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CAPILLARIA HEPATICA (*NEMATODE)* IN RODENTS OF THE LAHORE METROPOLIS CORPORATION – PAKISTAN

M. S. Ahmad, A. Maqbool[*], M. Mahmood-ul-Hassan[**], M. Mushtaq-ul-Hassan[***] and A. A. Anjum[****]

Provincial Diagnostic Laboratory, Livestock and Dairy Development Department, Lahore, 54000, Pakistan.
[*]Department of Parasitology, [**]Department of Wildlife and Ecology, [****]Department of Microbiology, University of Veterinary and Animal Sciences, Lahore
[***]Department of Zoology, Govt. College University Faisalabad
Corresponding author. e-mail: azhar2007m@yahoo.com;

ABSTRACT

A total of 3600 rodents were live-trapped from three different localities (1200 each) of the Lahore Metropolitans Allama Iqbal Town, Walled City and Railway Station and adjacent areas, and scanned for the prevalence of *Capillaria hepatica*. In each of these four types of structures were sampled for rats and mice namely residential houses (RH), flour mills (FM), fruit/vegetable shops (F/VS) and departmental stores/grocery shops (DS/GS). Majority of the trapped rodents included house rats *Rattus rattus* (n = 3190) with a few house mice *Mus musculus* (n = 410). Hepatic capillariasis was recorded in 7.0% of the rodents in Lahore city. The prevalence was statistically higher in females than in males and in adults than young animals. A significant difference was found in the infection rate between rats and mice. Similarly the infection rate varied significantly both monthly and seasonally and the peak prevalence was recorded during summer (10.8%). Inter-structure infection rate was non-significant.

Key words: C. hepatica, R. rattus, M. Musculus, Rodents, Hepatic Capillariasis.

INTRODUCTION

Rodents are well recognized as hosts and vectors of *Capillaria hepatica* (Amir *et al*., 2000; Stojcevic *et al*., 2002; Assis *et al*., 2004; Clavaria *et al*., 2005; Paramasvaran *et al*., 2005). The infection is transmitted to humans either through direct (Sambo *et al*., 2008) or indirect consumption of rat contaminated food (Rafique *et al*., 2009). Adult *C. hepatica* cause fatal infections in humans (Lammler *et al*., 1974; Berger *et al*., 1990) that may either be asymptomatic (Slais, 1973) or symptomatic associated with chronic fever, hypereosinophilia, hepatomegally, necrosis and fibrosis of liver (Choe *et al*., 1993; Davoust *et al*., 1997).

The prevalence of *C. hepatica* in rodents has been studied extensively in different parts of Asia (Liat *et al*., 1977; Bhattacharya *et al*., 1999; Sinniah *et al*., 1999; Xiong *et al*., 1999; Rasti *et al*., 2000; Tadahisa *et al*., 2000; Claviaria *et al*., 2005; Paramasvaran *et al*., 2005) but little is known in rodents of Pakistan. Similarly, the role of Norway rat (*Rattus norvegicus*) as vector of *C. hepatica* is well documented (Dubey and Frankel, 1998; Ceruti *et al*., 2001; Stojcevic *et al*., 2002) but of the house rat (*Rattus rattus*) and the house mouse (*Mus musculus*) populations inhabiting urban areas of Pakistan has not yet been explored. Studies conducted by Hayat and Akhtar (1991), Khatoon *et al*. (2004) and Mushtaq-ul-Hassan *et al*. (2008) do not provide any information on the prevalence of *C. hepatica* in rodents. Furthermore, no such study has ever been conducted in Lahore which is the second most populous city of Pakistan after Karachi. Keeping in mind this gap of knowledge, present study was designed to investigate the prevalence of *C. hepatica* infection in rodent populations inhabiting various urban localities of the Lahore metropolis.

MATERIALS AND METHODS

Study site: Three localities of Lahore metropolis were studied for the prevalence of *C. hepatica* in rats and mice. These included (a) Allama Iqbal Town, (b) Walled City of the Lahore, and (c) the metropolitan areas adjacent to the Lahore Railway Station. Allama Iqbal Town is the most developed area among these localities. This colony caters the needs of a modern lifestyle and inhabited by a rich and well educated segment of the society. The Walled city, on other hand, is the oldest part of the Lahore metropolis whose architecture dates back to Mughal dynasty. This area occupies whole-sale markets, inhabited by high income, low education level segment of the society and is characterized with poor sanitation facilities. The part of Lahore lying adjacent to the Lahore Railway Station is the least developed and is inhabited by the low income, low education level segment of society. Thus the Allama Iqbal Town was at the top, the Walled City in the middle while Railway Station at the bottom with respect to socio-economic status of the people.

Trapping of the rodents: Four types of structures viz., residential houses (RH), flour mills (FM), fruit /vegetable

shops (F/VS), and the departmental stores/grocery shops (DS/GS) were sampled for rats and mice populations in each of the three localities. Twenty five live traps were set at each of these structures per night per month. The traps were baited with bread soaked in cooking oil, fresh vegetables, fruits and peanut butter. The traps were set at dusk and collected at next dawn. A total of 3190 specimens of house rats and 410 of house mice were trapped. Each live trap with captured animal was tagged indicating locality, structure and date of collection. Each specimen was physically restrained as mentioned by Jann *et al*. (2003) to determine its species and age group (Roberts, 1997).

Examination of the liver: After being euthanized with ether, each animal was dissected and its viscera along with liver were removed from the carcass and kept separately in dissecting dish having tap water. Liver of each specimen was examined for the presence or absence of metacestodes of *C. hepatica*. In order to detect eggs, adult or larval stages of *C. hepatica,* each liver were inspected microscopically. When lesions were noted, further examination was performed by impression smear (Stojcevic *et al*., 2004) for the presence of the typical bipolor eggs, adults or larval stages. All livers without lesions were artificially digested (0.5% pepsim, 1% HCl).

Statistical analysis. χ^2 test was applied to compare month-wise, season-wise, structure-wise, age-wise, sex-wise and species-wise difference in the prevalence of *C. hepatica*. SPSS v 13 was used for this purpose.

RESULTS

A total of 3600 live specimens comprising rats (n = 3190) and mice (n = 410) were scanned for *C. hepatica* infection and 7.0% (n = 251) were found to be positive. The infection rate was highest in the rodents captured from FM (8.0%) and lowest in those from DS/GS (6.3%). The prevalence rate of this infection at RH and F/VS was 6.6% and 7.0%, respectively. The highest monthly prevalence was recorded during August at all the four structures sampled for rats and mice. It was 12.7% at RH, 13.3% at FM, 14.7% at F/VS and 10.7% at DS/GS (Fig. 1). Inter-structure variation in the prevalence rate was statistically non-significant. The lowest monthly prevalence was recorded during January (1.3%), December (4.0%), April (2.7%) and November (2.7%), at RH, FM, F/VS and DS/GS, respectively. The combined season-wise prevalence (Fig. 1) was the highest during summer (10.8%) that was followed by autumn (6.0%), spring (6.2%) and winter (4.9%). The lowest infection rate was recorded during winter (3.1%) at RH while the highest during summer (12.0%) at FM. The infection rate for the remaining three structures was also highest during summer. It was 11.1% at RH, 10.2% at F/VS and 9.8% at DS/GS (Fig. 1). The combined monthly and seasonal prevalence of *C. hepatica* was statistically significant.

Of the 3600 rodents, 8.4% of the females (n = 173) and 5.1% of the males (n = 78%) were found to be infected (Fig. 2). The combined sex-wise infection rate in all structures was statistically different. The infection rate for males was 4.8, 5.9, 5.4 and 4.2% at RH, FM, F/VS and DS/GS whereas in case of females, it was 7.9, 9.4, 8.1 and 8.0% at RH, at FM, at F/VS at GS / DS. The infection rate was higher in adults (7.7%) than in young (1.2%) and difference was significant. None of the young rodents caught from RH was infected (Fig. 2). The infection rate in young trapped from FM, F/VS and DS/GS of the Lahore was 0.9, 1.8 and 1.7%, respectively. The adults caught from all the four structures were infected. The highest infection rate in adults was recorded from FM (9.0%) which was followed by 7.7% in F/VS, 7.2% in RH and 7.0% in DS/GS.

The infection rate was higher in rats (7.3%) than mice (4.6%) but the difference was statistically non-significant (Fig.2). The infection rate in mice was highest (5.3%) in those captured from DS/GS (5.3%), followed by RH (5.0%), FM (4.4%) and F/VS (4.0%), where as the house rats inhabiting FM were the most infected (8.6%).

Locality-related variations in the prevalence of *C. Hepatica*

Allama Iqbal Town. Of the 1200 rodents captured from Allama Iqbal Town 5.4 % (n = 65) were infected with *C. hepatica*. The infection rate was the highest in the rodents captured from FM (6.7%) and the lowest in those captured from DS/GS (4.3%). Inter-structure variation in the prevalence of the disease was non-significant. The combined season-wise prevalence during summer was 8.7% that was followed by autumn (5.3%), spring (4.7%) and winter (3.0%). The difference in the seasonal prevalence was statistically significant. The infection rate was the lowest (1.3%) during winter at RH and the highest (10.7%) at flour mills during summer (Fig. 3). The infection rate was highest during summer at all the four structures. It was 9.3% at RH, 10.7% at FM, 8.0% at F/VS and 6.7% at DS/GS of the Allama Iqbal Town (Fig 3). Females (6.7%) were more infected than males (3.7%) (Fig. 4) and the difference was statistically significant. The infection rate in both males and females was 4.5%, 5.1%, 4.1% and 1.5%, and 6.0%, 7.6%, 6.2% and 6.7% at RH, FM, F/VS and DS/GS, respectively. None of the young caught from RH, F/VS and DS/GS was infected. The highest infection rate (7.5%) in adults was recorded from the FM which was followed by 6.1% in F/VS, 5.8% in RH and 4.8% in DS/GS. The adults (6.0%) were significantly more infected than young (0.7%). The infection rate was higher in rats (5.7%) than in mice (3.1%). It was the highest (3.85%) in mice captured from FM, followed by DS/GS (3.6%) and F/VS (2.8%) where as in case of the house rats; the rodents inhabiting the FM

were the most infected. The overall difference in the infection rate between rats and mice was however statistically non-significant.

Walled City: A total of 8.6% rodents (n = 104) were positive for *C. hepatica* in the Walled City. The highest infection rate (9.3%) was recorded at FM which was followed by F/VS (8.7%), RH (8.3%) and DS/GS (8.3%). The prevalence rate was non-significant at the four structures. Monthly variation in the infection rate was significantly different. The highest prevalence was recorded during summer (12.0%) that was followed by spring (8.0%), autumn (7.3%) and winter (6.7%). These seasonal variations was significantly different. The lowest infection rate (5.3%) was recorded in winter from both the RH and FM whereas the highest infection rate (13.3%) was recorded during summer at FM.

The prevalence rate was statistically higher in females (10.5%) than in males (6.3%). In case of males, the prevalence rate was highest at F/VS (7.3%) followed by FM (6.4%), DS/GS (6.1%) and RH (5.4%) whereas in case of females the highest prevalence was recorded at FM (11.9%) which was followed by RH (10.7%), DS/GS (10.1%) and F/VS (9.6%). In case of young, the infection rate was 2.3% at F/VS and 2.0% at DS/GS. None of the young was infected at RH and FM. The highest rate of infection in adults was recorded at FM (10.6%), followed by F/VS (9.7%), DS/GS (9.6%) and RH (9.0%). The overall prevalence rate of this disease in young was significantly lower (1.3%) than in adult (9.7%). The rats (9.1%) were non-significantly more infected than mice (6.21%). The house rats captured from FM (10.0%) were the most infected. The infection rate in mice was lowest (5.4%) at F/VS and highest at DS/GS.

Railway station/adjacent areas: A total of 82 (6.83%) rodents were found positive for C. hepatica at Railway station/adjacent areas. Of these 24 (8.0%) were captured from FM, 21 (7.0%) from F/VS, 19 (6.3%) from DS/GS and 18 (6.0%) from RH. The inter-structure difference was however statistically non-significant. The prevalence rate was 11.0% in summer, 6.0% in spring, 5.3% in autumn and 5.0% in winter and the difference was statistically significant. The infection rate at RH, FM, F/VS, and DS/GS was the highest during summer. It was 10.7%, 12.0%, 10.7% and 10.7%, respectively (Fig. 3). The lowest infection rate was observed in winter at RH (2.7%) and DS/GS (4%), in spring (5.3%) and autumn (5.3%) at F/VS while it was 6.7% for FM during winter, spring and autumn (Fig. 3).

The infection rate was higher in females (8.0%) than in males (5.2%), in adults (7.5%) than in young (1.6%) and rats (7.1%) than in mice (3.9%). Sex and age-related variation in the prevalence of *C. hepatica* was significant but species-wise difference was non-significant. The highest prevalence in both males (6.3%) and females (9.0%) was recorded at FM and the lowest was recorded at RH. All the young captured from RH and FM were free of *C. hepatica* infection while only a single young captured from F/VS (3.0%) and DS/GS (2.7%) was infected. In case of adults, the highest prevalence was recorded at FM (8.8%) and the lowest at RH (6.69%). The infection rate in mice and rats was 5.26% and 6.1% at RH, 3.03% and 8.61 at FM, 3.7% and 7.33% at F/VS, and 4.35% and 6.49% at DS/GS in mice and rats, respectively.

DISCUSSION

Prevalence observed in present experiment was 7.0% in rats/mice captured from different localities and structures of Lahore city of Pakistan. The literature survey reveals that distribution and extent of *C. hepatica* infection in rats/mice in different regions of the world is quite variable. Claveria *et al.* (2005) reported 100 % infection of rats by *C. hepatica* in wet markets of Quiapo, Manila and Balayan. Conlogue *et al*. (1979) on the other hand found 82% of the rats infected with *C. hepatica*. Xiong *et al.* (1999) in China (48.4%) and Davoust *et al*. (1997) in Marseille (44%) also reported six to seven times higher infection rates than in the present study. The infection rate of *C. hepatica* documented by Sinniah *et al.* (1999) was a little more than double (15.5%) of the present study. Almost similar results (7.89%) were reported by Namue and Wongsawad (1997) and a little lower (5.7%) infection rate was reported by Sambo *et al.* (2008) in Africa during 2005-06. Stojcevic *et al.* (2002) has reported the lowest rate of infection (1.95%) of all the studies conducted so far. The present study seems to be more reliable due to high number rodents examined for *C. hepatica*. The difference may also be attributed to the difference in social behavior, physiological development, hygiene status, awareness of people about risk of contracting infections from reservoirs and their feeding habits as described by Claveria *et al.* (2005).

Highest infection rate was observed in summer whereas the lowest during winter. The extent of infection was almost similar during spring (6.2%) and autumn (6.0%). The availability of surplus food and high relative humidity during summer provide the most conducive conditions to the rodents to breed which in turn results in increased predation by feral cats. Additionally, the presence of invertebrates in the environment also plays a significant role in maintaining and spreading *C. hepatica* infections in the present study area as described by Ceruti *et al*. (2001).

The adults showed a significantly higher rate of infection (7.7%) than young (1.2%) in the present study as compared to Stojcevic *et al.* (2002). Much higher infection rate in adult mice (64.1%) has been reported by Singleton and Chamber (1996) in South Australia and is not comparable with our findings. According to Conlogue *et al.* (1979) parasitism is more frequent in adults than

juveniles and our results are same. Significant difference of prevalence may be due the frequent wandering of adults at multiple places in search of food than young ones.

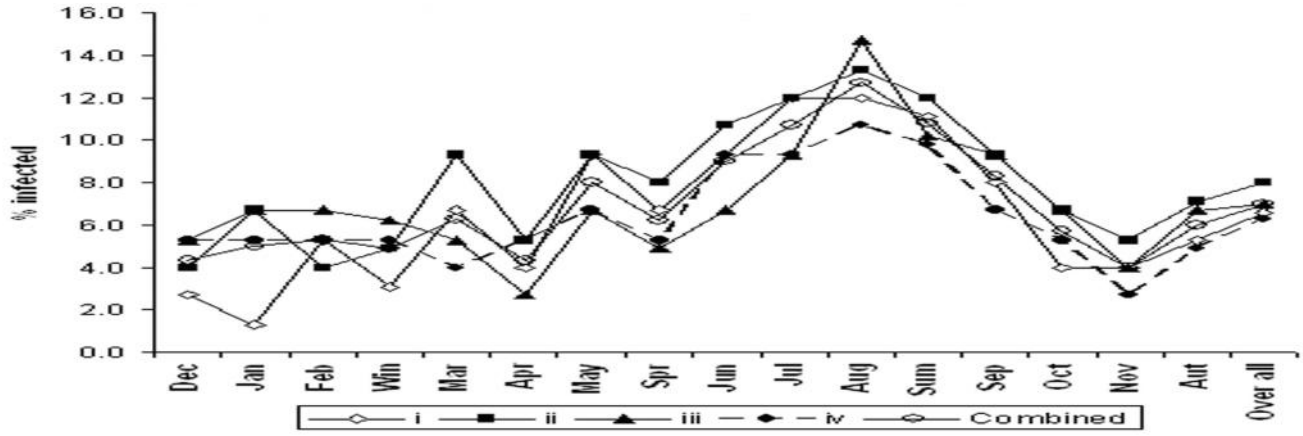

Figure 1. Combined monthly and seasonal variations in the prevalence of *Capillaria hepatica* infection in rats and mice at residential houses (i), flour mills (ii), vegetable / fruit shops (iii), and grocery shops/ departmental stores of the Lahore Meteropolis.

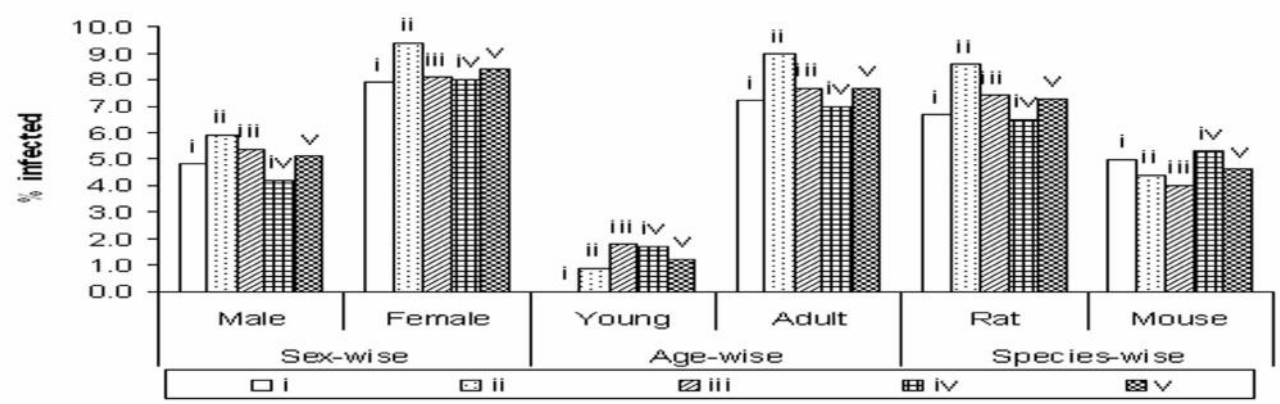

Figure 2. Sex-, age – and species – wise prevalence of Capillaria hepatica infection in the trapped from residential houses (i), flour mills (ii), vegetable / fruit shops (iii), grocery shops / departmental stores (iv), and combied for all the four structures at the Lahore Meteroplis.

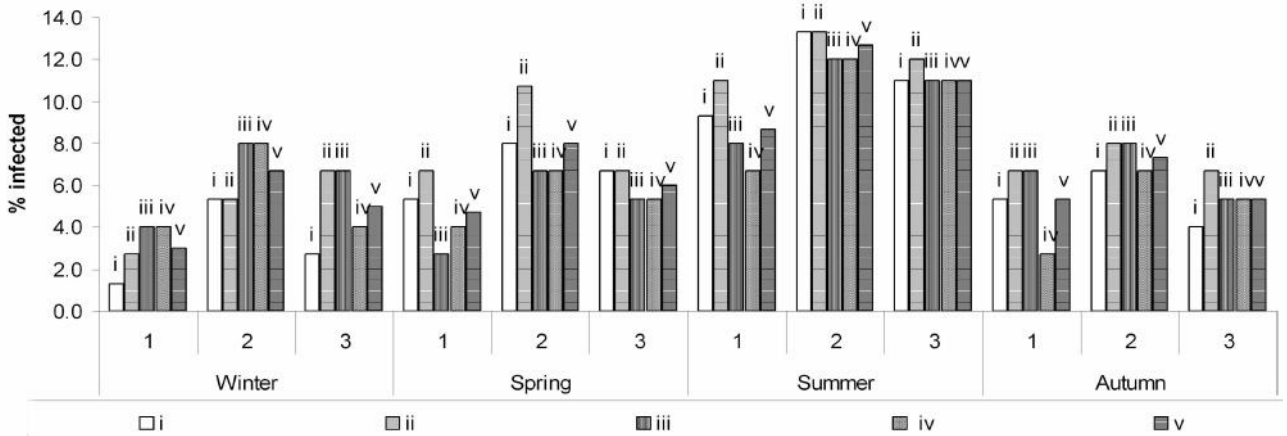

Figure 3. Seasonal variations in the prevalence of *Capaillaria hepatica* at residential houses (i), flour mills (ii), vegetable / fruit shops grocery shops / departmental stores (iv) and combined for all the four structures (v) at Allamma Iqbal Town (1), Walled City (2) and areas adject to the Lahore Railway Station in the Lahore Metropolis.

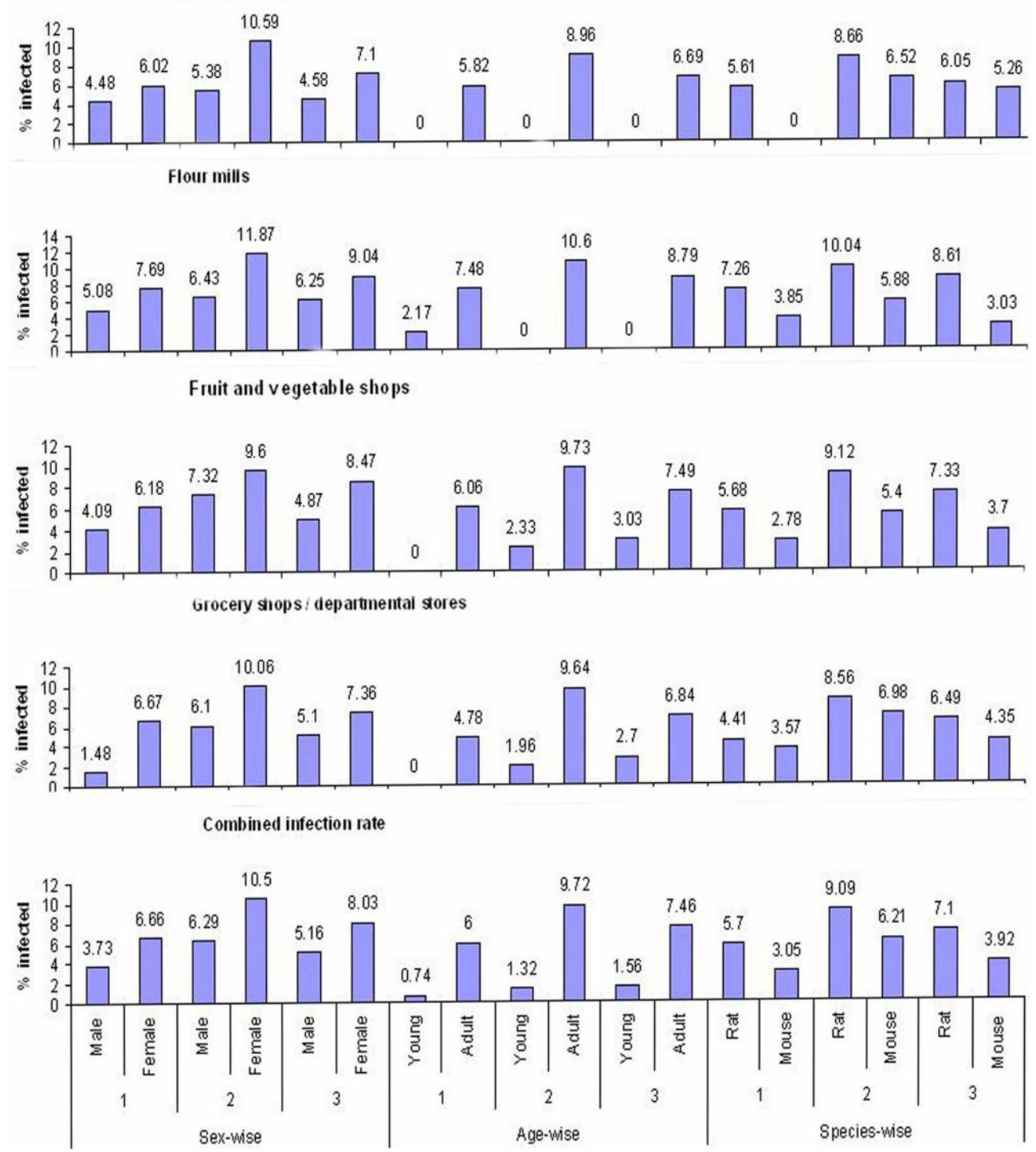

Figure 4. Sex-, age- and species-wise prevalence of *Capillaria hepatica* infection in the rodents trapped from Allamma Iqbal Town (1), Walled City (2) and the areas adjacent to the Lahore Railway Station in the Lahore Meteropolis.

The prevalence rate of *C. hepatica* was higher in female rodents (8.4%) as compared to males (5.0%) at the three localities. The infection rate was 6.0% in females at Allama Iqbal Town, 10.6% in Walled City and 7.1% in Railway Station / adjacent areas whereas in males it was 4.5, 5.4 and 4.6%, respectively. Similar infection pattern has been recoreded by Stojcevic *et al.* (2002) and the prevalence percentages were 1.59%

(male) and 2.54% (female). In findings of Resendes *et al.* (2009) the differences in prevalence of infection of *C. hepatica* in rats/mice are independent of size and sex of the rodents.

Although no study has been conducted to investigate the number of feral cats in Lahore so far, their number is extremely high that may help to transmit disease through their excreta in the grassy lawns and parks in the urban areas. At conclusion there is a need to create awareness among people below poverty level especially of villages regarding threats of contracting infection from rodents, importance of hygiene, vaccination against zoonotic parasites to pet carnivores and social behavior. This will help minimize the rate as well as risk infection to human beings from these rodents.

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