



Prevalence of *Dirofilaria immitis*, *Ehrlichia canis*, and *Borrelia burgdorferi* in pet dogs, racing greyhounds, and shelter dogs in Florida

Nirit Tzipory^a, P. Cynda Crawford^{b,*}, Julie K. Levy^b

^a Merial Shelter Medicine Clerkship, Department of Small Animal Clinical Sciences, College of Veterinary Medicine, 2015 SW 16th Avenue, University of Florida, Gainesville, FL 32610, United States

^b Maddie's Shelter Medicine Program, Department of Small Animal Clinical Sciences, College of Veterinary Medicine, 2015 SW 16th Avenue, University of Florida, Gainesville, FL 32610, United States

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ABSTRACT

Arthropod vectors of canine infectious diseases are present throughout Florida. Since crowded housing has the potential to bring vectors and infected dogs into close proximity, it is possible that prevalence of infection is higher in intensely housed dogs. In this study, the seroprevalence of *Dirofilaria immitis*, *Ehrlichia canis*, and *Borrelia burgdorferi* in dogs residing in two types of intensive housing, greyhound kennels and animal shelters, was compared to dogs residing in low-intensity housing, private homes. Serum was collected from a cross-section of 1500 adult dogs from Florida, including 500 pet dogs referred to the Veterinary Medical Center of the College of Veterinary Medicine at the University of Florida, 500 racing greyhounds, and 500 dogs residing in animal shelters. Serum was tested for *D. immitis* antigen, *E. canis* antibodies, and *B. burgdorferi* antibodies by ELISA. Seroprevalence of *D. immitis* was significantly higher (14.6%) in shelter dogs and in pet dogs (1.4%) than in racing greyhounds (0.2%) ($P < 0.04$). There were no significant differences in the seroprevalence of *E. canis* (0.4–1.6%) or *B. burgdorferi* (0–0.8%) among the groups. There was no association of sex or age with *D. immitis* infection, but pit bull type dogs were more than twice as likely to be infected than other breeds ($P = 0.003$). Evidence for vector-borne infections, particularly *D. immitis*, was found in dogs throughout the state. The prevalence was greatest for *D. immitis* infection in shelter dogs, likely due to lack of preventive medications prior to impoundment. Although heartworm infection is considered to be a treatable condition, insufficient resources in shelters may lead to euthanasia of infected dogs that would otherwise be considered adoptable.

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1. Introduction

A temperate to subtropical climate coupled with an abundance of water sources support a variety of arthropod vectors of infectious canine diseases in Florida. Chief among these are mosquitoes, which transmit *Dirofilaria immitis* (canine heartworm). In addition, Florida is home to the brown dog tick *Rhipicephalus sanguineus*, which is

the vector for *Ehrlichia canis* (the agent of canine monocytic ehrlichiosis), and the black-legged or deer tick *Ixodes scapularis*, which is the vector for *Borrelia burgdorferi* (the agent of Lyme disease) (Neer and Harrus, 2006).

In the case of *D. immitis* and *E. canis*, pathogen maturation occurs within a single arthropod host, thus the simultaneous presence of both infected dogs and the appropriate vector species may pose an increased risk of transmission among intensively housed dogs. Dogs may facilitate the transmission of tick-borne diseases when ticks take a blood meal on infected dogs, but also when tick-infested dogs transport contaminated ticks into facili-

* Corresponding author. Tel.: +1 352 273 8723; fax: +1 352 392 6125.
E-mail address: crawfordc@vetmed.ufl.edu (P.C. Crawford).

ties where the ticks may then transfer to other dogs. While ixodid ticks do not survive for extended periods indoors, the brown dog tick can survive unfed for more than a year, successfully reproduces indoors, and has been reported to infest animal shelters and greyhound kennels (Neer and Harrus, 2006; Breitschwerdt et al., 1983; News4Jax, 2007). Tick-infestation of facilities has been blamed for an outbreak of fatal ehrlichiosis in domestic and wild canids at a Florida zoo (Harvey et al., 1979). Few reports exist regarding the prevalence of these infections in intensively housed dogs residing in pathogen-endemic regions. The purpose of this study was to compare the seroprevalence and risk factors for *D. immitis*, *E. canis*, and *B. burgdorferi* infections among three groups of dogs in Florida that differ in regards to housing and use of preventive medications: owned pet dogs, intensively housed racing greyhounds, and intensively housed shelter dogs.

2. Materials and methods

2.1. Animals and sample collection

Blood was collected from 1500 adult dogs older than 6 months from Florida. This included samples from 500 pet dogs referred to the Veterinary Medical Center of the College of Veterinary Medicine at the University of Florida, 500 samples from racing greyhounds at 10 racetracks, and 500 samples from dogs residing at eight animal shelters. Demographic information was collected for each dog, but information about the clinical condition and medical history of dogs was not available. Serum was separated by centrifugation and stored at -80°C pending analysis. The study was approved by the University of Florida Institutional Animal Care and Use Committee.

2.2. Serologic testing

Samples were tested for *D. immitis* antigen, *E. canis* antibodies, and *B. burgdorferi* antibodies using a commercially available point-of-care ELISA (SNAP[®] 3Dx[®], IDEXX Laboratories, Westbrook, ME). The reported sensitivity/specificity of the test was 98%/100% for *D. immitis*, 99%/100% for *E. canis*, and 92%/100% for *B. burgdorferi*, respectively (Pack-

Table 1

Sex and age of dogs from which samples were collected for infectious disease testing. Significant differences in the proportions of dogs within a column are indicated by different superscripts within the column ($P < 0.05$).

Group	Male, no. (%)	Age, mean \pm SD
Greyhounds	267 (53.4)	2.3 \pm 0.7 year ^a
Pet dogs	242 (48.4) ^b	8.1 \pm 3.8 year ^b
Shelter dogs	278 (55.6) ^a	2.5 \pm 1.9 year ^a

age insert, SNAP[®] 3Dx[®], IDEXX Laboratories, Westbrook, ME).

2.3. Statistical analysis

Prevalence of infectious agents among dog groups and categorical risk factors (sex, breed) for infection were compared using the Fisher's Exact test or the Chi square test (Epi Info 2002, CDC, Atlanta, GA). Odds ratios (OR) with 95% confidence intervals (CI) were calculated for prevalence among groups. Mean ages were compared using the *t*-test or analysis of variance (SigmaStat 3.5, Syst Software, Inc., Chicago, IL). A value of $P < 0.05$ was considered significant.

3. Results

3.1. Demographics of dogs tested

There was a significantly higher proportion of male dogs in the shelter group than in the pet group ($P = 0.03$), but not between the greyhound group and the other groups ($P > 0.1$) (Table 1). The average age of pet dogs was significantly greater than that of the other groups ($P < 0.0001$). Only two breed groups of dogs composed more than 10% of the shelter dog samples. Dogs classified by shelter staff as "bully breeds" (105 pit bull dogs, 14 bulldogs, and their mixes) were the largest group and contributed 23.8% of the samples for testing. The second largest breed group was Labradors and their mixes (53 dogs), which contributed 10.6% of the samples.

Table 2

Prevalence of *D. immitis* antigen, *E. canis* antibodies, and *B. burgdorferi* antibodies in 1500 adult dogs from Florida housed in kennels (greyhounds, shelter dogs) or in individual homes (pet dogs).

Infectious agent	Group	No. tested	No. positive (%)	OR	95% CI	P-value
<i>D. immitis</i>	Greyhounds	500	1 (0.2%)	Referent	NA	NA
	Pet dogs	500	7 (1.4%)	7.1	0.9–153.8	0.035
	Shelter dogs	500	73 (14.6%)	85.3	12.8–1660.6	<0.0001
<i>E. canis</i>	Greyhounds	500	2 (0.4%)	Referent	NA	NA
	Pet dogs	500	7 (1.4%)	3.5	0.7–24.7	0.09
	Shelter dogs	500	8 (1.6%)	4.1	0.8–27.7	0.05
<i>B. burgdorferi</i>	Greyhounds	500	0	Referent	NA	NA
	Pet dogs	500	4 (0.8%)	NA	NA	0.06
	Shelter dogs	500	1 (0.2%)	NA	NA	0.5

OR = odds ratio, CI = confidence interval, and NA = not applicable.

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