

Snail Transmitted Diseases

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Abstract

Many parasites that use gastropods as intermediate hosts cause serious diseases in humans and animals worldwide. These infections occur when snails act as vectors and intermediate carriers for various parasites, enabling disease transmission to humans. Fascioliasis is a parasitic infection caused by liver flukes of the genus *Fasciola*, mainly *Fasciola hepatica* and *Fasciola gigantica*. Schistosomiasis, also known as bilharzia, is a group of parasitic flatworms—blood flukes—that produce the disease schistosomiasis. *Angiostrongylus cantonensis*, commonly called the rat lungworm, is a parasitic nematode that primarily infects rodents, with humans and other animals serving as accidental hosts. Paragonimiasis is an infection caused by lung flukes of the genus *Paragonimus*, especially *Paragonimus westermani*. *Clonorchis sinensis*, commonly known as the Chinese liver fluke, is a parasitic worm responsible for clonorchiasis. Snail-transmitted parasitic infections present symptoms such as fever, headache, abdominal pain, muscle aches, malaise, fatigue and eosinophilia. The available diagnostic methods for snail-transmitted parasitic infections rely on stool and urine microscopy for parasite detection.

Keywords: gastropods; fasciola; schistosoma; angiostrongylus; clonorchis

Introduction

Many parasites that use gastropods as intermediate hosts cause very severe illnesses in humans and animals worldwide (Singh et al. 2012). Lu et al. (2018) reported that diseases caused by gastropod-borne helminths (GBHs) are thought to affect over 300 million people globally. Booth (2018) indicated that this figure is likely to increase soon because these illnesses are spreading beyond their traditional zones due to international travel, climate change, and the ongoing disregard of these diseases as a global health issue. Pathak et al. (2024) stated that snail-transmitted parasitic infections represent major public-health problems worldwide, particularly in tropical and subtropical areas. Ugochukwu et al. (2024) noted in their review that these infections occur when snails function as vectors and intermediate hosts for a variety of parasites, enabling disease transmission to humans. Such infections are especially common in regions such as Africa, Asia (including China, Korea, and Japan), and parts of Latin America (Ugochukwu et al., 2024). Approximately 200 million individuals are impacted by these infections across about 90 countries (Singh et al., 2012). Prominent snail-borne parasites include *Schistosoma* species causing schistosomiasis, *Angiostrongylus cantonensis* the agent of angiostrongyliasis, *Fasciola* species causing fascioliasis, *Paragonimus* species causing

paragonimiasis, *Opisthorchis* species transmitting opisthorchiasis, and *Clonorchis* species causing clonorchiasis (Lu et al., 2018; Ugochukwu et al., 2024). Hu et al. (2024) reported that among helminth parasites, digenetic trematodes—also known as flukes—are common parasites of wild and domestic animals. Krupenko et al. (2022) explained that the life cycle of digenetic trematodes is highly intricate, completing in one or more intermediate hosts depending on the species. Wiroonpan et al. (2021) described that in this cycle, molluscs or freshwater snails serve as the first intermediate host where asexual reproduction occurs, housing larval stages—radia, sporocyst, cercaria, metacercaria. Sexual reproduction takes place in vertebrate definitive hosts such as fish, amphibians, reptiles, birds, and mammals, thereby affecting their health and potentially causing death (Sato, 2021). Gaye et al. (2024) emphasized that, based on snail roles and the developmental stages of the parasites they carry, snail-borne parasitic diseases (SBPDs) can be classified into five groups. According to Pandian et al. (2023), the first group comprises Nematoda diseases in which snails act as intermediate hosts, with *Angiostrongylus cantonensis* as a representative pathogen. The first-stage larvae (L1) of *A. cantonensis* are released into the environment via rat feces (Pandian et al., 2023). Griffin et al. (2025) reported that snails become infected when they ingest

contaminated rat feces or when these larvae penetrate their body wall or respiratory pores, and that L1 larvae molt twice into second-stage (L2) and third-stage (L3) larvae within the mollusc tissue (Griffin et al., 2025). The remaining four groups are linked to Trematoda (Gaye et al., 2024). Joof et al. (2021) noted that in the second group, snails serve as the sole intermediate host and are infected by penetrating miracidia; a typical example is *Schistosoma mansoni* (Joof et al., 2021). Lu et al. (2018) added that parasite eggs hatch, releasing ciliated miracidia that enter snails and undergo two generations of sporocysts, ultimately producing thousands of cercariae that are shed into water and infect humans who contact the contaminated water (Lu et al., 2018). Locke et al. (2025) described the third group as one in which snails are the first intermediate hosts, becoming infected by ingesting parasite eggs; *Clonorchis sinensis* is a typical species of this group (Locke et al., 2025). Pinto et al. (2018) explained that in these parasites, after miracidia are released from eggs, they develop into sporocysts and finally into cercariae, which then infect freshwater fish—the second intermediate host. Lu et al. (2018) stated that in the fourth group, snails may act as the first intermediate host and are infected by miracidia; *Paragonimus westermani* eggs hatch, releasing miracidia into water that undergo several stages within snails. Nesterenko et al. (2020) reported that miracidia progress to sporocysts, rediae, and cercariae sequentially, then invade a second intermediate host such as crabs or crayfish. Calvani et al. (2021) indicated that in the fifth group, snails are the first intermediate host, infected by penetrating miracidia, while the second intermediate host consists of aquatic plants; species such as *Fasciolopsis buski* and *F. hepatica* follow this pattern. They also noted that eggs hatch into ciliated miracidia that swim to snails such as *P. westermani*, and after colonizing the snails they transform into sporocysts, rediae, and then cercariae that encyst on aquatic vegetation and become metacercariae (Calvani et al., 2021).

Types of Snails Transmitted Diseases

Fascioliasis

Fascioliasis represents a parasitic disease produced by liver flukes belonging to the genus *Fasciola*, especially *Fasciola hepatica* and *Fasciola gigantica* (Srivastava et al. 2014). The cycle starts when adult flukes living in the bile ducts of a definitive host—such as cattle, sheep, or humans—release eggs (Singh et al. 2012). Srivastava (2013) noted in his thesis that the eggs are expelled

with the host's feces and, upon reaching water, hatch into a miracidium, a motile larval form. Attenborough et al. (2024) reported that the miracidium bears cilia and actively searches for an appropriate intermediate host, usually a freshwater snail. Within the snail, the miracidium converts into a sporocyst, which subsequently matures into one or several rediae (Attenborough et al. 2024). The rediae then generate cercariae, another larval stage, and these cercariae are expelled from the snail into the aquatic environment (Rachprakhon et al. 2024). They also indicated that cercariae are free-swimming and possess a tail that facilitates movement (Rachprakhon et al. 2024). Morley (2020) explained that cercariae attach to aquatic vegetation or other surfaces, forming metacercariae, and these encysted forms withstand environmental stresses until taken up by a definitive host. When a definitive host—such as a grazing animal or a human—consumes water or vegetation contaminated with metacercariae, the cysts become activated within the digestive system (Morley 2020). Lalor et al. (2021) reported that the metacercariae emerge in the intestine, breach the intestinal wall, and travel via the peritoneal cavity to the liver. There they enter the bile ducts and develop into adult flukes (Lalor et al. 2021). Ismail et al. (2025) indicated that adult flukes inhabit the liver's bile ducts, where they reproduce, releasing eggs into the ducts that are ultimately expelled with the host's feces, thus closing the cycle. Kaya et al. (2011) described the acute stage of fascioliasis as presenting with fever, abdominal pain, hepatomegaly, and gastrointestinal upset due to larval migration through the liver. During the chronic stage, adult flukes remain in the bile ducts, provoking inflammation, fibrosis, and blockage that may result in serious liver injury and biliary problems (Ishikawa et al. 2016). Alba et al. (2021) noted that fascioliasis is common in areas with intensive livestock agriculture and irrigation, particularly within temperate and tropical zones. Mewara et al. (2018) summarized Indian investigations reporting prevalence rates of 60% in Assam, 22.4% in Uttar Pradesh, and 63% in Maharashtra. Achra et al. (2020) found that 45.8% of inhabitants in a specific part of a village in Bihar were infected with *F. buski*. Rizwan et al. (2022) indicated that Satkania in Bangladesh's Chittagong district is the most susceptible area, with a 50% infection rate by the trematode *Fasciola hepatica*.

Schistosomiasis

They are also referred to as bilharzia, a group of parasitic flatworms (trematodes) commonly called blood flukes that cause schistosomiasis (Di Bella et al. 2018). Ponzio et al. (2024) stated that this illness represents a major public-health concern, especially in tropical and subtropical zones. They also noted that five species of parasites have been identified as human pathogens: *Schistosoma haematobium*, *Schistosoma japonicum*, *Schistosoma mansoni*, *Schistosoma mekongi* (Ponzio et al. 2024). Ndiour et al. (2024) reported that more than 240 million individuals worldwide suffer from schistosomiasis, with over 700 million people living in endemic areas across 78 countries. Sub-Saharan Africa bears the greatest share of the disease burden, accounting for roughly 90 % of global cases. Pathak et al. (2023) indicated that the disease is endemic in many nations of this region because of the plentiful freshwater bodies that support the life cycle of the parasite's intermediate host, freshwater snails. Van et al. (2020) found that Nigeria is among the most heavily impacted nations in Sub-Saharan Africa, with an estimated 29 million cases, making it the country with the highest global burden. Chatterji et al. (2024) explained that these parasites have a complex life cycle involving freshwater snails as intermediate hosts, beginning when human skin contacts water containing the infectious larval form called cercariae. They also mentioned that these larvae are released by infected freshwater snails, which act as the intermediate hosts (Chatterji et al. 2024). Skelly (2013) described that cercariae penetrate the skin, shed their tails, and develop into schistosomula, which travel through the bloodstream to the liver and mature into adult worms. He also noted that adult schistosomes inhabit the host's blood vessels, positioning themselves around the intestines or bladder depending on the species (Skelly 2013). Schwartz and Fallon (2018) reported that the adult's pair and lay eggs, which can cause harm as they move through tissues. They added that some eggs are expelled from the body in urine or feces, perpetuating transmission, while others become lodged in tissues, provoking inflammation and organ damage (Schwartz and Fallon 2018). Le Clech et al. (2024) stated that eggs reaching freshwater hatch into miracidia, which then infect specific freshwater snail species. Within the snail, miracidia develop into sporocysts that multiply and produce cercariae, which are released back into the water where they can infect humans, completing the cycle (Le Clech et al. 2024). Ekloh et

al. (2024) indicated that schistosomiasis spreads through activities involving contact with contaminated water, such as swimming, bathing, or farming. Clinical manifestations range widely, from mild symptoms like skin rashes and fever to severe outcomes such as liver fibrosis, bladder cancer, or damage to other organs due to chronic infection. Ugochukwu et al. (2024) reported that schistosomiasis is the second most prevalent NTD after hookworm in Sub-Saharan Africa, with children and young adults shouldering the majority of the disease burden in Africa.

Angiostrongyliasis

Angiostrongylus cantonensis, also known as the rat lungworm, is a parasitic roundworm that mainly infects rodents, while humans and various other animals act as accidental hosts (Rivory and Šlapeta, 2025). Cowie (2013) noted that the life cycle of *A. cantonensis* uses rats as the definitive hosts; adult parasites inhabit the pulmonary arteries, and females discharge larvae that exit the host via feces, which are subsequently consumed by intermediate carriers like snails and slugs. Sohal et al. (2025) added that within these mollusks the larvae mature to the infectious third-stage (L3), and humans acquire infection unintentionally by eating raw or insufficiently cooked snails, slugs, or other contaminated items like unwashed produce and water. Martins et al. (2015) reported that after being swallowed, L3 larvae breach the intestinal lining, enter the circulatory system, and migrate to the central nervous system, causing eosinophilic meningitis. They further observed that affected humans experience intense headaches, neck rigidity, and neurological problems, and although the parasite cannot finish its life cycle in humans, grasping these transmission routes is essential for prevention and management. Akbar et al. (2023) recommended preventive actions such as refraining from eating raw or lightly cooked mollusks, maintaining good hygiene, and informing vulnerable communities in endemic regions. Dard et al. (2017) stated that angiostrongyliasis results from the emerging pathogen *A. cantonensis*, initially identified in Canton, China. Yang et al. (2012) indicated that by 2008 over 2,800 cases had been recorded across almost 300 nations and regions, with the largest outbreaks occurring in endemic zones, especially China. They also noted that *A. cantonensis* possesses a worldwide distribution, with occurrences documented in Southeast Asia, the Pacific Islands, the

Americas, and sections of Africa. Cowie et al. (2022) observed that rising international travel and commerce have facilitated its dissemination, rendering it an emerging public-health issue. They further reported that Angiostrongyliasis has now expanded from endemic zones in the Pacific Basin and Southeast Asia to nations in the Americas such as Brazil, the Caribbean Islands, and the USA, and it has been detected in numerous locations across the globe (Cowie et al. 2022).

Paragonimiasis

Paragonimiasis is a disease resulting from lung flukes belonging to the genus *Paragonimus*, primarily *Paragonimus westermani*, though other species may also produce infection (Singh et al. 2012). Liu et al. (2024) noted that the condition is widespread across regions of Asia, Africa, and the Americas where customary eating habits involve raw or insufficiently cooked freshwater crustaceans; about 20 million individuals are infected with *Paragonimus* species and roughly 293 million face exposure. Lu et al. (2018) indicated that the illness is mainly endemic to China, Korea, Japan, and several other Asian nations, with *P. westermani* representing the most prevalent and widely dispersed species of the genus throughout Asia. The parasite is capable of invading human lungs, brain, spinal cord, and additional organs, leading to pulmonary, neurological, and abdominal disorders (Lu et al. 2018). Cumberlidge et al. (2018) reported that these parasitic trematodes mainly target the lungs, yet they may also affect other tissues such as the brain and skin. They further explained that the *Paragonimus* life cycle comprises multiple developmental stages and involves various hosts (Cumberlidge et al. 2018). Roy et al. (2015) observed that adult flukes inhabit the lungs or other organs of a definitive host like humans and expel eggs. The eggs are expectorated, ingested, and later eliminated in feces; upon entering water, they develop into miracidia, which are free-swimming larvae (Roy et al. 2015). Roy et al. (2015) also noted that these miracidia need to locate and infiltrate an appropriate freshwater snail, acting as the first intermediate host. Gaye et al. (2024) described that within the snail, miracidia evolve into sporocysts, which subsequently become rediae, and the rediae generate cercariae, another larval form. They further reported that cercariae emerge from the snail into the water, swim freely, and locate a second intermediate host, generally a crustacean like a crab or crayfish (Gaye et al. 2024). Ortiz et al. (2014) indicated that within the

crustacean host, cercariae encyst, forming metacercariae; these encysted larvae withstand environmental stresses and remain viable until consumed by a definitive host. They also stated that humans acquire infection by eating raw or insufficiently cooked crustaceans harboring metacercariae (Ortiz et al. 2014). Dubey (2023) reported that once ingested, metacercariae emerge in the gastrointestinal tract, travel through the abdominal cavity to the lungs or other organs, and develop into adult flukes, which then reproduce and lay eggs. He further explained that the eggs are expelled via sputum or feces, contingent on the infection site, thereby completing the lifecycle (Dubey 2023). Sasaki et al. (2023) noted that Paragonimiasis symptoms may vary from persistent cough and hemoptysis to serious neurological and systemic effects in instances of ectopic infection.

Clonorchiasis

Clonorchis sinensis, often referred to as the Chinese liver fluke, is a parasitic worm that causes clonorchiasis (Tang et al. 2016). Yuan et al. (2018) noted that the lifecycle of *Clonorchis sinensis* includes freshwater snails and fish as intermediate hosts, and humans acquire infection by eating raw or insufficiently cooked freshwater fish harboring the infective metacercariae. Ugochukwu et al. (2024) also indicated that the cycle starts with eggs being released by adult flukes located in the liver, gallbladder, or bile ducts of the definitive host (humans). These eggs travel with bile into the small intestine and are ultimately eliminated in feces (Ugochukwu et al. 2024). Gaye et al. (2024) further reported that once the eggs enter fresh water, they hatch into miracidia—free-swimming larvae that locate and invade an appropriate freshwater snail, the first intermediate host. Inside the snail, the miracidia develop into sporocysts, which then become rediae, and these rediae subsequently generate cercariae. Palmer et al. (2025) stated that cercariae exit the snail into the surrounding water, where they swim freely and actively locate a second intermediate host—usually a freshwater fish—in which they encyst as metacercariae (Palmer et al. 2025). Gabriël et al. (2023) observed that these encysted larvae are robust and can persist until the fish is eaten by a definitive host, leading to human infection when raw or undercooked fish containing metacercariae are consumed. They further noted that after ingestion, the metacercariae are liberated in the gastrointestinal tract, migrate to the liver, gallbladder, and bile ducts, and develop into

adult flukes (Gabriel et al. 2023). Adult flukes residing in the liver or bile ducts reproduce, depositing eggs that are expelled with bile into the intestine and subsequently eliminated in feces, perpetuating the cycle (Ugochukwu et al. 2024). Qian et al. (2024) indicated that the agents of clonorchiasis and opisthorchiasis are liver flukes *C. sinensis*, *O. viverrini*, and *O. felineus*, all belonging to the Opisthorchiidae family, and that the disease commonly occurs in East Asian nations where raw fish consumption is widespread. Wang and Mitchell (2022) estimated that about thirty-five million individuals are infected with *C. sinensis* globally, roughly 15 million of whom reside in China, and that around ten million people carry *O. viverrini*, with four-fifths of those cases occurring in Thailand and the remainder in Laos.

Chance of Infection of Diseases

Odeniran et al. (2020) noted that the spread of snail-borne parasitic disease is extensive and frequently seen in rural regions where work and leisure activities involve water contact because snail vectors are present. They also indicated that tourists who partake in freshwater recreation are at risk of acquiring the infection (Odeniran et al. 2020). Lund et al. (2019) observed that communities relying on surface water obtain their daily household water—such as for bathing, washing, and gardening—from rivers and dams, thereby exposing residents, especially school-age children, to water harboring snail intermediate hosts. Reitzug et al. (2023) reported that repeated exposure to contaminated water while bathing, swimming, fishing, or laundering clothes is linked to the high occurrence of schistosomiasis. They further pointed out that favorable climate conditions for snail intermediate hosts and inadequate environmental sanitation have contributed to the strong endemicity of snail-transmitted parasitic infections (Reitzug et al. 2023).

Symptoms of Diseases

Lu et al. (2018) noted that infection transmitted by snail manifests with fever, headache, abdominal pain, muscle aches, general malaise, tiredness and eosinophilia. Ugochukwu et al. (2024) observed that liver enlargement often occurs in severe stages and is typically linked to fluid buildup in the peritoneal cavity and increased pressure in abdominal vessels. Cozzi et al. (2020) reported that renal injury and fibrosis of the bladder and ureter may appear in late-stage disease, with bladder cancer also representing a potential complication. Shibuki et al.

(2024) further noted that the condition may manifest as genital lesions, vaginal bleeding, dyspareunia, vulvar nodules, abnormalities of the seminal vesicles, prostate and other organs, potentially leading to infertility or even fatality.

Detection of Parasites Transmitted by Snails Analysis of stool or urine

Chala (2023) noted that the current diagnostic approaches for snail-borne parasitic infections depend on microscopic examination of stool and urine to identify parasites. These methods comprise Kato-Katz (KK) and urine microscopy, serological antibody tests, antigen assays, and molecular detection of parasite DNA (Chala 2023). Loginova et al. (2024) indicated that diagnosis is confirmed by finding characteristic eggs in feces. Feleke et al. (2023) reported that the reference test for active schistosomiasis is the identification of living eggs in urine (*S. haematobium*) or in stool (*S. japonicum*, *S. mansoni*). Vaillant et al. (2024) mentioned that the WHO advises microscopic inspection of polycarbonate filters for urinary eggs, urine dipstick tests for hemoglobin, or Kato-Katz stool analysis for Schistosome surveillance and field-based control measures.

Serological assays for immunological Diagnosis

Partal et al. (2020) noted that Enzyme-linked immunosorbent assay (ELISA) and immunofluorescence assays (IFA) are capable of identifying antibodies targeting *Schistosoma* antigens in blood specimens, and these methods are valuable for diagnosing current or recent infections because they can stay positive for a period following therapy.

PCR method (Polymerase Chain Reaction)

Fuss et al. (2021) reported that molecular techniques such as PCR can be employed to detect fragments of pathogen-related DNA in samples like urine, stool, or blood. PCR yields highly specific and sensitive outcomes and may be applied when microscopic approaches are inconclusive or within research contexts (Fuss et al. 2021).

Conclusion

Snail-borne parasitic diseases such as clonorchiasis, fascioliasis, fasciolopsiasis, opisthorchiasis, paragonimiasis, schistosomiasis and certain nematode infections like angiostrongyliasis are widespread globally and cause significant adverse effects on human health, especially in tropical and subtropical

regions. Consequently, disrupting the transmission cycle by managing host snail populations offers an alternative strategy to curb these diseases, given the absence of effective vaccines for snail-borne parasites and the potential for parasites to develop resistance to existing anthelmintic medications. Compared with mechanical and synthetic chemical molluscicide approaches, plant-derived molluscicides are more eco-friendly, exhibit lower toxicity, and are less prone to induce snail resistance, indicating a promising new way to diminish endemic snail numbers. In addition, thorough molecular epidemiology investigations, a better grasp of the ecology of medically important snails, and deeper insight into snail-parasite relationships—particularly those derived from large-scale genomic data mining of snail datasets—are required to pinpoint specific or key molecules that govern snail survival, metabolism and development. These molecules could serve as targets for natural molluscicides, which might be developed into innovative and effective interventions for controlling snail-borne parasitic diseases.

Declarations

Competing Interests

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