Investigation of Enteric Parasites of Zoo Animals and Zookeepers in Beni-Suef Governorate, Egypt

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In this study, the enteric parasites of zoo animals and zookeepers in Beni-Suef governorate, Egypt were investigated. Fecal samples from thirteen animal species were examined by floatation and formol ether sedimentation techniques. Zoo animals were classified into non-human primates, carnivores and herbivorous animals. The examination of non-human primates revealed the presence of *Trichuris trichura* eggs, *Giardia intestinalis* and *Entamoeba histolytica* cysts. In carnivores, *Toxoascaris leonina* eggs and *Isospora felis* oocysts were the most predominant findings. In herbivore wild animals, gastrointestinal nematode (GIT) eggs and *Eimeria* species oocysts were present. Larval identification by fecal culture of (GIT) eggs demonstrated the presence of *Haemonchus contortus* and *Strongyloides papillosus* larvae. Examination of zookeepers and one lab worker revealed the presence of *Giardia intestinalis* and *Entamoeba histolytica* cysts. In conclusion, infection with *Giardia intestinalis* and *Entamoeba histolytica* in both of human and non-human primates suggests the zoonotic transmission in the zoo.

Material and methods

Study site and animal housing. This study was conducted in Beni-Suef Governorate zoo, Egypt. A total of 61 animals from 13 species were examined. Over six months from June to November 2012, zoo animals were examined regularly twice per month. Animals were classified into non-human primates, carnivores and herbivorous animals. Non-human primates were 8 Grivet monkeys housed in 4 boxes, 7 Hamadryas baboons housed in a large caged area and one Brown capuchin in a single box. Data of the examined animals were obtained from zoo labels on the cages and boxes of each species. Carnivores were 5 African lions, one Hyena and 2 Egyptian a jackal, each animal was in a separate box. Herbivorous animals were 3 Llama, 2 Shetland pony, 4 Simitar-horned oryx, 1 European deer, 20 Mountain goats, 5 Barbary sheep and 2 Hippo. Each herbivore species was housed in a specific yard.

Sample collection.

Animal samples. Fresh fecal samples were collected by zookeepers in the morning in labeled plastic bottles. Each sample was representing to one or more animals housed in a single cage.

Human samples. Fresh stool samples were taken from six zookeepers who have been in close association with the examined animals. Nature of work, degree of animal contact and health status of each zookeeper were recorded. An additional fecal sample was obtained from...
one faculty lab worker who suffered from digestive troubles at the end of the work.

All samples were properly transported to the parasitological laboratory, faculty of veterinary medicine, Beni-suef University where examination was immediately commenced.

Examination techniques. All fecal samples were examined macroscopically for adult nematodes and tapeworm proglottids. Each sample was subjected for examination by fecal floatation technique using different solutions (saturated salt solution, zinc sulphate and Sheathers solution) according to Zajac and Conboy (2006). Furthermore, formal ether sedimentation technique (Lee et al., 2010) was applied for each sample. Iodine solution was used to facilitate protozoan and cyst identification. Parasites were identified on the basis of egg or oocyst color, shape and contents (Soulsby, 1982).

Fecal cultures of the detected Strongyloida eggs were performed (Eckert, 1960) followed by larval identification according to the keys mentioned by Gibbons et al., (2006).

Results

Humans. Fecal examination of zookeeper samples revealed a positive result (83.3%) for each of Entamoeba histolytica and Giardia intestinalis cysts. In addition, Entamoeba coli and Endolimex spp. cysts were demonstrated in a level of 33.3%, while a rate of 16.7% was recorded for Anclystoma spp and Strongyloides spp. eggs. It was worth mentioning that the lab worker was found to be infected with Giardia intestinalis cysts.

Non-human primates. Microscopical fecal examination revealed the presence of Trichuris trichura eggs and Giardia intestinalis cysts in Brown capuchin. Trichuris trichura eggs, Entamoeba histolytica, Entamoeba coli and Giardia intestinalis cysts were reported in Grivet monkey. With regard to Hamadryas baboon samples, Trichuris trichura eggs, Entamoeba histolytica cysts and Giardia intestinalis cysts were detected. Macroscopically feces from Entamoeba histolytica and Giardia intestinalis infected animals were semi formed or diarrheic with offensive odor.

Table (1): Coproscopical examination of human and non-human primates for parasitic infection.

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Humans</th>
<th>Non-human primates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zookeepers</td>
<td>Brown capuchin (Cebus paella)</td>
</tr>
<tr>
<td>1 2 3 4 5 6</td>
<td>1 2 3 4 5 6</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Entamoeba histolytica cyst (2)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Giardia intestinalis cyst (2)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Entamoeba coli cyst (2)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Endolimex spp. cyst (2)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Anclystoma spp. egg (1)</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Trichuris spp. egg (1)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Superscript (1): Floatation (concentration floatation technique).
Superscript (2): Sedimentation (Formol ether technique).

Table (2): Results of fecal examination of carnivorous and herbivorous animals.

Table (2): Results of fecal examination of carnivorous and herbivorous animals.

<table>
<thead>
<tr>
<th>Parasites</th>
<th>Species</th>
<th>Herbiyores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>African lion</td>
<td>Egyptian jackel</td>
</tr>
<tr>
<td>Toxascarsis eggs leonina (1)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Isospora felis oocyst (1)</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Strongyloides papillosus eggs (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Haemonchus contortus eggs (1)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Eimeria species oocyst (1)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Superscript (1): Floatation (concentration floatation technique).
Carnivorous animals. African lions harbored *Toxoascaris leonina* eggs (80%) and *Isospora felis* oocysts (40%). Fecal examination of other carnivorous animals (Hyena and Egyptian jackal) revealed a negative result for gastrointestinal parasites.

Herbivorous animals. Gastrointestinal nematode eggs and *Eimeria* spp oocysts were found in Mountain goats and Barbary sheep. *Haemonchus contortus* and *Strongyloides papillosus* were the identified nematodes. Fecal examination of other herbivorous animals (Hippo, European deer, Simitar-horned oryx, Shetland pony and Llama) revealed a negative result for gastrointestinal parasites.

Discussion
Concerning non-human primates, *Trichuris trichiura*, *Entamoeba histolytica* and *Giardia intestinalis* were highly prevalent in Brown capuchin (*Cebus paella*), Grivet monkey and Hamadryas baboon. The obtained parasites are of direct life cycle, which illustrates their existence in all of them and increases the zoonotic potential for people at risk. The obtained results are consistent with those of Munene *et al.*, (1998) who declared that *Trichuris trichiura* and *Entamoeba histolytica* were prevalent in captive and wild-trapped African non-human primates. In addition, Thomas *et al.*, (2005) in Uganda remarked that *Trichuris spp.*, *Entamoeba histolytica*, and *Giardia lamblia* were detectable in Colobus monkey. Besides, Lee *et al.*, (2010) reported the infection with *Trichuris trichiura* and *Giardia lamblia* in two species of old world monkeys. Furthermore, Naoki *et al.*, (2012) isolated *Trichuris trichiura* eggs from wild Japanese Macaques. In the present study, infection with *Giardia intestinalis* in Brown capuchin (*Cebus paella*) was associated with persistent diarrhea, abdominal distension and weight loss, an observation that is in agreement with the results published by Toft and Eberhard (1998) and Lee *et al.*, (2010) who demonstrated that *Giardia* spp. caused diarrhea in monkeys.

Regarding carnivore animals, fecal examination of lions showed the presence of *Toxoascaris leonina* eggs and *Isospora felis* oocysts. Although each animal was in a separate box, 80% of zoo lions were found to be infected with *Toxoascaris leonina*. This may be attributed to the unhygienic manner of the zookeepers who might have shared in transmission of infection between lions specially when the direct life cycle
of *Toxoascaris leonina* and *Isospora felis*, is taken into account. Similar findings were reported by Pande *et al.*, (1970); Fagiolini *et al.*, (2010) who demonstrated the presence of *Toxoascaris* spp. in lions and Smith and Kok. (2006) who found *Isospora* spp. in African lions.

In wild herbivores, fecal examination revealed the presence of parasitic gastroenteritis eggs and *Eimeria* spp. oocysts. Further fecal culture identification of nematode eggs gave larvae of *Haemonchus contortus* and *Strongyloides papillosus*. These findings may be referred to the environment of captivity that provides favorable conditions for the occurrence of such parasites. These results are supported by Ibrahim *et al.*, (2012) who identified helminth larvae common in all wild ruminant species as *Haemonchus contortus*, *Trichostrongylus axei* and *Strongyloides papillosus*.

Concerning human beings included in this study, the prevalence of *Entamoeba histolytica* and *Giardia intestinalis* infection in zookeepers was as high as 83.3%. History of the examined zookeepers indicated that the same individuals reacting positively to these protozoal agents were concurrently suffering from digestive troubles. Data associated with the examined individuals have drawn the attention to the role of measures followed in the zoo in the occurrence of parasitoses, especially those of direct life cycle. Careless and unhygienic handling of workers with animals and their environment was highly obvious and has attracted our attention for the high zoonotic potential for people at risk. Close observation of the daily activity of zookeepers indicated that their feeding habits included common dealing with their food directly after removal of zoo animal excreta without application of any safety precautions. Not only zookeepers are exposed to such health hazards but also other categories may occasionally contract such infections from zoo animals and their keepers including zoo administrators and visitors ...etc. Visitor children are expected to be at high risk of infection. The discrepancy in parasitic infection among zookeepers may be correlated to the variation in degree of contact animals. One of zookeepers who had a restricted animal contact and was apparently healthy harbored only two non-pathogenic parasitic cysts (*Entamoeba coli* and *Endolimex* spp.). This explanation is well in line with the report of Adejinmi and Ayinmode (2008) who attributed the difference between the infected and uninfected zookeepers to varying levels of hygienic practices of individuals. One of the faculty lab workers harbored *Giardia intestinalis* cyst that was in harmony with the clinical data indicating that he was suffering from digestive troubles.

The detection of *Trichuris trichura* eggs in non-human primates may represent a risk factor for human beings dealing with them. This view is supported by Monteiro *et al.*, (2007) who illustrated that *Trichuris* spp. were experimentally transmitted from non-human primates to humans and provided evidence for the possible zoonotic potential.

In this study, parasites recorded in humans were found to be similar to those recorded in non-human primates than other zoo animals. Adejinmi and Ayinmode. (2008) remarked that fecal samples from the non-human primates contained ova and cysts of parasites that were found in the fecal samples from the zookeepers. Ezenwa (2003); Munene *et al.*, (1998) said that some of the parasites observed in non-human primates were reported to be zoonotic in various parasitological literatures.

The possibility of animal-to-man or man-to-animal transmission of the detected parasites in the current study should be considered. Fayer *et al.*, (2004) reported the transmission of *Giardia* spp. from humans to beavers, dogs and muskrats and supported this possibility by similar gene sequences among isolates. It is also not clear whether, *Giardia* spp. or *Entamoeba histolytica* is strictly host-specific or not (Asano *et al.*, 1991; Stanley., 2003).

In conclusion, this study showed that gastrointestinal parasites were mainly predominant in non-human primates and were found to be existent in their workers suggesting the possibility of their zoonotic potential. It is worth to mention that the detected parasites were of short and direct life cycle. However, the interventions recommended for prevention and control of such parasitic infections will not only improve animal health, but also will increase the safety to zookeepers and animal zoo visitors. Nevertheless, confirmation of zoonotic risk requires further molecular identification for the isolated parasites.

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References


