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Prevalence of *Capillaria hepatica* in Norway rats (*Rattus norvegicus*) in Croatia

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ABSTRACT

An analytical cross-sectional study of *Capillaria hepatica* in 307 Norway (brown) rats (*Rattus norvegicus*) was performed. Rats were trapped in two rural regions in Croatia. The prevalence of adult *C. hepatica* was 1.95%. The parasite was observed in 6 rats. Of these, 3 out of 189 (1.59%) were male and 3 out of 118 (2.54%) female. The adult parasite was a more common finding in large rats and was observed in 5 (1.95%) large rats and in one (2.17%) intermediate rat. Adult *C. hepatica* was not found among 4 examined young rats. Positive rats were derived from only four households. Clustering of adult parasites found among examined 17 households was significant ($P < 0.001$). Eggs of *C. hepatica* were found in 12 (3.91%) rats. The majority of positive rats with adult *C. hepatica* had parasite eggs ($P < 0.001$) and having adult parasite in livers, increases of 210 × odds of having parasite eggs in intestines (OR=210, $P < 0.001$).

Key words: *Capillaria hepatica*, Norway rat

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Introduction

Rodents, particularly those living in close association with man, play a significant role in human health and economy because they are important reservoirs for parasitic zoonoses such as trichinellosis and capillariosis.

Capillaria hepatica is found as an adult in the liver parenchyma of Norway rats and other species of mammals, including man, and is cosmopolitan in its distribution.

Great populations of rats are of considerable importance and can be considered as a potential health hazard. *C. hepatica* is unique among helminths of mammals in that its eggs are released only upon the death of an infected host. LIAT et al. (1977) considered Norway rats the main source for human infection.

Hepatic capillariosis is also a zoonosis and is seldom described in people. About 30 human cases, mostly in children, have been reported in the world (ATTAH, 1983). It can be stressed that the disease usually remains misdiagnosed or undetected (SLAIS, 1974). There is general agreement that infections occur through ingestion of soiled food or water, with embryonated ova previously released from the host liver through cannibalism, predation or decomposition of carcasses.

The nematodes provoke, in humans as in rats, inflammatory lesions, necrosis and fibrosis of the liver (DAVOUST et al., 1997). The significant symptom triad in humans are persistent high fever, hepatomegaly and excessive eosinophilia (PANNENBECKER et al., 1990; CHOE et al., 1993). Many authors have carried out investigations in order to determine the prevalence of *C. hepatica* in rats. In Italy, CERUTI et al. (2001) screened 47 brown rat livers for the presence of *C. hepatica* infection and found 36% of them to be infected. In France, DAVOUST et al. (1997) found 44% rats to be infected. In Baltimore, FARHANG-AZAD (1977) examined 845 brown rats and found 75% to be infected with *C. hepatica*. In Egypt, EL-NASSERY et al. (1991) found *C. hepatica* in 15.8% trapped rats. SINNIHAH et al. (1979) found 15.5% of 2324 rats to be infected. CONLOGUE et al. (1979) found as many as 82% of 86 Norway rats to be infected.

In addition to rats and humans, *C. hepatica* infections have been reported from numerous animals throughout the world. In Croatia, BABIĆ

and MIKAČIĆ (1953) found *C. hepatica* in 8% of hares. BRANDER et al. (1990) reported finding of *C. hepatica* in a dog and hedgehog in Switzerland; NATION and DIES (1978) found *C. hepatica* in a horse; CROWELL et al. (1978) in coyotes in Louisiana, and GRACZYK et al. (1999) in mountain gorillas in Rwanda.

Little is known of the epidemiology of *C. hepatica* in rat populations in Croatia as no detailed surveys have been undertaken. This research presents data on *C. hepatica* infections in brown rats and compares the prevalence in two different regions in Croatia.

Previous preliminary studies showed the presence of strange feeding habits in rats in Croatia, as was shown by the unusual findings of pseudoparasites (*Ascaris* sp., *Toxocara* sp.). Our study was therefore expanded in order to obtain detailed data for the presence of pseudoparasites in the study population. To accomplish this, faecal samples were screened for the presence of nematode eggs originating from different hosts.

Materials and methods

In the study, settlements and households were selected randomly from two counties. Brown rats (a total of 307) were trapped in two rural regions of Croatia, Vukovar-Srijem County and Zagreb County, in the periods February - June 2001 and February - May 2002. In Vukovar-Srijem County 230 rats were trapped in 7 households and in Zagreb County 77 rats in 10 households.

The investigation was carried out on small private rural farms with low biosanitary conditions where pigs and poultry were being reared. Cats and dogs were also present among the selected households.

Collection of rats. Rats were trapped alive using standard traps. After trapping, rats were euthanised with ether and carcasses were enclosed in marked and sealed plastic bags. The bags were transported to the laboratory and kept at 4° C until examination. The rats were examined 24 h after trapping.

Rats were categorised into three size categories depending on their total body length. Small rats were 0 -15 cm long, intermediate 15.1 - 30 cm long and large 30.1 - 45 cm long.

Parasitological study. All rats were eviscerated and intestines were slit lengthwise. Contents of intestines were examined under microscope for the presence of intestinal species of genus *Capillaria*.

Faecal specimens from rectum were also screened (sodium chloride flotation) for the presence of nematode eggs. All livers were examined for the presence of characteristic greyish-white lesions and when macroscopic evidence of liver pathology was seen, a microscopic examination of tissue was performed by the tissue press technique for the presence of the typical bipolar eggs, adults or larval stages. All livers without lesions were artificially digested (0.5% pepsin, 1% HCl)

Statistical analysis. Statistical analysis of data was performed by computer software STATA 6 (Stata Corporation, Texas, U.S.A.) Differences between groups of animals were analysed by Chi square test or by Fisher exact test, as appropriate. Significance was declared at a P-value <0.05.

Results

Description of the study population. During the study period 307 rats (*Rattus norvegicus*) were captured and examined. Among them, 189 (61.56%) were males and 118 (38.44%) females. Depending on their length 257 (83.71%) rats were categorized as large, 46 (14.98%) as intermediate and 4 (1.30%) as small. The 230 (74.92%) rats originated from Vukovar-Srijem County and 77 (25.08%) from Zagreb County. Rats were collected from 7 villages. The largest proportion of rats (114) was captured in the village Otok (46.91%), following by the village of Komletinci where 86 (28.01%) rats were trapped. In the villages of Domagović, 48 (15.64%), Krašić 15 (4.89%), Desinec 5 (1.63%), Stankovo 5 (1.63%) and Čabdin 4 (1.20%) rats were captured. Seventeen households participated in the study.

Infection with adult C. hepatica. Adult parasites were found in 6 (1.95%) rats. Among them, 3 (1.59%) rats were males and 3 (2.54%) were females. The observed parasitic infection did not differ significantly between sexes ($P > 0.05$). The parasite was found in 5 (1.95%) large rats and 1 (2.17%) intermediate rat. Three rats were found in Vukovar-Srijem County (1.30%) and 3 (3.90%) in Zagreb County. Observed difference in

Table 1. Specification of myomorphus mammals examined by renoculture and microscopic agglutination according to the trapping area with corresponding results

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parasite prevalence between counties was not significant. The highest prevalence of adult parasites was recorded in the village of Krašić where 13.33% of trapped rats were found to be infected. In the villages all positive rats originated from only one household (Table 1.).

Table 1. Prevalence of adult *C.hepatica* by counties and villages

	County						
	Vukovar-Srijem		Zagreb				
N ^o of exam. rats	230 (74.92%)		77 (25.08%)				
Prevalence of adult <i>C.hepatica</i>	3 (1.30%)		3 (3.90%)				
	Komletinci	Otok	Krašić	Desinec	Čabdin	Stankovo	Domagović
	2 (2.15%)	1 (0.75%)	2 (13.33%)	0	0	0	1 (2.08%)

The difference according to occurrence of the adult parasites between villages was not significant. On the other hand, a significant ($P < 0.05$) difference was found between households.

Eggs of C. hepatica. Eggs of *C. hepatica* were found in 12 (3.91%) rats. Of them, 8 (4.23%) rats were males and 4 (3.39%) were females. The observed parasitic infection did not differ significantly between sexes ($P > 0.05$). The parasite was found in 11 (4.28%) large rats and in 1 (25.0%) small rat. No significant difference in occurrence of the eggs of *C. hepatica* between villages was recorded.

In the village of Komletinci, rats with *C. hepatica* eggs originated from one household, while in the villages of Otok, Krašić and Domagović positive rats were from two households. Parasite eggs were found in 7 (58.53% of rats with eggs) rats with no presence of adult *C. hepatica*. Five (41.67%) rats with eggs had adult *C. hepatica* in the liver. The relationship between the presence of adult parasites in the liver and eggs in the intestine was significant ($P < 0.001$) and with strong correlation (odds ratio: 210, $P < 0.001$). Parasite eggs are 210 times more common among rats with adult parasites in the liver (Table 2.)

Table 2. Prevalence of eggs *C. hepatica* by counties and villages

	County						
	Vukovar-Srijem		Zagreb				
N° of exam. rats	230 (74.92%)		77 (25.08%)				
Prevalence of eggs <i>C. hepatica</i>	6 (2.61%)		6 (7.79%)				
	Komletinci	Otok	Krašić	Desinec	Čabdin	Stankovo	Domagović
	2 (2.15%)	4 (2.92%)	3 (20.00%)	0	0	0	3 (6.25%)

A total of 13 (4.23%) rats were positive for infection with *C. hepatica*. There was no significant relationship ($P>0.05$) of infection with *C. hepatica* or with sex, size and villages. A significant difference ($P<0.05$) in prevalence of infection with *C. hepatica* was recorded between counties and between households. Seven (53.85%) positive rats derived from Zagreb County and 6 (46.15%) from Vukovar-Srijem County, as well as 9.09% of examined rats deriving from Zagreb County and 2.61% from Vukovar-Srijem County (Table 3.).

Table 3. Total prevalence of adults and eggs of *C. hepatica* in rats

Adult <i>C. hepatica</i>	Eggs of <i>C. hepatica</i>		Total
	Positive	Negative	
Positive	5 (41.67%)	1 (0.34%)	6 (1.95%)
Negative	7 (58.33%)	294 (99.66%)	301 (98.05%)
Total	12 (100%)	295 (100%)	307 (100%)

Pseudoparasites. Among pseudoparasites, only eggs of *Ascaris* sp. and *Toxocara* sp. were observed in 14 (4.56%) and 4 (1.30%) of examined rats. The median number of eggs of *Ascaris* sp. was 2.5 (range 2-5). The median number of eggs of *Toxocara* sp. was 28 (range 2-840). *Ascaris*

sp. eggs were found in 8 (4.23%) male rats and in 6 (5.08%) female rats. Differences in prevalence for both of those parasites were not sex or size dependent ($P>0.05$). Also, we found no significant relationship between locality of rat capture and infection with those parasites.

Relationship between infection with *C. hepatica* and *Toxocara* sp. was significant.

On the other hand, no relationship between presence of adult *C. hepatica* and *Ascaris* sp. eggs was found ($P>0.05$).

Discussion

Prevalence of *C. hepatica* infection in rats is unevenly distributed throughout the examined regions. There seemed to be localized foci of infection. In the village of Krašić as many as 13.33% of rats were found to be infected, while in other villages the rats were found to be free from infection, which is in correlation with the results of SINNIAH et al. (1979). In some areas the authors found as many as 77.8% of rats to be infected, while in other areas the same species of rats were found free of infection. Moreover, this is supported by our finding of significant difference between two counties in the prevalence of *C. hepatica* (adults and eggs). The significant difference in occurrence of adult parasites and eggs was found between households. Our results showed that the prevalence of this parasite is not dependent on the size or sex of rats and are partly consistent with the data of CONLOGUE et al. (1979). The strong correlation found between the presence of adult parasites in the liver and eggs in the intestine presumes that parasite eggs are 210 times more common among rats with adult parasite in the liver. FARHANG-AZAD (1977) showed that cannibalism serves as a primary egg-releasing mechanism and is a source of infection within the burrows. According to this data, increased infection rates among juveniles in spring support the hypothesis of maintenance of *C. hepatica* infections within the burrow system through cannibalism. Predation was responsible for scattered foci of infection throughout the study area and is considered to be a secondary source of infection. Decomposition is a less important egg-releasing mechanism.

At this moment in time our findings of *C. hepatica* eggs mainly among rats with adults in the liver strongly support this theory. It can be presumed that cannibalism is a matter of the individual characteristics of the rat.

Differences in prevalence for *Ascaris* sp. eggs and *Toxocara* sp. eggs were neither sex nor size dependent ($P > 0.05$). Further, we found no significant relationship between locality of rat and infection with those parasites. Relationship between infection with *C. hepatica* and *Toxocara* sp. was found to be significant. On the other hand, relationship between presence of adult *C. hepatica* and *Ascaris* sp. eggs was not found ($P > 0.05$). At this time we are unable to give a clear explanation for these phenomena.

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STOJČEVIĆ, D., A. MARINCULIĆ, Ž. MIHALJEVIĆ: Proširenost nematoda *Capillaria hepatica* u smeđeg štakora (*Rattus norvegicus*) u Hrvatskoj. Vet. arhiv 72, 141-149, 2002.

SAŽETAK

Pretraženo je 307 smeđih štakora (*Rattus norvegicus*), podrijetlom iz dvije županije u Hrvatskoj, na prisutnost nematoda *Capillaria hepatica*. Proširenost adulta *C. hepatica* bila je 1,95%. Parazit je nađen u šest štakora, i to u tri od 189 mužjaka (1,59%) i tri od 118 ženki (2,54%). Adulti *C. hepatica* su nađeni češće u velikih štakora i to u 5 (1,95%), i u 1 (2,17%) štakora srednje veličine, dok u mladih štakora adulti *C. hepatica* nisu nađeni. Pozitivni štakori su potjecali iz samo 4 dvorišta. Nađeno grupiranje odraslih parazita među 17 dvorišta bilo je značajno ($P < 0,001$). Jajašca *C. hepatica* nađena su u 12 (3,91%) štakora. Većina pozitivnih štakora s adultima *C. hepatica* imali su i parazitska jajašca ($P < 0,001$).

Ključne riječi: *Capillaria hepatica*, smeđi štakor
