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Article

Intestinal helminth infestation in *Rattus rattus*: effect of habitat, sex, weight and season

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Abstract: The occurrence of gastrointestinal helminths was investigated in 50 house rats (*Rattus rattus*) trapped from two habitats; domestic area and paddy field area of Dhaka, Bangladesh during May 2014 to April 2015. The prevalence of helminths was 88% (44/50) and intensity was 34.73 (1528 parasites from 44 hosts). The study revealed that the rodents were infected with eight species of parasites (one trematode, four cestodes and three nematodes) which were collected from gastrointestinal tract and liver of the hosts. Of the helminths, the dominant parasites were *Echinostoma cinetorchis* (36.52%) followed by *Heterakis spumosa* (31.74%), *Hymenolepis nana* (7.26%), *Syphacia obvelata* (7.13%), *Hydatigera taeniaeformis* (6.68%), *Oesophagostomum eurycephalum* (5.04%), *Hymenolepis diminuta* (3.01%) and *Hymenolepis* sp. (2.62%). Domestic rats showed the highest prevalence of infestation (90%) compared to paddy field rats (85%), whereas the intensity was lower (30.30 ± 10.53) in domestic rats than in the paddy field rats (41.77 ± 12.79). Peak prevalence was observed in males but intensity was found higher in female host. Occurrence of double infection was higher in domestic rats (53.33%). Intestine was the favorite niche compared to other organs. The highest prevalence was observed in winter and spring and the intensity was the highest in autumn in domestic rat, whereas in paddy field rat, the highest prevalence was observed in autumn and spring, the intensity was also the highest in spring. In both the hosts, intermediate length groups and highest weight groups were more vulnerable to infection.

Keywords: *Rattus rattus*; helminths; prevalence; intensity; zoonosis

1. Introduction

The house rat (*Rattus rattus*) is widely distributed and a common pest in urban and rural areas of Bangladesh. They are important reservoirs of many rodent-borne diseases and also cause a great deal of economic damage by destroying food stores and (Aplin *et al.*, 2003). The occurrence of zoonotic helminths in house rats constitute serious public health risks as these rats commonly cohabit with humans, and are known to be natural reservoirs of some helminth infections of public health importance (Ihedioha *et al.*, 2009). Rodents borne diseases like rat bite fever, murine typhus, leptospirosis, toxoplasmosis, trichinosis, salmonellosis and the plague have accounted for the death of more than twenty million people (WHO, 2007).

Chandler (1927) suggested that rats were of major epidemiological importance in his study of *Hymenolepis nana* in human population in Indo-Pak subcontinent. *Hymenolepis nana* and *Hymenolepis diminuta* are commonly found in rats and mice and potentially transmittable to man. The occurrence of *H. nana* and *H. diminuta*in certain rodents is of interest since the possibility exists that rats and mice may serve as reservoir hosts and aid in the dissemination of these worms to domestic animals and man causes zoonosis (Jawdat and Mahmoud, 1980). Pinworms commonly infecting laboratory rodents include the rat pinworm *S. muris* and in

mice *S. obvelata* which has also been reported to infect humans. Experimentally with *S. muris* infected animals grew slower than uninfected animals (Wagner, 1988).

Buscher and Haley (1971) have reported that urban rats harbor a greater variety of helminths than rural rats and also had a higher incidence of infection. Sumangali *et al.* (2012) showed that urban rodents play important role in public health through being reservoirs of many zoonotic diseases. Majority of the human populations in Bangladesh live in rural areas and damage to crops are being made by rats in the rural fields. Feeding habits of rodents have shown a pronounced impact on human economics and health worldwide (Huq *et al.*, 1985). Their habit of utilizing kitchen wastes and sewage and their swiftness make them successful vector for various diseases. They transfer more than sixty known diseases to humans and the list is still on upward as more and more research on zoonoses continues (Khatoon *et al.*, 2004). Therefore, the objective of the study was to conduct a comparative study on the prevalence and intensity of helminth parasites in house rats from two selected habitats, evaluate the influence of habitat, sex, weight and season on parasite prevalence and intensity.

2. Materials and Methods

2.1. Sample collection

In the present study, a total of fifty house rat (*R. rattus*) was collected in a regular interval during May, 2014 to April, 2015. The host animals were caught from two different habitats i.e. domestic area (thirty rats) and paddy field area (twenty rats). They were caught using cage traps made of steel wire. The traps were baited with pieces of biscuit, bread and dry fish. Trapped rats were collected in the morning and brought to the laboratory.

2.2. Laboratory procedure

The host was killed by asphyxiation with chloroform vapors before autopsy. The total length, weight and sex of hosts were recorded. Weight of both domestic and paddy field rats were divided in five random groups i.e. domestic rats (201-230 gm, 231-260 gm, 261-290 gm, 291-320 gm and 321-350 gm) and paddy field rats (171-200 gm, 201-230 gm, 231-260 gm, 261-290 gm and 291-320 gm) Asphyxiated rats were dissected and selected organs i.e. stomach, small intestine, caecum, large intestine and liver were examined in normal saline solution under a dissecting microscope. The helminths were collected, counted and preserved in 70% alcohol. For identification, the worms were dehydrated in ethanol series (70%-100%) and the helminths were cleared in lacto-phenol, stained in borax carmine and mounted using DPX. The identification of helminth parasites was done by following Yamaguti (1958, 1959 and 1961).

2.3. Data processing

All the recorded data were analyzed using Statistical Package for the Social Sciences (SPSS) version 20. The relationships between different variables were studied using Pearson Correlation Coefficient and significance of those correlations was assessed using p values.

3. Results and Discussion

A total of fifty (30 domestic and 20 paddy field) house rats were examined during study period and total 1528 number of helminth parasites was collected. Eight species of helminths belonging to three groups (Trematoda, Cestoda and Nematoda) were found of which five species (*Hymenolepis nana, Hymenolepis diminuta, Hydatigera taeniaeformis, Heterakis spumosa* and *Syphacia obvelata*) from domestic rats and four species (*Echinostoma cinetorchis, Oesophagostomum eurycephalum, Hymenolepis* sp. and *Hydatigera taeniaeformis*) from paddy field rat. Only *H. taeniaeformis* was common in both groups.

In our study domestic rats (90%) were more infected than paddy field rats (85%) (Table 1). Chaisiri *et al.* (2010) also reported the highest occurence of infection (23.5%) in domestic habitats, followed by upland (17.6%), lowland (16.1%) and forests (8.8%). Intensity of infestation was lesser in domestic rats (30.30 ± 10.53) than in the paddy field rats (41.77 ± 12.79). Zain *et al.* (2012) found *R. rattus* harboured over 60% of all helminths compared with *R. norvegicus* and overall 80% of rats carried at least one species of helminth, with the highest prevalence being shown by *H. diminuta* (35%), *H. spumosum* (29.8%) and *H. nana* (28.4%).

In the present study, among both the domestic and paddy field rats, the occurence of helminth infestation was higher in males (94.12%) than females (84.62%) which agrees with the findings of Udonsi (1989). In both the groups, intensity of infestation was higher in female than male hosts (Table 1). Males are ascribed to have more active foraging capacity than females. As it is assumed that prevalence of infestations may depends on population density, food habit and the condition of living environment. Therefore, it can be said that females have to live in very crowded environment because of their habit of parental care and as they are not very active foragers, it is possible that they may be prone to parasitic infection.

In domestic rats *H. spumosa* showed the highest prevalence (76.67%) and intensity (21.09) of infection (Table 2). Huq *et al.* (1985) reported that the prevalence of infection of *H. spumosa* was 45.64% in rats, mice and moles; whereas, Shaha (1974) reported 76.47% prevalence in *R. rattus*, which supports the findings of the present study. Prevalence of *H. nana* was 30% in domestic rat and it was completely absent in paddy field rat. Ash (1962) stated that the highest prevalence (50%) of *H. nana* in *Rattus* sp. in Hawaii while, Kulasiri (1954) reported the lowest prevalence of *H. nana* (0.24%) in Ceylon. In our study, the lowest prevalence (13.33%) was of *H. diminuta* which contradicts the findings of Alam *et al.* (2003). He reported that prevalence of *H. diminuta* was 87.5%, which is six times higher than the prevalence observed in the present study.

In case of paddy field rats, prevalence of *O. eurycephalum* was the highest (50%) with a medium intensity (7.7±4.47). The parasite is usually found in goats and pigs. Its occurrence in paddy field rats is unusual. The result could not be compared with other works since no researcher reported the occurrence of *O. eurycephalum* in rats. Though the lowest prevalence (10%) observed was of *E. cinetorchis* and intensity of infection (279±96.07) was the highest observed in this study (Table 2). In the present study, prevalence of *H. taeniaeformis* was 50% in domestic rats and 40% in paddy field rats (Table 2). In Bangladesh, Huq *et al.* (1985) reported *Cysticercus fasciolaris* (larval stage of *H. taeniaeformis*) in 8.72% of rats; Shaha (1974) reported this worm in 50% of the host rats.

The distribution of helminth parasites in different organs of hosts was dissimilar. In domestic rats, among the 30 hosts, 27 were infected with 818 helminth parasites of which intestine was marked as the maximum prevalent zone (90%) followed by liver (50%) and caecum (23.33%) (Table 3). In paddy field rats, among the 20 hosts, 17 were infected with 710 helminth parasites of which intestine was marked as the peak prevalent area (65%) followed by liver (40%) and caecum (35%). Intensity of infestation in intestine was the highest in both domestic (25.85±13.85) and paddy field (48.54±106.83) rats (Table 3). In the present study, both the domestic and paddy field rats' intestine showed the highest occurrence than other organ. These may happen because intestine is rich with nutrients. The availability of convenient food in intestine is a probable cause of highest prevalence. In domestic rats; single, double, triple and also multiple infections of helminths were found and in case of paddy field rats, multiple infections were totally absent (Table 4).

In case of weight, the 1st and 3rd weight groups showed the highest prevalence (100%) and 5th weight group showed the lowest prevalence (75%) in domestic rat. The intensity of infestation was found the highest (41.67±15.30) in the 5th weight group and the lowest (13.33±9.07) in 1st weight group (Table 5). Only the relationship between body weight and intensity in domestic rat was statistically significant ($p<0.05$). In paddy field rats, three weight groups (2nd 4th and 5th) showed the highest prevalence (100%) and 1st weight group showed the lowest (50%). The highest intensity (86.86±138.30) was found in 4th weight group and the lowest (8) in 1st weight group (Table 5). Less weighted animals are usually taken as younger (except some ill-health older animals). Mafiana *et al.* (1997) recorded the highest prevalence and intensity in 100-130g weight groups.

Kataranovski *et al.* (2011) found higher numbers of infected juveniles-subadults in suburban-rural habitats, while an opposite tendency was noted in adult rats. High susceptibility of the very young and the old is probably due to immunological immaturity in the former group and waning immune mechanisms in the later which may explain the cause of higher prevalence of infection in smaller weight groups. On the other hand, older hosts consume more food and consequently acquire more infective stages and for this reason they harbor more worms. This may explain the reason of higher intensity in large weight groups.

In the present study, occurrence of helminth infestation varied with the alteration of seasons. Domestic rats showed the highest helminth occurrence (100%) in winter and spring and the lowest (77.78%) in autumn. On the contrary, paddy field rats had the highest prevalence (100%) in autumn and spring and the lowest (66.67%) in winter (Table 6). Madhavi (1979) stated that in tropical countries, temperature might not play an important role in determining seasonal cycles as there are no wide fluctuations or very negligible. In Bangladesh, there are considerable changes in temperature, rainfall and other environmental factors with seasons, which may exert some effect on the seasonal variation of prevalence and intensity of parasitic infestations.

Table 1. Sex wise occurence of helminth infestation in *R. rattus*.

Host	No. of host examined	No. of host infected	Total no. of parasite collected	Prevalence (%)	Intensity ± SD
Domestic rat					
Male	17	16	430	94.12	26.88 ± 12.27
Female	13	11	388	84.62	35.27 ± 8.68
Total	30	27	818	90	30.30 ± 10.53
Paddy field rat					
Male	10	9	100	90	11.11 ± 5.81
Female	10	8	610	80	76.25 ± 13.67
Total	20	17	710	85	41.77 ± 12.79

Table 2. Prevalence and intensity of each species of helminths in *R. rattus*.

Name of the parasites	No. of host examined	No. of host infected	Total no. of parasite collected	Prevalence (%)	Intensity ± SD
Domestic rat					
H. diminuta	30	4	46	13.33	11.5±4.51
H. nana		9	111	30	12.33±9.31
H. squamosa		23	485	76.67	21.09±13.28
H. taeniaeformis		15	67	50	4.47±3.25
S. obvelata		10	109	33.33	10.9±3.00
Paddy field rat					
E. cinetorchis	20	2	558	10	279±96.07
H. taeniaeformis		8	35	40	4.38±2.45
***Hymenolepis* sp.**		7	40	35	5.71±2.06
O. eurycephalum		10	77	50	7.7±4.47

Table 3. Distribution of helminth parasites in different organs of host (*R. rattus*).

Host	Location	Total no. of host examined	Total no. of host infected	Total no. of parasites collected	Prevalence (%)	Intensity ± SD
Domestic rat	Intestine	30	27	698	90	25.85±13.85
	Caecum		7	53	23.33	7.57±2.93
	Liver		15	67	50	4.47±3.38
Paddy field rat	Intestine	20	13	631	65	48.54±106.83
	Caecum		7	44	35	6.29±3.2
	Liver		8	35	40	4.38±2.45

Table 4. Single and concurrent helminth infestation in *R. rattus*.

	Domestic rat (30)		Paddy field rat (20)	
Type of infection	**No. of infected host**	**Prevalence (%)**	**No. of infected host**	**Prevalence (%)**
Single infection	3	10	8	40
Double infection	16	53.33	8	40
Triple infection	6	20	1	5
Multiple infection	2	6.66	-	-

Table 5. Occurrence of helminths infestation in different weight groups of *R. rattus*.

Weight groups (gm)	Total no. of host examined	Total no. of host infected	Total no. of parasites collected	Prevalence (%)	Intensity* ± SD
Domestic rat*					
1st 201-230	3	3	40	100	13.33±9.07
2nd 231-260	8	7	147	87.5	21±13.61
3rd 261-290	8	8	263	100	32.88±11.64
4th 291-320	7	6	243	85.71	40.5±22.84
5th 321-350	4	3	125	75	41.67±15.30
Paddy field rat					
1st 171-200	2	1	8	50	8
2nd 201-230	3	3	28	100	9.33±6.66
3rd 231-260	6	4	47	66.67	11.75±5.06
4th 261-290	7	7	608	100	86.86±138.30
5th 290-320	2	2	19	100	9.50±.71

*P<0·05=Significant association between body weight and intensity in domestic rats.

Table 6. Seasonal occurrence of helminth infestation in *R. rattus*.

	Domestic rat					Paddy field rat				
Seasons	**Total no. of host examined**	**Total no. of host infected**	**Total no. of parasites collected**	**Prevalence (%)**	**Intensity ± SD**	**Total no. of host examined**	**Total no. of host infected**	**Total no. of parasites collected**	**Prevalence (%)**	**Intensity ± SD**
Summer (June-Aug)	9	8	262	88.89	32.75 ±9.5	6	5	44	83.33	8.8 ±5.36
Autumn (Sep-Nov)	9	7	269	77.78	38.43 ±14.7	6	6	393	100.00	65.5 ±139.38
Winter (Dec-Feb)	6	6	73	100	12.17 ±10.19	6	4	45	66.67	11.25 ±5.42
Spring (Mar-May)	6	6	214	100	35.67 ±10.98	2	2	228	100.00	114 ±137.18

4. Conclusions

In the present study, *E. cinetorchis*, *H. nana* and *H. diminuta* were found in the rats captured from domestic and paddy field habitats. These parasites may pose risk of parasitic zoonosis and may create a risk for human. As house rats are usually infected with a number of zoonotic parasites, hence control of these animals is important to ensure the well-being of human.

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Conflict of interest

None to declare.

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