

# Ankylostomiasis

**Authors: Doctors Antonio Montresor<sup>1</sup> and Lorenzo Savioli**

**Creation date: August 2004**

**Scientific Editor: Professor Hermann Feldmeier**

<sup>1</sup>Vectorborne and other Parasitic Diseases, World Health Organization, 63 Tran Hung Dao Street. Mail P.O. Box 52, Ha Noi - VIET NAM. [montresora@vtn.wpro.who.int](mailto:montresora@vtn.wpro.who.int)

## Abstract

[Disease name / synonyms](#)

[Definition / diagnostic criteria](#)

[Differential diagnosis](#)

[Etiology](#)

[Clinical description](#)

[Diagnostic methods](#)

[Epidemiology](#)

[Management including treatment](#)

[References](#)

## Abstract

*Ankylostomiasis or hookworm infection is an intestinal infection caused by *Ancylostoma duodenale* or *Necator americanus*. Clinical diagnosis is difficult because this infection does not present specific symptoms. The identification of hookworm eggs in the fecal sample during microscopic examination is indicative of the infection. Hookworms are estimated to infect over 1300 million individuals worldwide. The infection has been recognised as an important cause of intestinal blood loss leading to iron-deficiency anaemia (IDA). Ankylostomiasis affects significant part of the population in tropical and subtropical areas because the hygienic and climatic conditions are particularly favourable for the transmission. In developed countries, hookworm infection is rare, however, it can be observed in travellers returning from developing countries or in immigrants. Four drugs are indicated for the treatment of hookworm infections (albendazole, levamisole, mebendazole, pyrantel pamoate). In area of high endemicity, the recommended strategy for disease control is the periodical (once or twice a year) treatment. The same approach is suggested for expatriates from developed countries living temporarily in endemic areas.*

## Keywords

Ankylostomiasis, Hookworms, *Ancylostoma duodenale*, *Necator americanus*

---

## Disease name / synonyms

Hookworm infection / Ankylostomiasis

## Definition / diagnostic criteria

Ankylostomiasis is an intestinal infection caused by one of the two hookworms species (*Ancylostoma duodenale* - *Necator americanus*). Clinical diagnosis is difficult because this infection does not present specific symptoms. The identification of hookworm eggs in the fecal sample during microscopic examination is indicative of the infection.

## Differential diagnosis

The differentiation between hookworm infection and other soil-transmitted helminthiasis (infections from *Ascaris lumbricoides* and *Trichuris trichiura*) is not essential because the therapeutic interventions are the same.

## Etiology

The parasite inhabits the small intestine and reproduces sexually. The fecundated female produces eggs that are passed into human faeces and deposited in the environment. In absence of appropriate sanitation and where climatic conditions are favourable, the eggs of

hookworms hatch in the soil and the resultant larvae reach the status of infective larvae after 2 moults. Infection typically occurs through larval penetration of the skin, but *A. duodenale* can also infect humans orally. Following host entry, the larvae migrate through the vascular system to the pulmonary vasculature and upon entry into capillaries penetrate the lung parenchyma; the larvae then ascend the respiratory tract and are swallowed in the gastrointestinal tract. In the intestine, the larvae develop to the adult stage of the parasite. The time required from the ingestion of eggs or larval penetration to the patent infection is 28-50 days and 40-50 days for *A. duodenale* and for *N. americanus*, respectively. Adult worms may persist in the human gastrointestinal tract for years.

### Clinical description

Acute infection results in mild and transient symptoms that can include itching, cough, fever, epigastric pain and other minor gastrointestinal symptoms. Hookworms cause blood loss through the attachment of cutting organs to the intestinal mucosa and sub-mucosa. The infection has been recognised as an important cause of intestinal blood loss leading to iron-deficiency anaemia (IDA).

In developing countries, women of reproductive age are frequently the ones most vulnerable to hookworm anaemia because of their underlying poor iron status (Bundy *et al.* 1995). There is increasing evidence that hookworm infection also contributes to anaemia in schoolchildren (Stoltzfus *et al.* 1997) and pre-schoolchildren (Brooker *et al.* 1999; Stoltzfus *et al.* 2000). Additional studies conducted throughout the developing world have provided evidence that schoolchildren infected with hookworms and other soil transmitted helminths, perform poorly in tests of cognitive function (Watkins and Pollitt 1997; Sakti *et al.* 1999; Drake *et al.* 2000) and present growth deficits (Stephenson *et al.* 1989; 1990; 1993) that are most pronounced in children with the heaviest infections.

### Diagnostic methods

Microscopic examination of a fecal sample allows the identification of hookworm eggs.

### Epidemiology

Hookworms are estimated to infect over 1300 million of individuals worldwide (WHO 2002). The infection affects significant part of the population in tropical and subtropical areas due to hygienic and climatic conditions that are particularly favorable for worms to complete their life cycle.

In an infected population, hookworms are unevenly distributed in the way that most individuals harbor just a few worms while a few

hosts harbor large worm burdens (Anderson *et al.* 1991). The heavily infected individuals are at the highest risk of disease and the major source of environmental contamination (Bundy *et al.* 1995). Such distribution is probably due to a combination of differences in exposure to infection, in susceptibility and in the ability to mount effective immunity. Age-specific prevalences show a rise in childhood with a plateau in young adults.

In developed countries, hookworm infection is rare, however, it can be observed in travelers returning from developing countries or in immigrants.

### Management including treatment

Four drugs are recommended by the World Health Organization (WHO, 2002) for the treatment of hookworm infections:

- Albendazole 400 mg (single administration)
- Levamisole 40 mg/Kg (single administration)
- Mebendazole 500 mg (single administration) or 200 mg/day for three days
- Pyrantel pamoate 10mg/Kg

In area of high endemicity, the recommended strategy for disease control is the periodical (once or twice a year) treatment. The same approach is suggested for expatriates from developed countries living temporarily in endemic areas. Particular attention should be given to women of childbearing age and children who are considered groups at risk for the morbidity due to hookworms.

Several intervention trials have shown that periodical anthelmintic treatment improves haemoglobin levels in schoolchildren (Stoltzfus *et al.* 1998; Guyatt *et al.* 2001) and pregnant women (Torlesse and Hodges 2001). The other nutritional deficits associated with hookworms and other soil transmitted helminth infections are also reversible (Stephenson *et al.* 1989; 1990; 1993).

The recommended drugs are effective and inexpensive; the ones requiring a single administration are particularly convenient for community administration. These drugs have been through extensive safety testing and have been used in millions of individuals with only few and minor side effects.

### References

- Anderson** RM, May RM. (1991) Infectious Diseases of Humans. Oxford: Oxford University Press
- Brooker** S, Peshu N, Warn PA, Mosobo M, Guyatt HL, Marsh K, Snow RW. (1999) The epidemiology of hookworm infection and its

contribution to anaemia among pre-school children on the Kenyan coast. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 93 (3): 240-246.

**Bundy DA**, Chan MS, Savioli L. (1995). Hookworm infection in pregnancy. *Trans R Soc Trop Med Hyg.* 89:521-522.

**Drake LJ**, Jukes MCH, Sternberg RJ, Bundy DAP. (2000) Geohelminth infections (Ascariasis, trichuriasis, and hookworm): cognitive and developmental impacts. *Semin Pediatr Infect Dis.* 11:245-251

**Guyatt HL**, Brooker S, Kihamia CM, Hall A, and Bundy DA. (2001) Evaluation of efficacy of school-based anthelmintic treatments against anaemia in children in the United Republic of Tanzania. *Bulletin of the World Health Organization* 79 (8):695-703.

**Sakti H**, Nokes C, Hertanto WS, Hendratno S, Hall A, Bundy DA, Satoto. (1999) Evidence for an association between hookworm infection and cognitive function in Indonesian school children. *Trop Med Int Health* 4:322-334.

**Stephenson LS**, Latham MC, Kurz KM, Kinoti SN, Brigham H. (1989) Treatment with a single dose of albendazole improves growth of Kenyan schoolchildren with hookworm, *Trichuris trichiura*, and *Ascaris lumbricoides* infection. *Am J Trop Med Hyg.* 41:78-87.

**Stephenson LS**, Latham MC, Kinoti SN, Kurz KM, Brigham H. (1990) Improvements in physical fitness of Kenyan schoolboys infected with hookworm, *Trichuris trichiura* and *Ascaris lumbricoides* following a single dose of albendazole. *Trans R Soc Trop Med Hyg.* 84:277-282.

**Stephenson LS**, Latham MC, Adams EJ, Kinoti SN, Pertet A. (1993) Physical fitness, growth and appetite of Kenyan school boys with hookworm, *Trichuris trichiura* and *Ascaris lumbricoides* infections are improved four months after a single dose of albendazole. *J. Nutr.* 123:1036-1046.

**Stoltzfus RJ**, Chwaya HM, Tielsch JM, Schulze KJ, Albonico M, Savioli L. (1997) Epidemiology of iron deficiency anemia in Zanzibari schoolchildren: the importance of hookworms. *Am. J. Clin. Nutr.* 65:153-159.

**Stoltzfus RJ**, Albonico M, Chwaya HM, Tielsch JM, Schulze KJ, Savioli L. (1998) Effects of the Zanzibar school-based deworming program on iron status of children. *Am J Clin Nutr.* 68:179-86

**Stoltzfus RJ**, Chwaya HM, Montresor A, Albonico M, Savioli L, Tielsch JM. (2000). Malaria, hookworms and recent fever are related to anemia and iron status indicators in 0- to 5-year old Zanzibari children and these relationships change with age. *Journal of Nutrition* 130:1724-1733.

**Torlesse H**, Hodges M. (2001) Albendazole therapy and reduced decline in Haemoglobin concentration during pregnancy (Sierra Leone) *Transactions of the Trans. R. Soc. Trop. Med. Hyg.* 95:195-201.

**Watkins WE**, and Pollitt E. (1997) "Stupidity or worms": do intestinal worms impair mental performance? *Psychological Bulletin* 121 (2):171-191.

**WHO** (2002). Prevention and control of schistosomiasis and soil-transmitted helminthiasis. Report of a WHO Expert Committee. WHO Technical Report Series 912. Geneva