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Human-specific hookworms

Note: description of *Ancylostoma caninum* (dog hookworm) can be found [here](#).

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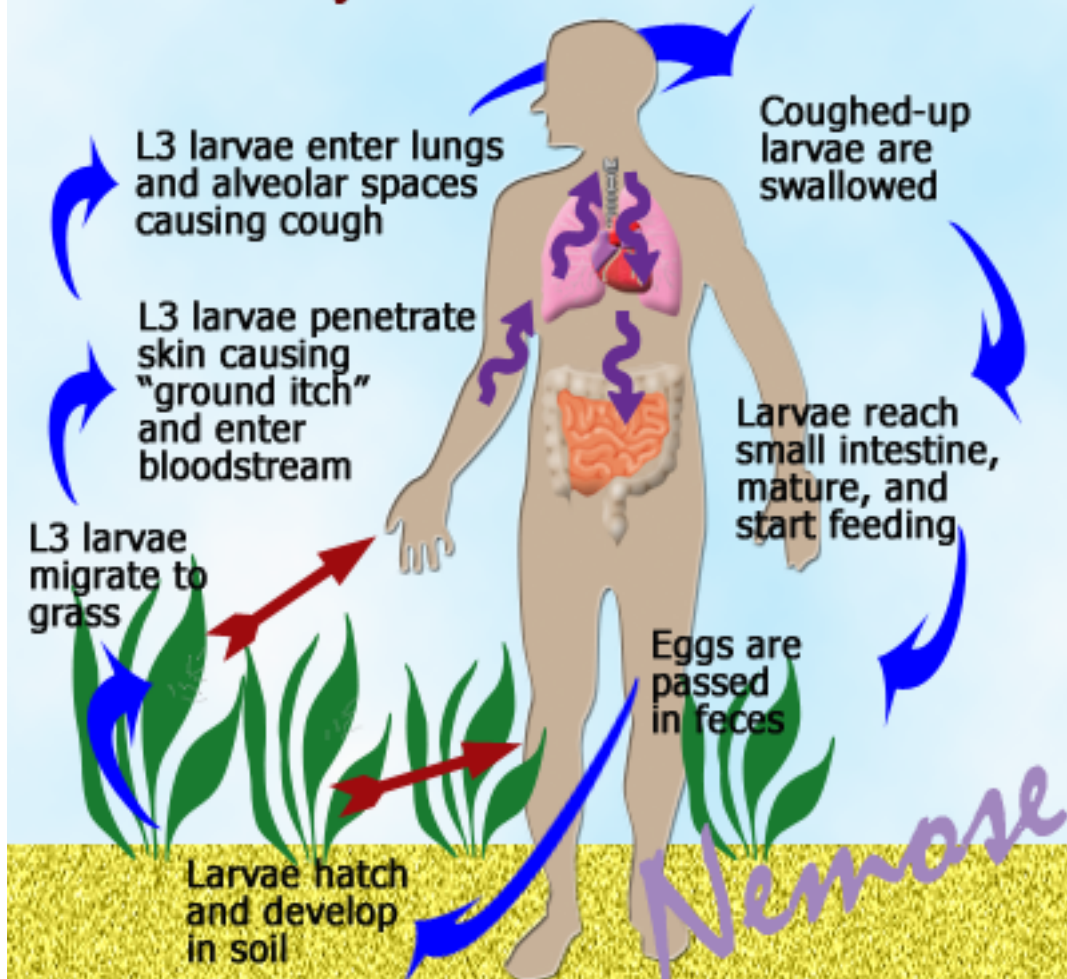
***Ancylostoma duodenale* taxonomy**

cellular organisms - Eukaryota - Fungi/Metazoa group - Metazoa - Eumetazoa - Bilateria - Pseudocoelomata - Nematoda - Chromadorea - Rhabditida - Strongylida - Ancylostomatoidea - Ancylostomatidae - Ancylostomatinae - Ancylostoma - Ancylostoma duodenale

***Necator americanus* taxonomy**

cellular organisms - Eukaryota - Fungi/Metazoa group - Metazoa - Eumetazoa - Bilateria - Pseudocoelomata - Nematoda - Chromadorea - Rhabditida - Strongylida - Ancylostomatoidea - Ancylostomatidae - Bunostominae - Necator - Necator americanus

Life cycle of hookworms



Brief facts

- Together with human roundworms (see *Ascaris lumbricoides* at [MetaPathogen](#)) and whipworms (*Trichuris trichiura*), hookworms belong to a group of so-called **soil-transmitted helminths** that represent one of the world's most important causes of physical and intellectual growth retardation.
- Hookworm infection in humans is usually caused by one of two species of **nematodes** (roundworms) - *Necator americanus* or *Ancylostoma duodenale*. *N. americanus* is most common human-specific hookworm worldwide, distribution of *A. duodenale* is geographically more restricted. Both *N. americanus* and *A. duodenale* are found in Africa, Asia and the Americas. *Necator americanus* predominates in the Americas and Australia, while only *A. duodenale* is

found in the Middle East, North Africa and southern Europe.

- Today, hookworm infection is among the most important tropical diseases in humans with more than 750 million infected people world-wide.
- Hookworm infection is the second most common human helminthic infection (after **ascariasis**).
- The species give similar clinical manifestations of the infection, although *A. duodenale* can lead to a greater blood loss and anemia.
- Infection with *N. americanus* can occur only through skin penetration by L3 larvae. *A. duodenale* can infect humans upon swallowing of the larvae.
- The major clinical symptom of the hookworm infection is iron-deficiency anemia accompanied by other physical signs such as sickly yellowish color of the skin, hypothermia, eosinophilia (high concentration of eosinophils in the blood), abdominal pain, fatigue, and impotence. Children may suffer from stunted growth and mental retardation.
- Intensity and probability of many common helminthic infections, including ascariasis, trichuriasis, and schistosomiasis, usually peak during childhood and adolescence. In contrast, occurrence of the hookworm infection grows with age, with highest intensity in middle-aged persons, or even older.
- Usually the hookworm infection is treated with a single dose of a benzimidazole antihelminthic, such as albendazole or mebendazole. There were troubling reports that the parasites gradually acquire resistance to these drugs.
- **Soil-transmitted helminths do not reproduce within the host: in order to be infective their eggs have to be released into environment where they are embryonated (roundworms, whipworms) or hatch into infective larvae (hookworms). Usually the eggs as well as the larvae do not enter the same host, who released them. This feature is crucial for understanding of the epidemiology and**

methods of control (compare with pinworm, *Enterobius vermicularis*, (pinworm) at MetaPathogen).

Developmental stages (life cycle)

Life Cycle Stages

The life cycles of hookworms species are similar. Parasites are dioecious, with male and female organs in separate individuals. They mate in host's small intestine and the females produce eggs. Following copulation, female lays her eggs.

- **egg**

usual daily output of eggs for single female hookworm is between 10,000 and 30,000 eggs; eggs are passed to the environment with feces

- **rhabditiform larva**

- **rhabditiform larva 1 (L1)**

rhabditiform larvae hatch from eggs in a warm soil (~48 hours); it feeds on bacteria and other microorganisms

- **rhabditiform larva 2 (L2)**

rhabditiform larvae first stage molt to rhabditiform larvae second stage by third day

- **filariform larva (L3)**

rhabditiform larva second stage molts to filariform larva (L3); this is infectious non-feeding stage of the hookworm; the larvae migrate to the grass blades and

"stand up" on their tails ready to stick to the passing host; the larvae survive for several week without feeding until they exhaust their metabolic reserves; they adhere to the host on contact and penetrate skin causing so-called "ground itch"

- **immature adult**

swept by blood stream L3 larvae in about 10 days after entry reach the heart and then, lungs, where they rupture capillaries and ascend the alveoli, bronchioles, bronchi, and trachea; the host coughs up the larvae and swallows them; when the larvae reach the small intestine, they settle, start feeding, and undergo two additional moltings

- **mature adult**

after 2 moltings the parasites mature into adults and mate; intestinal blood loss begins just before egg production and continues for the life of the worm (up to 5 years); to ensure blood flow, adults release anticlotting agents (the agents were isolated and applied in therapeutics to block blood coagulation in several diseases); adult females: 10 to 13 mm (*A. duodenale*), 9 to 11 mm (*N. americanus*); adult males: 8 to 11 mm (*A. duodenale*), 7 to 9 mm (*N. americanus*)

References

PubMed articles

- Hotez PJ et al. Hookworm infection. *N Engl J Med.* 2004 Aug 19; 351(8): 799-807. **PMID: 15317893**
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Websites

- **eMedicine: Ancylostoma Infection**
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