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ENTEROBIUS VERMICULARIS INFESTATION: AN OVERVIEW

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Abstract

Millions of people around the world are affected by parasitic infections caused by pathogenic protozoa and helminths. One such helminth is Enterobius vermicularis, *commonly known as the pinworm, which causes a condition called enterobiasis. This infection is often asymptomatic, but the most common symptom is itching around the anal area (perianal pruritus), particularly at night when the worms become more active and migrate. Other symptoms may include loss of appetite, abdominal discomfort, and irritability. The parasite's entire life cycle occurs within the human gastrointestinal tract. Once a person ingests infective eggs, the larvae hatch in the duodenum. These rhabditiform larvae undergo two molts as they mature in the jejunum and upper ileum. Adult worms then settle in the colon and typically live for around two months. At night, female worms travel outside the anus to lay eggs, which can be spread through contaminated hands or surfaces. These eggs are quite resilient and can remain viable in moist environments for up to three weeks. Transmission primarily happens through direct contact with an infected person or contaminated objects. Diagnosis is usually made by detecting the parasite's eggs under a microscope from a stool sample, or by visually identifying adult worms in the stool. The most effective treatment is a single oral dose of mebendazole.*

INTRODUCTION:

The human pinworm, *Enterobius vermicularis*, is the causative agent of enterobiasis, a highly contagious parasitic infection that affects over 400 million people globally. While parasitic diseases have largely been eradicated in industrialized nations, *E. vermicularis* remains prevalent, particularly in developing countries. For instance, in Pakistan, prevalence rates increased significantly from 0.2% in 1964 to 14.1% by 2017 (Farooqi, 1964; Khan et al., 2017a). The infection is less common in tropical regions with hot and dry climates, as the eggs cannot survive in such conditions (Afrakhteh et al., 2016). Commonly referred to as pinworm, *E. vermicularis* is an intestinal nematode helminth and the most widespread contact-transmitted helminth infection (Roberts & Janovy, 2009). The primary route of infection is the ingestion of eggs via contaminated hands or food. Adult worms reside in the lumen of the cecum and terminal ileum. The infection is especially prevalent among children, particularly in overcrowded and unhygienic living conditions. Some estimates suggest that up to one billion people worldwide may be infected (Cook, 1994).

Primarily a childhood infection, enterobiasis causes perianal itching, abdominal discomfort, restlessness, and sleep disturbances. In some cases, it may result in more serious complications such as recurrent urinary tract infections, appendicitis, and ectopic infections in the female reproductive system, liver, or lungs

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(Kubiak et al., 2017; Choudhury et al., 2017). Ullah et al., in 2025 investigated the prevalence of *E. vermicularis* in Khyber Pakhtunkhwa's (KP) Mardan district and concluded that children from 1 to 5 years had the highest prevalence.

PATHOGEN/ETIOLOGY

E. vermicularis, also known as threadworm or seatworm, is a human-specific intestinal nematode responsible for the condition known as enterobiasis (formerly oxyuriasis). First described by Carl von Linné in 1758, fossil evidence suggests this parasite has coexisted with humans for thousands of years. Adult worms are thin and thread-like, with females measuring 9–12 mm and males 3–5 mm in length. They are whitish in color and visibly active.

Female worms have a pointed tail and a reproductive system capable of producing over 10,000 eggs (Deplazes et al., 2013; Despommier et al., 1995). The eggs are oval, asymmetrical (resembling a slice of bread), translucent, and measure about 50–60 × 25 µm. They often contain a visible larva and can survive for several days outside the host. Transmission is facilitated by the eggs' sticky surface, which allows them to adhere to skin and surfaces easily (Reinhard et al., 2016; Wendt et al., 2019).

LIFE CYCLE:

The life cycle of *E. vermicularis* is simple and completed entirely within a single host human, who serve as the definitive host. There is no need for an intermediate host. Infection occurs when a person ingests fully developed eggs. Once inside the body, the egg shell is dissolved by gastric juices in the stomach, releasing larvae into the small intestine. These larvae then migrate to the large intestine, particularly the cecum and vermiform appendix, where they mature into adult worms within 15 to 30 days. During reproduction, females may release pheromones to attract males. Males use their curved tails to coil around females and hold them in place during copulation by using copulatory spicules. After fertilization, the male dies, while the female migrates to the perianal area at night to lay eggs. The warmth of the host's body and exposure to air stimulate the female to deposit eggs exclusively around the perineum. These eggs spread over the perianal region and can hatch larvae in the skin folds. The larvae may then re-enter the intestinal tract through the anus, a process called retro infection. In rare cases, larvae may invade the vagina in infected women. The entire life cycle completes within two to three weeks (Fleming et al., 2015) Figure 1. Transmission can occur through handling contaminated clothing or bedding, or by inhaling eggs present in dust. In adults, retro infection occasionally occurs. The primary mode of infection is through ingestion of eggs transferred from contaminated hands or nails, especially during scratching of the itchy perianal area this is most frequently observed in children (Waugh, 1974).

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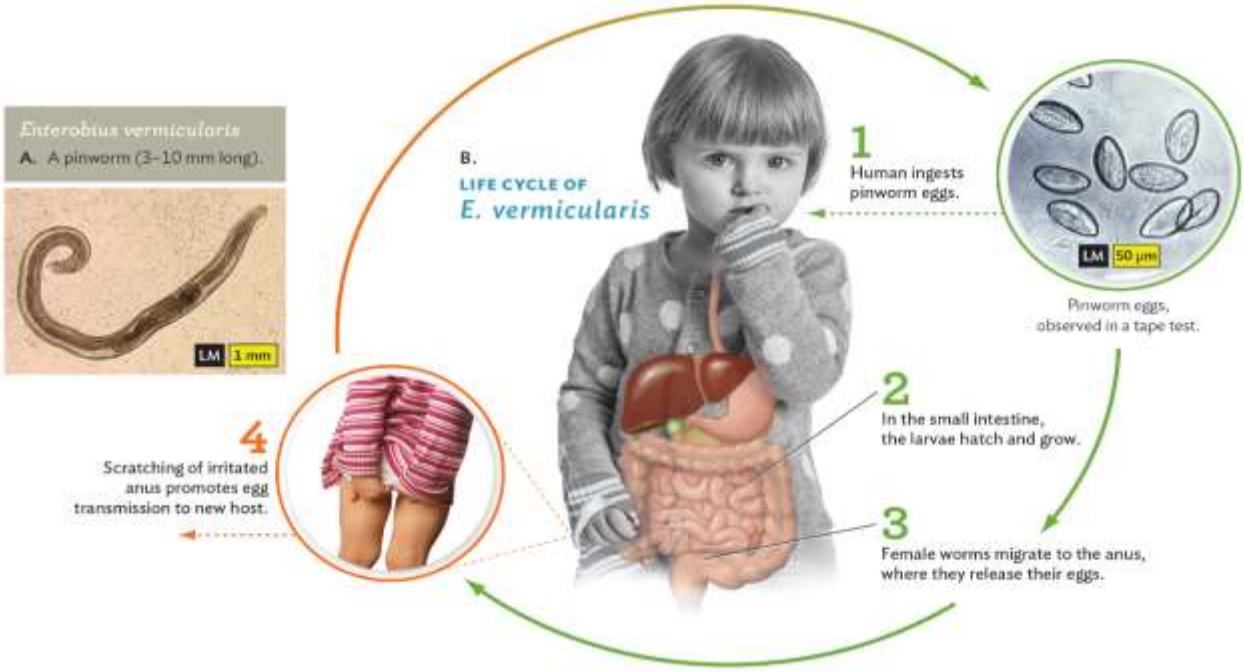


Figure 1: Pinworms

EPIDEMIOLOGY

It is estimated that over a billion people worldwide are infected with *E. vermicularis* (Ritcher et al., 2003; Norhayati et al., 2003; Li et al., 2015) Pinworm infections are also common in temperate climates and industrialized countries, affecting individuals across all social groups (Dutto et al., 2012). Several studies have examined infection rates in children across Europe: A Norwegian study found that 18% of 395 children tested positive for pinworm eggs using the Scotch tape test, with the highest prevalence (34%) among 6- to 11-year-olds (Bøås et al., 2012). Similarly, a Swedish study reported a 28.5% infection rate in children aged 4 to 10 (Herrström et al., 2011), while a large Estonian study involving 954 kindergarteners found a 24.4% prevalence (Rem, 2006).

According to reports, Pakistan has a prevalence of *E. vermicularis*, ranging from 2% (Farooqi, 1964) to 34.05% (Niaz et al., 2019). This intestinal parasite, which primarily affects youngsters, is still a serious threat. A German study in the Berlin area showed that detection rates doubled from 12.7% in 2007 to 23.6% in 2017, with a seasonal peak between October and December (Friesen et al., 2019). Data on adult infection rates are limited, but a Romanian retrospective study reported an average annual incidence of 777 cases per 100,000 people from 1993 to 2006, regardless of age (Neghina et al., 2013). Young children under 2 years, older children over 14 years, and adults tend to be infected less frequently.

RISK FACTORS AND MODES OF TRANSMISSION

Multiple studies have identified key risk factors for pinworm infection (Cranston et al., 2015; Tsai et al., 2018; Friesen et al., 2019, Chen et al., 2018; Wendt et al., 2019). Children between the ages of 4 and 11 are most commonly affected, with some studies noting a slightly higher prevalence in males. During this age range, many children attend kindergarten or primary school, where close social interactions and shared environments increase exposure to *E. vermicularis*. Behaviors such as putting toys or writing instruments in the mouth, nail biting (onychophagia/perionychophagia), and scratching the perianal area contribute significantly to transmission. Additional factors include poor hand hygiene especially not washing hands before eating frequent hand-to-mouth contact, and unsupervised or inconsistent personal hygiene routines. These behaviors are strongly linked to higher infection rates in children. Interestingly, certain household characteristics such as the type of home construction, cleaning habits, or sharing a bedroom with siblings

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were not found to significantly influence infection rates in some studies (Chen et al., 2018). For adults, there is limited data on specific risk factors. However, a few older studies have suggested that men who have sex with men (MSM) may represent a higher-risk group (Waugh 1974). Transmission within heterosexual relationships has also been documented as relevant (Abdolrasouli and Hart 2009).

The high transmission potential of *E. vermicularis* is largely due to the sticky, durable nature of its eggs, which readily adhere to hands and beneath fingernails (Herrström et al., 2001). This strong adhesive quality facilitates ongoing transmission through direct contact, continuous exposure, and autoinfection. Although many secondary sources highlight the importance of environmental contamination such as infective eggs in house dust this remains difficult to confirm through research. Laboratory studies have shown that at room temperature, pinworm eggs typically lose their infectivity after about five days (Hulínská 1974). Importantly, *E. vermicularis* is exclusively a human parasite; domestic animals do not serve as natural reservoirs and are not involved in its transmission.

Clinical Manifestations of *E. vermicularis* Infection

Around 40% of individuals infected with *E. vermicularis* experience mild or no symptoms (Kubiak et al., 2017; Ibarra, 2001). In cases where autoinfection does not occur, the infection is usually self-limiting due to the short lifespan of the adult worms (Mehlhorn et al., 2012). The most common symptom is intense itching around the anus or perianal area, particularly at night, which often disrupts sleep. This nocturnal discomfort can lead to secondary effects such as bedwetting (reported in up to 53% of cases), daytime fatigue, and reduced concentration (Otu-Bassey et al., 2005). In some cases, enterobiasis has been associated with developmental delays in children (Zhao et al., 2001). Frequent scratching of the affected area can result in skin damage (excoriation), increasing the risk of secondary bacterial infections. Complications may include anal dermatitis, perianal folliculitis, or, in rare cases, ischiorectal abscesses. Occasionally, worms may migrate to the female genital tract, causing vulvovaginitis (Eder et al., 2018), or contribute indirectly to urinary tract infections by carrying bacteria like *Escherichia coli* (Ok et al., 1999).

The involvement of *E. vermicularis* in acute appendicitis has been debated for years, although a clear causal relationship has not been conclusively established (Vleeschouwers et al., 2013; Fleming et al., 2015).

DIAGNOSIS:

The presence of eggs is the primary indicator for diagnosing a pinworm infection. The most effective method for detecting these eggs involves using clear cellophane tape, sticky side out, pressed against the anal area with a tongue depressor, preferably in the morning before bathing or using the toilet. The tape can then be placed directly on a microscope slide for examination. Traditional diagnostic techniques like fecal smears or flotation methods are often unreliable, as eggs are present in the stool of only about 5% or fewer of those infected, even in severe cases. To confirm the infection, multiple tape samples may be necessary because even a single worm depositing eggs can signal the end of an active infection. Performing tape-swab tests for seven consecutive days is recommended to confidently rule out the presence of pinworms. Adult worms are the second key diagnostic clue. These may be observed around the anus at night or occasionally in stool, especially after enemas. If worms are discovered in the stool or on a child, they should be preserved in alcohol or vinegar and taken to a healthcare provider or public health facility for proper identification.

Treatment

Pinworm infections are treated using mebendazole, albendazole, or pyrantel pamoate. Each is given as a single dose, followed by a second dose two weeks later to eliminate newly hatched worms, as the drugs do not reliably kill eggs. Caution is advised when treating children under two years old, and use during pregnancy should be delayed until the third trimester unless symptoms are severe. Mebendazole is safe during breastfeeding, as minimal amounts pass into breast milk. Data on the other drugs' presence in breast milk is limited. Repeated infections should follow the same treatment plan. In cases involving multiple household members or institutional outbreaks, treating everyone at the same time and

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repeating the dose after two weeks is recommended to prevent reinfection.

Prevention & Control

- Proper hygiene is the most effective way to prevent pinworm infections.
- Washing hands thoroughly with soap and warm water after using the toilet, changing diapers, and before handling food is essential.
- Infected individuals should bathe every morning preferably showering rather than bathing to remove eggs from the skin and prevent contaminating water.
- They should avoid sharing baths and practice good hygiene, including regular nail trimming and avoiding nail-biting or scratching the anal area.
- To reduce reinfection risk, underclothing and bed linens should be changed daily in the morning, carefully handled without shaking, and washed in hot water, then dried in direct sunlight. In communal settings like schools and daycares, controlling pinworm can be challenging, but mass treatment during outbreaks is effective.
- Teaching children proper handwashing habits is a key preventive measure.

CONCLUSION:

Enterobiasis caused by *Enterobius vermicularis* remains a significant public health challenge, particularly among children in crowded living environments. Despite its high prevalence, it is often underestimated and inadequately addressed. Promoting good personal hygiene is crucial to reducing transmission, but sustained efforts and further research are essential to develop effective control strategies and ultimately eliminate this parasitic infection.

Conflict of interests

The authors state that there are no conflicts of interest.

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