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Prevalence of *Hymenolepis* spp. in House Mice in Baghdad City, Iraq

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A B S T R A C T

The prevalence of house mice (*Mus musculus*) Hymenolepiasis was determined in Baghdad, Iraq to study the effects of location, sex, and months on the infection rate of *Hymenolepis* spp. in house mice. Fifty house mice were captured from Abu Ghraib and Al-Ameriya, Baghdad, Iraq and examined for detecting parasites in laboratory in College of Veterinary Medicine, University of Baghdad. The total infection prevalence of intestinal parasites was 11 (22%) out of 50 samples, the higher prevalence was 28.57% and found in Abu Ghraib area, while lower was (13.63%) and recorded in Al-Ameriya area. The study revealed that the house mice were infected with two species of *Hymenolepis*: *Hymenolepis nana* 4 (8%) and *Hymenolepis diminuta* 7(14%). The intestinal parasites revealed a significance prevalence value ($P<0.05$). There was statistical difference in between males and females in parasites infection, in which the higher rate was 8 (27.58%) and recorded in males and the lower was 3 (14.28%) and observed in females. The monthly distribution of confirmed cases over a 9-month period revealed that reported cases of house mice and Hymenolepiasis increased significantly ($P<0.01$) in autumn (65.44%), followed by winter (15.38%), and summer (13.33%). The findings showed that house mice play an important role in the spread of zoonotic parasitic illnesses to people, as well as attention must pay to public health.

Keywords: prevalence, house mice, *Hymenolepis nana*, *Hymenolepis diminuta*

INTRODUCTION

The house mouse (*Mus musculus*) and the black rat (*Rattus rattus*) are two of the most widespread mammals in the world (1). These species are serious pests in urban and rural environments. They are the cause of extensive economic damage to crops, stored food, farms, industries, and households (2). Rats and mice act as definitive hosts of *Hymenolepis diminuta* (3, 4) and it is found in humans only occasionally, since it needs an arthropod to complete its life cycle (4). In general, cestodes of the genus *Hymenolepis* require arthropod intermediate hosts in their life cycle, except for *Hymenolepis* nana *H. nana*, which is the only cestode known to be transmitted directly to another definitive host, in rodents. Light infections with *Hymenolepis* are usually non-pathogenic, but heavy infections can cause acute catarrhal enteritis or chronic enterocolitis (5). *Hymenolepis nana,* is also able to complete its entire life cycle in a single host and is therefore capable of autoinfection (6). *Hymenolepis nana,* in different rodents, such as rats and mice, is morphologically similar to human *H. nana* (7). *H. diminuta* in rats is transmitted by arthropod vectors. The affected rodents show inappetence, dullness, weakness, loss of body weight, pale mucous membrane, rough hair coat and mortality (8). Eggs of *H. diminuta* are released in faces of the infected host. Mature eggs of the tapeworm are ingested by an intermediate host (various arthropod adults or larvae). The oncospheres are released from the eggs and penetrate the intestinal wall of the arthropod and develop into cysticercoid larvae. The

definitive host acquires infection by ingestion of the infected arthropods. Occasionally, humans are infected by accidental ingestion of the infected arthropods, and thus *H. diminuta* has a zoonotic significance (9-11). Sharma et al. (12) showed that the rodents were infected with two species of cestodes *H. nana* (11.42%) and *H. diminuta* (5.71%) in mice. Panti-May et al. (13) who stated that *Hymenolepis diminuta* was the most prevalent pathogen among rodents (5.6%). Black rats were more frequently infected with *H. diminuta* (14.2%) than house mice (0.5%). Panti-May et al. (14) found that the infection with *H. diminuta* was more prevalent in *R. rattus* (14.1%) than in *M. musculus* (0.6%) in Yucatán, Mexico. Moreover, Al-Bajalan (15) reported that only one house mouse was found infected with *H. nana* with infection rate of 0.85% (one out of 117) and none of the mice were found infected with *H. diminuta* in Kalar district, Sulaymaniyah province, Iraq.

The aim of this study was to investigate Hymenolepididae species found in house mice, to evaluate location, sex, and season factors that related to infection rate.

MATERIALS AND METHODS

Fecal Sample Collection

Fifty house mice (*Mus musculus*) were trapped from bakeries, grain storage factories, and farms, located at districts of Baghdad city Abu Ghraib, Al-Amiriya area including College of Veterinary Medicine, University Baghdad during the period from the beginning of December 2019 to the end of November 2020 from two different area of Baghdad city. All samples of house mice were brought to the laboratory and 5grams of fecal sample was examined for detecting eggs and worms (*Hymenolepis* spp.) in Parasitology Laboratory located at the College of Veterinary Medicine, University of Baghdad (16).

Dissection and Collection of Parasites

The following day trapped house mice were killed humanely by anesthesia (9:1, ketamine concentration 10% (Germany) and xylazine concentration 20% per 10 g (Holland). Mice body weights were taken after the animal held from tail and an intraperitoneal injection of anesthetic was given as accorded by (17). Fecal samples fixed in formalin 10% (Germany) were further processed by concentration technique using formalin-ethyl acetate 10% (Germany) to detect eggs. Cestodes were collected directly from the intestine and kept in separate plastic containers, and the samples were transported to Parasitology Laboratory located at the College of Veterinary Medicine, University of Baghdad for identification. Permanent slides were prepared and stained with acetocarmine acid (manufacturers, USA) dehydrated in different grades of alcohols, cleared in xylene (China), and mounted on slides by Canada balsam (USA). Cestodes were morphologically identified under microscope using the taxonomic keys described previously (18).

Statistical Analysis

The Statistical Analysis System-SAS (19) program was used to detect the effect of difference factors in study parameters. Chi-square test was also used to significantly compare between percentage (0.05 and 0.01 probability) in this study.

RESULTS AND DISCUSSION

Eleven out of 50 (22%) house mice, examined by formalin-ethyl acetate (concentration technique) and acetocarmine acid staining, were found infected with Hymenolepiasis with significance differences ($P<0.05$) (Table 1). The higher prevalence was 8/28 (28.57%) and found in Abu Ghraib area, while the lowest was 3/22 (13.63%) and recorded in Al-Ameriya area. Also *H. diminuta* showed higher infection rate 7/50 (14%) with significance differences ($P<0.05$) in comparison to *H. nana* 4/50 (8%) with no significance differences. The overall prevalence rate of this study was 22%, the results of the present study are in agreement with (20) who reported that the overall prevalence rate getting closer with this study in mice was 25.71%. Also, (21) who recorded that the infection with cestodes was 19%. While this study disagrees with (22) who found that the overall prevalence rate of House mice *M. musculus* infection with cestode was 47 (13.6%) and (23) who recorded that the overall prevalence rate in mice was (61.64%). In this study, the intestinal infection of mice with zoonotic *H. diminuta* (14%) and *H. nana* (8%) agreed with studies of (24) who reported that the higher infection rate was with *H. diminuta* 13.5%, and the lower was with *H. nana* 8.1%. Also (22) who stated that the higher prevalence rate of infection with *H. diminuta* was (7.3%) than *H. nana* in house mice and rat was (3.5%).

The results of the present study disagree with (20) who reported that higher infection rate of *H. nana* in house mice was 4 (11.42%) than *H. diminuta* was 2 (5.71%) in Uttarakhand, India. So (25) who conducted in a study in house mice in Taiwan, that 63% of them were infected with *Hymenolepis nana* and (26) who found that the infection with *H. diminuta* was more prevalent in *R. rattus* (14.1 %) than in *M. musculus* (0.6%). Also, (27) reported that *H. diminuta* was the most prevalent pathogen among rodents, and black rats were more frequently infected with *H. diminuta* (14.2%) than house mice (0.5%). The difference in the infection rates could be due to the geographical divergences between middle and other parts of Iraq and public health crises following civil war since 2003 (28).

Table 1. Prevalence of house mice Hymenolepiasis according to areas of study

Area	No. examined	Infection			
		No.	%	*H. nana* No. (%)	*H. diminuta* No. (%)
Abu Ghraib	28	8	28.57	3 (10.71)	5 (17.85)
Al-Ameriya	22	3	13.63	1 (4.540)	2 (9.090)
Total No.	50	11	22.00	4 (8.000)	7 (14.00)
χ^2			5.63 *	2.33 NS	4.28 *

*$P \leq 0.05$

Our results revealed differences in the infection rates of house mice Hymenolepiasis according to sex. Eight out of 29 males examined (27.58%) were positive; whereas 3 out of 21 females examined (14.28%) were positive with *Hymenolepis* spp. Moreover, the results of the present study also revealed the differences in percentage of positive samples according to the sex. However, males showed higher percentage rate (27.58%) than females (14.28%) in house mice with significance differences ($P<0.05$) (Table 2). This result agrees with those observed by (29) who referred that the prevalence rates of male were higher than female; 76.6% and 54.5% in India, respectively. Further, (21) who recorded that infection in male rodents was higher than female 62.06% and 37.94%, respectively. Also, (30) reported that the prevalence rate in males were higher than females (83.33% and 47.61%, respectively); (15) who stated the prevalence in males of house mice were higher than females 1.49% and 0.0%, respectively in Kalar district, Sulaymaniyah province; (31) who referred that the prevalence rates of rodent male were much higher than female 15.9% and 7.80%, respectively; so (32) who found the prevalence in male were higher than female 61.8% and 38.2% respectively. On the other hand, this result disagrees with (3333) who mentioned that *Hymenolepis* spp. infection rates of male were less than female 37.7% and 62.4%, respectively. Also, (34) who recorded that parasite infection rate of male were less than female, could be related to suppressed immune response of female during pregnancy.

The results of monthly distribution of confirmed cases for the season period from December 2019 to December 2020 are illustrated in Table (3). The reported cases of house mice Hymenolepiasis increased in autumn 54.54% following by winter was 15.38% then summer was 13.33% with significance differences ($P<0.01$). The results of the present study are compatible with (35) who mention that the prevalence in the warm season reached 60%, and only reached the 10% in winter, where H. diminuta had higher abundance in summer. It is likely that unfavorable environmental conditions negatively affect the intermediate host populations in colder months (36).

Table 2. Prevalence of house mice Hymenolepiasis according to sex

Sex	No. examined	Infection			
		No.	%	*H. nana* No. (%)	*H. diminuta* No. (%)
Male	29	8	27.58	3 (10.34)	5 (17.24)
Female	21	3	14.28	1 (4.760)	2 (9.520)
Total No.	50	11	22.00	4 (8.000)	7 (14.00)
χ^2			5.11 *	2.73 NS	3.08 NS

*$P \leq 0.05$

Table 3. Prevalence of house mice Hymenolepiasis according to season

Season	No. examined	Infection			
		No.	%	*H. nana* No. (%)	*H. diminuta* No. (%)
Winter	13	2	15.38	1 (7.69)	1 (7.690)
Summer	15	2	13.33	1 (6.66)	1 (6.660)
Autmn	22	7	31.81	2 (9.09)	5 (22.72)
Total No.	50	11	22.00	4 (8.00)	7 (14.00)
χ^2			6.04 **	0.871 NS	6.44 **

**$P \leq 0.01$

Ahmad et al. (37) stated that the highest (48%) month-wise prevalence of *H. nana* and *H. diminuta* was found during August whereas the lowest (28%) was during January. Also, Gómez Muñoz et al. (38) who found that the helminths were significantly more prevalent in warm season which was (71%) higher than in cold season was (51%).The results of the present study are in disagreement with (38) who reported that the seasonal incidence was evident , appearing the highest prevalence of infested rats (91.3%) in autumn, this was notably lower in winter (14.2%), and

increased in summer (50%), and here were not animals captured to be compared in spring season.

In this study, the results showed that the trapped mice were infected with *Hymenolepis* species of parasites which is of zoonotic importance. This a significant public health risk to the humans residing in the study area. Therefore, there is need information on prevention and control of mice population. Further studies on mice associated zoonosis such as another parasite are also important.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

1. Battersby S. Hirschhorn RB, Amman BR. Commensal rodents. In: Bonnefoy X, Kampen H, Sweeney K, editors. Public Health Significance of Urban Pests. Copenhagen, Denmark: World Health Organization, Regional Office for Europe; 2008. p. 387-419.
2. Pimentel D, Zuniga R, Morrison D. Update on the environmental and economic costs associated with alien-invasive species in the US. Ecolo. Econ. 2005; 52: 273-288.
3. Mikhail MW, Metwally AM, Allam KA. Mohamed AS. Rodents as reservoir host of intestinal helminthes in different Egyptian agroecosystems. J Egypt Soc Parasitol. 2009; 39(2): 633-640.
4. Martínez-Barbabosa I, Gutiérrez-Cárdenas ME, Aguilar-Venegas JM, Shea M, Gutiérrez-Quiroz M, Ruíz-González LA. Infection por *Hymenolepis diminuta* enuna estudiant euniversitaria. Revista Biomédica. 2012; 23(2): 61-64.
5. Baker DG. Parasites of rats and mice. In: Baker DG, ed. Flynn's Parasites of Laboratory Animals, 2nd ed. Iowa: Blackwell Publishing. 2007; 303-397p.
6. Sirivichayakul C, Radomyos P, Praevanit R, Jojjaroen-Anant C,Wisetsing P. *Hymenolepis* nana infection in Thai children. J. Med. Assoc. Thailand, 2000; 83: 1035-1038.
7. Metwally DM, Al-Enezy HA, Al-Turaiki IM, El-Khadragy MF, Hany MYAl-Otaibi TT. Gene-based molecular characterization of cox1 and pnad5 in *Hymenolepis nana* isolated from naturally infected mice and rats in Saudi Arabia. Bioscience Report. 2019(39): 1-9.
8. Singh YD, Arya RS. Clinico-pathology, diagnosis, and management of *Cysticercus fasciolaris* and *Hymenolepis diminuta* co-infection in wistar rats, Vet. World. 2015; 8(1): 116-120.
9. Watwe S, Dardi CK. *Hymenolepis diminuta* in a child from rural area. Indian J. Pathol. Microbiol. 2008; 51(1): 149-150.
10. Karuna T, Khadanga S. A case of *Hymenolepis diminuta* in a young male from Odisha. Trop. Parasitol. 2013; 3(2): 145-147.
11. Saha R, Kaushik S, Gupta K, Das S. Human Infection with *Hymenolepis diminuta*: first case report from North India. J. Gastrointest. Infect. 2017; 7(1): 36-37.
12. Sharma D, Joshi S, Vatsya S, Yadav CL. Prevalence of gastrointestinal helminth infections in rodents of Tarai region of Uttarakhand J. of Paras. Dis.: Official Organ of the Ind. Soci. for Parasit. 2013; 37(2): 181-184.
13. Panti-May JA, Andrade RRC, Gurubel-González Y, Palomo-Arjona E, SodáTamayo L, Meza-Sulú J, et al. A survey of zoonotic pathogens carried by house mouse and black rat populations in Yucatan, Mexico, Epidemiol. Infect. 2018; 145: 2287-2295.
14. Panti-May JA, Palomo-Arjona E, Gurubel-González Y, Torres-Castro, MA, Vidal-Martínez VM, et al. New host, geographical records, and factors affecting the prevalence of helminths infection from synanthropic rodents in Yucatán, Mexico. J. of Helmi. 2017; 54 (3): 231-239.
15. Al-Bajalan MMM. Prevalence of intestinal cestode infections of conventionally maintained laboratory (albino) and house mice in Kalar district/Sulaymaniyah province. J. Uni. Garmian. 2019; 6(1): 566-575.
16. Battersby SA, Robin P, Webster JP. Urban rat infestations and the risk to public health. J. Environ. Health Res. 2002, 1(2): 57-65.
17. Struck MB, Andrutis KA, Ramirez HE, Battles AH. Effect of a short-term fast on ketamine-xylazine anesthesia in rats. J. Am. Assoc. Lab. Anim. Sci. 2011; 50(3): 344-348.
18. Palmer SR, Soulsby EJL, Torgerson PR, Brown DWG. Oxford textbook of zoonoses. Biology, clinical practice and public health control. 2nd ed. Newyork: Oxford University Press; 2011. 115 p.
19. SAS. Statistical Analysis System, User's Guide. Statistical. Version 9.1st ed. SAS. Inst. Inc. Cary. N.C. USA. 2012.
20. Sharma D, Joshi S, Vatsya S, Yadav CL. Prevalence of gastrointestinal helminth infections in rodents of Tarai region of Uttarakhand Journal of Parasitic Diseases: Official Organ of the Indian Society for Parasitology. 2013; 37(2): 181-184.
21. Pakdel N, Naem S, Rezaei F, Chalehchaleh AA. A survey on helminthic infection in mice (*Mus musculus*) and rats (*Rattus norvegicus* and *Rattus rattus*) in Kermanshah, Iran. Vet. Res. Forum. 2013; 4: 105-109.
22. Hasson RH. Zoonotic & nonzoonotic endoparasites of rodents from some districts in Baghdad. DJPS. 2010; 6(3): 102-112.
23. Milazzo C, Ribas A, Casanova JC, Cagnin M, Geraci F, Di Bella C. Helminths of the brown rat (*Rattus norvegicus*) (Berkenhout, 1769) in the city of Palermo, Italy. Helminthologia. 2010; 47: 238-240.
24. Mahmoud SN. Incidence and distribution of helminth parasites of the digestive tract of rats and mice of the family Muridae in Baghdad area [Thesis]. Baghdad, Iraq: University of Baghdad; 1974.
25. Chou CW, Lee PF, Lu KH, Yu HT. A population study of house mice (*Mus musculus castaneus*) inhabiting rice granaries in Taiwan Zool. Stud. 1998; 37(3): 201-212.
26. 14Panti-May JA, Palomo-Arjona E, Gurubel-González Y, Torres-Castro MA, Vidal-Martínez VM, Machain-Williams C, et al. New host, geographical records, and factors affecting the prevalence of helminths infection from synanthropic rodents in Yucatán, Mexico. Jurnal of Helminthologia. 2017; 54(3): 231-239.
27. Panti-May JA, Andrade RRC, Gurubel-González Y, Palomo-Arjona E, Sodá Tamayo L, Meza-Sulú J, et al. A survey of zoonotic pathogens carried by house mouse and black rat populations in Yucatan, Mexico, and Epidemiol. Infect. 2018; 145: 2287-2295.
28. Levy BS, Sidel VW. Adverse health consequences of the Iraq War. The Lancet. 2013; 381(9870): 949-958.
29. Goswami R, Somvanshi R, Singh SM, Sarman S. A preliminary survey on incidence of helminthic and protozoal diseases in rats. Indian J. Vet. Pathol. 2009; 33: 4750-4758.
30. Majeed ShA. Prevalence of intestinal parasites in *Rattus rattus* in some districts in Baghdad/Iraq. Al-Anbar J. Vet. Sci. 2016; 9(1): 43-48.
31. Khan W, Noor-un N, Rafiq N, Masood Z, Ahmed MS, Rahman HU, et al. Zoonotic and non-zoonotic helminths in black rats of rain-fed and irrigated areas of Swat, Khyber Pakhtunkhwa, Pakistan. Saudi J. of Biol. Sci. 2021; 28: 2285–2290.
32. Lima VFS, Rafael AN, Giannelli A, Andrade WWA, López IYT, Ramos ICN, et al. Occurrence of zoonotic gastrointestinal parasites of rodents and the risk of human infection in different biomes of Brazil. Brazil. J. of Vet. Med. 2021; 43, e113820.
33. Stojcevic D, Mihljevic Z, Marnculic A. Parasitological survey of rats in rural regions of Croatia. Vet. Med. Czech. 2004; 49(3): 70–74.

34. Engels G, Hierweger AM, Hoffmann J, Thieme R, Thiele S, Bertram S, et al. Pregnancy-related immune adaptation promotes the emergence of highly virulent H1N1 influenza virus strains in allogenically pregnant mice. Cell Host Microbe. 2017; 21(3): 321-333.
35. Hancke D, Navone GT, Suarez OV. Endoparasite community of *Rattus norvegicus* captured in a shantytown of Buenos Aires city, Argentina. Helminthologia. 2011; 48(3), 167–173.
36. Hancke D, Suarez OV. Infection levels of the cestode *Hymenolepis* diminuta in rat populations from Buenos Aires, Argentina. J. Helminthol. 2016; 90(2): 199-205.
37. Ahmad MS, Maqbool A, Anjum AA, Ahmad N, Khan MR, Sultana R, et al. Occurrence of *Hymenolepis diminuta* in rats and mice captured from urban localities of Lahore, Pakistan. J. Animal Plant Scien. 2014; 24(2): 392-396.
38. Gómez Muñoz MA, Robles MD, Milano AMF, Navone GT. Helminth infection levels on rattusrattus (rodentia: muridae) from corrientes city, argentina. Mastozoología Mastozool Neotrop. 2018; 25(1): 221-227.
39. Feliú C, López M, María S, Gómez MS, Torres J, Sánchez S, et al. Parasite fauna of rodents (Murinae) from El Hierro (Canary Islands, Spain): a multidisciplinary approach. Acta Parasitologica. 2012; 57(2): 171-178.

انتشار طفيلي الدودة الشريطية القزمة في الفئران المنزلية في محافظة بغداد، العراق

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الخلاصة

هدفت الدراسة الى تحديد انتشار مرض.Hymenolepiasis في الفئران المنزلية في بعض مناطق محافظة بغداد لدراسة تأثير الموقع والجنس والأشهر على معدلات الإصابة اعتمادا على المواصفات الشكلية لطفيلي *Hymenolepis* spp في الفئران المنزلية. تم اصطياد 50 فأر منزلي من بعض أحياء محافظة بغداد (أبو غريب والعامرية)، وتم فحصها في مختبر الطفيليات للكشف عن طفيلي *Hymenolepis* spp في كلية الطب البيطري جامعة بغداد. بلغت معدل انتشار الإصابة 11 (22٪) وكان أعلى اصابة 8 (28.57٪) في منطقة أبو غريب، بينما كانت اوطأ نسبة للإصابة 3 (13.63٪) في منطقة العامرية. وكشفت الدراسة أن نسبة الاصابة بطفيلي *Hymenolepis nana* 4 (8٪) و*Hymenolepis diminuta* 7 (14٪). أظهرت الاصابة وجود فروق معنوية عند ($P\leq0.05$). كشفت الدراسة عن وجود فروق معنوية بين الذكور والإناث حيث كانت اعلى اصابة 8 (27.58٪) في الذكور مقارنة بالإناث 3 (14.28٪). بينت الدراسة الموسمية اعلى اصابة في فصل الشتاء 7(31.81%) يليه فصل الخريف بنسبة 2 (15.38%) ثم 2 (13.33%) مع وجود فروق معنوية ($P\leq0.01$).
نستنتج من النتائج الى اهمية الفئران المنزلية في نقل الامراض والطفيليات المشتركة للإنسان اضافة الى ترويج وتعليم الانسان من خطر القوارض.

الكلمات المفتاحية: انتشار، فئران منزلية، *Hymenolepis nana*، *Hymenolepis diminuta*