
RESEARCH ARTICLES

PARAGONIMUS HETEROTREMUS INFECTION IN A COMMUNITY IN SARABURI PROVINCE, CENTRAL THAILAND

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ABSTRACT

Intensive surveys for Paragonimus heterotremus were carried out in a small upland village community in Saraburi Province, Central Thailand, in order to measure prevalence and intensity of infection among inhabitants, and to determine seasonal infection rates and intensity of infection of P. heterotremus in freshwater crabs. Both sputa and faeces of villagers were examined. P. heterotremus eggs were detected in 7.6% and 2.8% of individuals who provided sputa and faeces, respectively, for examinations. For both sexes combined, the prevalence was highest in the 25-29 year age-group (28.0%). The mean rate of infection in males was slightly lower than that in females (6.0% vs. 9.1%). Sputa were negative in all people above 60 years of age. The intensity of infection in males peaked at the 50-59 year age-group (>7,400 eggs per day), and in females at the 25-29 year age-group (>2,400 epd). The crabs Larnaudia larnaudii were found infected with P. heterotremus metacercariae every month, with an overall rate of infection as 25.0%. High rates and intensities of infection occurred during the dry season (in December and January). The P. heterotremus metacercariae were found more abundantly in the muscles of infected crabs.

INTRODUCTION

The first and second cases of human paragonimiasis were reported in Petchabun Province, North Thailand and Saraburi Province, Central Thailand by Prommas¹ and Harinasuta et al.,² respectively. Subsequently, Vajrasthira et al.³ discovered an endemic area of the disease in Viharn Daeng District, Saraburi Province. A few years later, Sirisumpan⁴ reported the infection in a patient from Nakhon Nayok, a province adjacent to Saraburi, which was later found to be another endemic area (Muang and Pakplee Districts)⁵. Since then there have been reports of human paragonimiasis in Chiangrai, Nong Khai, Loei and

Phitsanulok Provinces^{6,7}. So far, six species of *Paragonimus* have been reported in Thailand, but only *P. westermani* and *P. heterotremus* have been documented to utilize humans as their definitive hosts^{5,8,9}. In Thailand, the natural second intermediate hosts of *P. heterotremus* are freshwater crabs, but the first intermediate snail host has not yet been found in nature. Under laboratory conditions, *Tricola bollingi* and *Neotricula aperta*¹⁰, and five species of *Oncomelania*¹¹ have been reported to be susceptible to the parasite. The aims of this study were to ascertain prevalence and intensity of infection of *P. heterotremus* among inhabitants, and to determine seasonal infection rates and intensity of infection of *P. heterotremus* in freshwater crabs, at Jedkot Village, Kaeng Khoi District, Saraburi Province, Central Thailand.

MATERIALS AND METHODS

Study area

Ban Jedkot, a small upland village in Kaeng Khoi District, Saraburi Province, Central Thailand, was selected as the study area (Fig.1). It is situated approximately 150 km from Bangkok. Its 481 residents are Buddhist and work in maize fields. Villagers live in simple wooden houses which are scattered along the hills and streams.

Chest x-ray

A total of 366 individuals (76.1% of the village) underwent chest x-ray provided by the mobile x-ray unit of Kouynamthai Hospital in October 1985 in the ground of Tub Kwang Temple, near Ban Jedkot. The films used were 7x7 cm size.

Sputum examination

A total of 315 individuals (65.5%) rendered sputa for examination in October 1985. During the survey period, our field workers collected three morning samples of sputa on three successive days, from each of the villagers, and all the samples were brought back to a field laboratory in Ban Jedkot for processing. Each sample of sputum was mixed with 3% sodium hydroxide in equal amount in a centrifuge tube, and the mixture was shaken vigorously. Then the tube was centrifuged at high speed (2,000 rpm) for 10 minutes, the supernatant was decanted, and the whole sediment was examined for the eggs of *Paragonimus heterotremus*.

Stool examination

A total of 327 individuals (68.0%) provided stools for examination in October 1985. Three whole stools, one for each day, were collected in night pots from each of the villagers, and all the pots were brought back to the field laboratory for processing. Each stool was examined for the presence and absence of *P. heterotremus* eggs using the formalin-ether concentration technique¹².

The snail intermediate host

Snail searches were conducted in Jedkot Stream located in Ban Jedkot in January, April, July and October 1985. The snails collected were identified and set up for cercarial

shedding and, if negative, were crushed and examined for the presence or absence of *P. heterotremus* cercariae.

The crab intermediate host

At Ban Jedkot, the freshwater crabs *Larnaudia larnaudii* serve as the natural second intermediate host of *P. heterotremus*¹⁰. Following a general survey of *L. larnaudii* in and nearby Ban Jedkot in January 1985, 10 index sampling sites, each site covering an area of 10 m, were set up in Jedkot Stream. The distance from the first to the last site was 400 m. Each month, from May 1985 to February 1986, *L. larnaudii* were hand-caught (two assistants searched for crabs for 10 min at each site) and transported to the laboratory in Bangkok. The gills, muscles and visceral organs of each crab were examined for *P. heterotremus* metacercariae using a dissecting microscope.

RESULTS

The age structure of the 315 individuals who provided sputa for examination showed that about 50% of the population were less than 20 years old. The male : female ratio was 48:52 (Fig.2).

Prevalence and intensity of infection

Paragonimus heterotremus eggs were detected in the sputa of 24 individuals, or 7.6%, of those who provided sputa. For both sexes combined, the prevalence was highest in the 25-29 year age-group (28.0%) (Table 1). The mean rate of infection in males was slightly lower than that in females (6.0% vs. 9.1%). Sputa were negative in all people above 60 years of age. Children aged below 5 years were not included because they were unable to render sputa.

The population was divided according to the presence and intensity of infection from sputum samples as follows: uninfected, 92.4%; lightly infected (1-1999 eggs per day), 5.4%; moderately infected (2000-6099 eggs per day), 1.6%; heavily infected (7000-9999 eggs per day), 0.3%; very heavily infected (>10000 eggs per day), 0.3% (Fig.3). The mean egg counts (per day of sputa) for the examined population were 2819.5 for males, 1248.7 for females, and 1837.8 for combined sexes. The intensity of infection in males peaked at the 50-59 year age-group, and in females at the 25-29 year age-group (Table 1).

Out of 327 individuals who provided stools for examination, 9 (2.8%) were found infected with *P. heterotremus*. Sputum examination was better than stool examination in detecting eggs of *P. heterotremus*.

Chest x-ray

The radiographic findings in 366 cases are as follows: both lungs were found normal in 338 cases (92.3%); thickened pleura in 7 cases (1.9%); cardiomegaly in 7 cases (1.9%); pneumonitis in 6 cases (1.6%); emphysema in 1 case (0.27%); and chronic pneumonitis in 2 cases (.055%). The x-ray films of 5 patients were blurred and could not be diagnosed. The findings did not show any clear significant differences between infected and uninfected groups.

TABLE 1 Distribution of the population of Jedkot Village according to age group, sex and prevalence of *P. heterotremus* (* =no. infected).

| Age (years) | No. examined (positive) | | | Total prevalence | Egg counts/day of sputa from infected individuals (range) |
|-------------|-------------------------|----------|----------|------------------|---|
| | Male | Female | Total | | |
| 5-9 | 31 | 30 (3) | 61 (3) | 4.9 | 11.6 (0.7-33.5) |
| 10-14 | 31 | 42 (3) | 73 (3) | 4.1 | 915.2 (310.3-2115.7) |
| 15-19 | 12 (2)* | 16 | 28 (2) | 7.1 | 89.8 (18.5-161.0) |
| 20-24 | 11 | 17 (1) | 28 (1) | 3.6 | 0.5 |
| 25-29 | 11 (1) | 14 (6) | 25 (7) | 28.0 | 2135.9 (2.0-6605.0) |
| 30-39 | 27 (2) | 18 (2) | 45 (4) | 8.9 | 323.3 (0.3-1260.3) |
| 40-49 | 11 (1) | 11 | 22 (1) | 4.5 | 2625.7 |
| 50-59 | 13 (3) | 14 | 27 (3) | 11.1 | 7425.1 (877.3-10807.7) |
| >60 | 3 | 3 | 6 | 0 | |
| Total | 150 (9) | 165 (15) | 315 (24) | 7.6 | 1837.8 (0.3-10807.7) |

TABLE 2 Infection rates and mean numbers of metacercariae of *P. heterotremus* in naturally caught crabs, *L. larraudii*, collected in Jedkot Stream, Kaeng Khoi District, Saraburi Province, from May 1985 to February 1986.

| Month of collection | No.infected ————— No.examined (%) | Length of crab Mean±S.E. (cm) | No.of metacercariae Mean±S.E |
|---------------------|---|-------------------------------------|---------------------------------|
| 1985 | | | |
| May | 10/45 (22.2) | 3.34 + ₋ 0.15 | 0.60 + ₋ 0.20 |
| June | 7/37 (18.9) | 3.56 + ₋ 0.14 | 0.84 + ₋ 0.40 |
| July | 10/51 (19.6) | 3.58 + ₋ 0.10 | 0.73 + ₋ 0.23 |
| August | 10/66 (15.2) | 3.50 + ₋ 0.12 | 0.50 + ₋ 0.22 |
| September | 11/41 (26.8) | 3.59 + ₋ 0.14 | 0.73 + ₋ 0.26 |
| October | 25/83 (30.1) | 3.66 + ₋ 0.09 | 0.61 + ₋ 0.13 |
| November | 25/88 (28.4) | 4.16 + ₋ 0.46 | 0.94 + ₋ 0.26 |
| December | 20/47 (42.6) | 3.25 + ₋ 0.12 | 1.45 + ₋ 0.50 |
| 1986 | | | |
| January | 25/53 (47.2) | 3.40 + ₋ 0.10 | 1.66 + ₋ 0.41 |
| February | 4/77 (8.2) | 2.87 + ₋ 0.09 | 0.23 + ₋ 0.14 |
| Total | 147/588 (25.0) | | |

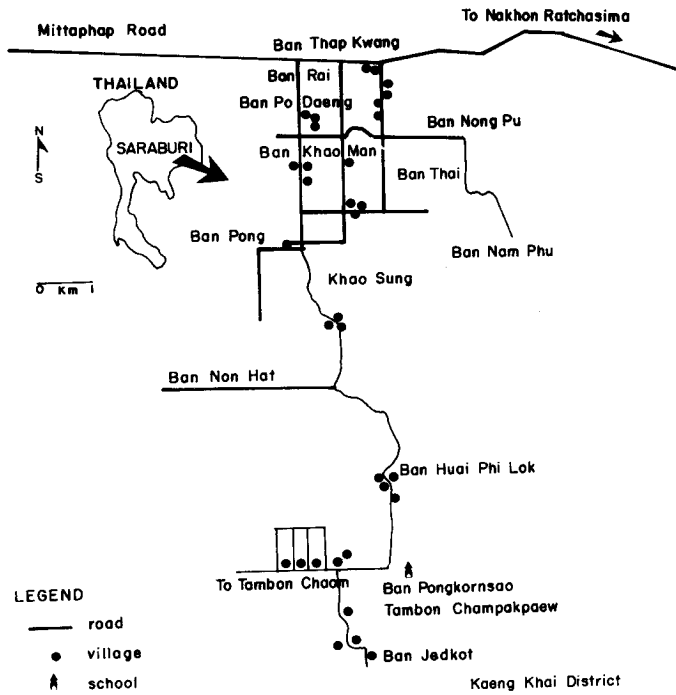


Fig. 1. Map of the study area.

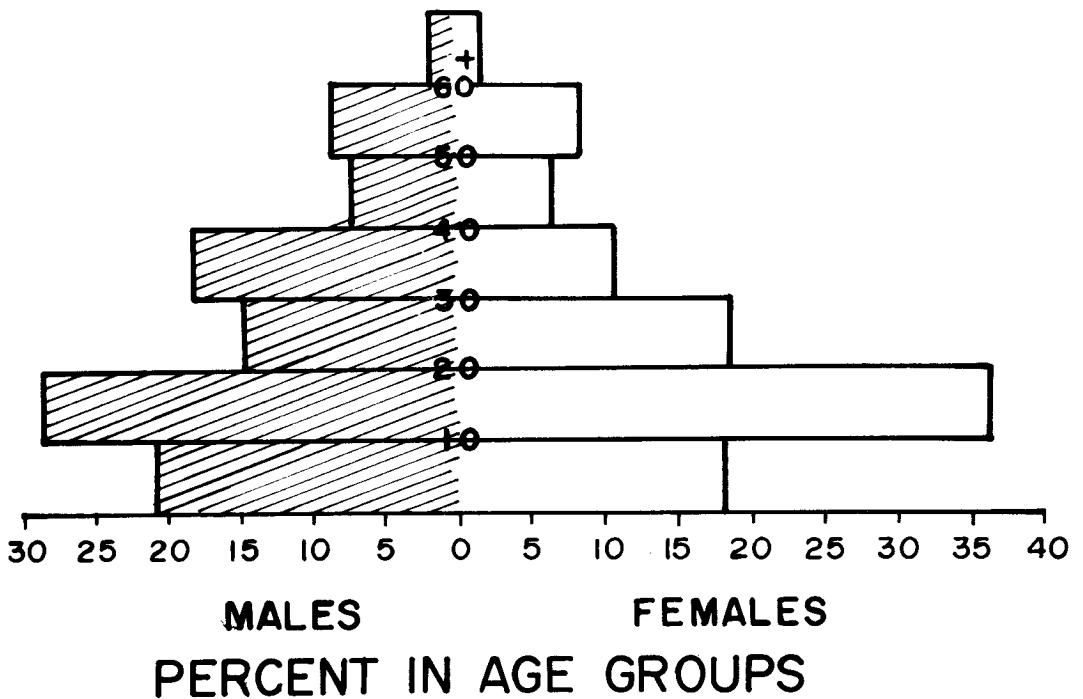


Fig. 2. Age structure of the study population of Jedkot Village.

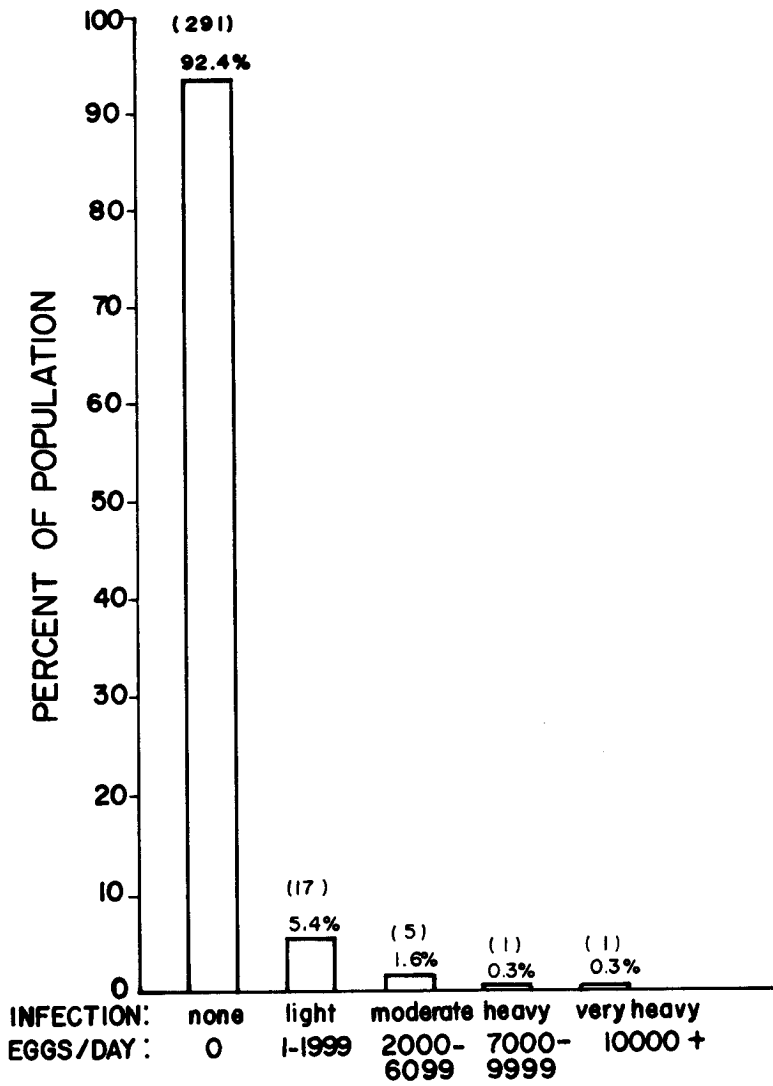


Fig. 3. Percentages of uninfected individuals and those with different intensities of *P. heterotremus* infection in the study population of Jedkot Village.

The snail intermediate host

Two species of snails, namely, *Gyraulus convexiusculus* and *Filopaludina (Siamopaludina) martensi martensi*, were collected during the surveys, but no cercariae of *P. heterotremus* were detected.

The crab intermediate host

The rates and intensities of infection of *P. heterotremus* in naturally caught *Larneria larnaudii* in Jedkot Stream, Kaeng Khoi District, Saraburi Province, from May 1985 to February 1986, are shown in Table 2. Crabs were found infected with *P. heterotremus* metacercariae every month, with high rates of infection in December 1985 (42.6%) and January 1986 (47.2%). The overall rate of infection was 25.0%. The mean numbers of metacercariae per crab were higher in muscles (0.21-1.51) than in gills (0.02-0.17), and some (0-0.08) were in the visceral organs of the crabs. The mean numbers of metacercariae per crab ranged from 0.23 ± 0.14 to 1.66 ± 0.41 , with high intensities of infection in December 1985 and January 1986.

DISCUSSION

In the present study, a comprehensive survey of lung fluke infection was conducted in a small upland village in Central Thailand. People of all age groups, except those above 60 years of age, were found to be infected with *P. heterotremus*, with an overall prevalence of 7.6% (Table 1). The highest prevalence found in the 25-29 year age-group indicates that this group of inhabitants consumed raw or improperly cooked mountain crabs more than other age-groups. The disease is slightly more common in females than in males (9.1% vs. 6.0%), probably due to higher frequency of raw crab consumption of females. Cabrera and Fevidal¹³ reported a higher infection rate in males than in females in the Philippines, whereas Vogel and Crewe¹⁴ found that in Africa females exhibited prevalence rates three times higher than males. Thus, sex differences in acquiring paragonimiasis may depend on the eating habits of inhabitants in each endemic area.

Concerning the sensitivity of diagnostic methods, it was found that sputum examination was more sensitive in detecting *P. heterotremus* eggs than faecal examination (7.6% vs 2.8%), which confirms the report of Cabrera and Fevidal¹³. Moreover, it was also found that chest x-ray did not give any definite result, and therefore may be considered as the least useful tool for diagnosis of paragonimiasis.

Intensive surveys of the intermediate hosts were also conducted in Jedkot Stream and in waterbodies near Ban Jedkot. Snails were not found to release *P. heterotremus* cercariae, but mountain crabs (*L. larnaudii*) were found to harbour *P. heterotremus* metacercariae, with an average infection rate of 25.0% (Table 2). The metacercariae were found mostly in the muscles of the crab body, while some were found in the gills and the visceral organs. Correlations between monthly infection rates and intensity of infection in the crabs were also observed. The highest infection rates and intensity of infection were encountered during December and January. The crabs were mostly infected at the end of the rainy season (starting in June and ending around October) and at the beginning of the dry season

(starting November), when snails and crabs were abundant, and where large numbers of *P. heterotremus* eggs were washed into the stream, thus enhancing opportunities for miracidia-snail and cercariae-crab contacts. Human infection probably occurs at the beginning of the dry season, when the water level in the streams is low, which enables villagers to catch crabs more easily for consumption.

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