

# Checklist of Endolimax Species Recognized in Human and Animals, a Review on a Neglected Intestinal Parasitic Amoeba

Hossein Hooshyar\*, Mohsen Arbabi, Parvin Rostamkhani

Department of Medical Parasitology, Kashan University of Medical Sciences, Kashan, Iran.

\*Correspondence to: Hossein Hooshyar (E-mail: hooshyar4@gmail.com)

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## Abstract

**Objectives:** *Endolimax* is a protozoan genus belongs to Amoebida order. The member of this genus occurrence in a vast range of vertebrate and invertebrate, but the species of this genus are not well studied. This review aimed to provide an updated list and some summarized information on *Endolimax* species, which were identified in human and animals up to the 2023.

**Methods:** The present study was carried out to evaluate the *Endolimax* species with a broad review of the literature, books and electronic databases such as ISI Web of Science, PubMed, Scopus, Science Direct and Google Scholar until 2023. The hosts, pathogenicity, synonyms and distribution of valid species were considered and recorded.

**Results:** Totally 20 defined species of *Endolimax* were found. Among them, only 12 species of *Endolimax* have been accepted as valid species. The valid species arranged by the host, including 1 species in human, 2 species in rodents, 1 species in birds, 2 species in reptiles, 1 species in amphibian, 4 species in arthropod and 1 species in fishes.

**Conclusion:** Intensive studies are needed in order to identification of other new and valid species in different animals and their characteristics.

**Key words:** *Endolimax*, Protozoa, Amoeba, Species

## Introduction

Parasites of the genus *Endolimax* belong to Amoebida order was first described by Kuenen and Swellengrebel in 1917 from human.<sup>1</sup> This genus in addition to *Entamoeba*, *Endamoeba* and *Iodamoeba* are members of the Endamoebidae family (order: Amoebida). The members of *Endolimax* genus have a cosmopolitan distribution and occurrence in a vast range of vertebrate and invertebrate, including human and other mammalian, birds, reptiles, amphibians, fishes, and insects.<sup>2</sup> Species of this genus have also been reported in the intestinal lumen of animal hosts and one species reported from various tissues of fish.<sup>3,4</sup>

The genera *Endolimax*, has two stages in their life cycle, an amoeboid trophozoite and a cyst stage. Intestinal colonization with *Endolimax* occurs after ingestion of mature cysts via fecal contaminated subjects. The trophozoite realized from the cyst, and multiply by binary fission after colonization. The cyst is produced from trophozoite.<sup>5</sup>

The correct identification of *Endolimax* from the other genus of Endamoebidae family is based on nuclear structure of trophozoite and the cyst. Species of *Endolimax* has a vesicular nucleus that has a large accumulated polymorphic endosome (karyosome) at the center and no peripheral chromatin.<sup>5,6</sup> Trophozoites are small, 8–15 µm long but may reach a size of up to 30 µm during locomotion by pseudopodia, exception *E. piscium* with trophozoite stage smaller than 5 µm that appears to be the smallest species.<sup>4</sup>

Ultrastructural analysis of *E. nana* cyst showed the existence of tubular structures made up of a double row of ribosome-like particles with a single membrane running between them that had not been described from other members of intestinal human amoeba.<sup>7</sup>

Although *Endolimax* species are considered to be a non-pathogenic intestinal protozoan, rare cases of abdominal pain, diarrhea,<sup>8–11</sup> polyarthritides<sup>12,13</sup> and urticaria<sup>14,15</sup> caused due to infection with *E. nana* in human reported.

Identification of non-pathogenic amoeba such as *Endolimax* in the stool of human and animal is significant because, it indicates exposure to fecal contamination and increase risk of exposure to pathogenic parasite organisms. Furthermore, the various stages of this nonpathogenic organism may provide diagnostic challenges to distinguish from pathogenic protozoa such as *Entamoeba histolytica* in the stool microscopic examination.<sup>16</sup>

There are some definite species of *Endolimax* were found and recorded in human and animals. Some of them are more prevalent and some reported as cases. Despite the existence of multiple species in the *Endolimax* genus, isolated from vertebrates and invertebrate hosts, *E. nana* in human is the only species that is better known. The other members of this genus are not well studied. Additional surveys for new data are needed to complete the life cycle, hosts and even cyst morphology, especially for species which reported as cases.

This review is conducted to present an update list and some summarized information about known *Endolimax* species, which were reported and published up to the 2023.

## Methods

Electronic and manual searches in international electronic databases, journals and books were conducted to find the related data reporting on human and animal *Endolimax* species. The search covered the articles published up to the 2023. Searching was performed in the international databases covering: ISI Web of Science, PubMed, EMBASE, Scopus, Science Direct and Google Scholar. To identify all related studies, a combination of relevant keywords and MeSH terms including “*Endolimax*”, “nonpathogenic amoeba”, “*Endolimax* diagnosis”, and “*Endolimax* and Case report” were used as a panel of key words. For more accuracy of search, the references of selected articles were checked.

The manual search was carried out in abstracts of scientific articles related to this topic presented at scientific congresses as well as some textbooks such as “Amoebas”,<sup>2</sup> “Parasitic protozoa”,<sup>5</sup> “Veterinary Parasitology”<sup>17</sup> and “Veterinary Protozoology”.<sup>6</sup> The search restricted to English and Persian languages, Taxonomic study, phylogeny data and new reports articles about *Endolimax* were included, repeated and unrelated cases were excluded to study. The trophozoite and cyst sizes, hosts, geographical distribution, habitat, and pathogenicity of the all species and synonyms for some species were collected.

## Results

Totally 20 defined species of *Endolimax* were found. Among them, only 12 species of *Endolimax* have been accepted as valid species. The valid species arranged by the host, including

1 species in human, 2 species in rodents, 1 species in birds, 2 species in reptiles, 1 species in amphibian, 4 species in arthropod and 1 species in fishes.

*Endolimax suis*, *E. tayassusi* isolated from pig and *E. kueneni* and *E. cynomolgi* that isolated from monkey have not been accepted as a separate species from *E. nana*.

*Endolimax intestinalis* is another synonym of *E. nana* in human. *Endolimax janisae* and *E. numidae* are two synonyms name for *E. gregarniformis* in birds.

In the rat, two species including *E. ratti* and *E. muris* are synonym. All species considered as a non-pathogen, except *E. piscium* that reported is causative agent of systemic inflammatory lesions in fish.

The sizes, hosts, geographical distribution, habitat, pathogenicity of the all species reported up to 2023 and synonyms are summarized in Table 1.

Table 1. Named *Endolimax* species and some characterization of them, reported up to 2023

Species	Host	Habitat	Size	Pathogenicity	Distribution	References
<i>Endolimax nana</i> * (Wenyon & O, connor, 1917)	Human, Primates. Pig	Colon and caecum, large intestine	Trophozoite 6–15 µ, cyst 8–10 µ.	None	Worldwide	1–3, 18
<i>Endolimax ratti</i> ** (Chiang, 1925)	Wild and laboratory rats	Colon and caecum, large intestine	Trophozoite 6–15 µ, cyst 5–10 µ.	None	United States, Britain, French	2, 17, 35
<i>Endolimax caviae</i> (Hegner, 1926)	Guinea Pig	Caecum	Trophozoite 5–11 µ, cyst not reported	None	United States, Philippines	17, 19
<i>Endolimax gregariformis</i> *** (Tyzzer, 1920)	Chickens and roosters, ducks, turkeys, geese, pheasants, horned chickens and some non-domesticated birds such as herons and owls.	Caecum	Trophozoite 4–13 µ, cyst 7–11 µ	None	Worldwide	2, 4, 19, 20, 26, 27
<i>Endolimax clevelandi</i> (Gutierrez-Ballesteros & Wenrich, 1950)	Turtle	Rectum	Trophozoite 4.7–17 µ, cyst 4.5–10 µ	None	Unknown	2, 18, 21
<i>Endolimax reynoldsi</i> (McFall, 1926)	Lizard ( <i>Sceloporus undulatus</i> )	Large and small intestine	Trophozoite 14.5 µ, cyst 12.4 µ (average)	None	United States	4, 22, 30
<i>Endolimax suggrandis</i> (Henderson, 1941)	Termite	Intestine	Trophozoite 12–48 µ, cyst unknown	None	Kenya, Africa	2, 4
<i>Endolimax termitis</i> (Kirby, 1927)	Termite ( <i>Mirotermes hispaniolae</i> )	Intestine	Trophozoite 9.5–27 µ, cyst unknown	None	Panama	24, 31
<i>Endolimax blattae</i> (Lucas, 1927)	Cockroach	Hindgut	Trophozoite 7–22 µ, cyst 3–15 µ	None	England, Egypt, Russia, Germany	32, 33, 37
<i>Endolimax leptocoridis</i> (Kay, 1940)	Bug ( <i>Leptocoris trivittatus</i> ) adult and nymph	Intestine and rectum	Trophozoite 10–40 µ, cyst up to 15 µ	None	Unknown	2, 38
<i>Endolimax ranarum</i> (Epstein and Ilovaisky, 1914)	Frog, Tadpoles	Colon and rectum	Non reported	None	Unated state	4–6, 25
<i>Endolimax piscium</i> (Constenla, Pardros and Palenzuela, 2013)	Senegalese sole ( <i>Solea Senegalensis</i> )	Digestive tract, liver, skeletal muscle, heart, kidney	Trophozoite up to 5 µ, cyst unknown	Systemic granulomatuse inflammatory lesions and abscesses	Spain	4, 18, 39, 40

\*Synonyms: *Endolimax suis*, *E. tayassusi* (De Mello and Amaral, 1951), *E. intestinalis* (Kuenen & Swellengrebel, 1917). *E. kueneni* and *E. cynomolgi*

\*\*Synonyms: *Endolimax muris* \*\*\*Synonyms: *Endolimax janisae* (Hegner, 1926), *E. numidae* (Hegner, 1929).

## Discussion

Exception of *Entamoeba* genus, other members of the Endamoebidae family (order: Amoebida), including: *Endamoeba*, *Iodamoeba* and *Endolimax* are less well studied intestinal amoebas. Most species of *Endolimax*, have been found and reported from animals before 1950. During the last 73 years ago, only one species, *E. piscium*, have found and reported in 2013.<sup>1,4</sup>

A systematic review on *E. nana* showed that most data on *E. nana* have emerged from general studies on human intestinal parasites in the absence of any particular focus on *Endolimax*.<sup>18</sup> Hence, the genus of *Endolimax* especially animal isolates has remained largely unexplored and some of them have described only as case reports.<sup>19–22</sup> Many named species of *Endolimax* are unexplored in morphology, taxonomy, genetic diversity, host specificity, and distribution. The low data about this genus may be due to the relatively its minor clinical importance.<sup>23</sup>

There is a clear need for further studies on some *Endolimax* species such as *E. ranarum*, *E. trmitis*, *E. caviae* to clarify the cyst stage and mode of transmission.<sup>19,24,25</sup>

Among all of the known *Endolimax* species, only *E. piscium* is known to be potential pathogen and harmful in Senegalese sole and the others are commensal. However, *E. piscium* can also be colonized in the intestinal epithelium of asymptomatic sole fish.<sup>4</sup>

There are some case studies that reported associate *E. nana* with abdominal pain, diarrhea, polyarthrititis and urticaria in human,<sup>8–13</sup> but there is not experimental data to support this opinion. However, the correct diagnosis of *E. nana* in stool examination has significant important to medicine because it may be misdiagnosed as *Entamoeba histolytica* that causing intestinal and extraintestinal amoebiasis in human.<sup>16</sup>

The mostly species of *Endolimax* are host specificity, exception *Endolimax gregariniformis* that isolated from a variety of birds.<sup>2,4,19,20,26,27</sup> Some research has been debated in the host specificity of *Endolimax*, and believed that human *Edolimax* is able to infect a wide range of hosts. It has been

discussed that some species that described as distinct species may be the synonyms of one species, for example, *E. kueneni*, and *E. cynomolgi* are the synonyms of human *E. nana* in monkey.<sup>3,18, 28,29</sup> Whereas others believe to host specificity and proposed new specific names for the species that isolated from different animals.<sup>4,6,20–22,24,30–33</sup>

Although Dobell experimental study showed that *Endolimax* from macaques could infect humans and vice versa,<sup>34</sup> another experimental study indicated that *E. nana* is not transmitted to the laboratory-bred amoeba free rat either by feeding or rectal injection.<sup>35</sup> It is still an unresolved issue which animal *Endolimax* species that can infect humans. DNA sequence data analyzed by phylogenetic methods obtained from human isolates as well as animal, proposed to investigate the host specificity and classification of *Endolimax* species.<sup>18</sup>

## Conclusion

It seems that this parasitic protozoan has been largely neglected compared with *Entamoeba* species, the other genus of Amoebida due to its non-pathogenic nature.<sup>36</sup> Intensive studies are needed in order to identification of other new and valid species in different animals and their characteristics, especially their host specificity and pathogenicity status.

## Conflict of Interest

None.

## Ethical Issues

Ethical issues have been fully observed while collecting information and writing this article.

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