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Prevalence of endoparasites in wild rats in Grenada

C Coomansingh, RD Pinckney, MI Bhaiyat, A Chikweto, S Bitner, A Baffa, R Sharma*
Pathobiology Academic Program, School of Veterinary Medicine, St. George's University, Grenada, West Indies.

*Corresponding author: Tel: 1-473-444-4175 ext2335. Email: rsharma@sgu.edu

Abstract

Recent significant increases in the population of rodents in Grenada warranted a study to determine the prevalence of helminth endoparasites in 242 *Rattus norvegicus* rats (Norwegian rats) captured from all six parishes. The overall prevalence of helminth endoparasites was 90.9%. Three nematodes, two cestodes and one acanthocephalan were identified: *Trichosomoides crassicauda* (1.2%); *Strongyloides ratti* (28.1%); *Nippostrongylus brasiliensis* (76.8%); *Hymenolepis diminuta* (16.1%); *Taenia taeniaeformis* (23.1%); *Moniliformis moniliformis* (3.7%). Significant parasite burdens were detected in the captured rats, some of which are of public health significance because they have zoonotic potential. As the rat population continues to grow, rodent surveillance and eradication programmes are warranted to prevent a disease outbreak.

Key words: Rattus norvegicus, helminth, endoparasites, zoonotic, prevalence, Grenada

Introduction

Rodents can be found on almost every continent and island in the world. They are abundant and live in close association with humans in order to obtain their basic survival needs such as food and shelter. In tropical and subtropical countries, at least 20 species of rodents have been recognized as pests of agricultural crops, including *Rattus norvegicus and Rattus rattus*[1]. Rats can cause destruction of foodstuff, electrical equipment and buildings by gnawing or contamination with excreta resulting in significant economic losses[2].

Rodents are also implicated in the spread of numerous diseases worldwide many of which have zoonotic potential. The most well- known zoonotic diseases include: leptospirosis; hymenolepiasis; rat-bite fever; Q-fever and hemorrhagic fever. In Jamaica[3] and Grenada[4] the zoonotic lung worm, *Angiostrongylus cantonensis* has been reported in *Rattus norvegicus*. There has also been evidence of exposure to Hantavirus and *Leptospira* spp. in *R. norvegicus* in Grenada[5,6]. The helminth endoparasites in the rodent population of Grenada have not been studied nor has their zoonotic potential been determined.

The main aim of this study was to establish the prevalence of endoparasite infections in the Norwegian rat (*R.norvegicus)* population, with particular reference to those of public health concern.

Materials and Methods

From April to December 2005, two hundred and forty-two wild *R. norvegicus* rats comprising 121 males and 121 females were caught using wooden and wire traps containing burnt coconut bait. Traps were set in various locations from both urban and rural areas representing each of the six parishes of Grenada. The number of rats caught in each parish included St. David, 74; St. Andrew, 40; St. John, 37; St George, 36; St Mark, 35 and St. Patrick, 20. It was imperative to sample 242 rats in order that a representative number of rats could be collected from each of the six parishes. Trapped rats were transported to the Pathology Laboratory in the School of Veterinary Medicine, St. George's University. Humane euthanasia of the rats was done using diethyl ether in a closed chamber. Approval protocols for trapping, transporting and humane euthanasia of rats was sought from the St George's University Institutional Animal Care and Use Committee.

At necropsy, the entire gastrointestinal tract and the liver were removed and fixed in 10% buffered formalin for parasitological examination. The intestines were cut longitudinally and examined macroscopically for the presence of helminths whereas the liver was also examined for *Taenia taeniaeformis* cycticerci and *Moniliformis moniliformis* larvae (cystacanths). Faeces were removed and centrifugation flotation with zinc sulphate (sp.gr. 1.20) was performed to recover helminth eggs for microscopic examination[7]. Nematodes

found within the intestines were removed and placed in lacto-phenol to clear the cuticle. The proglottids of cestodes were placed in a drop of saline and crushed so that the eggs could be examined microscopically. Acanthocephalans were placed in alcohol-glycerin and examined unmounted.

The association between prevalence and demographic factors (gender, parish) were evaluated using Chi Square Contingency analysis.

Results

Of the 242 rats examined, 220 (90.9%) were found to be infected with endoparasites. *Nippostrongylus brasiliensis* 186 (76.8%) was found to be the most prevalent in all parishes of Grenada. Other parasites were *Strongyloides ratti* 68 (28.1%), *Trichosomoides crassicauda* 3 (1.2%), *Hymenolepis diminuta* 39 (16.1%), *Taenia taeniaeformis* (cysticerci) 56 (23.1%), and *Moniliformis moniliformis* 9 (3.7%). Statistical analysis demonstrated that endoparasite prevalence was not influenced by gender (P=0.49). The overall prevalence of endoparasites by parish is represented in Figure 1. The prevalence of endoparasites in rats was similar across parishes (P=0.52).

Six species of helminths were recovered. These included 3 nematodes, 2 cestodes and 1 acanthocephalan. There were 112 single and 108 mixed endoparasite infections (Tables 1 and 2).

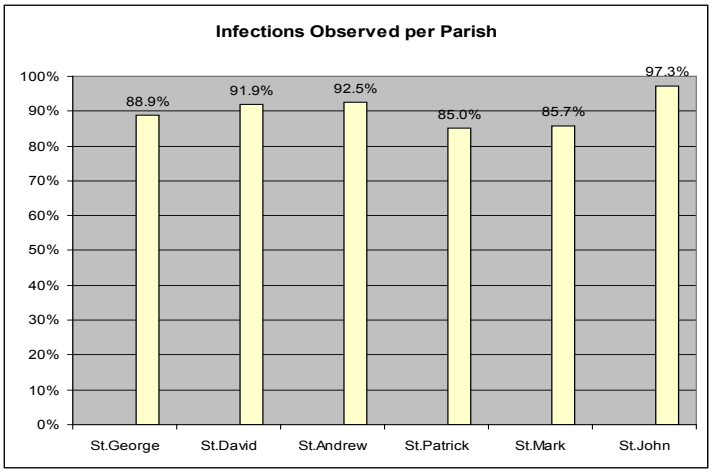

Figure 1. Prevalence of endoparasites in Rattus norvegicus in Grenada by parish (n=242)

Table 1. Number of single infections and types of helminth endoparasites in *Rattus norvegicus* from the six parishes of Grenada (n=242).

Parish	Examined	Infected	N	H	M	S	Tr	T
St. George	36	9	5	1	0	3	0	0
St. David	74	42	38	1	0	3	0	0
St. Patrick	20	10	6	1	0	1	0	2
St. Andrew	40	21	21	0	0	0	0	0
St. John	37	18	14	2	0	0	0	2
St. Mark	35	12	12	0	0	0	0	0
Total	242	112	96	5	0	7	0	4

N, *Nippostrongylus brasiliensis;* H, *Hymenolepis diminuta;* M, *Moniliformis mornilformis;* S, *Strongyloides ratti;* T,*Trichosomoides crassicauda;* T,*Taenia taeniaeformis*

Table 2. Number of mixed infections and types of helminth endoparasites in *Rattus norvegicus* from the six parishes of Grenada (n=242).

Parish	Examined	Infected
St. George	36	23 (4 N S, 4 N H, 4 S H ,3 N H T, 2 N T, 2 N S T, 2 S T, 1 N S H, 1 S H T)
St. David	74	26 (9 N S, 5 N T, 3 N S T, 3 S T, 2 H T, 1 N M, 1 N S M, 1NMT, 1 S M)
St. Patrick	20	7 (3 N H, 2 N H S, 1 N S M, 1 S H)
St. Andrew	40	16 (6 N S, 5 N T, 5 N S T)
St. John	37	18 (5 NH, 4 N T, 3 N S, 3 N H T, 1 N M,H, 1N S T, 1N S Tr)
St. Mark	35	18 (4 N S, 3 N T, 3 S T, 2 N H, 1 N M T , 1N M, 1N S T,1 N M T Tr, 1 N H T, 1 S Tr)
Total	242	108

N**,** *Nippostrongylus brasiliensis;* H, *Hymenolepis diminuta;* M, *Moniliformis mornilformis;* S,*Strongyloides ratti;* T,*Trichosomoides crassicauda ;* T,*Taenia taeniaeformis*

Discussion

The results of this study demonstrated that the overall infection rate of helminth endoparasites of *R.norvegicus* in Grenada was 90.9% (n=242). These findings are similar to other prevalence studies: 86.8% in Thailand[8], 87% in Iran[9], and 72.6% in Croatia[10]. However, the prevalence rates were relatively lower in Egypt (54%)[11], Jamaica (29.7%) [2] and in China (29.6%)[12]. Six species of helminth endoparasites were recovered in this study. In the Caribbean, similar surveys in Jamaica[2] and Puerto Rico[13] revealed 9 and 6 helminths, respectively. The majority 112 (50.9%) of the 220 infected rats harboured one species of endoparasite, 79 (35.9 %) 2 endoparasites, 28 (12.7 %) 3 endoparasites, 1 (0.5%) 4 endoparasites. Our findings of single infections compared to mixed infections are consistent with findings of a study in Jamaica where single infections were more common than mixed infections[2].

The findings of this study show that the nematode, *N. brasiliensis*, the rodent hookworm, was the most common endoparasite found in the *R.norvegicus* rats in Grenada. This finding is in agreement with that of Waugh *et al*.[2] in Jamaica where *N. brasiliensis* was the most common nematode among intestinal parasites. However, it contradicts similar research by De Leon[13] in San Juan, Puerto Rico who found *Gongylonema neoplasticum* to be most prevalent. In contrast to our study, surveys by Abd el-Wahed *et al*.[11] in Egypt and Yen *et al*.[12] in China found the cestode, *H. diminuta* to have the highest prevalence.

N. brasiliensis infection normally stimulates a T-cell mediated immune response that results in the expulsion of worms during a primary infection (spontaneous cure). However, this phenomenon fails to develop when infection occurs in rats less than 6 weeks old and worms persist into adult life[14]. The rats included in our study were adults and this phenomenon may be a possible explanation for high prevalence of *N. brasiliensis*.

The rodent tapeworm, *H.diminuta,* is transmitted when an egg is consumed by an arthropod intermediate host such as the cockroach or flour beetle. The egg then develops into a cysticercoid within the body cavity. Once the infected arthropod is eaten by a rodent development into an adult tapeworm occurs within the intestines. Accidental ingestion of infected arthropods by humans results in the development of an adult tapeworm within the intestines and has been reported in Jamaica[15], Italy[16] and Spain[17].

T. taeniaeformis infects cats but utilizes rodents as an intermediate host and the larva, strobilocercus develops in or on the liver. Infection in humans is rare and occurs by accidental ingestion of eggs and liver cysts. It has been reported in a child in Sri Lanka[18].

Rodents are the definitive host for *M. moniliformis* although humans can be incidental hosts upon ingestion of intermediate hosts such as beetles and cockroaches. Cases in humans have been reported from Nigeria[19], Iran[20] and Florida, U.S.A.[21].

Our findings indicate that intestinal parasite prevalence was not associated with gender of *R.norvegicus*. These findings conflict with those of Mafiana *et al*.[22] in Nigeria, who found that males have a higher prevalence of infection and Waugh *et al*.[2] in Jamaica where more females than male *R.norvegicus* were infected.

The majority of rats used in this study were infected with one or more helminth endoparasite, although they all appeared to be healthy. This observation suggests that there may be a symbiotic relationship between the helminth endoparasites and the rodent hosts. In Grenada the Norwegian rats (*R.norvegicus*) therefore possess a potential health risk to humans since some of the parasites they harbour are zoonotic. Based on these findings, it is recommended that rodent control and eradication measures be put into place in order to prevent rodent borne disease outbreaks.

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