

## Short Communication

# Urban rodents as potential reservoirs of zoonoses: a parasitic survey in two selected areas in Kandy district

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## ABSTRACT

Urban rodents play an important role in public health being reservoirs of many zoonotic diseases. Screening of rodents for ecto and endoparasites from two selected urban areas, Peradeniya and Pilimathalawe in Kandy district was carried out to assess their potential as reservoirs of zoonoses. Rodents were caught live using single-catch rat traps from July 2006 to February 2007. Six traps were set twice a week and three rodent species, the common house rat, *Rattus rattus* (n = 17), the Indian house mouse, *Mus musculus* (n = 2), and bandicoot, *Bandicota indica* (n = 2) were examined. Of the eleven species of parasites found, five were zoonotic namely, *Hymenolepis diminuta*, *Moniliformis moniliformis*, *Cysticercus fasciolaris*, *Raillietina* sp. and *Xenopsylla cheopis*. Tapeworms were the predominant parasitic group (52.4%) of which *C. fasciolaris* (42.7%) was the most common type followed by strongyle type eggs (19.0%). Among the infected rodents, 23.8% had mixed infections of *H. diminuta*, *X. cheopis* and *M. moniliformis* as well as that of *H. diminuta*, *Raillietina* sp. and *C. fasciolaris*. Although *Raillietina madagascariensis* was recorded in *R. rattus* in 1954, none of the rats examined in subsequent studies or in the present study were infected with *Raillietina*. However, one bandicoot was infected with *Raillietina* sp. in the present study which presents a new host record. Urban rodents carry many zoonotic infections and urbanization is in favour of the spread of these infections to humans specifically in developing countries where the communities are socio-economically challenged.

**Key words:** *Bandicota indica*, *Mus musculus*, *Rattus rattus*, tapeworms, *Raillietina*

## INTRODUCTION

Rodents are represented by many families, of which Family Muridae embraces all the small rodents known as rats, mice and rat-like rodents. Apart from their various devastating activities to man, acting as reservoirs and spread of zoonoses is a major concern. Urban rodents dwell in human altered habitats and hence it amplifies the possibility to acquire rodent-borne zoonoses. About forty diseases are spread by rats including plague, arena and hanta viruses, rat typhus, helminthiasis as hymenolepiasis, schistosomiasis and lung worm (Singleton *et al.*, 2003). Of these zoonoses, hymenolepiasis (*Hymenolepis diminuta*) affects about 36 million people (Peters and Pasvol, 2002) while schistosomiasis has its impacts on 200 million people (Nowak, 1991) worldwide. According to Nowak (1991) more people have died in the last ten centuries due to rat-borne diseases than of wars. The main reason for this accelerating health risk as described by

Singleton *et al.* (2003) can be the increasing human population density and rapid clearance of natural habitats which enhances rodent human contact. Further, the high rodent reproduction frequency worsens the situation.

As the emerging rodent-borne diseases have captured worldwide attention, little has been documented on this aspect in Asia, and Sri Lanka is not an exception with only a few notable investigations in the past on rodent parasites of both zoonotic (Kulasiri, 1954; Kumarasinghe *et al.*, 2006) and non-zoonotic (Cruz and Shanmugasunderam, 1971; 1974) significance. Kulasiri in 1954 reported three species of cestodes *Hymenolepis nana*, *H. diminuta* and *Raillietina madagascariensis* from *R. rattus* caught from Colombo. Later Cruz and Shanmugasunderam (1971) recorded some new cestodes namely, *Vampirolepis solisoris*, *V. montana*, *Hymenolepis sunci* and *Pseudhymenolepis eisenbergi* from shrews and an unidentified *Hymenolepis* sp. from the highland spiny rat, all belonging to the hill

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country. Again in 1974, the same authors surfaced another finding *Brachylaemus advena*, a trematode in the highland spiny rat. All these studies are more than thirty years old except a brief report by Kumarasinghe *et al.*, in 2006 which recorded blood and gastrointestinal parasites of rats and mice. Scarcity in updated scientific documentation on infections carried by urban rodents emphasizes the necessity of this study.

## MATERIALS AND METHODS

Two urban areas, Peradeniya and Pilimathalawe in Kandy district in the Central Province of Sri Lanka were selected as the study site. Rodents were caught live using single-catch rat traps for a period of eight months from July 2006 to February 2007. Six traps were set twice a week inside houses and in home gardens. Rodents caught were identified using taxonomic keys (Phillips, 1980). Necropsies were carried out soon after capturing the animals after anaesthetizing with chloroform. Blood was drawn from a heart puncture using a 3 ml (23 G x 11/4") syringe and was stored at 4°C in 2% EDTA until use.

### Collection of ectoparasites

External areas of the body such as fur, behind ears, armpits, anal area and between fingers and toes were examined for ectoparasites. Parasites found were preserved in 70% ethanol and slide mounted after boiling in 10% KOH. Ectoparasites were identified using taxonomic keys of Hopkins and Rothschild (1953).

### Examination of internal parasites

Thin blood smears were made using fresh blood, stained with Leishman's dye and observed under the light microscope using an oil immersion lens ( $\times 100$ ). The rodents were dissected after anaesthetizing to expose the gastrointestinal tract and the other internal organs and the body cavity was examined for the presence of any macro parasite visible to the naked eye. The gut region was cut opened and the contents together with faecal pellets were preserved in 10% formal saline solution separately for stomach, small intestine, caecum and large intestine. Parasite eggs were observed in the gut contents using a simple salt floatation method. Liver was examined for presence of cysts and migratory tracts of larvae. Any unusual growths were preserved in 70% alcohol. These were later

sectioned and double stained with Haematoxylin and Eosin for histopathological studies. Parasites recovered from the gut and liver were stained using Aceto Alum Carmine and identified using taxonomic keys (Jones *et al.*, 1994).

## RESULTS

A total of 21 rodents, belonging to three species namely, the common house rat, *Rattus rattus* (n = 17), the Indian house mouse, *Mus musculus* (n = 2), and bandicoot, *Bandicota indica* (n = 2) were examined. Eight of the rodents were females, of which two were pregnant while the remaining 13 were males. All the rodents were healthy and active and some even exhibited aggressive behaviours in captivity prior to dissection. External appearances did not indicate symptoms of any diseases such as diarrhea, skin rashes and loss of fur or fatigue.

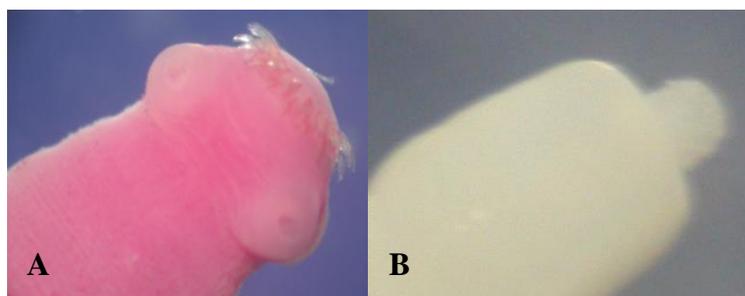
Of the 21 rodents examined, 14 (66.7%) were infected with one or more parasites (Table 1). Five of them (23.8%) had concurrent infections where one bandicoot had *H. diminuta*, *Raillietina* sp., *Cysticercus fasciolaris*, Strongyle type and unidentified spherical eggs with larvae. Cestode infections were the most prevalent type of infection (52.4%), of which *C. fasciolaris* infection was the most common (42.9%; Table 1). Only one individual of *R. rattus* was infected with *Xenopsylla cheopis*, the Oriental rat flea. All the rodents examined were free of haemoparasites. In the body cavity one bandicoot had a strobilocercus larva of a *Taenia* sp. of 8.2 cm long attached to the right side of the liver (Fig. 1A).

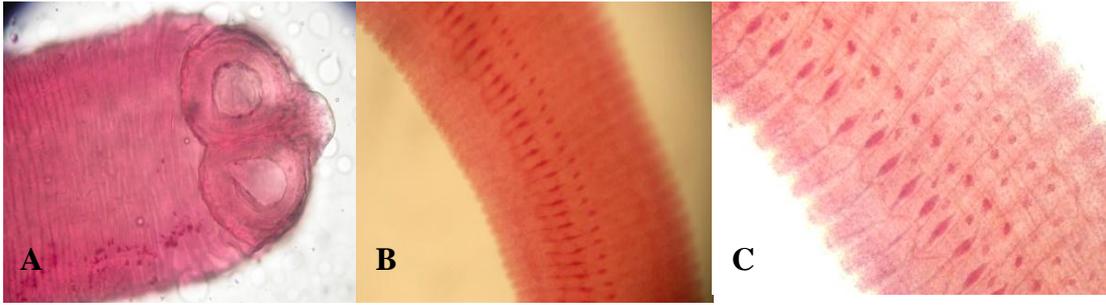
*Moniliformis moniliformis*, commonly known as the spiny-headed worm, (Phylum: Acanthocephala, Order: Moniliformida) was found in the fore region of the small intestine in two individuals of *R. rattus* (Table 1; Fig. 1B). Both specimens of *R. rattus* caught were infected with *M. moniliformis*, one with a male worm (4.3 cm) while the other had a female (17.6 cm) which was much fleshier and was found almost completely obstructing the gut. Among the cestodes, both *B. indica* and *R. rattus* were heavily infected with *H. diminuta* (Fig. 2) and *B. indica* also had *Raillietina* sp. infection (Fig. 3). Large number of cestode worms (an average of 20), were recovered and all of them were found crowded in the small intestine, obstructing the tract.

**Table 1.** Type of parasite, site of infection and number of infected individuals among the three rodent species (n=21).

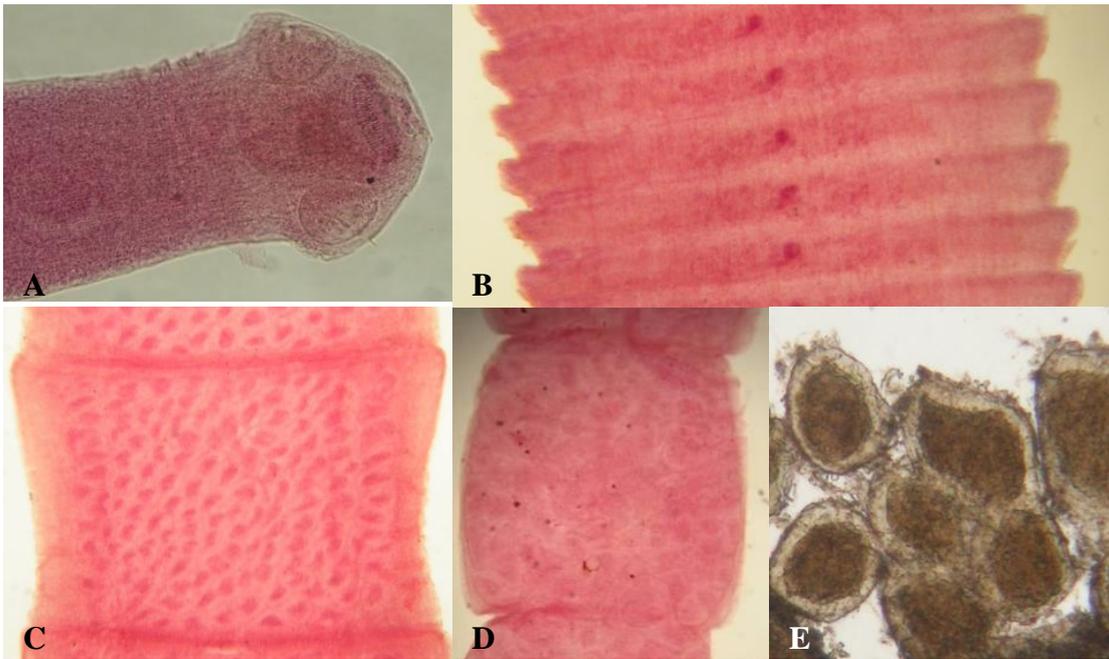
Parasite species	Site of infection	Host species	No. of individuals infected
<i>Xenopsylla cheopis</i> *	External (in fur)	<i>Rattus rattus</i>	1
<i>Hymenolepis diminuta</i> * (adults)	Small intestine	<i>R. rattus</i>	1
		<i>B. indica</i>	1
<i>Raillietina</i> sp.* (adults)	Small intestine	<i>B. indica</i>	1
Unidentified strobilocercus larva of <i>Taenia</i> sp.	Body cavity	<i>R. rattus</i>	1
<i>Cysticercus fasciolaris</i> * (strobilocercus larva of <i>Taenia taeniaeformis</i> )	Liver (cysts)	<i>B. indica</i>	2
		<i>R. rattus</i>	6
		<i>Mus musculus</i>	1
<i>Moniliformis moniliformis</i> * (adults)	Small intestine	<i>R. rattus</i>	2
<i>Trichuris</i> sp. (eggs)	Small intestine Large intestine Caecum	<i>B. indica</i>	1
Unidentified spherical eggs with live larvae	Large intestine Caecum	<i>B. indica</i>	1
Strongyle type eggs	Large intestine Caecum	<i>B. indica</i>	1
		<i>R. rattus</i>	3
Strongyloide types eggs	Small intestine Large intestine Caecum	<i>R. rattus</i>	2
Unidentified coiled larvae	Small intestine Large intestine Caecum	<i>B. indica</i>	2

\* zoonoses

**Figure 1.** (A) Anterior region and scolex of strobilocercus larva of *Taenia* sp. (x10x4) found attached to the right side of the liver in the body cavity of *B. indica* caught from a house in Pilimathalawe. (B) Proboscis of *Moniliformis moniliformis* with recurved hooks (x4x4) found in *R. rattus* caught in a house in Pilimathalawe.



**Figure 2.** *Hymenolepis diminuta* from *R. rattus* caught in a canteen in Peradeniya, Kandy district (A) unarmed scolex (x10x40) (B) immature proglottids (x10x10) with ovary and cirrus primordia and (C) maturing proglottids (x10x40) with a median ovary and three testes.

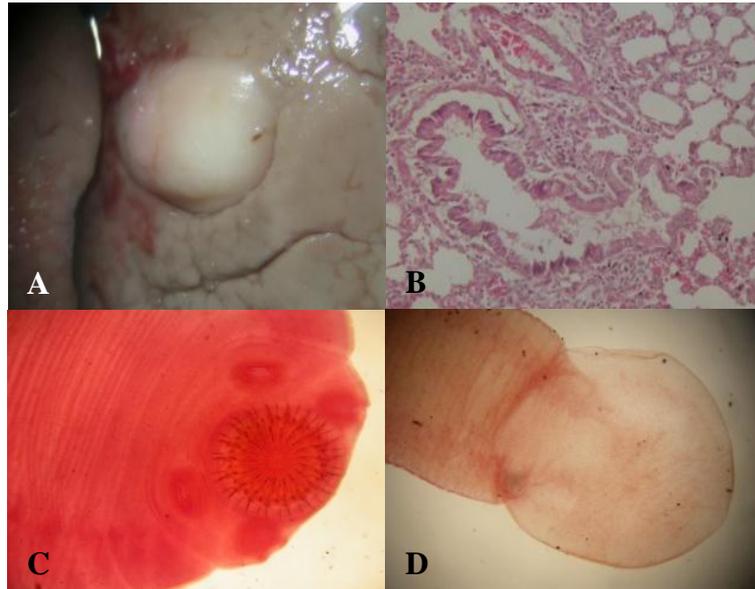


**Figure 3.** *Raillietina* sp. obtained from *B. indica* caught in a bakery in Pilimathalawe, Kandy district. (A) rostellum armed with tiny hooks (B) maturing segments with numerous testes and a median ovary (C) mature segments (D) gravid segments and (E) eggs teased apart from gravid segments. (Magnification x 10 x10).

#### Examination of liver and lungs

Pea-sized, whitish capsules of 1-9 mm diameter was found in the liver of nine specimens (42.9%; Fig. 4A). They were either embedded deep in the liver parenchyma or attached to the surface where each capsule contained a well coiled *C. fasciolaris* the strobilocercus larvae of *Taenia taeniaeformis* where the scolices had characteristic two rows of hooks (Fig. 4C) and a

chain of proglottids ending in a terminal bladder (Fig. 4D). They were not invaginated into the bladder but attached to it by a long segmented neck. However, the smaller cysts (< 2 mm) were examined histopathologically (Fig. 4B). Presence of larva was prominent from the tri laminar patch within the normal liver cells that had started to show tissue damage. None of the rodents were infected with lung parasites.



**Figure 4.** *Rattus rattus* caught in a house in Peradeniya, Kandy district infected with *Cysticercus fasciolaris*. (A) Liver (x3) showing pea sized whitish cyst (B) Histopathology of the liver tissue (x10x40) incorporating a cyst in the tissue section (C) Strobilocercus larvae of *T. taeniaeformis* (x10x10) with rostellum armed with double row of hooks and (D) terminal fluid filled bladder (x10x4).

#### Parasitic eggs and larvae from gut contents

Eggs of *H. diminuta*, *Trichuris* sp., *M. moniliformis*, strongyloides, strongyle infections and some unidentified spherical eggs with larvae inside (Table 1) were found in the gut contents. One individual of *B. indica* had numerous coiled unidentified larvae in its small intestine, large intestine and caecum.

#### DISCUSSION

Rodents play an important role as hosts of parasites and reservoirs of many zoonotic diseases. A total of eleven species of parasites were found of which five were zoonotic including, *X. cheopis*, *H. diminuta*, *M. moniliformis*, *C. fasciolaris* and *Raillietina* sp. Previously, Phillips (1980) reported *X. cheopis* and *X. astia*, the two plague fleas as highly prevalent in rats in many large towns in Sri Lanka including Kandy. However, in the present study *X. cheopis* was found only in one individual of *R. rattus*. Cestodes were the most common type consisting of *Raillietina* sp., *H. diminuta*, *T. taeniaeformis*, *C. fasciolaris* and strobilocercus larva of another *Taenia* sp. Kumarasinghe *et al.* (2006) recorded high prevalence of cestodes such as *H. diminuta* (38%) from Kandy district. Rodents examined in

the present study had *C. fasciolaris* (43%) as the most prevalent parasite species. Kulasiri (1954) studied the urban rats in Colombo Municipal area and reported *Raillietina madagascariensis* from *R. rattus*, but none of the rats examined in subsequent studies or in the present study were infected with *Raillietina*. However, in the present study one bandicoot was infected with *Raillietina* sp. which presents a new host record. Many new cestodes were recorded by Cruz and Shanmugasunderam (1971) namely, *Vampirolepis solisoris*, *Vampirolepis montana*, *Hymenolepis sunci* and *Pseudhymenolepis eisenbergi* from shrews and an unidentified *Hymenolepis* sp from highland spiny rat, all from the hill country. In 1974, the same authors found *Brachylaemus advena*, a trematode in highland spiny rat. None of these species were found in the present study. *Hymenolepis diminuta* can be found infrequently in humans where approximately 200 to 300 human cases have come primarily from India, Japan, former Soviet Union and Southern USA (Garcia, 1999). It was first recorded from children in Ceylon (Sri Lanka) by De Silva (1951). Although *Raillietina* sp. infections have long been under debate as a zoonosis, human infections have been recorded around the world from Australia, Africa and Asia (Chandler and Pradatsundarasar, 1957).

Mixed infections of two or more parasites were common in the rodents studied. Although

mixed infections of *H. diminuta* and *M. moniliformis* had been reported earlier (Kulasiri, 1954), concurrent infections of *H. diminuta*, *Raillietina* sp. and *C. fasciolaris* seem to be the first report of its kind. Adult stage of *C. fasciolaris*, *T. taeniaeformis* commonly occurs in cats and other carnivores (Singleton *et al.*, 2003).

*Moniliformis moniliformis* belonging to Phylum Acanthocephala was another parasitic species recorded with zoonotic potential. Solitary human infections of *M. moniliformis* have been reported from Italy, British Honduras and Sudan (Faust and Russell, 1964). Though Kulasiri (1954) had mentioned about this infection in rodents of Sri Lanka it was Kumarasinghe *et al.* (2006) who had recorded it as a highly prevalent parasite (19%) in Anuradhapura, Ampara and Kandy districts. The present study had recorded a low prevalence of only 9.5% where the infected individuals had either a solitary male or a solitary female of *M. moniliformis*, but not both.

Although, Kumarasinghe *et al.* (2006) reported the presence of three blood parasites, *Babesia microti*, *Trypanosoma* spp. and *Toxoplasma gondii* in urban rodents, in the present study none of the rodents had any blood parasites. Presence of *T. lewisi* infections in a laboratory colony of mixed bred rats (*R. norvegicus*) has been reported in Sri Lanka (Sannasuriya *et al.*, 1999). Three nematode infections namely, strongyle types, strongyloide types and *Trichuris* sp. were identified. Though, there was a possibility for the *Trichuris* sp. to be *T. muris*, the egg size did not correspond with the egg size given in the literature (Cheng, 1986). Urban rodents are potential reservoirs of many zoonoses. Urbanization is in favour of the spread of the rodent-reservoir zoonoses further amplified by the close association between rodents, man, his pets and livestock and arthropods such as cockroaches, fleas etc.

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