

# Medical Parasitology and Entomology



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# คำนำ

ปัจจุบันการติดเชื้อปรสิตยังเป็นปัญหาสาธารณสุขที่สำคัญ มีจำนวนผู้ป่วยเพิ่มขึ้นทุกปี อีกทั้งการติดเชื้อปรสิตชนิดใหม่ ๆ มีรายงานเพิ่มขึ้นทั่วโลก ทั้งในประเทศที่กำลังพัฒนาและประเทศที่พัฒนาแล้ว การตรวจวินิจฉัยและการรักษาผู้ป่วยให้ได้ทันที่จึงมีส่วนสำคัญในการดูแลสุขภาพผู้ป่วยและป้องกันการแพร่ระบาดในชุมชน หนังสือ “Medical Parasitology and Entomology” เล่มนี้ ผู้เขียนได้รวบรวมและสรุปข้อมูลที่สำคัญของปรสิตที่ติดต่อสู่คน เพื่อช่วยในการวินิจฉัยและดูแลรักษาผู้ป่วย โดยแบ่งเนื้อหาเป็น 5 บท คือ 1) พยาธิตัวกลม 2) พยาธิตัวดีด 3) พยาธิใบไม้ 4) โปรโตซัว และ 5) กิจุวิทยาทางการแพทย์ เนื้อหาในแต่ละบทผู้เขียนได้สรุปเป็นภาษาอังกฤษ เพื่อให้ง่ายต่อการใช้ศัพท์ทางการแพทย์ และจัดเป็นหมวดหมู่ในหัวข้อที่สำคัญ เช่น วงจรชีวิต อาการแสดงของผู้ป่วย การตรวจวินิจฉัย การรักษา แหล่งแพร่ระบาดของเชื้อ และได้บรรยายลักษณะเด่นของเชื้อแต่ละชนิดเพื่อช่วยในการตรวจแยกชนิดปรสิต นอกจากนี้ผู้เขียนได้รวบรวมคำศัพท์ที่สำคัญไว้ท้ายเล่ม โดยบรรยายเป็นภาษาไทย เพื่อให้ง่ายต่อการค้นคว้าและทำความเข้าใจ ผู้เขียนได้จัดทำภาพประกอบทั้งภาพวาดและภาพถ่ายจำนวน 151 ภาพ จัดพิมพ์เป็นภาพสีคมชัด ทำให้ง่ายต่อการศึกษาเปรียบเทียบรายละเอียดของปรสิตแต่ละชนิด จึงหวังเป็นอย่างยิ่งว่าหนังสือเล่มนี้ จะเป็นประโยชน์สำหรับแพทย์ นักเทคนิคการแพทย์ และพยาบาล ใช้ในการดูแลรักษาผู้ป่วย และเหมาะสำหรับการศึกษาค้นคว้าของนักศึกษาในสาขาวิชาวิทยาศาสตร์การแพทย์

ผู้เขียนขอขอบคุณบุคลากรหน่วยจุลทรรศนศาสตร์คลินิก ภาควิชาพยาธิวิทยา คณะแพทยศาสตร์มหาวิทยาลัยสงขลานครินทร์ ที่ช่วยเก็บตัวอย่างจากผู้ป่วย ขอขอบคุณหัวหน้าภาควิชาพยาธิวิทยา คณาจารย์ และผู้ร่วมงานทุกท่านที่ให้การสนับสนุนและเป็นกำลังใจให้ผู้เขียน

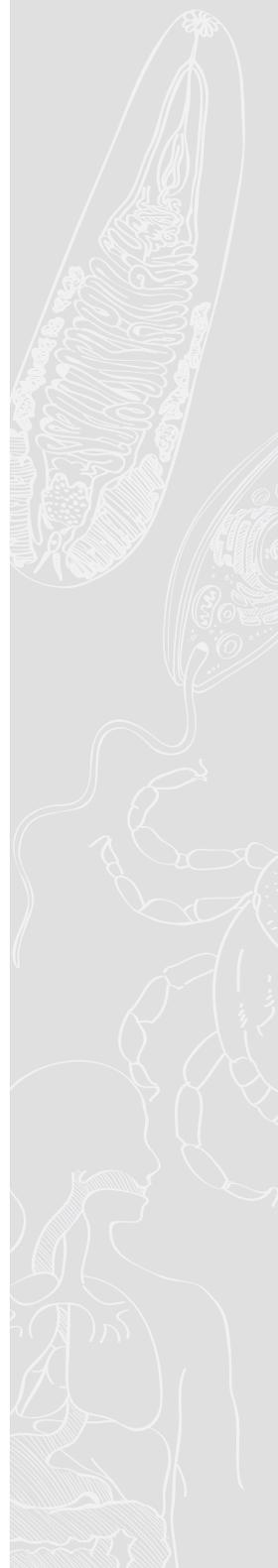
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ชวดี นพรัตน์

# Preface

Parasitic infection is still a major global health problem. The number of patients is increasing every year. The new type of infection has been also reported worldwide, especially in developing countries both in tropical and sub-tropical areas. Early diagnosis and treatment of the infection is an important part of health care. It is not only critical for preventing morbidity and mortality individually but also for reducing the risk of spread of infection in the community. In this book “Medical Parasitology and Entomology”, the authors have compiled and summarized the key information of parasites of medical importance to provide the guide for diagnosis and management of the infection. The content is divided into five chapters: 1) Nematodes (roundworms), 2) Cestodes (tapeworms), 3) Trematodes (flake), 4) Protozoa, and 5) Medical entomology. In each chapter, the content has been grouped and organized into categories such as the life cycle, clinical features, diagnosis, treatments, distribution, and described the characteristics of each type of infection to help specific identification of the parasites. At the end of this book, the glossary of medical terms with their definitions in Thai language has been included to make it easier to study and understand. The authors have prepared the drawings and photographs of about 151 pictures printed in full color to aid in comparison the details of each type of the parasites. It is hoped that this book is useful for physicians, medical technicians and nurses in patient care and for the study of students in the field of medical science.

The authors would like to thank the staff of Division of Clinical Microscopy, Department of Pathology, Faculty of Medicine, Prince of Songkla University for providing the patient’s samples. Thanks to the head of Department of Pathology and the colleagues for all their supports and encouragements.

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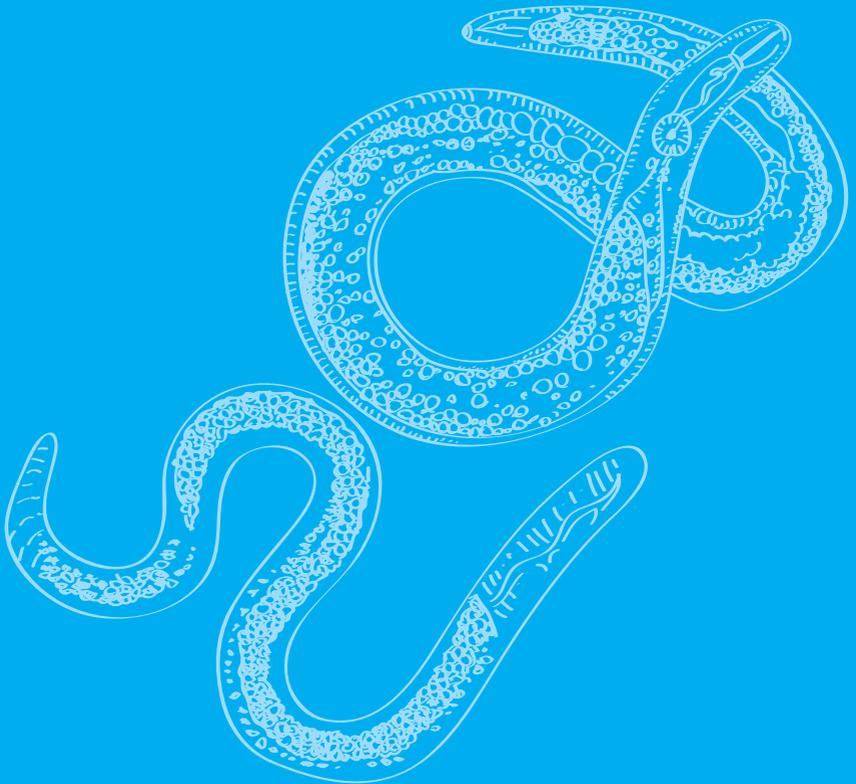
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## Chapter 1

# Nematodes

Chamnong Nopparatana



## Introduction

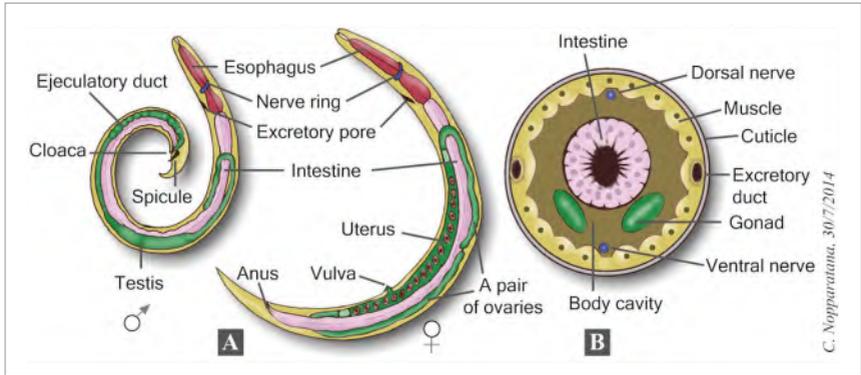
Nematodes are invertebrate roundworms that can be found in all environments, in freshwater, seawater, and in soil. They belong to the phylum Nematoda which includes parasites of plants and animals as well as free-living species. Some of these nematodes may have major roles in decomposition and biodegradation of toxic compounds. Some species are used as an indicator of environmental quality. Insect-parasitic nematodes, called entomopathogenic nematodes, can be used for biological control of insect pests. About 60 species of nematodes are parasites of humans that can cause a variety of disease conditions and symptoms. They are divided into 3 major groups according to the host organ in which they reside: **(1)** intestinal nematodes with transpulmonary migration (e.g., *Ascaris lumbricoides*, hookworms, *Strongyloides stercoralis*); **(2)** intestinal nematodes without transpulmonary migration (e.g., *Enterobius vermicularis*, *Trichuris trichiura*); and **(3)** blood and tissue-dwelling nematodes (e.g., *filarial worms*, *Dracunculus medinensis*, *Trichinella spiralis*, animal hookworms).

## Morphology

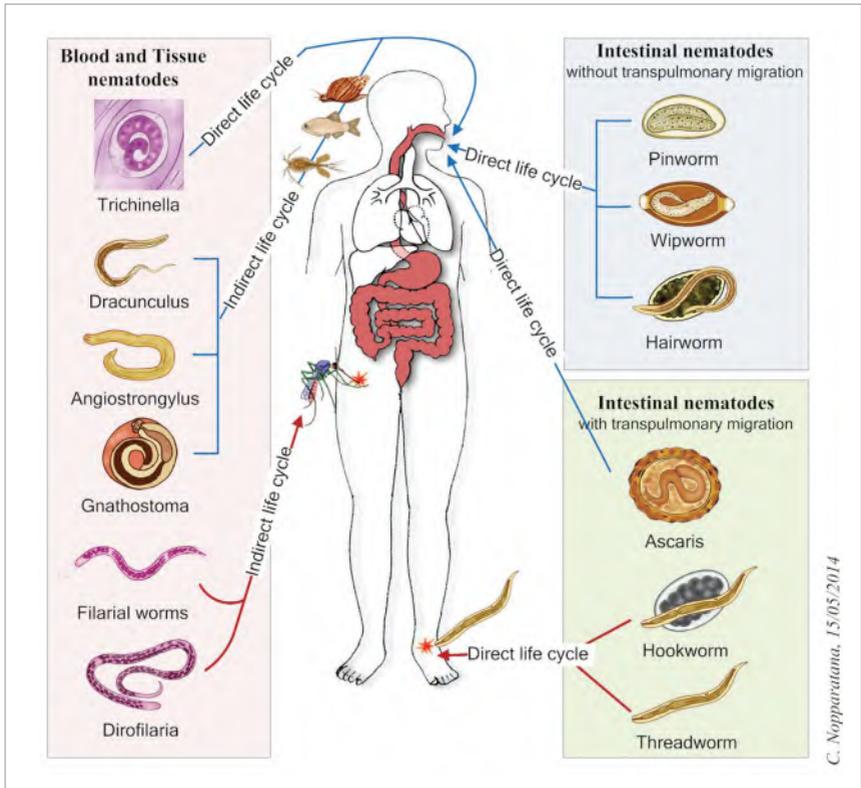
Nematodes are multicellular organisms. They are non-segmented helminths, cylindrical in shape, and tapering at both ends of the body. The digestive system extends from a mouth on the anterior end to an anus located at the posterior end. The nervous system consists of a nerve ring surrounding the pharynx and connecting to the dorsal and ventral longitudinal nerve cords which run along its length to motor neurons and sensory cells. The excretory organs lie within the lateral lines and open via a pore located ventrally to the esophagus. They are separate sexes with the male being smaller than the female. Female nematodes have a pair of ovaries consisting of cells (oogonia) that produce eggs. Male genital system consists of one testis and a seminal vesicle, which continues posterior as a muscular ejaculatory duct opening into the rectum or cloaca. Males usually possess copulatory spicules that protrude through the cloaca opening. The spicules are used to widen the vulva for sperm transfer.

## Life cycle

There are two types of life cycle in nematodes infecting humans: direct and indirect. In the direct life cycle, the parasites can reproduce without an intermediate host while the indirect life cycle the parasites require an appropriate intermediate host for their development. In most species the basic life cycle consists of seven stages: an egg, four larval stages (L1, L2, L3, and L4) and two adult stages [sexually immature (L5) and mature adults]. The L1 develops inside the egg, hatches, grows rapidly and then molts (M1) to L2. The L2 grows and molt (M2) to an infective, third stage larva (L3). After infecting the host, the L3 grows and molts (M3) to L4, the final larval stage. The L4 grows and undergoes a final molt (M4) to an immature adult (L5). The L5 passes through a final growth stage to become sexually mature male and female.



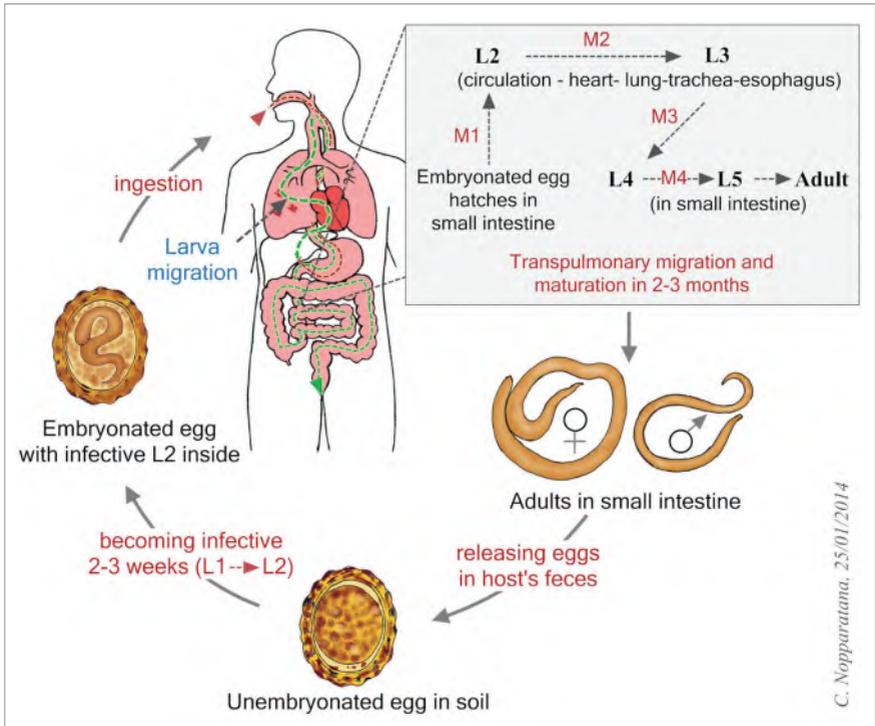
**Fig. 1-1** Structure of nematodes: **A** = adult male and female, **B** = cross section of intestinal region.



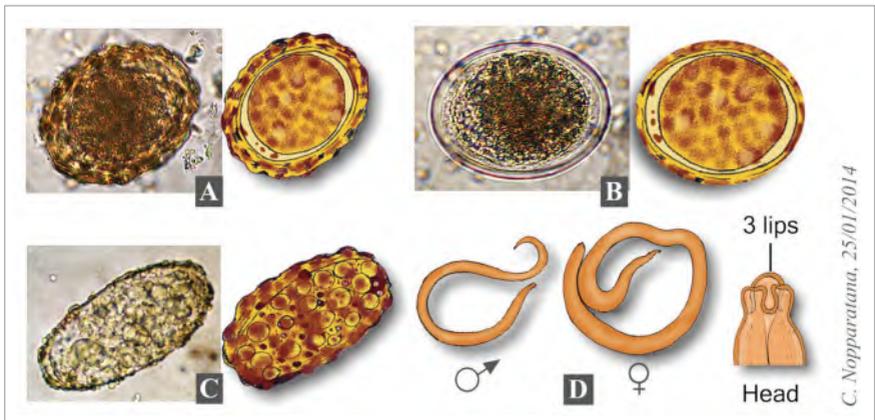
**Fig. 1-2** The basic life cycles of three nematode groups, illustration of their infective stages and routes of infection.

## *Ascaris lumbricoides* (roundworm)

Clinical disease	Ascariasis
Infective stage	Embryonated egg
Mode of infection	Ingestion of raw vegetable contaminated with embryonated egg
Hosts	<b>Definitive hosts:</b> humans
Habitat	Small intestine
Life cycle	<ol style="list-style-type: none"> <li>1. Adult worms live in the small intestine and feed on semi-digested food from the host.</li> <li>2. About 2-3 weeks after passage in the feces, the fertilized egg develops into an infective embryonated egg (L1 molts to L2). Humans are infected when they ingest these infective eggs.</li> <li>3. After ingestion, the eggs hatch in the duodenum to rhabditiform larvae (L2). These L2 larvae penetrate the intestinal wall, entering the hepatic circulation, and then migrate to the liver, then to the right side of heart and to the lungs.</li> <li>4. Transpulmonary migration phase: In the lung, the larvae penetrate the alveolar walls, molt twice (L2→L3→L4), and then migrate up to the pharynx where they are swallowed and descend the esophagus to mature in small intestine. The larvae that are swallowed directly from contaminated food may not show this migration.</li> <li>5. In the small intestine, the larvae grow and take the fourth molt to an immature adult (L5) and undergo the final development to sexual maturity. The interval from ingestion of infective eggs to the present of mature worms is about 2-3 months. The worm can live 1-2 years.</li> </ol>
Clinical fetures	<p><b>Incubation period:</b> 3 weeks</p> <p><b>Larva migration:</b> neumonitis, eosinophilia, and ascaris pneumonia (<i>Loeffler's syndrome</i>)</p> <p><b>Intestinal adult worms:</b> abdominal pain, intestinal obstruction, diarrhea, and malnutrition</p> <p><b>Adult migration:</b> migration to other organs causing appendicitis, pancreatitis, peritonitis, and fever</p>
Diagnosis	<ul style="list-style-type: none"> <li>• Detecting eggs or adult worms in feces</li> <li>• Detecting adult worms or larvae in sputum</li> </ul>
Treatment	<p><b>Albendazole</b> 400 mg single oral dose or <b>Mebendazole</b> 100 mg bid for 3 d or 500 mg single dose</p> <p><b>During pregnancy:</b> a single oral dose of Pyrantelpamoate, 11 mg/kg</p>
Distribution	The most common, >700 million people infected worldwide
Morphology	<p><b>Adult worms:</b> They are creamy white and have 3 prominent lips (one dorsal and two ventral lips). Male (15-30 × 3-4 mm in size) has a curled tail and 2 protruding spicules. Female (20-40 × 3-6 mm) has a straight pointed posterior end.</p> <p><b>Eggs:</b> They are stained golden brown by bile. <b>Fertilized egg</b> is round or oval, 60 × 40 μm in size, covered by albuminous layer (the resistant structure for many chemicals). <b>Decorticated egg</b> is the fertilized egg with no external albuminous layer. <b>Unfertilized egg</b> is longer and narrower (about 80 × 40 μm), containing mainly a mass of refractile granules.</p>



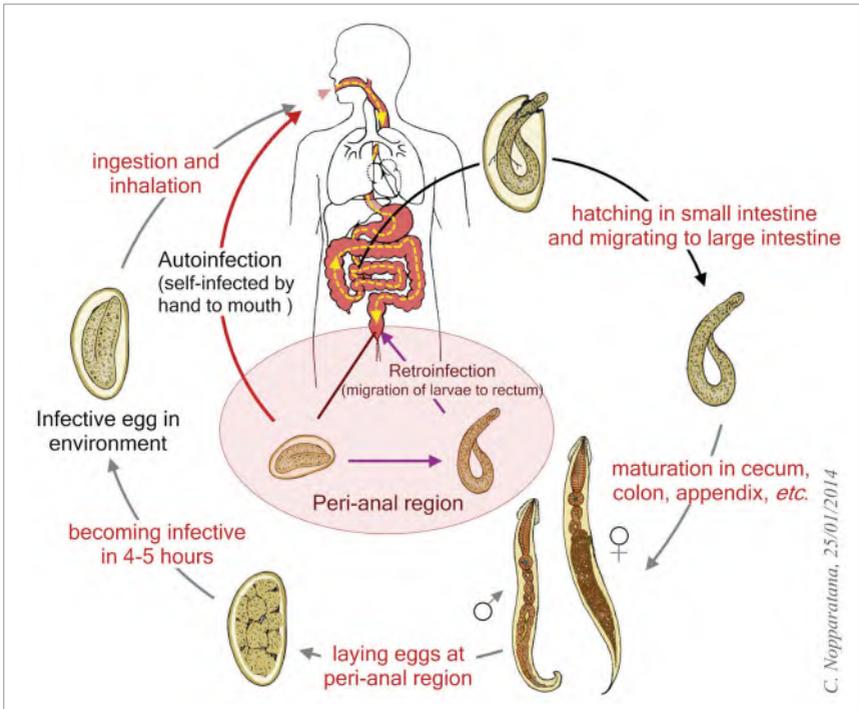
**Fig. 1-3** Life cycle of *Ascaris lumbricoides* (L = Larva, M = Molt).



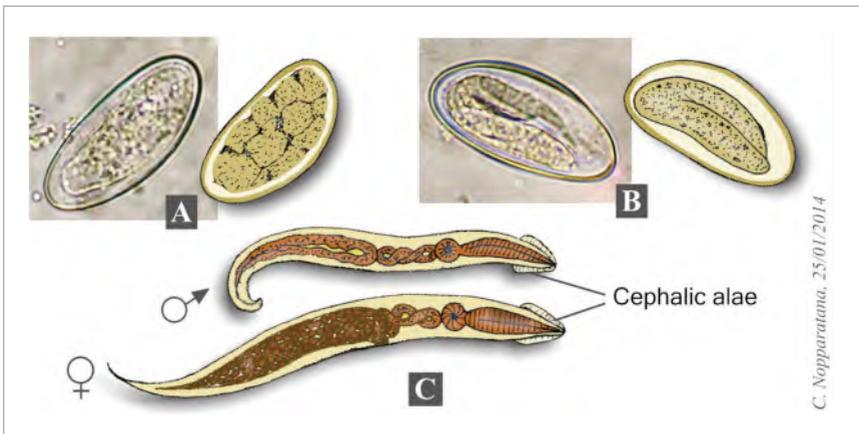
**Fig. 1-4** *Ascaris* eggs and adults found in feces: **A** = fertilized egg with outer albuminous layer, diameter 50-70  $\mu$ m; **B** = decorticated egg (albuminous layer is absent); **C** = unfertilized egg (longer and narrower), 80-90  $\mu$ m long; and **D** = adult male and female; and the anterior part with 3 prominent lips.

## *Enterobius vermicularis* (pinworm or seatworm)

Clinical disease	Enterobiasis or Oxyuriasis
Infective stage	Embryonated egg
Mode of infection	<b>Indirect infection or hetero-infection:</b> ingestion of contaminated eggs or aerosol inhalation, <b>Autoinfection:</b> self-infected by hand to mouth transmission, <b>Retroinfection:</b> The larvae from the anal skin migrate back into the rectum.
Hosts	<b>Definitive host:</b> humans
Habitat	Ileocecal area
Life cycle	<ol style="list-style-type: none"> <li>1. Adult worms live in a large intestine, but they can spread to adjacent regions of the small and large intestines. They feed on bacteria and epithelial cells.</li> <li>2. After copulation the gravid female crawls through the anus at night to deposit the eggs on perianal skin. The eggs become infective within 4-5 hours.</li> <li>3. The females die after laying eggs while the males die soon after copulation.</li> <li>4. Eggs develop into the infective third stage larvae which may migrate back into the rectum, this is known as retroinfection.</li> <li>5. When the human host ingests the infective eggs, the larvae hatch in the duodenum, undergo development, and migrate to the colon where they develop into mature adults. They complete the life cycle in about 2 months.</li> </ol>
Clinical features	<ul style="list-style-type: none"> <li>• Allergic reactions around the anus causes nocturnal itching (<b>pruritus ani</b>) which may lead to excoriations and bacterial superinfection.</li> <li>• Migration of the worms to other organs may produce appendicitis, ulcerative colitis, vaginitis and salpingitis.</li> <li>• Anorexia, irritability, and abdominal pain may occur.</li> </ul>
Diagnosis	Detecting eggs from stool specimen or from perianal skin by <b>Scotch-tape</b> slide test (can increase the sensitivity to 70-80%)
Treatment	A single oral dose of Mebendazole 100 mg or Albendazole 400 mg or Pyrantelpamoate 10 mg/kg
Distribution	The infection is the most common helminthic infection in the school-children and found more frequent in temperate than tropical countries.
Morphology	<p><b>Adult worms:</b> They are small, slender and white color. The anterior end has cuticular extensions called "<b>cephalic alae</b>". Female (8-12 × 0.3-0.5 mm) has a straight pointed posterior end (pin-like appearance). Male (2-5 × 0.1-0.2 mm) has a curved tail and a single large copulation spicule.</p> <p><b>Eggs:</b> They are 50-60 × 20-30 μm in size, oval shape, colorless, transparent, slightly flattened on one side (<b>plano-convex or D-shaped egg</b>), and usually contain larvae.</p>



**Fig. 1-5** Life cycle of *Enterobius vermicularis*.



**Fig. 1-6** Eggs and adults of *E. vermicularis*: A = plano-convex or D-shaped egg; B = infective egg; and C = adult male and female.

## *Trichuris trichiura* (whipworm)

Clinical disease	Trichuriasis
Infective stage	Embryonated egg
Mode of infection	Ingestion of raw vegetables contaminated with embryonated eggs
Hosts	Definitive hosts: humans
Habitat	Cecum and ascending colon
Life cycle	<ol style="list-style-type: none"> <li>1. Adult worms live in the colon with their anterior ends embedded in the intestinal mucosa. The gravid female lays eggs approximately 3,000-10,000 per day. The eggs are unembryonated when passed in feces.</li> <li>2. Under optimal conditions, the unembryonated eggs mature to the infective stage containing third-stage larvae within 3-6 weeks.</li> <li>3. When infective eggs are ingested by the host, the larvae hatch in the small intestine, molt twice and migrate to the large intestine. They develop into sexual maturity within 60-90 days after ingestion.</li> <li>4. The adult worms can survive approximately 2 years in the human host.</li> <li>5. They do not need a transpulmonary migration phase for their development.</li> </ol>
Clinical features	Incubation period is about 10-30 days. Heavy infections may cause gastro-intestinal problems including abdominal pain, diarrhea, <b>rectal prolapse</b> , appendicitis; and possibly growth retardation in children.
Diagnosis	Detecting eggs in the fecal sample
Treatments	<ul style="list-style-type: none"> <li>• Mebendazole 100 mg bid for 3-5 d, or</li> <li>• Albendazole 400 mg single dose, or</li> <li>• Ivermectin 200 µg/kg qd for 3 d</li> </ul>
Distribution	1.3 billion infected worldwide
Morphology	<p><b>Adults:</b></p> <ul style="list-style-type: none"> <li>• They are divided into a thin whip-like anterior part, and a thick and stout posterior part, <b>appearing as a whip</b>.</li> <li>• Their mouths are simply and do not contain any lips.</li> <li>• Male is 2-5 cm long, the posterior end is coiled and poses a single spicule.</li> <li>• Female is 8-13 cm long, the posterior end is straight.</li> </ul> <p><b>Eggs</b> are 50 × 22 µm in size, golden-brown color, <b>barrel-shaped</b>, and have a thick-shelled with a pair of <b>mucoïd plug</b> at each end. Usually unembryonate are found in fecal sample.</p>