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Survey of Some Gastrointestinal Cestodes and Nematodes from Stray Cats at Baghdad City, Iraq

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Abstract

As stray cats *Felis catus* Linnaeus, 1758 are known to be of a special public health concern in dispersing, directly or indirectly, some helminth parasites, a total of 254 stray cats were trapped from different sectors of both sides of Baghdad city (Al-Rasafa and Al-Karkh) during the whole year of 1996. Upon cats' dissection, five species of cestodes (*Diphyllobothrium latum*, *Diplopylidium acanthotetra*, *Dipylidium caninum*, *Joyeuxiella pasqualei* and *Hydatigera taeniaeformis*) and four nematodes (*Toxascaris leonina*, *Toxocara cati*, *Physaloptera praeputialis* and *Pterygodermatites cahirensis*) were detected from the small intestine. Only *P. praeputialis* was detected from the stomach. Among these worms, *D. latum* is reported in this article for the first time from stray cats in Iraq. No significant differences were noted in the infection of male and female stray cats with any of these worm species. The overall percentage incidence of infection with these worms ranged from 0.4% in case of *D. latum* to 58.3% in case of *J. pasqualei*, while the mean intensity ranged from one worm/infected stray cat in case of *D. latum* to 25.4 worms/infected stray cat in case of *D. acanthotetra*. Sex ratio (males: females) of all the investigated nematode species was in favour of the females as this ratio ranged from 1:1.1 in case of *P. cahirensis* to 1:1.6 in case of *T. cati*. Generally, the percentage incidence and mean intensity of infection with all parasite species (except *D. latum*) showed a noticeable increase during summer and, to some extent, autumn and spring in comparison with the infection during winter. All the examined cats were infected with at least one worm species and the triple infection showed the highest proportion (35.8%) in this respect. Big stray cats showed higher percentage incidence of infection in comparison with small stray cats with all the worm species, except *T. cati* in which the percentage incidence of infection of smaller cats was higher than that of the big cats.

Keywords

Stray Cats, Gastrointestinal Tract, Cestoda, Nematoda, Seasonal Variations, Baghdad, Iraq

1. Introduction

Stray cats are known to participate in transmission of some parasites to humans (Soulsby, 1968; Wiseman and Lovel, 1969; Roberts and Janovy, 1996). Many surveys were done on the helminth fauna of stray cats in different parts of the world. Among such surveys achieved during the last 40 year are those of Rep (1975) from Venezuela, Morsy *et al.* (1980) from Jordan, Engbaek *et al.* (1984) from Denmark, Calvete *et al.* (1997) from Spain, Jamshidi *et al.* (2002) from Iran, McGlade *et al.* (2003) from Western Australia, Labarthe *et al.* (2004) from Brazil, Zibaei *et al.* (2007) from Iran, Abu-Madi *et al.* (2008) from Qatar, Arbabi and Hooshyar (2009) from Iran, Sharif *et al.* (2009) from Iran, Raji *et al.* (2013) from Nigeria and Khademvatan *et al.* (2014) from Iran.

Despite the importance of stray cats in transmitting some parasites and diseases to humans, only few studies were achieved on the helminth fauna of stray cats in Iraq (Babero and Al-Dabagh, 1963; Al-Saeed, 1983; Salman, 1987; Dauod *et al.*, 1988; Nihad *et al.*, 1988; Al-Azzawi, 1989; Al-Kubaisi, 1992; Al-Sudani, 1993; Al-Mamori, 1994; Abdullah, 2007; Al-Obaidi, 2012; Hadi and Faraj, 2014; Al-Aredhi, 2015). Therefore, the present investigation was aimed to emphasis on the gastrointestinal worms of stray cats in both sides of Baghdad city (Al-Rusafa and Al-Karkh) in order to bring the attention of health authorities in Baghdad to take some appropriate measures to control stray cats in the city.

As stray cats live freely in urban areas and get easy contact with humans, they can easily contaminate soil, food and water and hence facilitate parasite transmission to humans. The economic embargo imposed by the UN against Iraq on August 6, 1990 had resulted in many negative aspects to human and animal life in Iraq. Among such aspects was the shortage of facilities for pest control and delay of garbage removal from city streets in addition to the layover of stray dog and cat campaigns. Such situations helped in creation of good habitats for spread of some parasitic diseases among stray cats.

2. Materials and Methods

During the period from January till December 1996, a total of 131 stray cats (*Felis catus* L.) were caught from Al-Rasafa side (sectors of New Baghdad, Al-Sadr, Al-Karrada and Al-Qahira) and 123 stray cats from Al-Karkh side (sectors of Al-Kathimiya, Al-Yarmouk, Al-Baia and Al-Dora) of Baghdad city. Cats were trapped by using iron cages (64 x 21 x 21 cm) provided with fish bait.

In the laboratory, stray cat's anaesthesia was achieved by their peritoneal injection with 5 ml commercial formalin. Their age was estimated depending on their teeth (Bayer, 1992). Cats were dissected out. The alimentary canal was separated from the body and was cut into three parts: the stomach, small intestine and large intestine. Each part was longitudinally cut in order to isolate any existing worms. The worms were washed with current tap water to get rid of any debris. Cestodes were exposed to slight gradual pressure between two slides and fixed in 5% formalin. They were stained with acetocarmine. Nematodes were fixed in hot 70% ethanol. Parasite identification was done according to Yamaguti (1959, 1961) and Soulsby (1968). Percentage incidence and mean intensity of infection with each worm species were calculated according to Margolis *et al.* (1982). Sex ratio (males: females) for each nematode species was calculated. Names and authorities of the cestodes were checked according to Global Cestode Database (2015). Names and authorities of the nematodes were checked with Gibbons (2010). Student t-test was applied to demonstrate any differences in the infection of both sexes of the stray cats while Chi square (χ^2) test was used to demonstrate any significant difference in the infection of small and big cats as well as changes of infection during different seasons according to Hill (1979).

3. Results and Discussion

The inspection of trapped stray cats revealed the occurrence of five species of cestodes and four species of nematodes as demonstrated below:

Phylum Platyhelminthes
Class Cestoda
Order Diphyllobthriidea
Family Diphyllobthriidae
Diphyllobothrium latum (Linnaeus, 1758) Lühe, 1910
Order Cylophyllidea
Family Dilepididae
Diplopylidium acanthotetra (Parona, 1898) Beddard, 1913
Dipylidium caninum (Linnaeus, 1758) Leuckart, 1863
Joyeuxiella pasqualei (Diamare, 1893) Schmidt, 1986
Family Taeniidae
Hydatigera taeniaeformis (Batsch, 1786) Lamarck, 1816
Phylum Nematoda
Class Secernentea
Order Ascaridida
Family Ascarididae
Toxascaris leonina (Linstow, 1902) Leiper 1907
Toxocara cati (Schrank, 1788) Brumpt, 1927
Order Spirurida
Family Physalopteridae
Physaloptera praeputialis Linstow, 1899
Family Rictulariidae
Pterygodermatites cahirensis (Jägerskiöld, 1909) Barus, Petavy, Deblock *et* Tenora, 1996

The following is a brief account on the occurrence of these parasites with emphasis on the previous known records of such parasites in Iraq.

3.1. Phylum Platyhelminthes

Five species of cestodes were detected from the intestine of the stray cats. These were *Diphyllobothrium latum*, *Diplopylidium acanthotetra*, *Dipylidium caninum*, *Joyeuxiella pasqualei* and *Hydatigera taeniaeformis*. The following is a brief account on the occurrence of these cestodes with emphasis on the previous concerned records in stray cats of Iraq.

3.1.1. *Diphyllobothrium latum* (Linnaeus, 1758) Lühe, 1910

Only one stray cat was infected with one specimen of the fish tapeworm *D. latum*. So, the percentage incidence was 0.4% while the mean intensity was one worm/infected cat (Table 1). This worm was previously reported from stray dog in Iraq (Al-Janabi and Rao, 1983).

Plerocercoids of this worm (which are the infective stage for humans and fish- eating mammals) were detected from some freshwater fishes of Iraq (Herzog, 1969, Ali *et al.*, 1987, Ali *et al.*, 1988; Abdullah, 1990). The possible explanation of the infection of the only one stray cat with this worm in the present investigation is through cat grabbing of a fish from a house while a land house was keeping fishes to dry under the sunshine, which is a traditional procedure in preparing fishes for cooking by many Iraqi families. Eating raw or inadequately cooked infected fish with the plerocercoids of this worm is considered as the common way to infect humans as well as fish-eating mammals (Roberts and Janovy, 1996). It is relevant to state here that after the record of *D. latum* from a stray cat in the present study in

1996; Al-Obaidi (2012) reported *Diphyllobothrium* sp. from stray cats at Mosul city, north of Iraq, while Al-Aredhi (2015) reported eggs of *D. latum* from faeces of stray cats from Al-Diwaniya province, mid Iraq.

EOL (2015), PESI (2015) and WoRMS (2015) also considered *D. latum* within the family Diphyllobothridae of the order Diphyllobothriidea which is in accordance with the Global Cestode Database (2015).

3.1.2. *Diplopylidium acanthotetra* (Parona, 1898) Beddard, 1913

D. acanthotetra was found in the intestine of 50.8% of the examined stray cats with a mean intensity of 25.4 worms/ infected cat (Table 1). Previously, this worm was reported by Salman (1987) from stray cats at Baghdad and Kirkuk cities of Iraq with prevalence of 51.1% and 39.3%, respectively, from Baghdad, Kirkuk and Al-Najaf cities by Dauod *et al.* (1988) with prevalence of 44.5%, 44.7% and 34%, respectively and by Abdullah (2007) from Basrah province, south Iraq with a prevalence of 31%.

It is appropriate to mention here that *D. acanthotetra* is considered within the family Dipylidiida by both EOL (2015) and PESI (2015) but within the family Dilepididae according to Global Cestode Database (2015). The life cycle of *D. acanthotetra* includes some form of coprophagous insects as the first intermediate host, some reptiles as second intermediate host containing cysticercoids and cats as final host when they become infected by their ingestion of the second intermediate host (AAVP, 2014).

3.1.3. *Dipylidium caninum* (Linnaeus, 1758) Leuckart, 1863

D. caninum was detected with a prevalence of 42.9% and a mean intensity of 11.3 worms/ infected stray cat. Previous records of this worm from Iraq included those of Babero and Al-Dabagh (1963) from different provinces of Iraq with an overall prevalence of 57.2%, Salman (1987) from Baghdad and Kirkuk cities with prevalence of 79.8% and 50%, respectively, Dauod *et al.* (1988) from Baghdad, Kirkuk and Al-Najaf cities with prevalence of 81.9%, 76.3% and 26.3%, respectively, and Al-Oubaidi (2012) from Mosul city, north of Iraq with prevalence of 64%.

D. caninum is considered within the family Dipylidiida by PESI (2015) but within the family Dilepididae according to EOL (2015) and Global Cestode Database (2015). The life cycle of *D. caninum* includes the infection of the larval stages of some fleas such as *Ctenocephalides felis*, *C. canis* and *Pulex irritans* as well as the dog louse *Trichodectes canis* by ingesting the eggs of this worm expelled with cats faeces, developing tailless cysticercoid within the adult fleas and lice, and the infection of cats by ingesting the infected adults of the above- named insects (AAVP, 2014).

3.1.4. *Joyeuxiella pasqualei* (Diamare, 1893) Schmidt, 1986

A prevalence of 58.3% and mean intensity of 14.7 worms/infected cat were calculated for the infection of *J. pasqualei* in the stray cats of the present investigation (Table 1). Previous records of *J. pasqualei* in stray cats of Iraq included those of Al-Saeed (1983) from Mosul city with a prevalence of 70%, Salman (1987) from Baghdad and Kirkuk cities with prevalence of 63.1% and 21.4%, respectively, Dauod *et al.* (1988) from Baghdad, Kirkuk and Al-Najaf cities with prevalence of 60.5%, 32.2% and 47.4%, respectively and Al-Oubaidi (2012) from Mosul city with prevalence of 78%.

J. pasqualei is considered within the family Dipylidiida by both EOL (2015) and PESI (2015) but within the family Dilepididae according to Global Cestode Database (2015). The life cycle of *J. pasqualei* includes some arthropods as the first intermediate host, reptiles as the second intermediate host and cats as the final host (AAVP, 2014).

3.1.5. *Hydatigera taeniaeformis* (Batsch, 1786)

H. taeniaeformis was detected from 13% of the examined cats with a mean intensity of 1.7 worms/infected cat (Table 1). Previously, this worm was recorded from stray cats of Iraq by Al-Saeed (1983) from Mosul city with a prevalence of 23.3%, Salman (1987) from Baghdad and Kirkuk cities with prevalence of 10.7% and 3.6%, respectively, Dauod *et al.* (1988) from Baghdad, Kirkuk and Al-Najaf cities with prevalence of 10.5%, 5.3% and 5.3%, respectively and Abdullah (2007), as *Taenia taeniaeformis*, from Basrah province with a prevalence of 13%.

H. taeniaeformis is considered within the family Taeniidae of the order Cyclophyllidea by EOL (2015) and Global Cestode Database (2015), but according to PESI (2015), it belongs to the order Tetraphyllidea under the name of *Taenia taeniaeformis* which is considered as a synonym of *H. taeniaeformis* by both EOL (2015) and Global Cestode Database (2015). The life cycle of *H. taeniaeformis* includes passing the eggs with faeces, ingesting them by the first intermediate hosts which are mice, rats, rabbits and squirrels and then ingesting the first intermediate host by the final hosts which are cats and foxes (Taylor *et al*., 2007).

3.2. Phylum Nematoda

Four species of nematodes were detected from the stray cats. These were *Toxascaris leonina*, *Toxocara cati*, *Physaloptera praeputialis* and *Pterygodermatites cahirensis*. All these nematodes were found in the intestine except *P. praeputialis* which was found in the stomach. The following is a brief account on the occurrence of these nematodes with emphasis on previous concerned records in stray cats of Iraq.

3.2.1. *Toxascaris leonina* (Linstow, 1902) Leiper, 1907

T. leonina was detected from 18.5% of the examined cats with a mean intensity of two worms/infected cat (Table 1). Sex ratio was 1: 1.3. Previous records from stray cats of Iraq included Al-Kubaisi (1992) from Baghdad city with a prevalence of 24.3%, Al-Sudani (1993) from Baghdad city with a prevalence of 41.9%, Al-Mamori (1994) from Baghdad city with a prevalence of 3.3%, Al-Obaidi (2012)

from Mosul city with a prevalence of 30%, Al-Aredhi (2015) from Al-Diwaniya province with a prevalence of 7% and Abdullah (2007) from Basrah province with a prevalence of 2%.

The life cycle of *T. leonina* includes passing of eggs with the faeces, development of larvae inside the eggs in the environment and cat's ingestion of the eggs containing larvae or ingestion the transport host such as squirrels (Pest and parasites.org, 2012).

3.2.2. *Toxocara cati* (Schrank, 1788) Brumpt, 1927

This nematode was detected with a prevalence of 35.4% and a mean intensity of three worms/ infected cat (Table 1). Sex ratio was 1: 1.6. In comparison with other nematodes, *T. cati* was reported earlier by more researchers from Iraq who included Al-Saeed (1983) from Mosul city with a prevalence of 36.7%, Salman (1987) from Baghdad and Kirkuk cities with prevalence of 16.6% and 20.2%, respectively, Dauod *et al.* (1988) from Baghdad, Kirkuk and Al-Najaf cities with prevalence of 23.7%, 7.9% and 65.8%, respectively, Al-Azzawi (1989) from Baghdad city with a prevalence of 34.2%, Al-Kubaisi (1992) from Baghdad city with a prevalence of 13.7%, Al-Sudani (1993) from Baghdad city with a prevalence of 65.1%, Al-Mamori (1994) from Baghdad city with a prevalence of 64.8%, Abdullah (2007) from Basrah province with a prevalence of 2%, Al-Obaidi (2012) from Mosul city with a prevalence of 40%, Hadi and Faraj (2014) from Baghdad city with a prevalence of 12.9% and Al-Aredhi (2015) from Al-Diwaniya province with a prevalence of 25.6%.

In cats, there are three ways by which infection with *T. cati* occurs: Consuming infective worm eggs from soil in the environment (generally through normal grooming), nursing from a mother cat that was herself infected in late pregnancy (most kittens are infected by this way) and consuming a prey animal (usually rodent) that is carrying developing worms (Pest and parasite.org , 2012).

3.2.3. *Physaloptera praeputialis* Linstow, 1899

P. praeputialis was recorded from the stomach of the stray cats of the present study with a prevalence of 41% and a mean intensity of 5.9 worms/infected cat (Table 1). Sex ratio was 1: 1.2. Previously, this worm was recorded from stray cats of Iraq by Al-Saeed (1983) from Mosul city with a prevalence of 46.7%, Salman (1987) from Baghdad and Kirkuk cities with prevalence of 39.3% and 34.5%, respectively, Dauod *et al.* (1988) from Baghdad, Kirkuk and Al-Najaf cities with prevalence of 34.2%, 28.9% and 44.7%, respectively, Abdullah (2007) from Basrah province with a prevalence of 23% and Al-Obaidi (2012) from Mosul city with a prevalence of 78%.

Eggs from cat faeces swallowed by an arthropod such as the German cockroaches *Blatella germanica* develop to third-stage infective larvae in their body cavities. Cats fed larvae from naturally infected lizards (*Varanus griseus*) and the long-eared hedgehogs (*Hemiechinus aratus*) develop infections from these paratenic hosts. Thus, cats are more likely to be usually infected by the ingestion of these paratenic hosts than by the ingestion of the arthropod intermediate host (AAVP, 2014).

3.2.4. *Pterygodermatites cahirensis* (Jägerskiöld, 1909) Barus, Petavy, Deblock *et* Tenora, 1996

P. cahirensis was recorded from the intestine of stray cats with a prevalence of 22.8% and mean intensity of 2.9 worms/infected cat (Table 1). Sex ratio was 1: 1.1. This nematode was previously recorded from stray cats of Iraq under its synonym *Rictularia cahirensis* by Al-Saeed (1983) from Mosul city with a prevalence of 26.7%, Salman (1987) from Baghdad and Kirkuk cities with prevalence of 7.1% and 36%, respectively, Dauod *et al.* (1988) from Baghdad, Kirkuk and Al-Najaf cities with prevalence of 7.9%, 7.9% and 2.6%, respectively and by Abdullah (2007) from Basrah province with a prevalence of 58%.

The first intermediate host of *P. cahirensis* is some arthropods such as the insect *Tachyderma hispida*. When parasite larvae from the intermediate host were fed to a young cat, eggs appeared in the faeces 38 days later. Larvae were also found encapsulated in the wall of the intestine and in the abdominal mesenteries of some lizards. A successful experimental infection occurred when larvae from these lizards were given to cats. Larvae recovered from a naturally infected frog *Rana tigrina* infected puppies (AAVP, 2014).

The absence of significant differences in the infection of male and female stray cats with the cestodes and nematodes of the present investigation is due to the similarity of their food and feeding habits as well as to their living in the same habitat. Some other researchers also showed that no significant differences were noted in the infection of male and female cats with some intestinal worms (Nichol *et al.*, 1981; Shaw *et al.*, 1983; Engbaek *et al.*, 1984; O'Lorcain, 1994; Zibaei *et al.*, 2007; Raji *et al.*, 2013). This sort of similarity is common with most helminths which are passively acquired with host food (Kennedy, 1975).

Generally, the seasonal variations in the percentage incidence of infection of stray cats with most worm species showed no significant differences. This can be attributed to the availability of the intermediate hosts of such worms during the whole year. According to Soulsby (1968) and AAVP (2014), these intermediate hosts include the flea *Ctenocephalides felis* for *D. caninum* and *T. cati*, house rodents for *H. taeniaeformis*, *T. cati* and *T. leonina*, dung beetles and some lizards for *D. acanthotetra* and *Blatta germanica*, *Gryllus animilis* and *Centophilus* spp. for *P. praeputialis*. However, insignificant increase in some seasons, especially summer was noticed in the infection with *D. acanthotetra*, *J. pasqualei*, *T. cati* and *P. praeputialis* (Table 1). Such increase might be attributed to the abundance of intermediate hosts of some helminths, especially the insects and lizards, in great numbers during spring and summer especially when taking in consideration the lack of insect control practices during the years which followed the

economic embargo imposed against Iraq on August 6, 1990.

Table (1). *Seasonal changes in percentage incidence (upper numbers) and mean intensity (lower numbers) of infection of stray cats from Baghdad city with some cestodes and nematodes.*

Parasite species	Winter (64)	Spring (63)	Summer (66)	Autumn (61)	Overall (254)	Probability
D. latum	1.6	0	0	0	0.4	P>0.05
	1.0	0	0	0	1.0	P>0.05
D. acanthotetra	40.6	42.9	60.6	59.0	50.8	P>0.05
	15.9	23.4	30.9	27.5	25.4	P>0.05
D. caninum	39.1	39.7	48.5	44.3	42.9	P>0.05
	8.0	9.4	13.2	13.7	11.3	P>0.05
J. pasqualei	46.9	57.1	68.2	60.7	58.3	P>0.05
	11.2	12.8	17.3	16.2	14.7	P>0.05
H. taeniaeformis	12.5	12.7	15.2	11.5	13.0	P>0.05
	1.5	1.8	2.0	1.6	1.7	P>0.05
T. leonina	15.6	15.9	21.2	21.3	18.5	P>0.05
	2.2	1.6	2.1	1.9	2.0	P>0.05
T. cati	28.1	33.3	40.9	39.3	35.4	P>0.05
	2.6	2.8	3.4	3.0	3.0	P>0.05
P. praeputialis	35.9	39.7	47.0	41.0	41.0	P>0.05
	3.4	5.6	7.2	6.7	5.9	P>0.05
P. cahirensis	14.1	25.4	28.8	23.0	22.8	P>0.05
	1.9	2.8	3.5	2.6	2.9	P>0.05

The calculated sex ratio (males: females) of the four nematode species of the present investigation showed a clear trend of high female numbers in comparison with male numbers. Sex ratio was 1:1.6 in *T. cati*, 1:1.3 in *T. leonina*, 1:1.2 in *P. praeputialis* and 1:1.1 in *P. cahirensis*. Dubey (1966) and Engbaek *et al.* (1984) also detected a sex ratio in favour of the females of *T. cati*.

The percentage incidence of infection of big stray cats with the worm species was higher in comparison with the small cats, except for the infection with *T. cati* where small cats were more infected (Table 2). The high infection in big cats is due to their ability to catch a wide variety of insects and lizards which carry the infective stages in comparison with the small cats which are unable to catch such variety of intermediate hosts. Similar trend of infection among small and big cats was demonstrated by other researchers (Oldham, 1965; Dubey, 1966; Niak, 1972; Shaw *et al.*, 1983; Engbaek *et al.*, 1984; Salman, 1987; Al-Azzawi, 1989; Raji *et al.*, 2013). Engbaek *et al.* (1984) attributed the high percentage of infection of the small cats with *T. cati* in comparison with big cats to the direct contact between the kittens and their mothers which facilitates the easy transmission of the flea *C. felis* (the intermediate host of *T. cati*) from the mothers to the kittens. The accumulation of infective stages in big cats is also attributed to the higher infection in comparison with the small cats (Shaw *et al.*, 1983).

None of the examined stray cats was free of gastrointestinal parasites. Out of the detected infections in the present investigation, 18.1% of the examined cats were infected with one parasite species, 22.5% with two parasite species, 35.8% with three parasite species and 23.6% with four and more parasite species. Ismail *et al.* (1983) and Salman (1987) showed that the double infection was the dominant, while in the present study, the triple infections, followed by both quadruple and double infections were the dominant. The fact that 81.9% of the infected stray cats were infected with more than one worm species indicated that stray cats became obliged to feed on more different insects and rodents to fulfil their nutritional requirements instead of their dependence on food remains deposited from houses to the streets. This is another negative indirect indicator of the economic embargo on stray cats of Iraq.

Table (2). *Percentage incidence and mean intensity of infection of small and big stray cats from Baghdad city with cestodes and nematodes.*

Parasite species	Small cats (59)		Big cats (195)		All cats (254)		Probability
	Incidence	Intensity	Incidence	Intensity	Incidence	Intensity	
D. latum	0	0	0.5	1.0	0.4	1.0	P>0.05
D. acanthotetra	39.0	4.4	56.4	28.0	50.8	25.4	P>0.01
D. caninum	13.6	2.6	51.8	11.9	42.9	11.3	P>0.01
J. pasqualei	33.9	4.3	65.6	16.3	58.3	14.7	P>0.01
H. taeniaeformis	0	0	16.9	1.7	13.0	1.7	P>0.01
T. leonina	0	0	24.1	2.0	18.5	2.0	P>0.01
T. cati	45.8	3.0	32.3	3.0	35.4	3.0	P>0.01
P. praeputialis	16.9	2.2	48.2	4.4	41.0	5.9	P>0.01
P. cahirensis	3.4	2.0	28.7	2.9	22.8	2.9	P>0.05

4. Conclusions

Results of inspection of 254 stray cats trapped from different sectors of Baghdad city, showed the occurrence of five cestode species (*D. latum*, *D. acanthotetra*, *D. caninum*, *J. pasqualei* and *H. taeniaeformis*) and three nematode species (*T. leonina*, *T. cati* and *P. cahirensis*) in the intestine as well as one nematode species (*P. praeputialis*) from the stomach. Among these worms, the fish tapeworm *D. latum* is reported for the first time from stray cats of Iraq.

Male and female stray cats showed no significant differences in their infection with these worms. Apart from *D. latum*, the infection with the remaining parasite species showed a noticeable increase during summer, autumn and spring in comparison with the infection during winter.

The present study also showed that the sex ratio (males: females) of the four nematode species was in favour of the females. Such ratio ranged from a minimum value of 1:1.1 in *P. cahirensis* to 1:1.6 in *T. cati*.

Big stray cats showed higher percentage incidence of infection with the gastrointestinal worms in comparison with small cats. The one exception was the infection with *T. cati* as 45.8% of the small cats were infected in comparison with 32.3% in big cats with the same species. Reasons of high infection in big cats are attributed to the profound hunting ability of the adult stray cats to a wide variety of insects and lizards which carry the infective stages as well as to the accumulation of these infective stages in their bodies in comparison with the small cats. On the contrary, the reason for the high infection of small cats with *T. cati* in comparison with big cats is attributed to the direct contact between the kittens and their mothers which facilitate the easy transmission of the flea *C. felis* (the intermediate host of *T. cati*) from the mothers to their kittens.

None of the examined stray cats was free of any gastrointestinal parasite. The infection with double, triple, quadruple and more infections in the present investigation constituted 81.9% of the total infected cats. In comparison with some previous reports which showed that double infections were the dominant (Ismail *et al.*, 1983; Morsy *et al.*, 1983; Salman, 1987), the infection with double and more infection in the present study indicated one of the negative indirect effects of the economic embargo on cats of Iraq.

Finally, with such number of worms parasitic in the stray cats together with their percentages and intensities of infection, rapid and active programs should be taken to control some of these zoonotic parasites which are either common or transmissible to humans through direct or indirect contact with stray cats. What is urgently needed is performing stray cat and dog campaign to control these animals, quick removal of garbage from the streets as well as campaigns for insect and rodent controls. Such measurements will exert no direct effect on the domestic cats as all the few numbers of such domestic cats in Baghdad city are never allowed to be outside the houses of their owners.

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