Hookworm, *Ancylostoma* species, is more localised in Africa than *Ascaris* and *Trichuris* infections. Some communities are heavily infested, while other communities, although close, are not. Specific soil types in areas of heavy rainfall promote the survival and infectivity of the larvae and the adult parasite is long-lived, allowing maintenance of individual infection for many years without re-infection.

The 2 species that cause disease in people are *Ancylostoma duodenale* and *Necator americanus*, the latter being more prevalent overall. However, the medically relevant difference between them is that *A. duodenale* causes more morbidity at a smaller worm load. Humans become infected by walking barefoot in contaminated soil, which is often contaminated when night soil is used as fertilizer. Eating unwashed vegetables can result in *A. duodenale* infection. The larvae penetrate the skin or enter the intestine. If they are acquired through the skin, they migrate to the lungs through the small blood vessels, are coughed up, swallowed and pass to the intestine where they mature. Fertile eggs are passed in the faeces and hatch in soil.

**Clinical features**

**Ground itch – larval invasion**

A local dermatitis, called ground itch, is associated with larval invasion. In the case of an intense itch along with a serpiginous inflamed area that moves a few centimetres each day, the most likely organism is the dog hookworm, *A. brasiliense*. This will not survive in a person and is self-limiting, but will respond to thiabendazole in a steroid ointment. Ground itch is more transient and is not common among local African children. Larval invasion of the lungs causes cough.

**Anaemia**

Infection by the adult worm is chronic, leading to anaemia as the adult worms attach to the mucosa of the small intestine and suck the host’s blood. Heavy infestation can account for as much as 200 ml blood loss a day. In children the anaemia is cumulative and is hypochromic and microcytic. Nutritional deficiencies lead to oedema, hypalbuminaemia and growth failure but are not specific to hookworm infestation. Zinc, folate and vitamin A deficiency are likely to be found in children in communities infested with hookworm. Anaemia particularly affects adult men who do not have access to health services and who may progressively lose physical fitness without realising that they are ill. Heart failure is a later sign. Women are more likely to be recognised as anaemic in pregnancy, which may lead to diagnosis of their helminth infection. However, the anaemia is itself a significant cause of morbidity and mortality in pregnancy.

**Diagnosis**

This is done using stool microscopy and eggs can be quantified per gram of stool, provided the stool is examined within a few hours of collection, as the eggs are fragile.

**Treatment**

Mebendazole and albendazole are effective. The dose of mebendazole is 100 mg twice daily for 3 days or, in mass treatment, 500 mg as a single dose. The dose of albendazole is 200 mg twice daily for 3 days, or 400 mg at night as a single dose.

**Pinworm, Enterobius vermicularis, is a nematode.** The worms are small, white and thread-like. The female is about 10 mm long and larger than the male. They live on intestinal content in the large bowel and the female comes out of the anus at night and sheds sticky eggs. Perianal itching leads to scratching and the infective eggs re-infect the host or cross-infect other children in the family or at school. The eggs also survive in dust if it is not too dry. Fortunately, although common, pinworm infestation is not of major medical importance. It is also not associated with poverty and can occur in any family or school.

**Clinical features**

These are classically itching around the anus at night, which can disturb sleep. Forward migration of the female worms in young girls can lead to inflammation of the vulva and introitus, resulting in discharge and secondary bacteriosis.

**Diagnosis**

Sticky tape placed over the anus at night is peeled off onto a glass slide in the morning showing the eggs, although treatment is usually given on history alone.

**Treatment**

The parasite is sensitive to mebendazole and albendazole and single doses will kill the adults. It is a good idea to treat all children in the household and to repeat several times because embryonated eggs on host or sibling may escape.
**Whipworm**

The whip-shaped *Trichuris trichiura* is about 4 cm long. One end lies in the colonic mucosa in superficial tunnels, while the other end is free in the lumen where both copulation and egg release occur. The eggs are passed in the stool, embryonate in the soil and become infectious. When ingested by a person, the larva is released into the stomach and passes into the intestine where it penetrates the epithelium in the caecum and the larvae mature. The females can produce up to 20,000 eggs in a day and the adults live for between 1 and 3 years. *Trichuris* eggs survive well in soil contaminated with human faeces and often co-exists with *Ascaris*. Co-infections in a single host are also common and in some communities nearly 100% of stools contain the eggs. Children are more intensely infected and worm burdens of several thousand involve the terminal ileum, the whole colon and the rectum.

**Clinical features**

Intense infections are associated with geophagia, frequent mucoid stools often with frank blood, rectal prolapse, extreme hypochromic, microcytic anaemia comparable to that with hookworm infection, stunted growth and delayed development and clubbing of the fingers. Low intensity infections are usually asymptomatic.

**Diagnosis**

Robust eggs are found in the stool and are easy to recognise under the microscope.

**Treatment**

*Trichuris* is more resistant to treatment than *Ascaris* and hookworm, although albendazole and mebendazole are highly and equally effective. But, single-dose treatment is unlikely to clear the infection. The dose of mebendazole is 100 mg twice daily for 3 days and albendazole 200 mg twice daily for 3 days. It is a good idea to re-treat symptomatic children every 3 months.

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