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Prevalence of intestinal and blood parasites among wild rats in Kuala Lumpur, Malaysia

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Abstract. A survey was undertaken to investigate the prevalence of intestinal and blood parasites among wild rats in urban area of Kuala Lumpur, Malaysia. A total of 137 stool and blood samples were collected from wild rats from Sentul and Chow Kit areas. Five species of rats were captured and supplied by Kuala Lumpur City Hall. The most common was *Rattus rattus diardii* (Malayan Black rat), 67%, followed by *Rattus norvegicus* (Norway rat), 10%, *Rattus argentiventer* (rice-field rat), 10%, *Rattus tiomanicus* (Malaysian field rat), 9% and *Rattus exulans* (Polynesian rat), 4%. *Rattus rattus diardii* is commonly known to live in human environment and they are normally identified as pests to human community. More male rats were captured (61%) compared to female (39%). Out of 137 samples, 81.8% samples were positive with intestinal parasites, with 86.2% from Sentul area and 78.5% from Chow Kit area. Six different parasites were detected. The most common intestinal helminth parasite detected was *Nippostrongylus brasiliensis* (80.3%), followed by *Hymenolepis nana* (23.4%), *Capillaria hepatica* (13.9%) and *Hymenolepis diminuta* (2.9%). Intestinal protozoan detected was *Entamoeba histolytica/E. dispar* (8.8%). *Trypanosoma lewisi* (1.5%) was the only blood parasite detected.

INTRODUCTION

Rats are highly successful in adapting to many environments throughout the world. There are more than 1700 species of rodents identified in the world. Rodents form the largest group of mammals in Malaysia. They act as reservoir host for many zoonotic pathogens including parasites that pose a health risk to humans (Paramasvaran *et al.*, 2009).

Many studies have been done on the prevalence of parasites among wild rats throughout the world. Tung *et al.* (2009) examined 95 rodents and shrews from different localities of Taichung, Taiwan. The overall prevalence of parasites was 93.7%. Easterbrook *et al.* (2008) examined 162 rats in Baltimore, Maryland, USA. Endoparasites detected were mainly *Nippostrongylus braziliensis* (71.6%) and *Hymenolepis diminuta* (34.4%). Elshazly *et al.* (2008) studied the prevalence of helminths in rodents in Egypt. The overall prevalence of helminths was 52.8%. The commonest cestode detected was *H. diminuta* and the commonest nematode detected was *Capillaria hepatica*.

In Malaysia, the first recorded prevalence of parasite in wild rats was reported by Adams in 1933 (Adams, 1933). Singh & Chee-Hock (1971) examined 999 feral rats and 450 were positive for nematode parasites. Then in 1977, Liat *et al.* (1977) reported the prevalence of *C. hepatica* infection in wild rodents collected from the States of Kelantan, Selangor and Johore in peninsular Malaysia. *Capillaria hepatica* appears to be widespread throughout Malaysia with a wide range of hosts among rodent species. Leong *et al.* in 1979 examined 151 house rats, *Rattus rattus diardii* from five different localities, Jinjang, Dato Keramat, Kuala Lumpur, Sungai Besi and

Selayang Baru, for parasites. Nineteen species of parasites were recovered. *H. diminuta* and *N. brasiliensis* were the predominant species (Leong *et al.*, 1979). Paramasvaran *et al*. in 2009 studied 97 rodents collected from five wet markets (Chow Kit, Dato Keramat, Setapak, Jinjang and Kepong) in Kuala Lumpur. A total of 17 different species of parasites were identified from three species of rats. Up to date, none of the above studies reported blood parasite, *Entamoeba histolytica/E. dispar* in the rats.

The main objective of this study was to conduct a complete study on the prevalence of intestinal and blood parasites in wild rats in Kuala Lumpur. The results should facilitate evaluation of the endemic level of these parasites in rats and to evaluate the infection risk to human.

MATERIALS AND METHODS

Sample collection

A total of 137 rats were captured mostly from wet markets in Sentul (58) and Chow Kit (79), Kuala Lumpur, Malaysia by Kuala Lumpur City Hall workers (Dewan Bandaraya Kuala Lumpur, DBKL) between June 2011 until end of July 2011. Steel wire traps (28cm x 18cm) were used and baited with tapioca and dried fish. These rats were collected the night before and were examined immediately the following morning. Morphometric measurements were taken, together with records of length and fur colour, to assist in species identification. The dissection was performed at the Pusat Kurungan Haiwan, Jalan Air Jernih, Taman Air Panas, Kuala Lumpur. Trapped rats were killed humanely by placing them into a cloth bag containing cotton wool soaked with chloroform. The rats were disposed off by DBKL. The percentage of male rats captured were higher (61%) than female (39%). Out of 137 samples, 112 (81.8%) samples were positive with intestinal parasites with 86.2% (50 out of 58) from Sentul area and 78.5% (62 out of 79) from Chow Kit area. The prevalence of intestinal parasites were more frequent in male rats than female rats, 83% (70 out of 84) and 79% (42 out of 53) respectively. According to the general age group, higher prevalence were among juveniles 95.7% (22 out of 23) compared to adults, 78.9% (90 out of 114). Stool samples were collected from rectum using a scoop and placed immediately into the screw-capped stool container. Blood was collected from the heart using a needle and syringe and placed into EDTA bottle. A drop of blood was used to make a thin blood smear. The samples were transported back to Department of Parasitology, Faculty of Medicine, University of Malaya. Stool samples were preserved in 5% potassium dichromate to avoid fungal growth and stored in cold room at 4°C before being processed.

Sample examination

Keys and illustrations used to identify the rodent species were those of Harrison (1962) and Medway (1969). All stool samples were examined microscopically by both saline and iodine wet mounts. Saline wet mounts was made by mixing approximately 2 mg of stool with a drop of saline on a glass microscope slide. Similarly, iodine wet mount was prepared by adding approximately 2 mg of stool to a drop of Lugol's iodine on a glass microscope slide and placing a cover slip on the stool suspension. These wet mounts were microscopically examined initially by using a low-power (10×) objective and then using a high-power (40×) objective of a compound light microscope. Thin blood smear was made and stained with Giemsa and examined microscopically. The study protocol was approved by the Ethics Committee of Animal House (Pusat Haiwan Makmal), University of Malaya, Malaysia (Ethic Ref. No.: PAR/20/09/2011/JI (R).

RESULTS

A total of 137 wild rats' stool and blood samples were collected from Sentul and Chow Kit areas in Kuala Lumpur, Federal Territory of Malaysia. Five rat species were captured by Kuala Lumpur City Hall. The most common was *R. rattus diardii* (the common house rat/Malayan black rat) (67.2%). The house rat is one of the principal domestic pests in urban Malaysia, commonly seen

nesting in fields and bushes near human habitations (Harrison, 1962). They are reservoirs for a number of parasites (Leong *et al.*, 1979; Sinniah, 1979) and pose a threat as a potential disseminator of plague, scrub and murine typhus, tularaemia and bartonellosis. This was followed by *R. norvegicus* (Norway rats) (10.2%). Norway rat is found wherever food and shelter are abundant. They are aggressive and extremely adaptable to a wide range of conditions. They are found in towns, cities, and rural areas. They may be found in barns, fields, ditches, corn cribs, and dumps. They often burrow in the ground beneath protective cover (Linzey, 1995). Next was *R. argentiventer* (rice-field rat) (10%), primarily resides in cultivated areas such as rice fields and grasslands. It is largely dependent on human rice fields and plantations for survival. Rice field rats take shelter in burrows in soil, under rocks, and in logs (Kennedy, 1999). *Rattus tiomanicus* (Malaysian field rat) (8.8%) is a highly arboreal species that inhabits secondary forest and is a serious pest of oil palm plantations in peninsular Malaysia, feeding on the ripening fruit (Wood & Chung, 1990). The least species captured was *R. exulans* (Polynesian rat) (4.4%). These rats can live in a wide range of habitats including grassland, scrub and forest, however they do require adequate food supplies and shelter (Taylor, 1975).

The percentage of male rat captured was higher (61%) than female (39%). The infections were more frequent in male than female, 83% and 79% respectively. According to the general age group, juvenile was more prevalent with 95.7% compared to adult, 78.9%. Out of 137 samples, 81.8% were positive with intestinal parasites. The highest prevalence was *N. brasiliensis*, 80.3%, followed by *Hymenolepis nana*, 23.4%, *C. hepatica*, 13.9% and the least was *H. diminuta*, 2.9%. The only intestinal protozoan detected was *E. histolytica/E. dispar*, 8.8%. *Trypanosoma lewisi* (1.5%) was the only blood parasite detected (Table 1).

DISCUSSION

Nippostrongylus brasiliensis (rat's hookworm) was the most common intestinal parasite detected in this study among wild rats in urban area of Kuala Lumpur, Malaysia. This nematode was also reported by many previous studies among wild rats in Belgrade (Kataranovski *et al.*, 2011), Taiwan (Tung *et al.*, 2009), Baltimore, Maryland, USA (Easterbrook *et al.*, 2008) and Kuala Lumpur wet market, Malaysia (Paramasvaran *et al.*, 2009). It was also found in the wood rat *R. tiomanicus* in West Malaysia (Krishnasamy *et al.*, 1980), and Chiangmai, Thailand (Namue & Wongsawad, 1997). It was also reported among house rats, *R. rattus diardii* from Sungai Besi area, Kuala Lumpur in 1979 (Leong *et al.*, 1979).

Hymenolepis nana (the dwarf tapeworm) was the most common cestode detected in this study. Other researchers also

Table 1. Prevalence of intestinal and blood parasites among wild rats in Kuala Lumpur

Parasites	Number of positive sample (n)	Prevalence (%)
Intestinal Helminthes		
Nippostrongylus brasiliensis	110	80.3
Hymenolepis nana	32	23.4
Capillaria hepatica	19	13.9
Hymenolepis diminuta	4	2.9
Intestinal Protozoa		
Entamoeba histolytica/E. dispar	12	8.8
Blood Protozoa		
Trypanosoma lewisi	2	1.5

reported this parasite in their studies among wild rats, in Sudan (Fagir & El-Rayah, 2009), Taiwan (Tung *et al.*, 2009), and Malaysia (Paramasvaran *et al.*, 2009) and among the wood rat in Malaysia (Krishnasamy *et al.*, 1980). *Hymenolepis nana* is the smallest tapeworm that infects human. Most patients infected are children due to swallowing of rat's flea which contains the infective cysticercoid stage. Mild infections are usually asymptomatic. Severe infection may cause headache, dizziness, pruritis, diarrhoea, restlessness or even convulsion in man (Sun, 1988).

Capillaria hepatica, the second commonest nematode reported in this study was also reported among rats in Belgrade (Kataranovski *et al.*, 2011), Taiwan, (Tung *et al.*, 2009), and Malaysia (Paramasvaran *et al.*, 2009). It causes a disease known as hepatic capillariasis, a zoonosis, mainly a disease of rats and is rarely seen in man. Cases have been reported in India, USA, Turkey, South Africa, Mexico and Brazil. Clinical features are acute or subacute hepatitis with eosinophilia. The cause of death is extensive liver damage or secondary bacterial infection. The major pathologic change is granulomatous inflammation in the liver (Sun, 1988). The disease is contracted by ingesting embryonated eggs in food and drink. In the animal host, the larvae hatch in the caecum, then penetrate the mucosa and find their way to the liver. Within 3 weeks, the parasites mature and start to lay eggs in the liver. The eggs remain in the liver until the host dies, whereupon they are released into the soil and become embryonated within 2-6 weeks. When the liver of an infected animal is eaten, the unembryonated eggs are discharged in the stool. This phenomenon is known as spurious infection and 19 cases were detected in this study.

Hymenolepis diminuta has also been reported among rats in Belgrade (Kataranovski *et al.*, 2011), Sudan (Fagir & El-Rayah, 2009), Baltimore, USA (Easterbrook *et al.*, 2008), in the city of Doha, Qatar (Abu-Madi *et al.*, 2005), Nigeria (Mafiana *et al.*, 1997), Kuala Lumpur, Malaysia (Leong *et al.*, 1979) and peninsula Malaysia (Krishnasamy *et al.*, 1980). Man acquires the infection in the same manner as *H. nana* that is via ingestion of infected intermediate host. Its infection may cause diarrhoea or occasionally cachexia in man (Sun, 1988).

Entamoeba histolytica/E. dispar was detected for the first time in the stool of the rats in Malaysia. *Entamoeba histolytica* was reported among wild rats caught in London. The naturally infected rats were restricted to a localized focus, in which cases of human amoebiasis were discovered, thus providing circumstantial evidence of the human origin of the infection, and throwing light on the possible role of rats as reservoir hosts (Neal, 1951). In severe amoebiasis, trophozoites invade the intestinal mucosa, enter the circulation and spread hematogenously causing development of extra-intestinal abscesses. Mostly it will end up in the liver causing amoebic liver abscesses. Brain and lung may be infected, but cases are rare. *Entamoeba dispar* is not pathogenic.

Trypanosoma lewisi is transmitted by fleas to rat and is the only blood parasite detected in this study. *Trypanosoma lewisi* normally infects rodents and utilize fleas as vectors. Rats are infected principally by oral route, through ingestion of flea faeces or fleas. *Trypanosoma lewisi* has been reported in numerous studies among wild rodents all over the world. Among black rats in Niger, West Africa (Dobigny *et al.*, 2011), *Rattus* and *Bandicota* species in Thailand (Jittapalapong *et al.*, 2008), free living rats in Poland (Karbowiak & Wita, 2001), *R. norvegicus* in Brazil (Linardi & Botelho, 2002), rats collected from different localities in northern Iraq (Molan & Hussein, 1988), and house rats in Ibadan (Akinboade *et al.*, 1981).

Although this trypanosome subgenus is considered non-pathogenic to rodents, on rare occasions it was reported to cause disease in humans. *Trypanosoma lewisi* is an animal species and is usually non pathogenic in humans but can acquire the desired virulence and emerge as human pathogen causing serious disease, in the right combination of environmental, host and organism related factors. Under the fast changing environmental scenario there is an urgent need to be prepared for these emerging zoonoses (Kaur

et al., 2007). *Trypanosoma lewisi* infection has been reported in infants including a 45-day-old Thai infant displaying fever, anaemia, cough and anorexia (Sarataphan *et al.*, 2007). It was also reported in a two months old infant in urban Mumbai, India (Kaur *et al.*, 2007) and in a 4-month-old Malaysian infant with a 3-week history of lassitude, loss of appetite, feverish and anaemic with a heavy trypanosome infection upon admission (Johnson, 1933). Weinman disagree that this was *Trypanosoma lewisi* and he thought that Johnson's patient may have been infected with the trypanosomes of primates (Weinman, 1970). Recently, trypanosomes of *T. lewisi* were observed in the peripheral blood smear of a 37-day-old Indian infant admitted off feeds, with fever and convulsions (Verma *et al.*, 2011).

Rats being closely associated with man harbours many different kinds of intestinal and blood parasites and serve as great potential for zoonotic infections to man. This study as well as previous studies clearly shows that control of domestic rats is of prime importance in the prevention and control of zoonotic infections in man.

This study clearly showed that intestinal parasites are highly prevalent in rats in the urban city of Kuala Lumpur, Malaysia. The ever increasing in the amount of garbage collected and the rise in the number of slums in big cities contribute to the high prevalence of rats. The close proximity of man with rats in housing areas may contribute significantly to the spread of many zoonotic diseases.

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