pence and Rhodes in Texas<sup>19</sup> who reported *Physa gyrina* and *P. anatine* as intermediate hosts, respectively, the genus *Physa* has not been infected in any of the Iranian investigations. Therefore, it seems that this genus is not a suitable host for avian schistosomes in Iran.

In light of the observations reported here and the analysis of recent publications, cercarial dermatitis may be regarded as an endemic disease in northern and southern Iran, but other aspects of its epidemiology and symptomatology need to be further evaluated.

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