

## ASCARIS LUMBRICOIDES

Kingdom:	<a href="#">Animalia</a>
Phylum:	<a href="#">Nematoda</a>
Class:	<a href="#">Chromadorea</a>
Order:	<a href="#">Ascaridida</a>
Family:	<a href="#">Ascarididae</a>
Genus:	<a href="#">Ascaris</a>
Species:	<i>A. lumbricoides</i>



*Ascaris lumbricoides* The number of people in the world with *Ascaris* is probably second only to those infected with the pinworm, *Enterobius vermicularis*. *Ascaris* was well known in Roman times as *Lumbricus teres* (confused with the common earthworm) and has probably been infecting humans for thousands of years. It is prevalent in moist, warm climates, but can also survive in the temperate zones.

*Ascaris* species are very large (adult females: 20 to 35 cm; adult males: 15 to 30 cm) nematodes (roundworms) that parasitize the human intestine. *A. lumbricoides* is the primary species involved in human infections globally.

The adult worms are cylindrical, with a tapering anterior end. They are the largest of the common nematode parasites of humans; females measure 20 to 35 cm long and the males are 15 to 31 cm long, with a curved posterior end. Also, the three well developed lips are characteristic of this group.

Infection in humans is acquired through ingestion of the embryonated eggs from contaminated soil. On ingestion, the eggs hatch in the stomach and duodenum, where the larvae actively penetrate the intestinal wall; they are then carried to the right heart via the hepatic portal circulation.

Then the larvae are carried into the pulmonary circulation, where they are filtered out by the capillaries. After approximately 10 days in the lung, the larvae break into the alveoli, migrate via the bronchi until they reach the trachea and pharynx, and are then swallowed.

The worms then mature and mate in the intestine, with the eventual production of eggs which are passed in the stool. The entire developmental process from egg

ingestion to egg passage from the adult female takes from 8 to 12 weeks. During her life span, egg deposition may reach a total of 27,000,000 eggs.

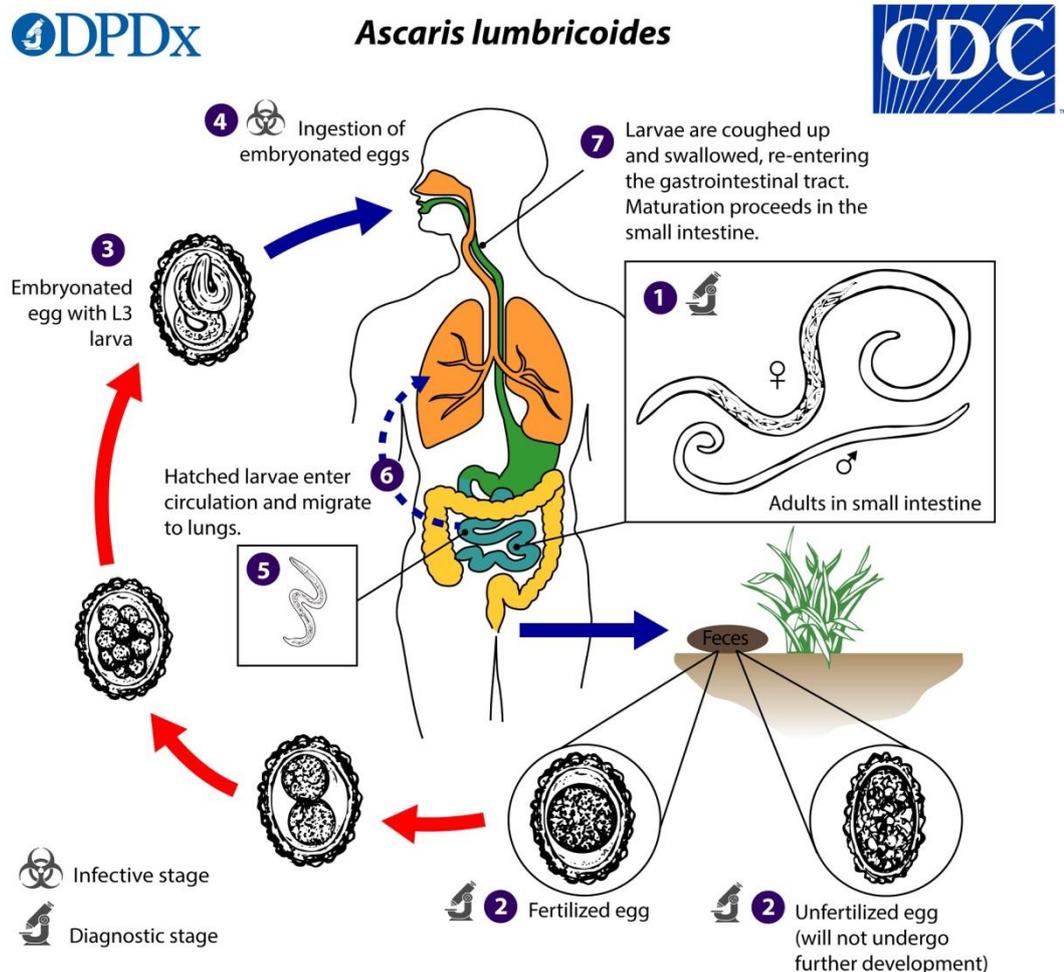
Both unfertilized and fertilized eggs are passed. Often only female worms are recovered from the intestine. Fertilized eggs will become infective within 2 weeks if they are in moist, warm soil where they may remain viable for months or even years.

The fertilized egg is broadly oval, with a thick, mammilated coat, usually bile-stained a golden brown. These eggs measure up to 75  $\mu\text{m}$  long and 50  $\mu\text{m}$  wide.

Unfertilized eggs are usually more oval, measure up to 90  $\mu\text{m}$  long, and may have a pronounced mammilated coat or an extremely minimal mammilated layer.

Often both types of eggs are found in the same stool specimen. The total absence of fertilized eggs means only female worms are present in the intestine.

## LIFE CYCLE



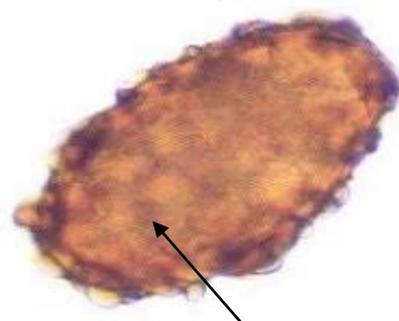
Adult worms **1** live in the lumen of the small intestine. A female may produce approximately 200,000 eggs per day, which are passed with the feces **2**. Unfertilized eggs may be ingested but are not infective. Larvae develop to infectivity within fertile eggs after 18 days to several weeks **3**, depending on the environmental conditions (optimum: moist, warm, shaded soil). After infective eggs are swallowed **4**, the larvae hatch **5**, invade the intestinal mucosa, and are carried via the portal, then systemic circulation to the lungs **6**. The larvae mature further in the lungs (10 to 14 days), penetrate the alveolar walls, ascend the bronchial tree to the throat, and are swallowed **7**. Upon reaching the small intestine, they develop into adult worms. Between 2 and 3 months are required from ingestion of the infective eggs to oviposition by the adult female. Adult worms can live 1 to 2 years.



Adults



Fertilized egg



Unfertilized egg

## **CLINICAL DISEASE**

Pathogenesis caused by *Ascaris* infections is attributed to

- (1) The host's immune response,
- (2) Effects of larval migration
- (3) Mechanical effects of the adult worms, and
- (4) Nutritional deficiencies due to the presence of the adult worms.

Although the initial passage of larvae through the liver and lungs usually elicits no symptoms, there can be signs of pneumonitis if the number of larvae is quite large.

When the larvae break out of the lung tissue and into the alveoli, there may be some bronchial epithelium damage. With reinfection and subsequent larval migrations, there may be intense tissue reactions, even with small numbers of larvae.

There may be pronounced tissue reaction around the larvae in the liver and lung with infiltration of eosinophils, macrophages, and epithelioid cells. This has been called *Ascaris* pneumonitis and is accompanied by an allergic reaction consisting of dyspnea, a dry or productive cough, wheezing or coarse rales, fever (39.9-40.0°C), transient eosinophilia, and a chest x-ray suggestive of viral pneumonia and a couple of weeks, associated with peripheral eosinophilia is frequently called Loeffler's syndrome.

In addition to eosinophils and Charcot-Leyden crystals, the sputum may also contain larvae. Asthma and urticaria may continue during the intestinal phase of ascariasis.

The presence of the adult worms in the intestine usually causes no difficulties unless the worm burden is very heavy; however, due to the tendency of the adult worms to migrate, even a single worm can cause serious sequelae.

Worm migration may occur as a result of stimuli such as fever (usually over 38.9°C), the use of general anesthesia, or other abnormal conditions. This migration may result in intestinal blockage; entry into the bile duct, pancreatic duct, or other small spaces; or entry into the liver or peritoneal cavity.

They can also migrate out of the anus or come out the mouth or nose. Other body sites have been involved such as the kidney, appendix, or pleural cavity. In children, particularly those under the age of 5, there may be severe nutritional impairment related to the worm burden. Directly measurable effects would include increased fecal nitrogen and fecal fat, and impaired carbohydrate absorption, all of which would return to normal with elimination of the adult worms. Worms can also be spontaneously passed without any therapy.

## **LABORATORY DIAGNOSIS**

1. Both fertilized and unfertilized eggs can easily be recovered using the sedimentation concentration. (Unfertilized eggs will not float using zinc sulfate flotation concentration.)
2. Because of the potential problems caused by migration of the adult worms, patients who are undergoing elective surgery and general anesthetic should be checked for the presence of *Ascaris* if there is any possible exposure history (some anesthetics stimulate the worms to migrate). Usually a single stool examination will suffice to rule out the infection.
3. Larvae could be recovered from sputum (larval migration through the lungs); however, this is not a common finding.
4. Eggs may be very difficult to recognize on a permanent stained smear. They will usually be very darkly stained and may be mistaken for debris. Epidemiology and Prevention Since the ultimate transmission of ascariasis depends on fecal contamination of the soil, the use of appropriate sanitary facilities is the primary means of prevention.

There are apparently no practical means of killing the eggs while they are in the soil, especially when they are in clay soil with good environmental conditions (warmth, moisture). In some areas of the world where infections are common, some mass population treatment plans have been used with great success, even in areas with high reinfection rates. The use of human feces, or "night soil," for fertilization of crops should be recognized as a potential hazard. Any vegetables or fruits cannot be eaten raw or unprocessed from such fields. Even with proper pretreatment of night soil, *Ascaris* eggs remain viable and infective more often than eggs of any other helminthes species.

## **SYMPTOMS/PATHOLOGY**

Infection with *Ascaris lumbricoides* often causes no symptoms. Infections with a large number of worms may cause abdominal pain or intestinal obstruction. Adults feed on the contents of the small intestine and in heavy infections this may compound problems in malnourished individuals (especially children).

Migration of larvae may cause localized reactions in various organs. Penetration of the larvae from capillaries into the lungs can lead to Loeffler's pneumonia, in which pools of blood and dead epithelial cells clog air spaces in the lungs. Resulting bacterial infections can be fatal.