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Gnathostomiasis in Wild Boars from Japan

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ABSTRACT: *Gnathostoma doloresi*, a nematode parasite producing ulcerative and/or granulomatous lesions in the gastric wall of domestic pigs and wild boars (*Sus scrofa leucomystax*) throughout southeastern Asia, is an important zoonosis causing cutaneous larva migrans in humans. Patients infected with *G. doloresi* have been found yearly in the vicinity of Miyazaki Prefecture, Japan. Adult nematodes were found in 31 of 32 wild boars captured at two different geographic locations in the prefecture, a location in the high mountains and one at sea level. The parasite-free animal had gastric lesions typical of a previous infection with this parasite. The nematode intensities were higher in wild boars caught in the mountains than those caught at near sea level. The extremely high prevalence of *G. doloresi* in wild boars indicates that the life cycle of this parasite is well established in this area of Japan.

Key words: *Gnathostoma doloresi*, prevalence, survey, *Sus scrofa leucomystax*, wild boars.

Gnathostoma doloresi is a nematode parasite distributed throughout southeastern Asia which parasitizes the stomach wall of domestic pigs and wild boars (*Sus scrofa leucomystax*) causing ulcerative and/or granulomatous lesions (Miyazaki, 1960). The first intermediate hosts are copepods and the second intermediate/paratenic hosts are various species of freshwater fishes, salamanders, frogs, toads, snakes, mice and rats (Daengsvang, 1980; Nawa et al., 1993). In Japan, *G. doloresi* occurs where there are wild boars, their main definitive host. There is an especially high prevalence in Kyushu and Shikoku Districts of Japan (Miyazaki, 1960). Since Ogata et al. (1988; Nawa et al., 1989) first found human cases of cutaneous larva migrans due to *G. doloresi* infection in Miyazaki Prefecture, this parasite is known as one of the important food-borne zoonoses. Infection of humans occurs by ingestion of uncooked/under-

cooked meat of infected second intermediate/paratenic hosts. Because patients with gnathostomiasis have been found almost every year in the vicinity of Miyazaki Prefecture (Maruyama et al., 1996), we determined the prevalence of *G. doloresi* in wild boars captured in this area.

Thirty-two wild boars captured in two localities in Miyazaki Prefecture during November and December 1996 were examined. Twelve animals were caught at Shiromi (32°16'N, 131°15'E) located in a high mountainous area, and 20 were captured in Kushima (31°24'N, 131°20'E), an open area with a few low hills near the sea.

The stomachs of wild boars were incised along the greater curvature and nematodes attached to the gastric mucosa were carefully removed with forceps. Gastric contents were diluted in a large volume of water and strained through several layers of stainless steel mesh of different pore sizes to collect free nematodes. All specimens were identified as *G. doloresi* under a dissecting microscope according to their characteristic morphology of cuticular spines covering the whole body surface, swollen posterior body with irregularly folded cuticle, and eggs with two caps at each end of the shells. Body length of nematodes were measured from 11 animals. Representative specimens of *G. doloresi* are deposited in the Department of Parasitology (Miyazaki Medical College, Miyazaki, Japan; accession numbers GdA 961217, 961219, 961225, 961227, 970113).

All statistical analyses employed Stat-View SE+Graphics (Abacus Concepts, Inc., Berkeley, California, USA). The nematode intensities of the hosts in two different locations were compared by the Mann-Whitney *U* test. Significance was accepted

TABLE 1. *Gnathostoma doloresi* infection in wild boars from Miyazaki, Japan.

| | Shiromi | Kushima | Total |
|-----------------------------|--------------------------------|-----------------------------|--------------------------------|
| Number of animals | 12 | 20 | 32 |
| Sex (Male/Female) | 7/3 ^a | 6/14 | 13/17 ^a |
| Body weight (Mean \pm SE) | 58.5 \pm 6.8 kg ^a | 51.9 \pm 3.6 kg | 54.1 \pm 3.3 kg ^a |
| Range | 40–100 kg | 15–80 kg | 15–100 kg |
| Prevalence (%) | 12/12 (100) | 19/20 (95) | 31/32 (97) |
| Intensity (Mean \pm SE) | 57.1 \pm 11.5 ^b | 20.1 \pm 4.7 ^b | 34.4 \pm 6.2 |
| Range | 16–148 | 5–91 | 5–148 |

^a Not identified for 2 animals.^b Significantly different from each other by Mann-Whitney's *U* test ($P < 0.01$).

when $P \leq 0.05$. Correlation between the nematode intensities and body weights of hosts or the average length of nematodes in individual hosts were examined using a simple regression test.

Twelve and 20 wild boars were from Shiromi and Kushima, respectively. An average body weight of animals ($n = 30$) was 54.1 kg ranging from 15 to 100 kg, and the sex ratio was male: female = 1:1.3. Of 32 wild boars examined, 31 (97%) were infected with *G. doloresi*. One uninfected animal had many burrows in the gastric wall indicating that it also had been infected previously. The mean intensity (\pm SE) was 34.4 ± 6.2 (range = 5–148). When the nematode intensity of the hosts in two different places were compared, that in Shiromi was 57.1 ± 11.5 , whereas that in Kushima was 20.1 ± 4.7 , and they were significantly different from each other ($P < 0.01$ by Mann-Whitney's *U* test).

The nematode intensities were not correlated with body weights of the hosts (correlation coefficient $r = 0.366$), suggesting that the parasites do not accumulate along with the age of hosts. To determine whether crowding effect is observed in *G. doloresi* infection in wild boars, length of individual nematodes was measured for those obtained from 11 animals. The average length of nematodes in individual hosts was not correlated to the nematode intensity ($r = 0.033$), indicating no such a effect in this study.

Most wild boars in Miyazaki Prefecture were infected with *G. doloresi* regardless

of geographic locality. A survey conducted in Shiromi, 9 yr previously (Nawa and Imai, 1989) also indicated a high prevalence (70%) of *G. doloresi* in wild boars. High prevalence ($>50\%$) of *G. doloresi* in wild boars in the mountainous areas of Shikoku and Kyushu Districts was reported by earlier studies (Miyazaki et al., 1953; Isobe, 1956; Miyazaki, 1960; Sakaguchi et al., 1985). In contrast, prevalence of *G. doloresi* in pigs from other southeastern Asian countries is $<10\%$ (Daengsvang, 1980). Because the life cycle of *G. doloresi* requires two or more intermediate/paratenic hosts depending on predator/prey relationships, ecosystems like those of Kyushu District may be exceptionally suitable for this species.

Although practically all wild boars were infected with *G. doloresi*, we noted a difference in intensities in hosts caught at Shiromi and Kushima. Shiromi is located in a mountainous area, 500 to 1,000 m above sea level, whereas Kushima is located in an open plain with a few low hills near the sea. The intermediate/paratenic hosts for *G. doloresi* may be distributed more densely in the mountainous areas. Conversely, wild boars living in mountainous areas may ingest more animal foods than those living in the plains because of the difference in the relative availability of animal and plant foods in two locations. This needs further clarification.

Nawa and Imai (1989) reported that wild boars of about 20 kg body weight had the highest nematode intensities com-

pared to larger or smaller animals. However, no such correlation was observed in the present study. This may simply be due to the number of animals examined. We examined over 30 animals in the present study, whereas only 10 animals were examined in the previous study. Adult nematodes do not accumulate in wild boars with time, suggesting that their survival may be fairly short and infection is continuously occurring. Alternatively, once hosts were infected with *G. doloresi*, they might become resistant to further infection. This also needs further clarification.

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