RODENTS AS A POTENTIAL SOURCE OF SOME ZOONOTIC ENTERIC PARASITES IN BENI-SUEF PROVINCE

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ABSTRACT

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Parasitic infections affecting the world's populations have a global significance. Infections are predominant in underdeveloped agricultural and rural areas of tropical and subtropical regions, causing reduced worker productivity and a waste of economic resources. The current study aimed to investigate epidemiological aspects and the occurrence of some zoonotic enteric parasites in different areas of Beni-Suef province, Egypt. Therefore, a total of 536 human stool samples (149 from diarrheic individuals of different ages and both sexes and 387 from apparently healthy individuals). Moreover, 95 fecal samples from rodents were collected from both rural and urban areas in Beni-Suefprovince for the detection of zoonotic enteric parasites by examination of direct fecal smears and concentration methods using different solutions (Shethear's solution, Zn sulphate and formol ether). Recovered parasites were *Paragonimus*-like (0.7%), *Hymenolepis nana* (12.5%), *Hymenolepis diminuta* (0.18%), *Enterobius* (7.1%), *Giardia spp.* (11%), *Entamoeba histolytica* (16.9%) and mixed infection with more than one parasite represent 1.7%. Abundance of positive cases show rural residence with both rats and animal contact, with the young age groups were more liable to the infestation than the other groups. Examination of fecal samples from rats revealed infection rates of 33.7%. *Hymenolepis diminuta* was the most common parasite (20%) followed by *Hymenolepis nana* (12.6%) and *Capillaria hepatica* (1.05%).

Keywords: *Giardia sp, Entamoeba histolytica, Hymenolepis spp., Rats, zoonoses*

INTRODUCTION

Gastrointestinal protozoon parasites are a major health problem with a high prevalence worldwide (Abd El Bagi *et al.*, 2004). The prevalence of parasitic diseases depends on environmental, social and economic factors to such an extent that the presence of intestinal parasites is an indicator of vast collective ill health. In Egypt, clinical and economic impacts of parasitic zoonoses have been reported by several researchers. School-age children are prone to intestinal parasites because of crowding and behavioral patterns that greatly contribute to the spread of parasitic infection. A high prevalence of parasitic infection in children has been recorded, with levels reaching up to 48% (Banta *et al.*, 1964). In addition, parasitic diseases are prevalent among the residents of rural areas. Previous literature of parasitic infections performed on villages revealed high infection rates of single and multiple gastrointestinal parasitic infections (85%) in small villages (Banta *et al.*, 2009; Fawzi *et al.*, 2004). Parasitic diseases pose serious public health effects on both immunocompromised and immunocompetent patients (Baiomy *et al.*, 2010; Abdel-Hafeez *et al.*, 2012). Moreover, parasites are considered to be the mainetiologic agent of diarrhea, with prevalence 61% among individuals suffering diarrhea (El-Naggar *et al.*, 2006; Mousa *et al.*, 2010). In a survey conducted in the Delta region, 67.1% of chronic diarrheic patients were found suffering from parasitic infections. In such work, single infection (54.2% of all patients) and mixed infections (12.9% of total chronic diarrhea patients) were present (Baiomy *et al.*, 2010).

During the last decades, the presence of *Giardia* sp. and *Entamoeba* spp. in the environment, especially

water, and in mammals, including humans, has been raised (Tavarez *et al.,* 1991; Fayer *et al.,* 2000). Giardiasis is a major diarrheal disease found worldwide. It has been found that animals are considered as reservoirs for *Giardia* sp., with *G. intestinalis* could be detected in wild rats (Abdel-Wahed *et al.,* 1999). Many literatures reported that amoebiasis is the most aggressive protozoal disease that affects the human bowel and is considered as a mandatory cause of death among the parasitic diseases (WHO, 1997). Amoebiasis is a global protozoal disease, with approximately 50 million people are infected annually, with the end result of 100,000 deaths (WHO, 1997; Gatti *et al.,* 2002). It is thought to be more common in areas of poor sanitation and nutrition, particularly in the tropics (Gatti *et al.,* 2002). Zoonotic transmission of *E. histolytica* has been discussed by Jackson *et al.* (1984). Experimental infection with *E. histolytica* occurred in dogs, cats, rats, monkeys and other laboratory animals. These animals might be infected with human strains as a result of close contact with humans. *Hymenolepis diminuta* infection in humans is uncommon (Levi *et al.,* 1987; Hamrick *et al.,* 1990; Varghese, 1998); with few hundred cases have been reported (Tesjaroen *et al.,* 1987; Lo *et al.,* 1989). *H. nana* is more commonly detected as a cause of human infection since its transmission does not require intermediate host, so it can be directly spread from infected person to another.

Paragonimiasis is a cosmopolitan in many parts of Africa, Asia and South America (Gary, 2009). In humans, infection occurs by ingestion of raw or undercooked freshwater crabs or crayfishes (Singh *et al.,* 2005). *Capillaria hepatica*, the causative agent of hepatic capillariasis, mainly affects rats and is rarely seen in man. Pinworms spread through human-to-human transmission, by fecal-oral route (Burkhart and Burkhart 2005).

Household pets often carry eggs in their fur, while infection by this route is not recorded yet (Wolfe 1978).

Rats act as reservoir host for many zoonotic pathogens including parasites that pose a health risk to humans (Paramasvaran *et al.,* 2009). Several helminthes parasites are common in both man and rodents. Some are accidentally infect and have a little public health importance, while others naturally occur in rodents and play a significant role in the prevalence of some of human parasites (Flynn, 1973).

The current work aimed to detect the prevalence of different zoonotic parasites infecting humans and rats in different localities of Beni-Suef province, Egypt with determination of the role of rats in transmission of such zoonotic parasites among human beings.

MATERIALS and METHODS

2.1. Rat fecal samples:
A total of 95 fecal samples were collected from rats from different areas in Beni-Suef province (coordinates: 29°04′N 31°05′E), Egypt. Each sample was put into individual plastic container and was transferred to the Laboratory of Parasitology, Faculty of Veterinary Medicine, Beni-Suef University and stored at 4°C for parasitological examination.

2.2 Human stool samples:
Human stool samples were collected from nearby hospitals from Beni-Suef province and from outpatients admitted to clinics. Accordingly, a total of 536 samples were collected. Data of patients were recorded for each sample (residence, age, sex, consistency of the stool,... etc). According to age grouping, patients were classified into 5 groups, each of 10 years interval and beginning from the old of one year. Samples were collected in accordance with WHO guidelines of collection of fecal samples (WHO 1991). Each sample was labelled and sent to the laboratory for further parasitological examination.

3. Laboratory procedures
3.1. Macroscopic examination:
All fecal samples were visually examined by naked eyes to detect adult nematodes and proglottides of tapeworm.

3.2. Floatation and sedimentation techniques:
Each sample was subjected to fecal floatation technique using different solutions (saturated salt solution, zinc sulphate solution and Sheather's solution) according to Zajac and Conboy (2006). Furthermore, formol ether sedimentation technique was applied for each sample (Lee *et al.,* 2010). Lugol's iodine solution was used to facilitate identification of protozoal cysts and trophozoites. Parasite eggs/oocysts were identified based on color, shape and contents according to the key given by Soulsby (1982) and examined by light microscopy using different magnifications.

RESULTS

Table 1: Distribution patterns of enteroparasitic stages recovered from patients in different localities in Beni-Suef province, Egypt.

Parasite	Age	1-10y		11-20y		21-30y		31-40y		More than 40y		Total	
		♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	No.	%
Single infection	***Paragonimus*-like**	1	0	1	0	0	0	1	1	0	0	4	0.7
	Hymenolepis nana	15	18	9	8	4	5	2	5	1	0	67	12.5
	H. diminuta	0	0	1	0	0	0	0	0	0	0	1	0.18
	Enterobius	7	15	9	5	0	2	0	0	0	0	38	7.1
	***Giardia* spp.**	12	15	13	10	1	5	1	1	1	0	59	11
	Entamoeba histolytica	23	13	7	9	7	14	9	2	5	2	91	16.9
***Mixed infection**		4	3	0	2	0	0	0	0	0	0	9	1.7
Negative		63	34	15	17	27	16	21	7	33	34	267	49.8

*****Mixed infection with *Hymenolepis nana* & *Entamoeba histolytica* found in 7 (1.3%), *Hymenolepis nana*, *Enterobius* & *Entamoeba histolytica* in 1(0.18%) and *Enterobius* and *Entamoeba histolytica* in 1 (0.18%).

Table 2: incidence of enteric parasite in examined rats.

Parasite	Examined No.	Infected No.	Percentage of infection
Hymenolepis nana	95	12	12.6
Hymenolepis diminuta	95	19	20
Capillaria hepatica	95	1	1.05
Total	95	32	33.7

DISCUSSION

Light microscopic examination of randomly selected fecal samples obtained from patients revealed the presence of multiple parasitic infections including species belonging to trematoda, cestoda, nematode and protozoa. Among trematodes, *Paragonimus*-like digenean was found only in four (0.7%) patients. This finding is consistent with that obtained by Nworie *et al.* (2013) who found a prevalence rate of 0.78% (7 out of 900 stool samples) in Ebonyi, Nigeria. They attributed the low prevalence to the fact that paragonimiasis is a lung infection and eggs are expected to be highly found in sputum not in stool samples. Meanwhile, in few cases, swallowing of sputum may probably give rise to the occurrence of few eggs could be observed in stool samples. The present study revealed that there were no significant differences of infections rates between males and females. Previous literature reported that there were no sex- related differences in prevalence rates (Uchiyama *et al.,* 1999; Ashitani *et al.,* 2000). On the other hand, Nworie *et al.* (2013) found that infection rate in males was significantly higher (11.11%) than females (5.19%) ($P \leq 0.05$). Likewise with data obtained by Singh *et al.* (1986); Udonsi (1987); Uttah *et al.* (2013) who found that males are more infected than females. This opinion opposed the results of Ibenga *et al.* (1997); Asor *et al.* (2003); Uttah *et al.* (2013) who determined that infection rates were significantly higher in females than males. It is worthy to mention that, although both sexes can acquire the infection through food, males encounter crabs more than females.

The current work revealed that *Hymenolepis nana* was found in 67 (12.5%) examined human stool samples. *H. nana*, the dwarf tapeworm infecting humans, was the second most prevalent cestodal worm detected in this study. Most infected patients were children aged one to 10 years. Mild infections usually passed asymptomatic. In severe infection patients suffered from headache, dizziness, purities, diarrhea, restlessness or even convulsion (Sun, 1988). Lower infection rate by *H. nana* was recorded in Baghdad by Alia and Afkar (2009) (1.8%). Khalaf *et al.* (1979) in Egypt found that out of 471 stools samples obtained from patients suffering from

gastrointestinal disease, 62.6% had ova of *H. nana* in their stools. Moreover, Jassim *et al.* (1986) estimated infection rate of 8% in Kirkuk city. In the authors' opinion, the considerably higher infection rate in the present investigation might be related to the habits of wandering outdoors with neglected personal hygiene as well consuming foods from outdoor vendors whom may be carrier of some parasites with high possibilities to human transmission. The present findings revealed one (0.18%) positive sample for *Hymenolepis diminuta* in accordance with Daniel (1998) who found one case of *H. diminuta* infection in a child from Guadalajara, Spainand Massimo *et al.* (2003) in Italy who reported a case of *H.diminuta* infection in an Italian child. Other studies recorded infection rate ranging between 5.5 and 0.001 Panpiglione *et al.* (1987) and Mercado and Arias (1995), respectively. Human infection with *H. diminuta* is rather uncommon due to the accidental mode of transmission by swallowing of rat fleas which contains the infective cysticercoids. Our study exhibited investigation rate of 7.1% for pinworms. This prevalence is lower than the results obtained by Rafique *et al.* (2009) who found *Enterobius* spp. in 76% of human stool samples. On the other hand, lower infection ratewas obtained by Khalaf *et al.* (1979) as *Enterobius* was detected in 5.8% ofexaminedstool samples. Pinworms infection are often less dangerous but remain one of the most common parasitic nematodes seen by the family physician, particularly prevalent in the pediatric age group, but less in adults. In both groups, the most common symptoms wereanal purities. These helminths were also found in GIT contents of commensal rats and mice (Flynn 1973 and Ceruti *et al.*, 2001).

Microscopic examination showed infection rate of 11 % for *Giardia* spp. Higher infection rates (44%) were recorded in Egypt by Zaki *et al.* (1986) and 44.1%in the aborigine community in Pahang, Malaysia by Noor *et al.* (2007). Yakubu and Sathiakumar (1985) in Nigeria donated that *Giardia lamblia* represented 41% of the enteropathogenic agents identified in patients stool samples. In Amman, Jordan Shakkoury and Wandy (2005) recorded infection rate of 78% among the examined children. Even lower prevalence has been reported by other authors in different areasas in Kumasi, Ghana (11.0%) by Addy and Aikins (1986) and in Gaza, Palestine (10.3%) by Al-Hindi and El-Kichaoi (2008). Results exhibited that the age groups 1-10 and 11-20 years showed higher incidence rates. Wongjindanon *et al.* (2005); Ayeh *et al.* (2009); Nyarango *et al.* (2008) explained that the nature of everyday activities exposing people, particularly children, to be contact with natural sources of contamination such as soil and water, with consequent increase of their risk to infection with parasites.

The present study revealed infection rate for *E. histolytica/dispar* 16% in the age group 1-10 years and the incidence was higher in males than females. Lower percentages have been reported by Inabo *et al.* (2000) in Northern Nigeria, conducting that the prevalence of *E. histolytica* in primary school pupils in five villages in Kaduna and Zaria districts were 8.55%. Regarding to age, it has beennoted that 5-9 years age group was prone to the infection than the 10-15 years group. Moreover, in Makkah, Saudi Arabia, a prevalence rate of 2.6% was reported by Saeed and Manal (2007). Higher incidence was recorded by Yakubu and Sathiakumar (1985) in Nigeria. Theyobserved that enteropathogenic agents were identified in stools of 26(23%) patients representing *E. histolytica*. Aza *et al.* (2003) in Malaysia reported that the prevalence of *E. histolytica* was 21%.Meanwhile, Obadiah (2012) found that 72 (37.9%) were positive for *E. histolytica* in stool samples. The age groups mostly infected were 0–9 years, and most cases were significantly associated with diarrhea. Zoonotic transmission of *E. histolytica* has been suggested by Jackson *et al.* (1984). Experimental infections with *E. histolytica* have been done in dogs, cats, rats, monkeys and other laboratory animals. Previous literature determined the presence of *E. histolytica* in wild rats. Among those, Fagir and El-Rayah (2009) in Sudan; Tung *et al.* (2009) in Taiwan, and Paramasvaran *et al.* (2009) in Malaysia. Krishnasamy *et al.* (1980) in Malaysia reported the protozoan in the wood rat. These animals might acquire human strains as a result of the close contact with humans. Amoebiasis is an invasive protozoal infection caused by *Entamoeba histolytica* (WHO, 1997), and considered the most aggressive protozoal disease that affects the human bowel and incriminatedin some deaths. Among the parasitic diseases, Amoebiasisare worldwide, with approximately 50 million people infected annually, causing close to 100,000 deaths (WHO, 1997 and Gatti *et al.*, 2002). It is said to be more common in areas of poor sanitation and nutrition, particularly in the tropics (Gatti *et al.*, 2002).

Rats are highly adaptable to many environments throughout the world. Unfortunately they act as reservoir host for many zoonotic pathogens including parasites that pose a health risk to humans (Paramasvaran *et al.*, 2009). Several species of helminthes parasites are common to both man and rodents. From which some are accidentally infect humans and are of minor public health importance; while the others play a significant role in human diseases (Flynn, 1973).

Our examination of fecal samples obtained from rats as shown in table (2) revealed the presence of multiple parasitic stages belonging to cestoda and nematode. The results exhibited infection rate of 12.6%, 20%, and 1.05%, for *Hymenolepis nana,*

Hymenolepis diminuta and *Capillaria hepatica* respectively with overall prevalence of 33.7%. This result is lower than that obtained by Tung *et al.* (2009) who found that the overall prevalence of parasitesin rodents from different localities in Taichung, Taiwan was 93.7%.

From the result it was obvious that *H. nana* and *H. diminuta* were the common parasites in examined rodents with *H. diminuta* is the most prevalent one. The results are nearly in agreement with Webster and MacDonald (1995) who found that 22% *H. diminuta* eggs in 225 examined rats in one farm in UK. Furthermore Easterbrook *et al.* (2008) recorded that *Hymenolepis diminuta* represent (34.4%) in 162 examined rats in Baltimore, Maryland, USA. Moreover Mohd Zain (2008) stated that *H. diminuta* represented (35%) in two urban rat populations in Kuala Lumpur, Malaysia.

Lower percentage of H. nana (11%) recovery recorded by Webster and MacDonald (1995) in the rats they examined. In contrast higher percentage (48%) was detected by Rafeique *et al.* (2009) in wild rodents in Pakistan. Moreover Gilioli *et al.* (2000) and Mohd Zain (2008) stated that *H. nana* represented 40% and 28.4% in rats they examined.

Hymenolepis species are tapeworms occurring throughout the world. Over 400 species are found in higher vertebrates, while the definitive hosts are rodents (Little and Ambrose, 2000 and Bahadir, 2002). It is the most notorious for causing pathologic effect of public health importance (Ceruti *et al.*, 2001). *H. nana* and *H. diminuta* are the two most problematic for humans. Although *H. nana* is mainly a parasite of humans, but it is found more commonly in rats and mice, and has been widely used as a model system for the study of cestode tape worm biology (Ito and Itagaki, 2003) *H. nana* is a zoonotic parasite and is common in children and institutionalized groups (Rauch, 1993 and Alvez *et al*., 2003). *H. diminuta* has also been reported among rats in Belgrade (Kataranovski *et al.,* 2011), Sudan (Fagir and El-Rayah, 2009), Baltimore, USA (Easterbrook *et al.*, 2008), in the city of Doha, Qatar (Abu-Madi *et al.*, 2001), Nigeria (Mafiana *et al.*, 1997), Kuala Lumpur, Malaysia (Leong *et al.*,1979) and peninsula Malaysia (Krishnasamy *et al.*, 1980). Man acquires the infection via ingestion of infected intermediate host. Its infection may cause diarrhea or occasionally cachexia in man (Sun, 1988).

Capillaria hepatica, reported in this study was also reported among rats in Belgrade (Kataranovski *et al.*, 2011), Taiwan, (Tung *et al.*, 2009), and Malaysia (Paramasvaran *et al.*, 2009). Moreover Elshazly *et al.* (2008) studied the prevalence of helminths in rodents in Egypt. The overall prevalence of helminths was 52.8%. The commonest cestode detected was *H. diminuta* and the commonest nematode detected was *Capillaria hepatica.* Siti *et al.* (2012) found that out of 137 samples among wild rats in urban area of Kuala Lumpur, Malaysia, 81.8% samples were positive with intestinal parasites .Six different parasites were detected. The most common intestinal helminth parasite detected was *Hymenolepis nana* (23.4%), *Capillaria hepatica* (13.9%) and *Hymenolepis diminuta* (2.9%).

Capillaria hepatica is a very rare zoonotic infection which primarily infects rodents and is rarely found in humans. Infection manifested by fever of unknown origin and hepatomegaly peripheral eosinophilia.

From the results it is clear the high prevalence of parasitic infection in rats exhibiting no signs in rats except in heavy infection (Tanaka *et al.*,1974; Baker, 1998). The study throw light on the role of rodents in the spread of enteric parasite in environment and the need for application of appropriate control measures to prevent the human disease transmission.

CONCLUSION

Rats being closely associated with humans and may harbors many different kinds of intestinalparasites serving as great potential for zoonotic infections to man. These rodentscan serve as a source of human infection especially with poor environmental/hygienic conditionsso control of rats is of prime importance in the prevention and control of zoonotic infections in man. The continuous increasing in the amount of garbage collected contributes high rat prevalence. Close proximity of man with rats as well contributing significantly in the increase of zoonotic disease spread.

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القوارض كمصدر محتمل لبعض الطفيليات المعوية المشتركة فى محافظة بني سويف

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الإصابات الطفيلية تصيب العديد من سكان العالم ولها أهمية عالمية. تنتشر الإصابة فى المناطق الريفية كذلك الدول النامية خاصة فى المناطق الإستوائية وشبه الإستوائية مسببة انخفاض الإنتاجية وخسارة اقتصادية. لذلك تهدف الدراسة الحالية الى تحديد الجوانب الوبائية ومدى انتشار الطفيليات المعوية فى مناطق مختلفة من محافظة بنى سويف كذلك تحديد دور القوارض فى نقل هذة الطفيليات الى الإنسان. لذلك تم تجميع عدد ٥٣٦ عينة براز (١٤٩ من اشخاص مصابة بالإسهال و٣٨٧ من اشخاص اصحاء ظاهرياً من مختلف الأعمار والجنس). بالإضافة الى ذلك تم تجميع ٩٥ عينة براز من القوارض من كل من المناطق الريفية والحضرية فى محافظة بنى سويف وذلك باستخدام المحاليل المختلفة. اثبتت الدراسة وجود طفيل شبية بالباراجونيمس فى ٠.٧ ، الهيمينوليبس نانا فى ١٢.٥% ،الهيمينوليبس ديمنيوتم فى ٠.١٨%، الإنتروبيس فى ٧.١% ، مثلت الجياردیا نسبة ١١% والإنتاميبا هستوليتيكا فى ١٦.٩% من الحالات كما سجلت الإصابة باكثر من نوع من الطفيليات في ١.٧% من الحالات كما تبين من الدراسة ان اغلب المصابين كانوا من المناطق الريفية وان الأعمار الأصغر سناً كانت اكثر عرضة للإصابة. كما ابرزت الدراسة معدلات اصابة فى الفئران بنسبة ٣٣.٧% منها ٢٠% لطفيل الهيمينوليبس ديمنيوتم، ١٢.٦% لطفيل الهيمينوليبس نانا كذلك نسبة ١.٠٥% للكابيلاريا.