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The Prevalence of Canine Dipylidiasis in Baghdad city, Iraq

Dunya AA Mohammad Salih*, and Athmar K Abbas

Department of Parasitology, College of Veterinary Medicine, University of Baghdad, Baghdad, Iraq

***Correspondence**:
donia.abd1105a@covm.uobaghdad.edu.iq

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A B S T R A C T

Dipylidiasis is a zoonotic intestinal cestode disease caused by *Dipylidium caninum*. The objective of this study was to investigate the prevalence of *Dipylidium caninum* infections in dogs from Baghdad city. The study involved the impact of sexes, age, during nine months (from January to October 2021) on dipylidiasis infection in pet and stray dogs. 108 faecal samples were collected from (54 pets and 54 stray dogs) then examined for the detection of D. caninum egg capsules and eggs using coprological diagnosis (flotation and sedimentation methods) in the laboratory of parasitology / College of Veterinary Medicine, University of Baghdad. The overall infection rate was 14.81% (16/108). The study revealed the infection rate of *D. caninum* from pets and stray dogs was 9.26% (5/54), and 20.37% (11/54), respectively. Infection rates in stray dogs were high during March, April, and May (12.5% for each month), compared with pet dogs (0%, 6.25%, 6.25%) respectively, while in January, the rate of infection was 0% in both types, significantly (P<0.05) during March. A significant difference was recorded (*P*<0.01) between the sexes in both dog types, females recorded a higher 25% (3/12) infection rate than males 19.05% (8/42) in stray dogs, compared to the females, 5.9% (1/17) and males, 10.8% (4/37) in pet dogs, respectively. According to the age, a high infection rate was found in stray dog adults (20.51%), while the infection rate was zero (0%) in pet dog puppies, with a significant difference (p < 0.01) between the age groups in both types. The results revealed that stray and pet dogs may play a larger role in the spread of zoonotic dipylidiasis and that public health needs more concerted efforts to educate dog owners and implement control programs to prevent the infective stage maturation by cutting life cycle of intermediate hosts.

Keywords: *Dipylidium caninum*, pet dogs, stray dogs, prevalence, zoonosis

INTRODUCTION

Dogs play an important role in people's lives, including hunting, protecting, and as pets in many countries (1). They are owned by urban, and rural families who have stray dogs (free-roaming habits) and frequent contact with wildlife, livestock animals and the public (2). Dogs are also important as reservoirs or definitive hosts for many zoonotic diseases, posing greater public health, economic, and problems are given the transmission potential to humans through dogs (3), especially in developing countries where management and movement of dogs are hard to control (4).

Double-pore tapeworm, *Dipylidium caininum*is a parasitic cestode (Family: *Dipylidiidae*). The adult cestode resides in the small intestine of the definitive hosts, consisting of carnivorous mammals (5), or wild carnivorous such as the spotted hyaena (*Crocuta crocuta*) (6), and rarely

young children (7). The gravid proglottid are detached from the adult cestode's posterior end and released into the environment when they disintegrate, allowing the release of egg capsules, and then the intermediate host larvae ingest them, including *Ctenocephalides canis, C. felis, Pulex irritans* and *Trichodectes canis* (8). An oncospher develops inside the flea's hemocoel into a cysticercoid larva; accidently, the definitive host ingests infected fleas with cysticercoid that develops into the adult tapeworm when attached to the intestinal wall (9).

Many cases of canine dipylidiasis have been reported indifferent countries all over the world, such as in Ethiopia, where a higher prevalence in pet and stray dogs was 75.26% and 84.78%, respectively (10); and this parasite has also been reported at 100% in Egypt (11); 2% in Iran (12); and 14.8% in Nigeria (13). Recently, throughout Palestine's pet and stray dogs, it was 48.4% and 81.4%, respectively (14); while it was 0.5% in France (15).

Locally, less informational data is available on this cestode in both stray and pet dogs. Additionally, in Baghdad, stray dogs are now most problematic, neglected, and seldom included in research and development control programs (16). More studies are needed to gain better understanding of prevalence of dog dipylidiasis (as a borne zoonotic disease), and it is important to design effective intervention measures. Therefore, this study was designed to determine the prevalence of canine dipylidiasis as a risk factor in pet and stray dogs in the city of Baghdad, Iraq.

MATERIALS AND METHODS

The Scientific Committee of the Faculty of Veterinary Medicine, University of Baghdad, reviewed and approved all procedures used in this study in compliance with the ethical principles of animal welfare.

Sample Collection

A total of 108 fecal samples of about 5-10 g were directly collected from the ground after the defecation of 54 pets and 54 stray dogs. All of them came from different areas in Baghdad during the nine-month period from January to October 2021. Each fecal sample was placed in a clean small plastic bag containing 10 mL (10%) formalin to avoid cross contamination, labeled with the data of age (puppies and adults), sex and months then were sent to the parasitology laboratory, College of Veterinary Medicine, University of Baghdad.

Laboratory Examination

The corpological examination reported by (17) was used to process fecal samples. First, the feces were sieved to eliminate any debris before being diluted in a centrifuge test tube (1:10 in saturated NaCl solution; specific gravity was 1.20). A centrifuge was used to speed the eggs to the surface, after which a glass coverslip was placed over a filled tube (for 15-30 min) to allow the eggs to float, and lastly a cover slide was placed over a slide to be inspected under a microscope. A second approach (used to detect egg capsules) was water sedimentation in which fecal samples (1-2 g) were centrifuged, and a few drops of sediment solution were examined under a microscope. The egg capsule's morphology, with eggs recognized using descriptive (length and breadth) measurements (18).

Statistical Analysis

The Statistical Analysis System SAS (19) program was used to detect the effect of difference factors in study parameters. Chi-square (χ^2) test was also used to significantly compare between percentage (0.05 and 0.01 probability) in this study.

RESULTS AND DISCUSSION

The results showed that *D. caninum* eggs' morphological features were characterized by spherical forms, yellowish to colorless, containing an onchospher having six hooks (hexacanth embryo) and the numbers were about 8-28 inside each egg capsule (Figure 1).

Figure 1. Eggs capsules of *Dipylidium caninum* under microscopic. 40×

Sixteen out of 108 (14.81%) fecal samples were found infected with *D. caninum* in different areas of Baghdad city (Table 1). The highest infection rate was 20.37% (11/54) found in stray dogs, while the lowest was 9.26% (5/54) in pet dogs, with a significant difference (P<0.01)

Table 1. *Dipylidium caninum* infection rate in pet and stray dogs' fecal samples

Type	No. examined	Positive	%
Pet dogs	54	5	9.26
Stray	54	11	20.37
Total	108	16	14.81
χ^2			11.45 **
P-value			0.0002

**P≤0.01

Our estimation of *D. caninum* infection was similar to recorded 14.8% (59/400) from Nigeria (13), also 18.7%

(18/96) in Nigeria (20), and 11.8% (18/152) in Pakistan (21). While the study's results were lower than the one in Palestine, which was 23% (35/150) (14) which was higher than the 1% (1/77) reported in Iran (22).

According to the months of the study, infected stray dogs were shown to have the highest rates in March, April, and May (12.5% each month), while there was no rate of infection throughout January. For the pet dogs, the rate of infection was shown to be highest in February, April, May, June, and September (6.25% each month), and no infection rate in months of January, July, and August, with significant differences (P<0.05) (Table 2).

Infection has been reported to variable values in which the lowest infection rate showed in Iran of pet and stray dogs by 1% (4/28), 0% (0/49) respectively (22); in Bosnian-Podrinje canton, the infection rate was 3.74% (4/107), 11.43% (12/105), respectively (23); while the highest infection rate of *D. caninum* in pet and stray dogs was 75.26%, 84.78% respectively in Ethiopia (10) and Palestine; 48.4%, 81.41% respectively (14). A study on gastrointestinal helminths from Basra province, southern Iraq (24) recorded infection rates in pet and stray dogs of 0% (0/12), 15.4% (2/13), respectively. The variation in the infection rate of *D. caninum* by different workers is attributed to varied factors. These factors might be the study area was covered the availability of suitable intermediate hosts and their exposure to dogs, the examination source, and managerial practice, which may predispose towards the prevalence of *D. caninum* in the present investigation, that is rare in the dog population because suitable intermediate hosts may be common in the country. Depending on climatic conditions, the seasonal prevalence of dipylidiasis is higher in March and April (spring) than in autumn (25). Temperature influenced the development of onchospher to cysticercoid synchronous with infected larval fleas' development into adults, so they cannot be developed until their adult flea hosts are placed on skin animals (26). When adult fleas grown at 30-32°C emerged from their cocoons, they had fully formed cysticercoid. A prolonged development was found at more or less optimal temperatures, at 20°C, rather than at higher temperatures (27).

Table 2. *Dipylidium caninum* infection rates in pet and stray dogs according to the months

	Pet			Stray				
Month	**No. examined**	**Positive**	**%**	**No. examined**	**Positive**	**%**	**χ^2**	***P*-value**
January	6	0	0.00	6	0	0	0.00 NS	1.000
February	6	1	6.25	6	1	6.25	0.00 NS	1.000
March	6	0	0.00	6	2	12.5	4.37 *	0.049
April	6	1	6.25	6	2	12.5	2.19 NS	0.089
May	6	1	6.25	6	2	12.5	2.19 NS	0.089
Jun	6	1	6.25	6	1	6.25	0.00 NS	1.000
July	6	0	0.00	6	1	6.25	2.19 NS	0.089
August	6	0	0.00	6	1	6.25	2.19 NS	0.089
September	6	1	6.25	6	1	6.25	0.00 NS	1.000
Total	54			54				

*P≤0.05, NS=non-significant

According to the animal sex, fifty-four fecal samples were collected from (12 females and 42 males) stray dogs. A higher infection rate was shown in females, which was recorded at 25% (3/12), then males at 19.05% (8/42), compared to 54 fecal samples collected from pet dogs (17 females and 37 males), where a lower infection rate was shown in females at 5.88% (1/17), while in males it was 10.8% (4/37). The study showed significant (P≤0.01) differences between the two sexes in both pet and stray dogs (Table 3).

Table 3. *Dipylidium caninum* infection rates in pet and stray dogs according to the sex

	Pet			Stray		
Sex	**No. examined**	**Positive**	**%**	**No. examined**	**Positive**	**%**
Male	37	4	10.8	42	8	19.05
Female	17	1	5.88	12	3	25
Total	54	5	9.26	54	11	20.37
χ^2			11.33 **			3.43 **
P-value			0.0001			0.0001

*P≤0.01

Similar findings were found by (28), in which it was observed that a higher infection rate of 17.85% (5/28) in stray dogs' females than in males 12.5% (4/32) was existed. Other research outcomes recorded by (29) showed a lower infection rate 37.5% (3/20) in stray dog females than in males 58·3% (7/20). This variation between sexes

population may be due to different hormonal disturbance levels and their effects in both sexes; in the case of female dogs, during physical stress factors (pregnancy, lactation, and multiple births), they may become less resistant to specific parasitic diseases, thus reducing their immune systems (3).

Depending on the dog's age, they were divided into two groups: adults and puppies. A total of 10 puppies and 44 adults of pet dogs; and a total of 15 puppies and 39 adults of stray dogs were examined. Adult stray dogs showed a higher infection rate (20.51%, 8/39) than adult pet dogs (11.36%, 5/44) and stray puppies had a higher infection rate (20%, 3/15) compared to pet puppies (0.00%, 0/10). Data analysis showed significant (P<0.01) variation in both age groups of the two types (Table 4).

Infection rate of *D. caninum* according to animals' age was close to what was found by (30), in which it was recorded that the adult stray dog ratio was 10.4% (22/212) than puppies which was 1.9% (6/105) mentioning that the adult stray dogs were more susceptible to dipylidiasis. While (3) revealed a lower infection rate (2.52%) in puppies and a high (15.55%) in adults. Furthermore, the infection rate in adults pet dog of the present study was lower than 28.13% (18/64) and higher than in puppies 8.25% (15/55) that recorded by (14). The dogs' age is not thought to be a limitation for disease. Although the adult cestode produces a mild immunological response in the dog, this does not protect the infection from spreading or intensifying. The definitive (final) host's nutrition management, condition, hygiene, and habitat will all influence the incidence of this cestode (31). Stronger immunity may be a contributing factor as a result of repeated exposures to low numbers of infected fleas with cysticercoids as a source of infection (32).

Table 4. *Dipylidium caninum* infection rates in pet and stray dogs according to the age

	Pet			Stray		
Age	**No. examined**	**Positive**	**%**	**No. examined**	**Positive**	**%**
Puppies	10	0	0.00	15	3	20
Adults	44	5	11.36	39	8	20.51
Total	54	5	9.26	54	11	20.37
χ^2			16.50 **			12.44 **
P-value			0.0001			0.0001

*$P \leq 0.01$

Generally, the spread of *D. caninum* is limited by the range of localities of intermediate hosts like fleas and lice; whose importance as zoonotic vectors of disease should not be ignored (23). Another study by (9) described how *D. caninum* is one of the most neglected species among human tapeworms. These findings, however, are balanced by reports (27) showing that severity is based on arthropod intermediate host and environmental conditions, as is the case with most diseases.

The high infection rate 20.37% with double pores tapeworm was in stray dogs, which are considered a reservoir for dipylidiasis infectious. The source of zoonotic diseases affecting public health because they are associated with human and intermediate hosts for the completion of their life cycle. This may be related to the fact that stray dogs are free to roam any city scavenging area through leftover food, also contaminated dead animal carcasses with fleas or lice from local butchers and restaurants in the city (33). Lack of public education in the cities means people in usual contact with dogs carrying flea vectors are at risk of transmitting cysticercoid to clean dogs and complete their life cycle. It is important for local government to control the high number of stray dogs, especially those that are scavenging freely inside the city. In this study, the majority of examined stray dogs were located in suburban and rural areas around Baghdad, which it is believed the reason of increased the number of positive samples for the infection of *D. caninum* in the stray dogs. The results indicated that the stray dogs that have not received any type of preventive double tapeworm treatments and are residing in habitats suitable for large numbers of fleas and lice. These intermediate hosts may be a source of infection for uninfected stray dogs and humans, and these untreated dogs may act as an important source of unexposed for *D. caninum*, which may help in reduced anthelmintic resistance (34), while pet dogs may have prophylactic and/or treatment for tapeworm prevention, and thus spend less time in areas where infected fleas and lice are present (35). As a result, there is little data to evaluate the importance of dog cestode transmission to humans. It is necessary to continue studying the role of *D. caninum* in the present in order to understand the size of the problem.

From this study, it could be concluded that pets and stray dogs carry the *D. caninum* infection that has been identified in the Baghdad areas and can cause serious health problems for humans. Thus, more serious efforts should be made to increase the educated and informed dog

owners by updating to embrace modern dog disease control programs, and measures have to be taken to eliminate stray dogs.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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انتشار داء ذات المنفذين الكلبية في محافظة بغداد، العراق

[1]دنيا عبد الملك محمد صالح، [2]اثمار خضير عباس

الخلاصة

هدفت الدراسة الحالية الى تحديد انتشار مرض ذات المنفذين الكلبية في كلاب بعض مناطق محافظة بغداد. اشتملت الدراسة على تأثير الجنس والعمر خلال 9 أشهر(من يناير إلى أكتوبر 2021) على معدلات الإصابة بداء ذات المنفذين الكلبية في الكلاب الاليفة والكلاب السائبة. تم جمع 108 عينة براز من 54 حيوانا أليفا و54 كلبا ضالا وفحصت للكشف عن محافظ بيض الطفيلي والبيض باستخدام التشخيص الطبقي للبراز (بطريقة التطويف والترسيب). بلغت معدلات الإصابة الكلي 14.81٪ (108/16) من جميع عينات البراز. أوضحت الدراسة أن نسبة الإصابة بداء ذات المنفذين الكلبية في الكلاب الأليفة ليفة والكلاب السائبة ٪9.26 (54/5) و ٪20.37 (54/11)، على التوالي . خلال 9 أشهر من كانون الثاني إلى تشرين الأول 2021, تم الكشف عن ارتفاع معدل الإصابة في الكلاب السائبة خلال اذار نيسان وايار (12.5% من كل شهر) مقارنة بالكلاب الأليفة (0%، 6.25%، 6.25%) ، على التوالي، بينما بلغ معدل الإصابة في شهر يناير 0٪ في كلا النوعين، مع وجود فارق معنوي (P <0.05) في شهر آذار. وكشفت الدراسة بوجود فروق معنوية عند (P< 0.01) بين كلا الجنسين في كلا النوعين من الكلاب . حيث كانت اعلى اصابة 25 ٪(12/3) في الإناث مقارنة بالذكور 19.05٪ (42/8) في الكلاب السائبة مقارنة بالإناث 5.9٪ (17/1) والذكور 10.8٪ (37/4) في الكلاب الأليفة، على التوالي. حسب الأعمار، تم العثور على معدل إصابة مرتفع في الكلاب البالغة السائبة والاليفة (٪11.36;20.51) ،على التوالي، مقارنة بالجراء، كانت معدل الإصابة صفرًا (0٪) في جراء الكلاب السائبة ، مع وجود فرق معنوي (P< 0.01) بين الاعمار والأنواع . نستنتج من النتائج الى أثر الكلاب السائبة والاليفة في نقل الأمراض والطفيليات المشتركة بين الكلاب المنزلية والإنسان اضافة الى تثقيف وتعليم مربي الكلاب وتنفيذ برامج السيطرة لمنع نضوج المرحلة المعدية عن طريق قطع دورة حياة المضيف الوسطي.

الكلمات المفتاحية: *Dipylidium caninum*، الكلاب الاليفة، الكلاب السائبة، انتشار