

Strongyloides: A Neglected Tropical Disease

The disease caused by *Strongyloides stercoralis* has been declared by the World Health Organisation a Neglected Tropical Disease. This is a hidden disease. There are many infected people who have suffered ill health for years before being diagnosed (Anning 2001, Sheorey 2003). Others have had ineffective treatment, and the possibility of *Strongyloides* as the cause of their current symptoms was not considered (Lim & Biggs 2001). There is a mistaken belief among health professionals that *Strongyloides* lives and reproduces indefinitely in the soil. In fact, there is a maximum of one life cycle in the soil, and a maximum survival in the soil of 3 weeks after contamination by faeces from an infected person, even in ideal conditions.

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1. Strongyloides are present in many parts of the world including Aboriginal and non-Aboriginal Australia.

Strongyloides stercoralis are tiny parasitic worms that infect many Aboriginal people who live in the northern two-thirds of Australia (Jones 1980, Prociv & Luke 1993, Flannery & White 1993, Sampson et al 2003, Van Ingen 2003, Adams et al 2003, Page et al 2006, Einsiedel et al 2014, Shield et al 2015). Although the disease affects primarily Aboriginal people, it also affects non-Aboriginal people such as workers in Aboriginal communities (Soulsby et al 2012), co-residents of places with an Aboriginal population (Eager 2012) and "grey nomads" (Beaman 2015). The infective worms are found in or near faeces from infected people. When the infective worms get on to the skin, they burrow through the skin and cause a disease called strongyloidiasis (Speare 2003). This disease can be diagnosed and cured (Page et al 2006), but because its symptoms mimic those of other diseases, strongyloidiasis is often not recognized (Lim & Biggs 2001). A person with Strongyloides whose immunity is impaired is in danger of dying (Scowden et al 1978, Grove 1989, Byard et al 1993, Hansman 1995, Speare et al 2003). Under those circumstances, the worms multiply rapidly, invade any part of the body and overwhelm the patient (Speare 2003). Secondary bacterial infection increases the intensity of the illness (Grove 1989, Speare et al 2003). If such patients are not promptly diagnosed correctly and given the specific treatment for Strongyloides, they die (Speare 2003).

Strongyloides also affects refugees and immigrants from parts of the world where the disease is endemic (De Silva et al 2002, Rice et al 2003, Einsiedel & Spelman 2006), and ex-servicemen and others who have spent time in these areas of endemicity (Grove, 1981, Pelletier et al 1984, Pattison 2008, Rahmanian 2015).

2. People with Strongyloides remain infected for life unless they get treatment that eliminates all the worms.

People with Strongyloides have the worms until they die, unless they receive effective treatment. Typically, people with Chronic Strongyloidiasis have the disease for decades before being diagnosed and treated (Grove, 1981, Pelletier et al 1984). Their immune system keeps the worms in check but never eliminates the worms (De Silva et al 2002, Rice et al 2003). The adult worms are stunted and their reproductive rate is slow (Speare 2003).

3. Treatment with corticosteroids precipitates severe strongyloidiasis and death unless the patient receives effective treatment in time¹⁰.

60% of deaths due to strongyloidiasis are caused by the administration of corticosteroid drugs to patients with chronic strongyloidiasis (Lim & Biggs 2001, Speare et al 2003). Corticosteroid drugs suppress the component of the immune system that controls *Strongyloides*. When these drugs are present in the body, the adult worms recover and multiply out of control. Other conditions which depress the immune system also lead to severe strongyloidiasis and death if not successfully treated (Speare et al 2003). These conditions include malnutrition (Scowden et al 1978) and HTLV-1 infection (Sato et al 2002, Keiser & Nutman 2004, Einsiedel et al 2014). The duration of the final illness varies from 1 to 90 days with a mean of 14 days (Speare et al 2003).

4. *Strongyloides* spread when a person comes into contact with infective worms in or near faeces from a person with *Strongyloides*.

People get *Strongyloides* when immature infective *Strongyloides* worms touch the skin. They penetrate the skin and enter the body. The infective *Strongyloides* are present in or near faeces from a person with *Strongyloides* (Speare 2003). The infective *Strongyloides* live outside the body for a short time, a few hours or a few days (Schad 1989). They die if they are too hot or too cold or too dry and die within 3 weeks even when the conditions are just right for them (Schad 1989).

People who live in the same household as someone with *Strongyloides* are more likely to have the disease than their neighbours (Lindo et al 1995).

Strongyloides are not transmitted where there are good hygienic facilities and practices (Grove 1982).

5. *Strongyloides* cycle through the body and the soil and also multiply inside people.

Inside the body, *Strongyloides* migrate through the tissues until they reach the small intestine. They burrow into the mucosa where they lay embryonated eggs. The eggs hatch quickly, and the larvae escape into the lumen of the small intestine. Some pass out of the body with the faeces, others develop quickly and penetrate the body through the side of the lower intestine, and migrate through the tissues until they reach the small intestine where they also become adults and reproduce. This is the way *Strongyloides* multiply in the body (Speare 2003).

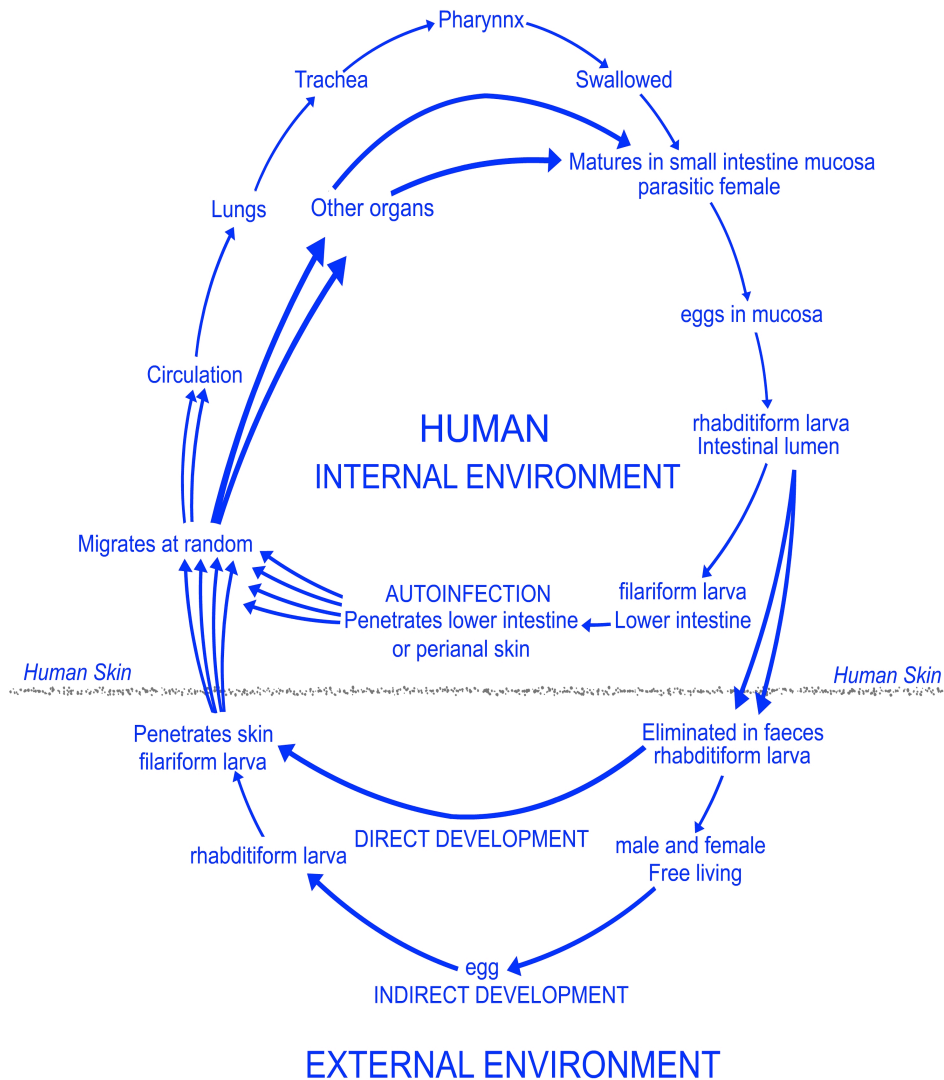
Some of the larvae leave the body with the faeces. Some of these become infective within 24-48 hours, others become adult and complete a single generation in the soil (Yamada et al 1991). All the offspring of the adults become infective larvae. They reproduce again only if they enter a

person through the skin and find their way to the small intestine. The maximum time in the environment from the time of faecal contamination is less than 3 weeks (Speare 2003).

6. Strongyloidiasis is frequently accompanied by secondary infection by gut bacteria.

When *Strongyloides* multiply in the body, the infective larvae carry gut bacteria with them into the body when they penetrate the side of the lower gut, and they take the bacteria with them to any part of the body (Mak 1993). The bacteria may cause pneumonia, meningitis or septicaemia (Grove 1989, Speare et al 2003), or abscesses in the liver or kidneys. Infections in the tissues or blood with species of bacteria that normally live in the gut may indicate an underlying infection with *Strongyloides* (Speare et al 2003).

The Life Cycle of *Strongyloides stercoralis*



7. Symptoms of *Strongyloides* often mimic other diseases.

Intermittent abdominal pain and diarrhoea, itchy skin rashes, and respiratory symptoms are common symptoms of chronic strongyloidiasis. These same symptoms in a more severe form and shock are common symptoms of severe *Strongyloides* disease (Acute Strongyloidiasis and Disseminated Strongyloidiasis or Hyperinfection) (Grove 1989, Speare 2003). *Strongyloides* may cause symptoms in many parts of the body (Grove 1989, Speare 2003), including chronic bronchitis (Mukerjee 2003).

The only symptom that is found only in strongyloidiasis is *larva currens*, a raised linear rash that moves randomly across the skin typically at about 2 cm in an hour (Grove 1989).



8. *Strongyloides* is usually diagnosed by a blood test or a faeces test.

For those people with chronic *Strongyloides* disease a blood test will tell whether they have *Strongyloides*. The blood test is for specific IgG antibodies against *Strongyloides*. A positive test indicates a current infection (Page et al 2006), not a past infection. Stool tests are very insensitive for chronic strongyloidiasis (Conway et al 1995, Dreyer et al 1996), but the sensitivity is improving with the advent of DNA testing using the Polymerase Chain Reaction (PCR) (Verweij 2009).

People who acquired *Strongyloides* recently (Sudarshi 2003, Pattison & Speare 2008), and people with severe disease may not have the antibodies (Speare 2003, Keiser & Nutman, 2004). Their faeces should be examined for *Strongyloides* larvae microscopically and using the agar plate test (Speare 2003, Conway et al 1995). A positive value from any one test indicates *Strongyloides*.

9. Ivermectin is a safe drug (Pacque et al 1989, Pacque et al 1990) and the most effective drug available for *Strongyloides* (Page et al 2006)

Ivermectin 0.2mg/kg is the most effective drug It kills *Strongyloides* in the gut and in the tissues. It is not recommended for children under 15kg or pregnant women. It cures about 80% of patients (Datry et al 1994, Page et al 2006). Albendazole 400mg for 3 days, the standard treatment, cures only about 40% of patients (Datry et al 1994). Two courses of treatment are more effective than one (Page et al 2006).

All the worms must be killed by the treatment, or the remainder will multiply again in the body and reestablish the patent infection (Schad et al 1997, Page et al 2006).

10. Criterion for cure is negative blood test, negative stool test and no symptoms, all three (Archibald et al 1993).

The serum of a person who has been cured becomes negative for *Strongyloides* IgG antibodies by 6 months after treatment. If the test is positive, they still have *Strongyloides* and must be treated again. The process must be repeated until the test is negative and the person has no symptoms (Page et al 2006). Even if the test is negative, if symptoms persist, the person needs retreatment (Archibald et al 1993). If repeated treatment does not kill all the worms, the person must be treated periodically so that only a few worms remain in the body (Satoh et al 2002).

11. Infected people are the reservoir for *Strongyloides* infection. Mass treatment by ivermectin is likely to markedly reduce transmission.

Strongyloidiasis is a preventable disease. Where there is a good water supply and sanitation and good hygienic practices, there is no transmission of the disease (Grove 1982). People are the reservoir for *Strongyloides*. *Strongyloides* live for only a short time outside the body (Galliard 1951). If *Strongyloides* worms are eliminated from everyone in a community at the same time during the dry season, there is a good chance of eliminating it from that group of people (Prociv & Luke 1993). Vigilance should be exercised because infected visitors could reestablish *Strongyloides* in the community.

12. *Strongyloides* results in unnecessary costs to the health system and infected individuals.

Most of the cost of *strongyloidiasis* is borne by the individual sufferer in the form of chronic ill health, loss of earnings, cost and pain of medical investigations, and the psychological pain that is caused by medical practitioners who do not believe their symptoms are real.

There are also hidden costs to the health system as sufferers unsuccessfully seek a diagnosis of their illness. This can include the considerable cost of evacuation of patients from remote communities and the cost of treatment in intensive care for those with the severe form of the disease (Van Ingen 2003, Speare & Durrheim 2004).

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