Original Article

Zoonotic and Non-zoonotic Parasites of Wild Rodents in Turkman Sahra, Northeastern Iran

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Abstract

Background: This study was conducted to collect informative data on the parasitic infection of wild rodents, emphasizing on finding parasites, which have medical importance to human.

Methods: During 2012-2014, a total number of 91 wild rodents were captured from rural areas of Turkmen Sahra, Golestan Province, using handmade traps. Animals were anesthetized, surveyed for any ectoparasite and then their carcasses were carefully dissected for examination of endoparasites.

Results: Four species of rodents including Mus musculus (52.75%), Rattus norvegicus (38.46%), Rhombomys opimus (4.40%) and Meriones libycus (4.40%) were captured. Parasitic infestation was detected in 38.5% of sampled rodents. Parasite infestation rates of sampled rodents was Hymenolepis diminuta = 7.7%, Cryptosporidium spp = 6.6%, Trichuris spp. = 5.5%, Cysticercus fasciolaris = 2.20%, Angiostrongylus spp. = 2.20%, Capillaria sp. = 1.09%, Rhizoccephalus spp. = 8.70%, Noospylysfasciatus = 1.09%, and Laelaps nuttalli = 3.29%. Among 10 genera/species of identified parasites, at least 8 of them were zoonotic with public health importance. L. nuttalli and N. fasciatus were the only two non-zoonotic detected parasites in this survey.

Conclusion: Harboring a wide variety of zoonotic parasites in sampled wild rodents particularly when they live nearby villages, represents a potential risk to native inhabitants. Hence, controlling rodents’ population in residential regions and improving awareness of local people about the risk of disease transmission through rodents seems to be entirely necessary.
Introduction

Rodentia is one of the largest order of the mammals, with the highest diversity in mammals’ population (43%). Rodents cause wide variety of disorders with medical and veterinary importance (1). As rodents are highly adaptable to different types of climates, they are widely distributed in most areas in the world except Polar Regions (2).

Rodents harboring ectoparasites and endoparasites play critical role in distribution of various kinds of viruses, bacteria, rickettsia, protozoa and helminthes (3). Many of these agents can cause zoonotic diseases such as plague, tularemia, leishmaniasis, leptospirosis, toxoplasmosis and salmonellosis (4).

Some rodent species such as Rattus norvegicus play more important role in distribution of zoonotic diseases. The close association between commensal rodents and humans especially in rural areas facilitates the spread of zoonotic agents (5). Data about parasite life cycle, reservoirs dispersal and transmission models in each ecosystem are necessary for limitation of zoonotic parasites.

There are some reports on the parasite infestation of rodents in Iran (2, 3). However, regarding the vast extent of the country and variation of geographical conditions many studies are still needed to improve knowledge of parasitic fauna of rodents in different parts of Iran.

This study was conducted to collect some informative data about the parasites of wild rodents in rural areas, where rodents are in close association with human settlements, with emphasis on finding parasites, which have medical importance to human for implementation of any prevention and control measures in Turkmen Sahra.

Materials and Methods

Study area and sampling

Turkmen Sahra (36° 50’ 21.48” N, 54° 26’ 39.84” E) is located in Golestan Province, North-East of Iran. Rodents were captured in 9 villages of 4 towns (located in Turkmen sahra) by handmade traps, and were transported to the laboratory of Gorgan University of environmental resources and natural sciences (Fig. 1).

Parasitological examination

To follow ethical principles, after euthanizing trapped rodents by ether, their morphological characteristics and sex were registered. The Ethics Committee of the university approved the study.

Using valid identification keys, species of captured rodents were recognized (6). Initially ectoparasites were recovered by combining rodents’ body hair against a water filled white tray. Blood sample was taken immediately from heart of the dead rodent. Afterwards the rodents were cut open and dissected, every internal organ including the lungs, liver, intestines etc., were investigated for macroscopic parasites. All recovered macroscopic parasites were preserved in ethanol 70% for further investigation.

Fecal samples were examined as wet smear after fecal flotation with saturated sodium chloride solution. Thick and thin blood smears were prepared as well as impression smears of spleen, kidney, lung and liver. The prepared slides were stained with Geimsa and examined microscopically with suitable magnification power (100x-1000x) (7, 8). Smears were prepared from intestinal contents and stained with Modified Ziehl-Neelsen (MZN) for detection of acid-fast organisms like Cryptosporidium.

After identification of parasites, statistical analysis was performed using SPSS version 18 (Chicago, IL, USA) software.

Results

Ninety-one rodents including Mus musculus (52.74%), Rattus norvegicus (38.46%), Rhombomys
opinus (4.40%) and Meriones libycus (4.40%), were captured in this study. 60.43% of sampled rodents were male and 39.57% were female. Parasite infestation, including endoparasites and ectoparasites was detected in 38.5% of sampled rodents (Table 1). Parasite infestation of male rodents (43.63%) was higher than female rodents (30.55%).

Fig.1: Collection sites around 4 selected cities of Golestan Province, North-East of Iran

Table 1: Detected endoparasites and ectoparasites in the sampled rodents species

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Non- Zoonotic</th>
<th>Zoonotic</th>
<th>Infested species</th>
<th>Percent of infested samples (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endoparasites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cysticercus fasciolaris</td>
<td>-0-</td>
<td>R. norvegicus (n=2)</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Hymenolepis diminuta</td>
<td></td>
<td>R. norvegicus (n=7)</td>
<td>7.6</td>
<td></td>
</tr>
<tr>
<td>Angiostrongylus spp</td>
<td></td>
<td>M. musculus (n=2)</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>Capillaria sp</td>
<td></td>
<td>M. musculus (n=1)</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Cryptosporidium spp</td>
<td></td>
<td>R. norvegicus (n=6)</td>
<td>6.5</td>
<td></td>
</tr>
<tr>
<td>Trichiuris spp</td>
<td></td>
<td>R. norvegicus (n=4)</td>
<td>5.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M. libycus (n=1)</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td><strong>Ectoparasites</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nosopsyllus fasciatus</td>
<td></td>
<td>M. musculus (n=1)</td>
<td>1.09</td>
<td></td>
</tr>
<tr>
<td>Rhipicephalus spp</td>
<td></td>
<td>R. norvegicus (n=7)</td>
<td>8.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>M. musculus (n=1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lealaps nuttalli</td>
<td></td>
<td>M. musculus (n=3)</td>
<td>3.2</td>
<td></td>
</tr>
</tbody>
</table>

**Zoonotic parasites/ Detected Zoonotic endoparasites**

Totally, 25.30% (23/91) of the sampled population were infested with endoparasites which all of them have been introduced as zoonotic parasites. Detected endoparasites comprised of 5 species of helminths (Cysticercus fasciolaris 2/91 (2.2%), Hymenolepis diminuta 7/91 (7.6%) (Fig. 2), Angiostrongylus spp 2/91 (2.2%) (Fig. 3), Capillaria sp 1/91 (1.09%) (Fig. 4), Trichiuris spp 5/91 (5.4%) (Fig. 5) and 2 species of protozoan parasites (Cryptosporidium spp 6/91 (6.5%) C. fasciolaris was detected macroscopically in the liver tissues of two R. norvegicus while eggs of other identified helminthic parasites and the protozoans were observed during microscopic examination of the tissues, fecal wet and stained smears. Trichiuris spp.

Available at: http://ijpa.tums.ac.ir
nematode was macroscopically noted and separated from intestine of four *R. norvegicus* and one *M. libycus*. *Capillaria* spp. and *Trichuris* eggs were differentiated based on egg morphology as described by Baker (2007)(7). The larval stage of *Angiostrongylus* was found in the lung impression smears of two *M. musculus*. *Cryptosporidium* species were identified based on the oocyst size as oocysts of *C. muris* are larger than *C. Parvum* oocysts (7). Examination of prepared blood smears did not show any blood parasites in sampled rodents.

**Detected zoonotic ectoparasites**

*Rhipicephalus* spp. was isolated from a *M. musculus* (1.09%) and seven *R. norvegicus* (7.6%).

*Nosopsyllus fasciatus* (Fig. 6) was detected in a *M. musculus* (1.09%) (Table 1).

**Non-zoonotic**

*Laelaps nuttalli* (Fig. 7) was the only non-zoonotic ectoparasite which has been detected in three (2%) *M. musculus* (Table 1).

**Parasite infestation of sampled rodents according to the region and rodent species**

Most parasite infestation of sampled rodents was detected in Bandar Turkmen (28.57%) and the lowest was found in Gonbad (5.5%). Parasite infestation of *R. norvegicus* (28.5%) was higher than other sampled species (Table 3).
Table 2: Frequency of detected parasites according to the species and location

<table>
<thead>
<tr>
<th>Location</th>
<th>R. opiums (H. diminuta, Trichuris spp, Rhipicephalus spp, L. nuttalli) No. infected/no. sampled (%)</th>
<th>M. musculus (Angiostrongylus spp, Capillaria sp, Rhipicephalus spp, L. nuttalli) No. infected/no. sampled (%)</th>
<th>M. libycus (Trichuris spp) No. infected/no. sampled (%)</th>
<th>R. norvegicus (H. diminuta, Trichuris spp, C. fasciolaris, Cryptosporidium spp, Rhipicephalus spp, N. fasciatus) No. infected/no. sampled (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gomishan</td>
<td>-</td>
<td>26.66</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Bandar Turkmen</td>
<td>-</td>
<td>18.75</td>
<td>-</td>
<td>91.66</td>
</tr>
<tr>
<td>Gonbad</td>
<td>-0</td>
<td>-0</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Agh Ghala</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>80</td>
</tr>
<tr>
<td>Total frequency of parasite infection</td>
<td>0/4(0)</td>
<td>18.75</td>
<td>25</td>
<td>28.5</td>
</tr>
</tbody>
</table>

Discussion

In the present study, 91 rodents belonging to one subfamily and four species (M. musculus 52.74%, R. norvegicus 38.46%, R. opimus 4.40%, and M. libycus 4.40%) were sampled from Turkmen Sahra. Predominance of M. Musculus and R. norvegicus was expected regarding to their living habits, dispersal in majority of regions, and adaption to all habitats (9). In agreement with the present study, M. Musculus and R. norvegicus were predominant species (10), whereas Rasti et al. reported that Great gerbil (25.8%) and Libyan jird (24.2%) were predominant species (11). Besides, Milazzo et al. detected 73 M. musculus and 40 R. rattus in Italy (12).

In this work, 60.43% (55 mice) of the rodents were male. The highest amount of infestation with intestinal parasites was seen in males, although no significant difference was seen between female and male mice (P>0.05). This might be owing to more activity or higher number of the males. The highest parasite infestation rate was detected in sampled rodents of Bandar Turkmen (50%) and the lowest was found in Gonbad (5.5%). Higher parasite infestation rate in Bandar Turkmen can be caused by higher pollution in shores as well as number of sampled rodents in this region compared to other regions.

In a study in Kashan, the zoonotic parasites H. nana fraterna (10.8%), H. diminuta (4.2%), and Trichuris muris (1.7%) were identified in 120 rodents including Meriones persicus, M. libycus, Gerbillus nanus, M. musculus, R. norvegicus, R. rattus and Jaculus lanfordii (11).

In a research on 90 rodents including R. norvegicus, R. rattus, and M. musculus in Ahvaz, the parasites Trypanosoma lewisi, Trichosomoides crassicauda, Gongylonema monigi, Streptopharagus kunztj, and Rictularia ratti were identified; none of these parasites resembled the ones found in the present study (15). This might be explained by difference in geographical situations and climates of Ahvaz and Turkmen Sahra.

The most commonly recognized zoonotic parasite in the present study was H. diminuta (rat tapeworm) with the highest infestation rate in R. norvegicus. This is consistent with the results of Kia et al. in Ardebel and Rokni in Hamedan (13, 14). Several reports of infestation with this parasite exist in human populations of Iran and the highest outbreak of human infestation with this parasite was reported in rural area of Minab (15). In Tabriz, 24.47% of sampled rodents (56 M. Musculus, 38 R. norvegicus, and 26 Cricetulus migratorius) were infested by this zoonotic parasite (10). 4.2% of sampled rodents in Kashan were also infested by this parasite (11). In Mazandaran, 15% of the sampled rodents including M. musculus, R. rattus, R. norvegicus, Glisglis, Apodemus witherby,
Tatera indica and Microtus arvalis were infested with H. diminuta (16).

Infestation with C. parvum and C. muris was also detected in 6 R. norvegicus (6.6%). Different kinds of rodents, especially those in close contact with humans such as M. musculus and R. norvegicus, were identified as main sources of this parasite (17). Although this single-celled organism has not been regarded as a zoonosis from rodent origin, few cases of human infestation have been reported in recent years and it is known as a parasite causing diarrhea in humans (18,19). Infestation with different genotypes of C. parvum has been reported in M. musculus and R. norvegicus (18, 20). In Tehran, 13% of the samples in dye method and 27% of them in molecular method were infected with C. parvum (19). Therefore, it seems that more comprehensive studies via sensitive molecular methods are necessary to determine the role of rodents in dispersion and transmission of this parasite.

In the present study, the zoonotic parasite Trichuris spp. was detected and separated from intestine of four R. norvegicus and one M. libycus, but the species were not further identified. In a study on 77 R. opimus in the eastern Turkmen Sahra (Maraveh Tappeh) in 2014, infestation with the same parasite with similar frequency (5.5%) was reported. The role of climate in achieving the same results in similar regions is inevitable. It is noteworthy that the species of Hymenolepis was H. nana whereas here, it was H. diminuta (21, 22). Infestation with H. diminuta, T. muris, and C. hepatica in the species M. musculus and R. rattus has been reported in Thailand (22).

The eggs of Capillaria sp. were detected in the feces of sampled M. musculus. This parasite is abundantly identified in rodents in Iran. For instance, Capillaria spp was identified in 13% of M. Musculus and R. norvegicus in Kermanshah (2013) (23).

Infestation with external zoonotic parasites, Rhipicephalus spp. was detected in one M. musculus and seven R. norvegicus. Besides, Nososerylus fasciatus was detected in one M. musculus. Rhipicephalus spp. takes part in transmission of zoonotic diseases such as Crimean Congo Haemorrhagic Fever (CCHF), Babesia microti, Q fever and some cases of Rickettsiosi (25). Similarly, two zoonotic parasites N. fasciatus (47.22%) and R. sanguineus (13.88%) were detected in rodents of Tabriz (10). Additionally, infestation with N. fasciatus, a potential vector of plagues and rat typhus, was found in the rodents caught in Mazandaran Province (26, 27).

Laelaps nuttali was the only non-zoonotic ectoparasites detected in three M. Musculus. In Thailand, Laelaps nuttali and Laelaps echidninus were identified in rodents (Bandicota indica, Bandicota savilei, Rattus losea, R. rattus, Rattus exulans, R. norvegicus, Menetes berdmorei and Taminops meliellandii) (22). In Bandar Abbas, L. nuttali was the only non-zoonotic parasite in rodents and only M. Musculus was infested with this parasite (27). Infection of M. Musculus with L. nuttali indicates the susceptibility of this species to this parasite

Conclusion

Considering the infestation of sampled rodents with various zoonotic parasites, especially H. diminuta and Cryptosporidium spp, it is strongly recommended to take measures in order to control rodent populations in the mentioned regions of current study and make local people aware of the risk of disease transmission to humans through rodents.

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