

Parasitic worm infestations

In this article, **Christine Clark** describes worm infestations that pharmacists in the UK might encounter, and their treatments

Many species of worm are parasitic and have humans as their hosts. In developing countries worm infestations are a major problem and can result in growth deficiencies in children, deformities and blindness, and organ damage. Fortunately the UK is not affected by species of worm that cause such problems but infestations by less harmful species exist.

Parasitic worm (helminth) infestations are caused by three groups of worms: nematodes (roundworms), trematodes (flukes) and cestodes (tapeworms) — see Panel 1 for examples. The most common worm infestation in the UK is threadworm.

Large roundworm (commonly simply referred to as roundworm), hookworm and whipworm infestations are endemic in tropical and subtropical countries and in the UK they are usually found in immigrants or travellers. The increasing popularity of travel to exotic destinations could lead to an increase in these types of infestation. Pharmacists should be aware that such travel could also expose people to the risk of other tropical worm infestations, such as schistosomiasis (see Panel 2, p344).

Threadworms

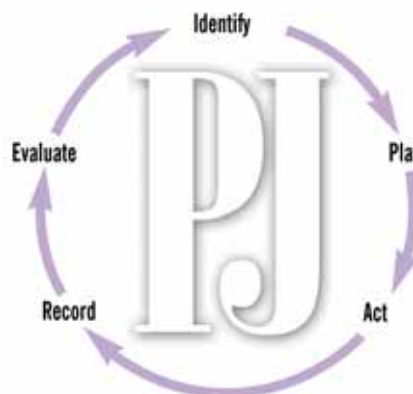
Threadworm (or pinworm) is the most common nematode parasite in temperate climates. Human threadworms are small (between 2mm and 13mm long), white, thread-like worms that live in the upper part of the colon. Infestation is limited to humans; threadworm cannot be caught from or passed to animals. Threadworms most commonly affect children (it has been estimated that up to 20 per cent of children aged under 10 years will have threadworm at any one time) but can affect whole families. High rates of infestation also occur in residential homes.

The incidence of infestation usually peaks in midwinter and decreases towards summer.



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Itching in the perianal area is often the first sign of threadworms



Identify knowledge gaps

1. What types of worm infestation are encountered in the UK?
2. What are the cautions for over-the-counter anthelmintics?
3. What advice should be given when selling or dispensing a treatment for worms?

Before reading on, think about how this article may help you to do your job better. The Royal Pharmaceutical Society's areas of competence for pharmacists are listed in "Plan and record", (available at: www.rpsgb.org/education). This article relates to "common disease states".

Infestation is caused by swallowing threadworm eggs. The larvae hatch in the small intestine and establish themselves in the colon, reaching maturity in two weeks. Host inactivity allows the movement of the adult female to the anus and large numbers of small eggs (invisible to the naked eye) are laid around the anus. In female hosts, eggs may also be laid around the vagina and urethra.

The eggs are deposited with an irritant mucus that can cause intense itching. Spread of the infestation, or re-infestation, occurs through the hand-to-mouth transmission of eggs after scratching. Threadworms only live for between three and six weeks so an infestation can usually only continue if more eggs are swallowed. However, reinfestation, where the eggs hatch around the anus and the larvae migrate into the rectum, has been reported.

Although intense itching in the perianal area (usually at night), is often the first sign of threadworms, in many cases infestation is asymptomatic. The diagnosis can be confirmed if threadworms are seen in the perianal area (most likely when the host is resting, eg, at night) or, more rarely, in stools.

If infestation is suspected but no threadworms are found, the eggs can be detected. A hypoallergenic adhesive tape is applied to the perianal skin first thing in the morning, before wiping or bathing, and then examined under a microscope. Stool examination is less reliable

Panel 1: Examples of parasitic worms

Group	Examples	Disease
Nematodes (roundworms)	<i>Enterobius vermicularis</i> (pinworm, threadworm)	Enterobiasis
	<i>Ascaris lumbricoides</i> (large roundworm)	Ascariasis
	<i>Trichuris trichiura</i> (whipworm)	Trichuriasis
	<i>Ancylostoma duodenale</i> (old world hookworm)	Ancylostomiasis
	<i>Necator americanus</i> (new world hookworm)	Necatoriasis
	<i>Strongyloides stercoralis</i>	Strongyloidiasis
Trematodes (flukes)	<i>Schistosoma japonicum</i> , <i>S mansoni</i> , <i>S haematobium</i>	Schistosomiasis, bilharzia
Cestodes (tapeworms)	<i>Taenia saginata</i> (beef tapeworm), <i>Taenia solium</i> , (pork tapeworm), <i>Hymenolepis nana</i> (dwarf tapeworm), <i>Diphyllobothrium latum</i> (fish tapeworm)	Taeniasis

because eggs are only present in the faeces of about 5 per cent of threadworm sufferers.

Scratching of the perianal region can damage the skin and predispose to infections. Persistent or heavy infestations can cause loss of appetite, weight loss, insomnia, enuresis and irritability. Occasionally, threadworms are found in the female genital tract or more distant organs.

Treatment of threadworm infestation

Threadworm infestation can be treated with an anthelmintic or by meticulous attention to hygiene for six weeks.

Non-drug treatment Threadworms in the intestine will die within six weeks and if no new eggs are swallowed, no new worms will replace them. In order to ensure that no further eggs are swallowed, the measures listed in Panel 3 should be applied for six weeks. It is

Panel 2: Worm infestations in travellers

Two worm infestations that may be picked up by travellers are strongyloidiasis and schistosomiasis. Although these are rare, pharmacists should always ask about overseas travel if a patient presents with gastrointestinal symptoms. They could also consider including avoiding worm infestation in the advice they give when supplying antimalarials and other travel-related products.

Strongyloidiasis

Strongyloides stercoralis is a nematode that has both a free-living and a parasitic form. It is found worldwide although most commonly in tropical and subtropical regions. Larvae are initially acquired through skin contact with contaminated soil. Worms then live and grow in the small intestine. Infective larvae are excreted in the stool and can also penetrate the perianal skin, setting up a cycle of auto-infection. Strongyloides infestation can cause a variety of gastrointestinal and pulmonary symptoms but it can also be asymptomatic for months or even years. The most serious complication of this condition is the potentially fatal strongyloides hyperinfestation syndrome. This involves widespread dissemination of the larvae and usually occurs in immunocompromised individuals. For this reason it is important to look at the likelihood of infestation (eg, previous Far East prisoners of war) before chemotherapy.

Diagnosis is made by detecting larvae in the stools. The treatment of choice is tiabendazole at a dosage of 25mg/kg (1.5g maximum) every 12 hours for three days. Albendazole and ivermectin are alternatives.

Travellers should avoid going barefoot in areas where strongyloidiasis is endemic.

Schistosomiasis (bilharzia)

Schistosomiasis is caused mainly by three species of trematode. Schistosome eggs are excreted in the faeces (*S japonicum*, *S mansoni*) or urine (*S haematobium*) of infested individuals. The eggs hatch releasing larvae (miracidia) that penetrate an intermediate snail host. In due course, infective larvae (cercariae) are released from the snails. These are able to penetrate the skin of people swimming or wading in the water. The organisms move through several organs before reaching the bowel or bladder, where mature worms mate and produce eggs.

Most infestations are asymptomatic although initial contact with cercariae can cause an itchy rash, known as "swimmer's itch". Some people also experience an acute phase (Katayama fever), between two and six weeks after exposure, involving fever, malaise and eosinophilia. Other symptoms can include cough, diarrhoea, weight loss, haematuria, headache, joint and muscle pain, and enlargement of the liver and spleen. Chronic schistosomiasis is associated with serious long-term organ damage.

Diagnosis is usually made by finding schistosome eggs on microscopic examination of stool or urine, or by rectal biopsy. Praziquantel is effective against all human schistosomes. The dose is 40mg/kg in two doses 4–6 hours apart (60mg/kg in three divided doses on one day for *S japonicum* infestations).

Travellers should avoid swimming or wading in fresh water in endemic areas. Chlorination kills schistosomes so there should be no risk in well maintained swimming pools. Schistosomiasis cannot be contracted through seawater.

important that every member of the household follows these measures strictly.

Threadworm eggs can survive for up to two weeks on objects as well as bedding and clothing so surfaces should be damp-dusted daily and the dustcloth washed frequently in hot water. Daily vacuuming of all carpets is also recommended. Good ventilation and low humidity both help to reduce the viability of eggs.

Non-drug treatment may be considered when drug treatment is contraindicated (eg, for pregnant women or babies aged under three months) or is not desirable.

Drug treatment Although reinfestation can be prevented by following the hygiene measures described above, for many people, threadworm infestation is both distressing and embarrassing and they will want to use an anthelmintic straight away. Both mebendazole and piperazine are listed in the British National Formulary for threadworm. Both agents are available over the counter and are included in the Nurse Prescribers Formulary (indicated for threadworm only).

Mebendazole is the treatment of choice in adults and children older than two years. It is usually given as a single oral dose, but may need to be repeated after two or three weeks if reinfestation occurs. Mebendazole acts by inhibiting the uptake of glucose by the worms, causing immobilisation and death. It is largely unabsorbed so systemic side effects are minimal. Transient abdominal pain and diarrhoea can occur if a large number of threadworms is present.

Piperazine is licensed for adults and children over three months of age. Piperazine blocks the neurotransmitter acetylcholine in the worm, leading to paralysis. In one OTC product (Pripsen), it is combined with senna. The product is given in two doses, 14 days apart. The senna helps the host to expel the worms. Piperazine is generally well-tolerated but it is systemically absorbed and can, on rare occasions, be neurotoxic with symptoms ranging from headache and inco-ordination (known as "worm wobble") to epileptic seizures.

All members of a household should be treated simultaneously unless contraindicated. This is important because asymptomatic infestation is common, and person-to-person transmission of threadworm is possible through handling of contaminated food, clothing and bed linen. Pharmacists should stress that effective treatment also includes good hygiene measures because the anthelmintics have no effect on threadworm eggs, which can remain viable for up to two weeks on clothing, bedding and carpets. Without such measures, reinfestation can be difficult to avoid, especially in children. Hygiene measures need to be introduced on the day that the first dose is taken and should be continued for two weeks.

Children who are diagnosed with threadworm infestation do not need to be kept away from school. If the hygiene measures are

Panel 3: Hygiene practices for the non-drug treatment of threadworms

Every member of the household must:

- Wear close-fitting underpants at night
- Have a bath or shower and wash around the anus immediately on rising
- Change and wash underwear, nightwear and, if possible, bed linen and towels each day (avoid shaking them because this also spreads eggs)
- Avoid sharing towels and flannels
- Keep fingernails short
- Wash hands and scrub under the nails first thing in the morning, after using the toilet or changing nappies, and before eating or preparing food
- Keep toothbrushes in a closed cupboard, and rinse them well before use
- Avoid eating food in the bedroom because of the higher risk of exposure to eggs

Adapted from Prodigy

implemented they will not be able to pass the infestation on to others. Threadworm infestation can generally be avoided by teaching children to wash their hands after using the toilet and before eating.

Soil-transmitted helminths

Roundworms, hookworms and whipworms are sometimes collectively described as soil-transmitted helminths (STH) because they can be acquired from soil contaminated with human or animal faeces. These worms cannot complete their life cycle in humans — fertilised eggs need to mature in soil before the parasites are able to infest a new host. STHs tend to be prevalent in areas of poor sanitation. They are not endemic in the UK and infestations are usually picked up overseas. Between October and December 2005, 15 cases of roundworm infestation, four cases of whipworm and six cases of hookworm were reported in the UK.

Roundworms and whipworms are acquired by ingesting the eggs, usually on unwashed vegetables or directly from unwashed hands.

Roundworms Roundworms look similar to earthworms (see Figure 1) but mature females can be up to 30cm long and live for up to two years, releasing 200,000 eggs per day. Roundworm eggs hatch in duodenum and the larvae enter the circulation and migrate to the lungs. They penetrate the alveoli, causing mild irritation, which results in them being coughed up and then swallowed. When they reach the small intestine, they develop into adult worms. It takes between 60 and 70 days from the ingestion of eggs to the first passage of new eggs in the stools. The worm cannot complete its life cycle inside the human host and a heavy infestation results from the ingestion of many eggs not the multiplication of worms in the gut.

Mild infestations can be asymptomatic and the infestation is often only discovered when adult worms are excreted via the rectum or vomited. In the early stages of infestation, migration of the larvae can cause a pneumonitis (Löffler's syndrome) that is characterised by fever, cough, sputum, dyspnoea, eosinophilia,



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Figure 1: *Ascaris lumbricoides* is the largest of the human intestinal parasites



Dr P Marazzi/ Science Photo Library

Figure 2: animal hookworms can accidentally infest humans

and an abnormal lung X-ray. This stage usually last two to three weeks. Heavy infestation can cause colic and diarrhoea and, occasionally, intestinal obstruction due to a mass of worms occurs.

The diagnosis of roundworm infestation is made by microscopic detection of eggs in the stool or the recovery of an adult worm. The drug of choice for roundworm infestation is levamisole, which is given as a single dose of 120–150mg, available on a named patient basis. Alternative options are mebendazole or piperazine.

Whipworms Whipworms are 3–5cm long, and are so-called because of their whip-like appearance (the front end of the worm is thinner than the posterior end). Adult worms live in the caecum and ascending colon where they are embedded in the mucosa. They release up to 20,000 eggs per day and live for up to three years. Mild infestations are asymptomatic but heavy infestations can cause abdominal pain, diarrhoea and anaemia.

Whipworm infestation is diagnosed by the detection of eggs in the stool on microscopic examination. Whipworm can be treated with mebendazole at a dose of 100mg twice daily for three days.

Hookworms The first recorded outbreak of hookworm in the UK occurred in Cornish tin miners in 1902. Hookworms (*Necator americanus* or *Ancylostoma duodenale*) can reach about 1.3cm in length and are acquired when the tiny larvae burrow through skin, usually on the feet. This can cause a temporary stinging and itching and may cause a rash. The larvae enter the circulation and when they reach the lungs, they are coughed up and swallowed. Once in the small intestine they attach themselves to the mucosa where they feed on blood and tissue fluids. Adult worms can move to different attachment sites. Depending on the species, hookworms can produce up to 30,000 eggs per day and can live for up to three years. Heavy infestations can cause abdominal pain, anaemia and growth retardation in children.

Hookworm infestation is diagnosed by microscopic analysis of stool samples for eggs. The infestation can be treated with mebendazole at a dose of 100mg twice daily for three days. A project is currently under way to develop a vaccine for hookworm.

Cutaneous larva migrans (also known as “the creeping eruption”) is usually caused by the animal hookworm, *Ancylostoma braziliense*. This nematode affects cats and dogs in warm, moist climates and is not usually a problem in the UK — humans are accidental hosts. Like human hookworm, the larva penetrates the skin but is then unable to penetrate the basement membrane and so is confined to the epidermis. Typical lesions are snake-shaped, raised erythematous tracks (see Figure 2) that are intensely itchy. They can occur on the feet, buttocks, hand or knees, depending on where the larva first entered the skin. Tiabendazole is the treatment of choice for a single track. Ivermectin or albendazole can also be used.

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Panel 4: Uses for worms in medicine?

Research is beginning to suggest that helminths might hold the key to more effective management of a number of common conditions. Many people with worm infestations are asymptomatic and it appears as if their immune systems have learnt to tolerate their presence. Investigators have shown that established helminth infestations are associated with down-modulation of the immune system.¹ This appears to work through effects on regulator T-cells (the cells that are responsible for stopping the immune system from attacking the body's own proteins and for preventing it from attacking harmless environmental molecules).

In recent decades there has been a considerable rise in the incidence of allergic diseases, such as asthma and hay fever, and diseases with an auto-immune element, such as diabetes and inflammatory bowel disease. This pattern has been seen in Western countries, where worm infestation is now rare compared with developing countries. The low prevalence of human helminth infestations in the developed world is a relatively recent phenomenon — on an evolutionary timescale, infestation with parasites is the normal human condition.

These observations gave rise to the hypothesis that it might be possible to treat some auto-immune diseases by deliberately dosing patients with helminths that would bring about a down-regulation of immune activity. The thinking behind much of this work is that if the molecules which worms produce that influence regulatory cell activity could be identified and their modes of action elucidated, new drugs could be designed to combat diseases that involve over-active immune responses.

Ulcerative colitis In a recent randomised controlled trial, eggs from the pig whipworm, *Trichuris suis*, were used to treat patients with ulcerative colitis. *T. suis* can infect people, but does not develop properly or cause disease. After 12 weeks, 13 out of 30 patients (43.3 per cent) treated with worm eggs reported an improvement in symptoms, compared with four out of 24 patients (16.7 per cent) given placebo. No patients reported any side effects. The authors concluded that *T. suis* eggs should, therefore, be considered as a possible treatment for inflammatory bowel disease. A firm in Germany has developed a product called TSO (short for *T. suis* ova) for this purpose.²

Diabetes Other researchers have shown that mice bred to develop type 1 diabetes do not do so if they are infected with the eggs of schistosome parasites.³

Hay fever Researchers based in the school of pharmacy at Nottingham University are investigating the effects of mild hookworm infestation on hay fever. In this study, each participant is given 10 hookworm larvae (research has shown that infestation at this level is largely asymptomatic). Participants will be given a dose of a suitable anthelmintic at the end of the study.⁴

Liquid nitrogen cryotherapy applied to the progressive end of the larval burrow has also been suggested.

Prevention of STH infestations STH infestations can be prevented by avoiding areas where the soil or sand might be contaminated with human or animal faeces, wearing shoes to avoid hookworm larvae, avoiding unwashed vegetables and careful handwashing. Children should not play in grounds that may be contaminated. In areas where STHs are endemic, risks are reduced by good sanitation.

Tapeworms

Tapeworms are hermaphroditic worms that attach to the intestines of vertebrates. The beef tapeworm and the dwarf tapeworm are most commonly seen in the UK. About 40 cases per year of each are reported to the Health Protection Agency. The pork tapeworm and fish tapeworm are rarely seen. Tapeworms are now rare in Western Europe but endemic in Eastern Europe and in developing countries.

Tapeworms have a head (scolex) that attaches to the host's gut, and a chain of flat

segments (proglottids) forming the body. Each proglottid contains both male and female reproductive organs and forms by budding off at the beginning of the chain behind the head. Eggs are released from the terminal proglottid after it breaks away from the body and is excreted in the faeces.

The definitive host for the beef tapeworm is human but cattle are intermediate hosts. If the feed or grazing of cattle is contaminated with human faeces they can become infested. In the animal's intestine eggs hatch, invade the intestinal wall and migrate to striated muscles, where they develop into cysts (cysticerci). A cysticercus can survive for several years in the animal. Beef tapeworms are acquired by eating raw or undercooked beef which contains cysticerci. The wall of the cysticercus is digested and a new scolex attaches itself to the wall of the new host's small intestine and begins to grow. The beef tapeworm can reach five metres in length with 1,000 proglottids. Proglottids break off at the rate of about six per day and are excreted.

Tapeworm infestations can be asymptomatic. Some people will experience nausea and pain in the upper abdomen and altered appetite. Anal itching is frequently present and emerging proglottids may be found. Beef tapeworm infestation is diagnosed by detecting eggs in faeces or perianal swabs.

The dwarf tapeworm is smaller than the other species (~40mm with 150–200 proglottids) and only causes problems with a heavy worm burden. It is passed between humans by oral-faecal contact without an animal intermediary. Auto-reinfestation is also possible. Infestation is usually more common in children than adults. It is diagnosed by detecting eggs in the faeces.

The treatment of choice for taenia infestations is a single 2g dose of niclosamide. Praziquantel is as effective as niclosamide and is given as a single dose of 10–20mg/kg after a light breakfast or a single dose of 25mg/kg for dwarf tapeworm.

Action: practice points

Reading is only one way to undertake CPD and the Society will expect to see various approaches in a pharmacist's CPD portfolio.

1. Would you recommend an OTC treatment for a six-year old with an "itchy bottom" but no sighting of worms? Discuss with a colleague.
2. Make sure pharmacy staff know what advice to give when selling an OTC anthelmintic.
3. Are OTC anthelmintics suitable for breastfeeding women? Find the relevant information in the British National Formulary.

Evaluate

For your work to be presented as CPD, you need to evaluate your reading and any other activities.

Answer the following questions: What have you learnt? How has it added value to your practice? (Have you applied this learning or had any feedback?) What will you do now and how will this be achieved?

References

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