# Intestinal Parasites in Shelter Dogs and Risk Factors Associated with the Facility and its Management

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## ABSTRACT

In the framework of a health-care program applied in different canine rescue shelters in Barcelona – Catalonia, North-Eastern Spain, detection of intestinal parasites and risk factors associated with the facility and its management were evaluated in order to improve the effectiveness of control strategies. For that purpose, 544 canine fresh stool samples were collected. The overall prevalence was 61.8% and *Giardia* spp. was the most frequent parasite detected. Our results showed that factors that would play an important role in reducing parasite prevalence in shelters were, as regards the facility, the use of non-porous material or adequate drainage systems and with respect to the management, the use of appropriate disinfectant. Thus, a coprological examination should be performed periodically in the shelter in order to know which parasites are present, and then, which suitable disinfectant and de-worming treatment should be employed. This information could be useful in guiding decisions about shelter healthcare programmes and control strategies against parasite infection.

**Keywords:** Dog, shelter, intestinal parasites, facility, management.

## INTRODUCTION

Canine groups provide suitable conditions for the occurrence and spread of parasitic infections, especially those transmitted by direct contact or intestinal parasites that spread by means of the oral-faecal route. Several studies comparing different dog populations (household dogs, stray dogs and kennelled dogs) showed a higher prevalence among shelter and kennelled dogs than pet dogs due to greater exposure to parasites when the dogs are confined in a limited area, leading to environmental contamination and heightened risk of infection (1,2,3). Thus, internal parasites that can enter with one single animal and be efficiently transmitted between animals are of greatest concern in shelters (4).

Previous studies have been carried out on the prevalence of intestinal parasites in dogs all over the world. In the USA, the overall prevalence was 12.5% (5), 28.7% in Western Australia (6), 19.6% in Switzerland (7), 20.5% in the Netherlands (8), 5.9% in Finland (9), 52.4% in Argentina (10). But the prevalence was higher in surveys carried out about dogs housed in shelters: 36% in USA (11), 34% in Canada (12), 37% in Western Australia (6), 57.9% in the French Island of St. Pierre (13), 63% in Belgium (14), 71.2% in Poland (15). In Spain, the prevalence of intestinal parasites in shelter dogs ranges from 25% to 71.3% (2,16,17,18).

Epidemiological studies are being carried out to identify those factors that are associated with the presence of the disease or pathogen; if risk factors can be identified then appropriate control measures can be developed to minimise the prevalence of the condition (19). All of the surveys mentioned above focused on the prevalence of intestinal parasites and risk factors associated with the individual such as age, gender, sex, breed, origin etc. Nevertheless, to our knowledge, no information on the influence of risk factors related

to the facility and management in different canine shelters is available. The objective of this study was to estimate the prevalence of intestinal parasites in different canine shelters in Barcelona, North-eastern Spain and the risk factors associated with the facility and the management.

## MATERIAL AND METHODS

### Shelter details

The shelters were set up by the town council or by animal protection societies. The dogs housed were lost or abandoned and taken in by the local authority, or brought by their owners who did not want to keep them anymore. According to the Animal Protection Law in Catalonia, North-Eastern Spain, no shelter dog is euthanized; these dogs were to be kept there until they were adopted or claimed. There were various breeds of dogs and mongrels and most of the dogs were adult.

### Study procedure

The study was carried out in 12 rescue shelters located on the outskirts of Barcelona, North-Eastern Spain. The appropriate sample number of dog faeces was determined using the Epi-Info v.6.[a] computer programme for an estimated prevalence of 85% using a confidence interval of 95% and a maximum sampling error of 3%. Five hundred and forty four (544) fresh dog stool samples were randomly collected from cage floors, soil and playgrounds between September 2005 and October 2008. Stool samples were collected from long-term stray dogs that had received their last antihelmintic treatment more than one month prior to the beginning of the study. Fresh stool samples were collected, put into plastic containers, stored at 4ºC and examined within 48 hours.

A questionnaire completed at the time of sampling provided information about the facility itself and the management. As regards the facility, the information provided details of the box material (concrete, wood, metal), floor material (concrete floor, waterproof painted floor, soil, sawdust or straw) and housing (communal or individual). Information about management-related factors included quarantine (yes/no), disinfection protocol (manner, products used and frequency), de-worming protocol (product and frequency) and food (commercial food – dry or soft – or freshly cooked food).

### Microscopic examination of faeces

Faecal samples were first examined for macroscopic parasitic structures such as cestode proglottids or nematode adults. Diagnosis was then performed using a 33% zinc sulphate solution centrifugation-flotation technique (20) with a specific gravity of 1.18 g/mL. Briefly, the standard operating procedure specifies that 2-4 g of faeces is suspended in 33% zinc sulphate, previously washed to remove debris, and placed in a 10 mL centrifuge tube. The samples are centrifuged at 500-650 g for 5 minutes to concentrate any parasite eggs, cysts or oocysts present in the uppermost layer. Once removed from the centrifuge, the tubes were filled with a 33% zinc sulphate solution to form a reverse meniscus to which a cover-slip was applied. The tubes were left undisturbed for an additional 8 minutes to allow the eggs to rise, and then the cover-slip is removed and placed on a glass slide to be examined by microscopy (x100, x400). Any parasite stages were identified morphologically (5).

### Statistical analysis.

The results were analysed statistically using the Epi-Info v.6*. The statistical comparison of prevalence according to the variables highlighted in the questionnaire was made using contingency tables and chi-square tests. The significance level was set at $P \leq 0.05$.

## RESULTS

The overall prevalence of parasitisation was 61.8% (336/544). The prevalence of each parasite is shown in Table 1.

106 out of 336 stool samples (31.5%) had mixed infections. The most frequent mixed parasitisation was observed among protozoa: *Giardia* spp. and *Isospora* spp. (n=45). Cestode proglottids were observed in *Dypilidium caninum* infection. Taenidae and *Hymenolepis diminuta* were detected by microscopic examination. Cestode infection was observed in cases of multiparasitism, especially when the dog was affected by more than four parasites.

As regards the facility, statistical differences were observed when examining prevalence with regard to cage mate-

* Dean AG, Dean JA, Coulombier D, et al. *Epi Info™, Version 6.04a, a word processing, database, and statistics program for public health on IBM-compatible microcomputers.* Atlanta: Centers for Disease Control and Prevention, July 1996.

**Table 1.** Prevalence of each parasite in faecal samples examined

| | No. of positive samples | Prevalence | Nr. shelters affected |
|---|---|---|---|
| *Giardia* sp. | 221 | 40.6 % | 12 |
| *Isospora* sp. | 89 | 16.4 % | 12 |
| *Trichuris vulpis* | 60 | 11 % | 10 |
| *Toxocara canis* | 41 | 7.5 % | 11 |
| Hookworms | 29 | 5.3 % | 10 |
| *Toxascaris leonina* | 12 | 2.2 % | 6 |
| *Strongyloides stercoralis* | 6 | 1.1 % | 4 |
| *Capillaria* sp. | 4 | 0.7 % | 2 |
| Taenidae | 4 | 0.7 % | 3 |
| *Hymenolepis diminuta* | 3 | 0.6 % | 1 |
| *Dypilidum caninum* | 2 | 0.4 % | 2 |

rial (*P*=0.047). A higher prevalence was observed in wooden boxes than in metallic or concrete boxes (Table 2). A positive statistical association was also observed when prevalence was examined with regard to floor material (*P*=0.0010). In that case, higher prevalence values were detected for concrete floors than for waterproof surface painted floors (Table 2).

367 dogs were living in communal housing (67.5%) and 177 (32.5%) were living in individual cages. No significant effect was observed with regard to prevalence of parasitisim (P>0.05).

As regards management, quarantine was applied in 5 shelters (n= 211, 38.8% of the dogs sampled). The duration of quarantine was 2-3 days. No statistical relationship was detected with regard to overall parasitism prevalence.

As regards the de-worming protocol, dogs were given antihelmintic treatment on arrival and then were periodically retreated, either once a month (n=60, 11.2%), every 3 months (n=242, 44.5%), every 4 months (n=170, 31.2%) or every 5 or more months (n=16, 2.9%). 56 dogs (10.3%) were only deparasitised on arrival. De-worming was based on oral administration of a praziquantel-pyrantel-febantel combination in 66.2% (n=360) of the sampled dogs, fenbendazole in 25.9% (n=141), a milbemycin-praziquantel combination in 6.3% (n=34), and praziquantel in 1.7% (n= 9). The dosage was according to the manufacturer's instructions. No statistical differences were observed with regard to prevalence and de-worming protocol.

Cleaning and disinfection standards were very similar in all the shelters studied. Faeces were removed daily in all shelters. Grossly visible debris was removed using water pressure hose in 68.6% of faeces sampled (n= 373), water vapour was applied in 22.6% (n=123) and no water was used in 8.8% of samples (n=48). With respect to chemical disinfectants, bleach (sodium hypochlorite) was the most common compound used (58%, n=316) followed by a quaternary ammonium compound (29.2%, n=159) and a bleach-ammonia combination was used in 12.6% (n=69). Statistical differences were observed when examining parasitic prevalence according to the disinfectant product used, showing lower prevalence values in those shelters where ammonia compounds were used as a main disinfectant (*P*=0.004).

The dogs were fed a commercially-produced dry food in all the shelters except one, the smallest, where freshly cooked food was prepared. The number of samples from this shelter was too small to perform a valid statistical analysis.

## DISCUSSION

The overall parasitic prevalence detected in our study (61.8%) revealed a high level of infection. This result is to be expected

**Table 2:** Number of positive samples and cage in relation to floor material used at the kennel (*P* value by chi-square test)

| | Cage material [a] | | | Floor material [b] | | | | |
|---|---|---|---|---|---|---|---|---|
| | Concrete | Metal | Wood | Concrete | Waterproof Paint | Soil | Sawdust | Straw |
| **Positives** | 200 | 93 | 43 | 166 | 86 | 75 | 5 | 4 |
| **N** | 347 | 139 | 58 | 240 | 154 | 122 | 17 | 11 |

[a] *P*=0.047; [b] *P*=0.0010

in rescue shelters, where dogs of unknown origin are confined and hygienic conditions favouring environmental contamination increase the risk of infection. The prevalence observed in the present study is similar to that reported for kennel dogs in Belgium (63%) (14) and in Córdoba, southern Spain (16). Surprisingly, the prevalence reported by other authors in shelter dogs from Barcelona was very low (26.9%) (18). Caution should be taken when comparing these to our study since they sampled dogs shortly after having been taken in to the kennel. In the case of our study we sampled long-term stay shelter dogs, meaning dogs that had been living in the shelter for more than one month and would stay there until being adopted. According to other investigations (21), significant increases in the prevalence of some parasites were found after staying in the shelter.

Protozoa infection was present in all the shelters studied. The prevalence of *Giardia* infection was markedly high (40.6%). This result is similar to that obtained by other authors (22) who detected that 55.2% of dogs from three different shelters were infected with *Giardia*. Other surveys of *Giardia duodenalis* in kennelled dogs detected a prevalence ranging from 11% to 20.5% in Italy (23), 43.9% in Belgium (14) and 29% in Australia (6). Dogs from households, shelters and commercial kennels presented a progressively higher prevalence of *Giardia* (1) since environmental contamination through dog faeces observed in kennels is an important risk factor for giardiosis (3).

Mixed infections were especially observed among protozoa (*Giardia* spp. and *Isospora* spp.). The most frequent association with the nematode species was observed with hookworms and *Trichuris vulpis*. This observation was consistent with other studies (10). Mixed helminth infections, especially those with nematodes and cestodes were at very low levels and observed only in those cases in which four to six parasite species were present.

Factors related to the facility, such as cage material or floor material, could play an important role in the maintenance of *Giardia* cysts, oocysts or helminth eggs. Our results showed that prevalence was higher in wooden cages than in concrete cages. An explanation for this could be that wood is a porous material that retains moisture for long periods of time and is more difficult to clean. As regards floor material, it was observed that those shelters in which the floor was covered with a nonporous material, such as waterproof paint, showed lower overall prevalence than those floors constructed of porous material or without adequate drainage systems. Porous surfaces retain humidity for a long time, especially when water pressure is used daily for cleaning, as is the case in most of the shelters studied.

Although quarantine is one of the most important principles of infectious disease control, no statistical relationship was detected since not all shelters applied it and a lack of a rigorous quarantine protocol was found in those shelters that did apply it.

Communal housing was considered a risk factor for *giardiosis* in a shelter environment, especially when this was associated with other factors such as age (23). Nevertheless, no correlation was observed in our study when comparing prevalence in shelters where dogs were kept individually in cages to those where dogs were in communal housing. It should be taken into account that as part of their animal welfare, in those shelters where dogs were kept individually, they had daily access to a common paddock as a play space or exercise area.

The de-worming protocol was applied systematically in all shelters and administered in a prophylactic manner with no prior faecal examination. Moreover, most shelters employed identical de-worming protocols. Thus, no statistical differences were detected.

The most commonly used disinfectant was bleach. As well as being cheap, sodium hypochlorite is considered a very appropriate disinfectant because of its full efficacy against helminth eggs, such as *Toxocara canis* (24). On the other hand, ammonia disinfection seems to be an effective measure against a natural *Giardia* infection (25). *Giardia* was present in all shelters studied and its prevalence was high; a lower prevalence was observed in those shelters where an ammonia compound –alone or combined- was applied as disinfectant. Regardless of the effectiveness of the disinfectant, daily removal of faeces from the floor seems to be an effective preventive measure (26).

In conclusion, intestinal parasites are highly prevalent in canine shelters and protozoa are present in all of them. As regards the facility, those shelters which floors were covered with non-porous material showed lower prevalences than those with concrete floors. Lower prevalence values were also observed in metallic or concrete boxes than in wooden boxes. Management factors such as housing –individual or communal- had no effect on prevalence. But, the use of appropriate disinfectant

played an important role in reducing parasite prevalence. Thus, a coprological examination should be performed periodically in the shelter in order to know which parasites are present and then which suitable disinfectant and de-worming treatment should be employed. This information could be useful in guiding decisions about shelter healthcare programmes and control strategies against parasite infection.

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