

Preplanned Studies

Reappearance of Risk of Schistosomiasis Transmission and the Response After 27 Years of Interrupted Transmission — Guangdong Province, China, 2019

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Summary

What is already known about this topic?

No live specimens of the snail *Oncomelania hupensis* (*O. hupensis*) and indigenous infected cases of schistosomiasis japonicum have been found in Guangdong Province since 1993, but live *O. hupensis* was found again in 2019. This study conducted *O. hupensis* identification and elimination.

What is added by this report?

In 2019, live *O. hupensis* specimens were detected by routine surveillance in areas in Qujiang of Shaoguan City and Yingde of Qingyuan City, and an emergency response was launched immediately.

What are the implications for public health practice?

The suspected habitat of *O. hupensis* in originally endemic areas of schistosomiasis in Guangdong is still complicated, so it is necessary to record suspected habitats comprehensively and carry out scientific routine surveillance for *O. hupensis*.

Oncomelania hupensis (*O. hupensis*) is the only intermediate host of *Schistosoma japonicum* (1). Guangdong Province is also a province with endemic *O. hupensis*, and there used to be an estimated 110 million square meters of original habitat for *O. hupensis* (2). In order to eliminate schistosomiasis, a team in Guangdong modified the environment to undertake *O. hupensis* control measures, and since 1993, live *O. hupensis* have disappeared in Guangdong (3). Unexpectedly, live *O. hupensis* were found during the spring *O. hupensis* survey in Qujiang District of Shaoguan City and Yingde City of Qingyuan City of Guangdong in early April of 2019 (Figure 1). In order to maintain the state of no live *O. hupensis* in Guangdong Province and to eliminate the risk of possible recurrence of schistosomiasis, a team in Guangdong was dispatched to carry out prevention

and control measures to eliminate *O. hupensis* and modify its breeding area from April to August 2019 in this study.

The first *O. hupensis* habitat area was located in the junction area of Changjiang Dam of Shakou Town, Yingde (county-level jurisdiction), Qingyuan City, and Qunxing Village of Zhangshi Town, Qujiang District (county-level jurisdiction), Shaoguan City, which was originally an *O. hupensis* habitat area (Figure 1), with diverse and complex surrounding environments. The *O. hupensis* density survey was carried out by 5 meter systematic sampling combined with 2-frame environmental sampling. Both dead and live snails were identified, and the infection rate of *Schistosoma japonicum* cercariae in live snails was detected by anatomical microscope, polymerase chain reaction (PCR), and loop-mediated isothermal amplification (4). At the same time, the whole mitochondrial genome DNA of snails was sequenced and phylogenetic analysis was carried out using next generation sequencing. In order to further understand the schistosomiasis infection status of people and livestock in the affected areas, the venous blood and feces of people and cattle were collected, and schistosomiasis antibodies were detected for using indirect haemagglutination assay (IHA). The feces were detected by metacercaria incubation method and Kato Katz. In addition, in order to completely eliminate the snails, comprehensive environmental treatment was adopted in the response process. The main measures include the following: comprehensively managing ditches by weeding and clearing the surface; spraying the area with 26% metaldehyde and niclosamide suspension concentrate combined with either black ground rubber film cover or with soaking to eliminate *O. hupensis*; and filling old ditches and constructing new ditches and hardening three sides with smooth surfaces.

The results showed a total of 1,847 suspected

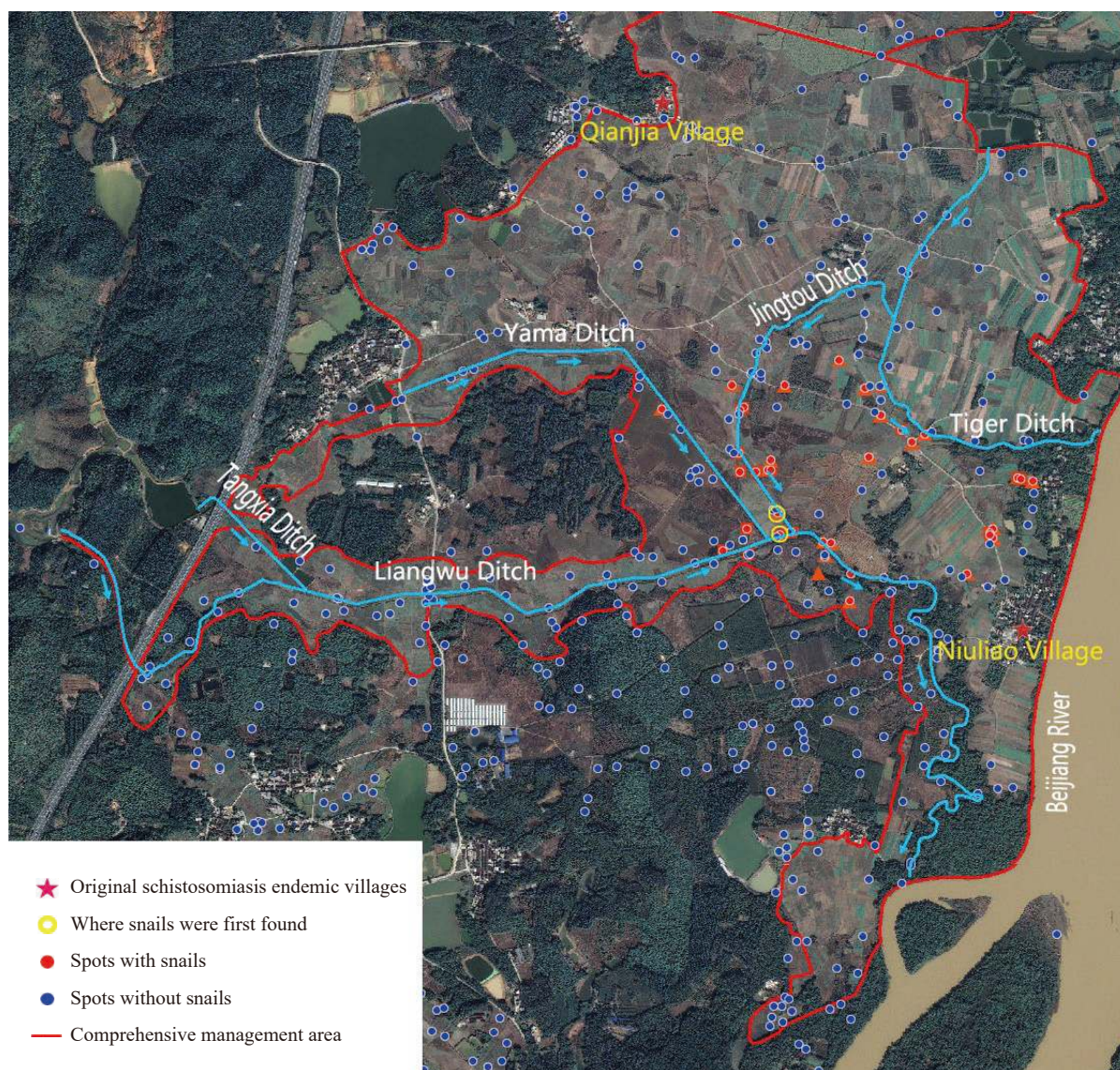


FIGURE 1. The map of comprehensive management of *Oncomelania hupensis* in Guangdong Province in 2019.

environments suitable for *O. hupensis* habitat that were investigated, with a total area of about 2.26 million square meters. A total of 40 environments with *O. hupensis* were identified covering an area of about 124.7 thousand square meters. The occurrence rate of the survey frames with *O. hupensis* in the habitat environment was 0.32%–66.09%, and the density of live *O. hupensis* was 0.01–7.66/frame (Table 1). A total of 8,612 snails were collected and identified as live snails. The whole mitochondrial genome sequence (15,850 bp) of *O. hupensis* was obtained by second-generation deep sequencing. The results of identification and evolutionary analysis showed that *O. hupensis* in Guangdong Province and the Yangzhou (JF284688.1) strain in Jiangsu Province were located in the same evolutionary branch, and identification

with the strain at the nucleotide level was 100% (Figure 2). A total of 4,861 human blood samples were collected, with a test response rate of more than 95%. The IHA test results were positive for schistosomiasis antibody in 14 people (0.29%), and the stool samples of 14 IHA positive people were negative for schistosomiasis eggs and metacercaria. The blood and fecal samples of 269 buffalo in all affected areas were collected, and the examination rate was 100%. No *Schistosoma* antibodies, eggs, and cercariae were found. In the process of environmental treatment, a total of 51.94 km of canals were newly built and repaired, 3 screw basins were newly built, 27 culverts were rebuilt, and more than 3,000 acres of farmland remediation and rehabilitation were completed. The cumulative drug snail extermination area was 1.45 million square

TABLE 1. Investigation on *Oncomelania hupensis* and its breeding area in the affected areas of Qujiang and Yingde, Guangdong Province from April to August 2019.

County-level jurisdiction	No. of snail environment	Environment type	Environmental area (m ²)	No. of survey system frames	No. of live snail frames	Rate of live snail frames	No. of live snails collected	Live <i>Oncomelania</i> density (No./ frame)
Qujiang	1	Ditch	78	43	6	13.95	147	3.42
Qujiang	2	Ditch	1,575	12	1	8.33	1	0.08
Qujiang	3	Ditch	400	23	5	21.74	11	0.48
Qujiang	4	Ditch	800	174	115	66.09	794	4.56
Qujiang	5	Ditch	60	26	1	3.85	1	0.04
Qujiang	6	Waste land	865	66	1	1.52	1	0.02
Qujiang	7	Waste land	5,004	133	2	1.50	2	0.02
Qujiang	8	Ditch	50	13	2	15.38	5	0.38
Qujiang	9	Ditch	50	12	4	33.33	20	1.67
Qujiang	10	Ditch	320	308	1	0.32	17	0.06
Qujiang	11	Ditch	65	28	4	14.29	16	0.57
Qujiang	12	Ditch	175	33	3	9.09	6	0.18
Qujiang	13	Waste land	2,200	262	4	1.53	16	0.06
Qujiang	14	Ditch	240	83	1	1.20	1	0.01
Qujiang	15	Waste land	30	11	3	27.27	15	1.36
Qujiang	16	Waste land	50	11	2	18.18	15	1.36
Qujiang	17	Waste land	7,178	414	54	13.04	97	0.23
Yingde	18	Waste land	10,525	32	11	34.38	164	5.13
Yingde	19	Ditch	1,592	31	8	25.81	63	2.03
Yingde	20	Waste land	22,056	55	17	30.91	179	3.25
Yingde	21	Waste land	2,653	111	26	23.42	144	1.30
Yingde	22	Waste land	1,781	70	25	35.17	154	2.20
Yingde	23	Waste land	2,164	77	7	9.09	590	7.66
Yingde	24	Waste land	7,676	77	12	15.58	28	0.36
Yingde	25	Waste land	13,603	98	21	21.43	300	3.06
Yingde	26	Waste land	8,935	36	11	30.56	28	0.78
Yingde	27	Waste land	2,175	73	5	6.85	25	0.34
Yingde	28	Ditch	4,064	138	11	7.97	37	0.27
Yingde	29	Waste land	1,752	17	2	11.76	13	0.76
Yingde	30	Waste land	337	18	8	44.44	90	5.00
Yingde	31	Ditch	259	99	42	42.42	629	6.35
Yingde	32	Waste land	10,599	347	18	5.19	89	0.26
Yingde	33	Waste land	6,215	147	4	2.72	33	0.22
Yingde	34	Waste land	6,245	162	10	6.17	189	1.17
Yingde	35	Ditch	278	175	102	58.29	726	4.15
Yingde	36	Ditch	250	43	8	18.60	25	0.58
Yingde	37	Ditch	620	169	1	0.59	1	0.01
Yingde	38	Ditch	1,370	238	44	18.49	1,312	5.51
Yingde	39	Ditch	200	35	20	57.14	76	2.17
Yingde	40	Ditch	300	107	1	0.93	1	0.01
Total			124,789	4,007	623	15.55	6,061	1.51

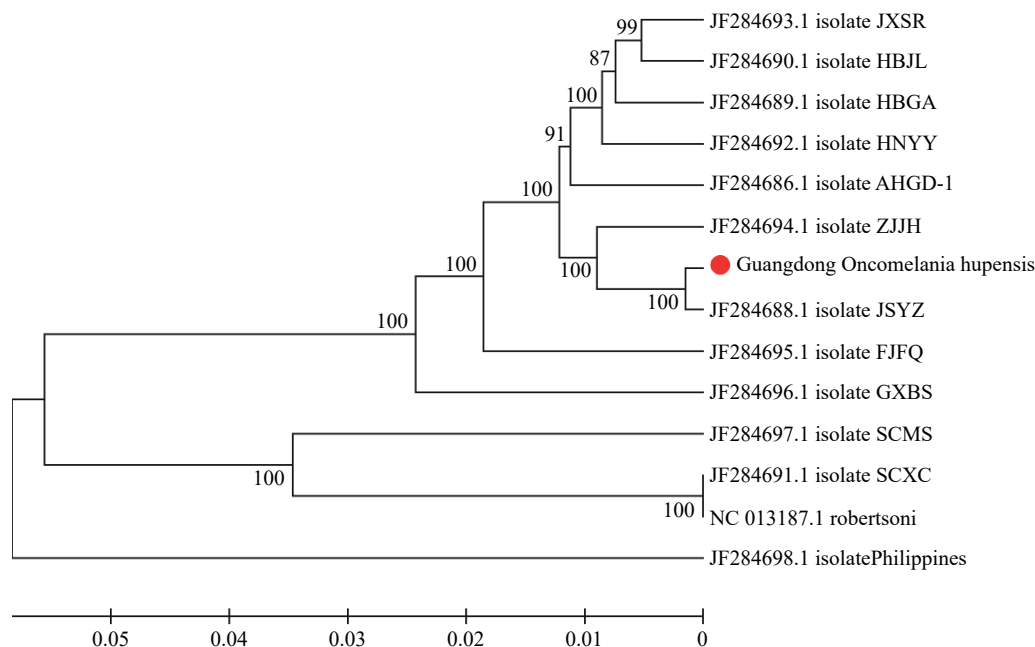


FIGURE 2. Phylogenetic tree of *Oncomelania hupensis* mitochondrial genomic DNA obtained from Qujiang in 2019 in Guangdong Province, China.

Notes: A total of 14 sequences were used for phylogenetic tree reconstructions. The Guangdong *Oncomelania hupensis* strain was indicated by red circle.

meters. From December 2020 to May 2021, 40 environments with *O. hupensis* and the surrounding environments were monitored and evaluated several times, and no more live *O. hupensis* were detected.

DISCUSSION

Schistosomiasis epidemic areas in Guangdong Province were mainly distributed in the middle and lower reaches of the Beijiang River in the Pearl River System (2). Guangdong Province announced the elimination of schistosomiasis in 1985 as there were no *O. hupensis* found in 7 years. Since then, in 1992, an outbreak of *O. hupensis* reappeared in Caozhai Village, Sanshui District, Foshan City. It was found that there were 2000 m² of *O. hupensis* and 3 persons with positive fecal eggs, including 1 case of previous infection and 2 cases of new infection (5). No *O. hupensis* had been reported in affected area in Yingde since 1982, and no sick cattle have been found since 1983 (5). Fortunately, we did not find any human and animal infections, so we inferred that the possible reasons for the recurrence of *O. hupensis* were as follows. First, there might be some remaining *O. hupensis* still living in the local environments at that time, and the environmental conditions were suitable for the reproduction of *O. hupensis*, which reached a

certain density after many years. Second, the environment was low-lying and waterlogged during the flood season, resulting in abandoned fields and overgrown weeds, forming an environment suitable for *O. hupensis* habitation. Third, the environmental terrain and its altitude, the mode of production and grazing, etc., were all possible factors causing *O. hupensis* to spread in a large area in this region. Fourth, the local reporting of suspicious environment suitable for *O. hupensis* habitat was not comprehensive enough, which might have resulted in insufficient monitoring coverage and missed investigation for many years (6). In 2018, Yingde strengthened the reporting efforts and monitored the environment of the newly built datasets in 2018, subsequently finding the *O. hupensis* habitats. Of the 40 areas affected by *O. hupensis*, half were distributed along the water system, and the other half were distributed at independent points. It is analyzed that the habitat and diffusion of the remaining snails in this area might be categorized in three passive diffusion modes (7): 1) carried and spread by water flow along the river system, flooding, and waterlogging water; 2) carried by human production and living activities; and 3) carried by activity of grazing animals in affected areas.

The following points were learned and implemented in this emergency response: 1) the monitoring system

must be maintained and be effective by adhering to surveillance procedures, team training, and quality evaluation every year; 2) the reoccurrence of the *O. hupensis* epidemic was confirmed quickly, and the provincial, municipal and county levels immediately launched emergency response, quickly established multidepartment joint management mechanisms, and took emergency implementation measures; 3) according to the characteristics of the environments with *O. hupensis*, molluscicide was utilized with environmental reforms to eliminate *O. hupensis* rapidly and consolidate the effects of *O. hupensis* eradication; 4) environments containing *O. hupensis*, surrounding water systems, and suspected environments must be comprehensively managed to reduce suspected environments suitable for *O. hupensis* breeding and minimize the risk of *O. hupensis* breeding and diffusion in the affected places, and relevant departments must be synchronized and collaborate on their work.

There are some limitations in the snail disposal. Firstly, the limitation of snail traceability. At present, there is no whole genome sequence of *Oncomelania*, so it can only be compared according to the mitochondrial genome sequence. Secondly, the limitation of snail distribution survey. Based on the current method of snail investigation, probability of missing inspection is high in the environment with low density; There may also be very few residual snails in the environment after snail disposal.

Strengthening surveillance is an important measure to consolidate and eliminate schistosomiasis. In order to consolidate the *O. hupensis* control effect, it is necessary to further strengthen the effect evaluation and monitoring, improve the environmental management, and conduct sustainable environmental management. In schistosomiasis surveillance areas, it is necessary to further strengthen the comprehensive reporting and registration of suspected environments suitable for *O. hupensis* habitation, strive to fully grasp the distribution and quantity of suspicious habitat

environments, simultaneously carry out dynamic filing management, carry out rational *O. hupensis* monitoring, ensure monitoring coverage and *O. hupensis* survey quality, and prevent missing investigations.

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