

Veterinary Parasitology

**Seroprevalence of canine dirofilariosis in South Korea**

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## Abstract

Eight hundred and forty eight dogs (480 females and 368 males) not on chemoprophylaxis were examined for *Dirofilaria immitis* infection from 2001 to 2002. Three hundred and thirty nine (40.0 %) of 848 samples tested with antigen detecting ELISA kits showed positive reaction for *D. immitis* antigen. More male (43.5 %) than female (37.3 %) dogs were affected in this study, although there was no significant difference between both groups.  $X^2$  analysis showed that female and male dogs of shoreline areas had higher significant prevalence than other areas ( $p<0.001$ ), respectively. The mean overall positive rates of heartworm infection were 10.4 % in dogs < 2 years old group, 46.5 % in 2-4 years old groups, 48.4 % in 4-6 year old group and 50.3 % in > 6year old group. The older the age, the higher the prevalence of *D. immitis* infection in this study.  $X^2$  analysis revealed a significant higher prevalence in 4-6 year old group (100 %) of shoreline areas and in 2-4 old year group (51.2 %) of urban areas (Chungnam province), respectively ( $p<0.001$ ), and also revealed that the over 6 year old group (50.3 %) in mean overall prevalence had the significant higher prevalence than other age group ( $p<0.001$ ). In climate comparison, our data showed that shoreline areas (69.5%) had the significant higher prevalence than urban areas and mountain areas ( $p<0.001$ ). This survey confirms that the prevalence of canine heartworm infection increases, and also that the prevalence in shoreline areas is higher than in other areas in South Korea.

*Keywords:* *Dirofilaria immitis*; seroprevalence; dog; climate

## 1. Introduction

Dirofilariosis is a disease of world-wide distribution, but the most endemic areas are those with temperate, tropical and subtropical countries (Kume et al., 1970). In recent years, many epidemiological surveys of this disease have been performed in many countries (Hatsushika et al., 1992 in Japan; Matola et al., 1991 in Tanzania; Montoya et al., 1998 in Canary Islands of Spain; Rosa et al., 2002 in Argentina). South Korea is one of the enzootic regions of *D. immitis*, and the prevalence of heartworm infection in dogs appears to have increased in recent years. This is due to lack of administration of the preventive medication (Lee, 1993) and education for owners since heartworm disease is relative new problem in veterinary clinics of South Korea. This study was performed to investigate the prevalence of canine dirofilariosis and also to compare the prevalence of this disease in four areas with different environmental conditions such as shoreline areas, two urban areas and mountain areas in South Korea.

## 2. Materials and methods

### *2.1. Sampling and detection of D. immitis antigen*

The study was carried out in four different areas (one shoreline area, two urban areas and one mountain area) in South Korea (Fig.1). Environmental conditions of these areas, such as altitude, climate, temperature, relative humidity in the summer season was summarized in Table 1.

Eight hundred and fourty eight dogs (480 females and 368 males) were examined for *D. immitis* infection from 2001 to 2002. A blood sample was collected from the dogs brought to the private veterinary clinics for routine health care examination. None of the dogs in the study received heartworm prophylactic treatment. The age range was from 8 months to 14 years old. Blood was collected from a cephalic vein of the dogs, and the serum was separated by centrifugation and stored at -20°C in freezer for analysis.

The circulating antigen of *D. immitis* was detected using DiroCHEK® (Synbiotics Co., San Diego, USA) ELISA kit.

### *2.2. Statistical analysis*

The data were analyzed with a database (SPSS v. 10.0, K). Statistical analysis of the prevalence was carried out with  $\chi^2$  test

### 3. Results and discussion

In South Korea, Pak and Lee (1962) first reported that microfilaraemic rate of canine heartworm was 21% in the Chinju area. Lee et al (1996) reported that the mean positive rate of canine heartworm was 28.3 % in the two rural areas (Hoengsung-gun and Chungwon-gun) and the three urban areas (Yechon city, Gimhae city and Gwangju city) using antigen-detecting ELISA kit. Three hundred and thirty nine (40.0 %) of 848 samples tested with antigen detecting ELISA kits showed positive reaction for *D. immitis* in this study. More male (43.5 %) than female (37.3 %) dogs were affected, although there was no significant difference between both groups (Table 2). In our study more male dogs lived in the outdoors, due to their use to defend safety and property. The outdoors can be attributed to more favorable environmental conditions for the intermediate host (Johnson and Harrell, 1986).  $\chi^2$  analysis showed that female and male dogs of shoreline areas had higher significant prevalence than other areas ( $p < 0.001$ ), respectively. The risk of infection for dogs will probably stay throughout life and the likelihood of acquiring infection with heartworm increases with the increased length of period of exposure to the mosquitoes (Rhee et al., 1998). Lee (1993) reported that the positive rate for *D. immitis* increases with age. Our data also suggests that older dogs had a higher prevalence of *D. immitis* infection than younger dogs.  $\chi^2$  analysis revealed a significant higher prevalence in 4-6 year old group (100 %) of Kyunggi province (shoreline area) and in 2-4 old year group (51.2 %) of Chungnam province (urban area), respectively ( $p < 0.001$ ), and also revealed that the over 6 year old group (50.3 %) in mean overall prevalence had the significant higher prevalence than other age group ( $p < 0.001$ ).

Factors that affect the transmission of *D. immitis* include increased mosquito population density, mosquito species, mosquito fecundity and environmental temperature (Ludlam et al., 1970). South Korea is located in a temperate zone, its hot and humid environment in the summer season (June to September) is conducive for the growth and reproduction of mosquitoes (Rhee et al., 1998). Geographic distribution of *D. immitis* is mainly on riverside and shoreline areas, with an extended habit over a large part of tropical world (Theis, 1997; Theis et al., 1999). Rosa et al. (2002) reported that increases in prevalence might also occur in dogs who live in riverside areas due to the higher probability of being exposed to additional risk factors (types of confinement and presence of intermediary hosts). In climate comparison, our data revealed that shoreline areas (69.5%) had the significant higher prevalence than other areas ( $p < 0.001$ ). In the present study, higher prevalence in the shoreline areas can be attributed to more opportunities for exposure to the mosquitoes since more mosquitoes inhabit in shoreline areas than mountain areas and urban areas. In conclusion, this survey demonstrated that the prevalence of canine heartworm infection is high and the prevalence of *D. immitis* in dogs is on the increase, and higher in shoreline areas than other areas in South Korea. Therefore, life-

long chemoprophylaxis to decrease the outbreak of canine dirofilariosis is needed.

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Table 1. Environmental conditions of four areas in the summer season (June to September)

Province	climate (area)	Altitude (m. about)	Temperature (°C, range)	Relative humidity (% range)
Kyunggi	shoreline	200	21.2-27.7	76.6-84.6
Chungnam	urban	100	20.3-25.5	73.2-80.1
Kyungnam	urban	250	20.9-25.6	76.6-82.1
Kangwon	mountain	400	18.9-24.5	72.7-80.4



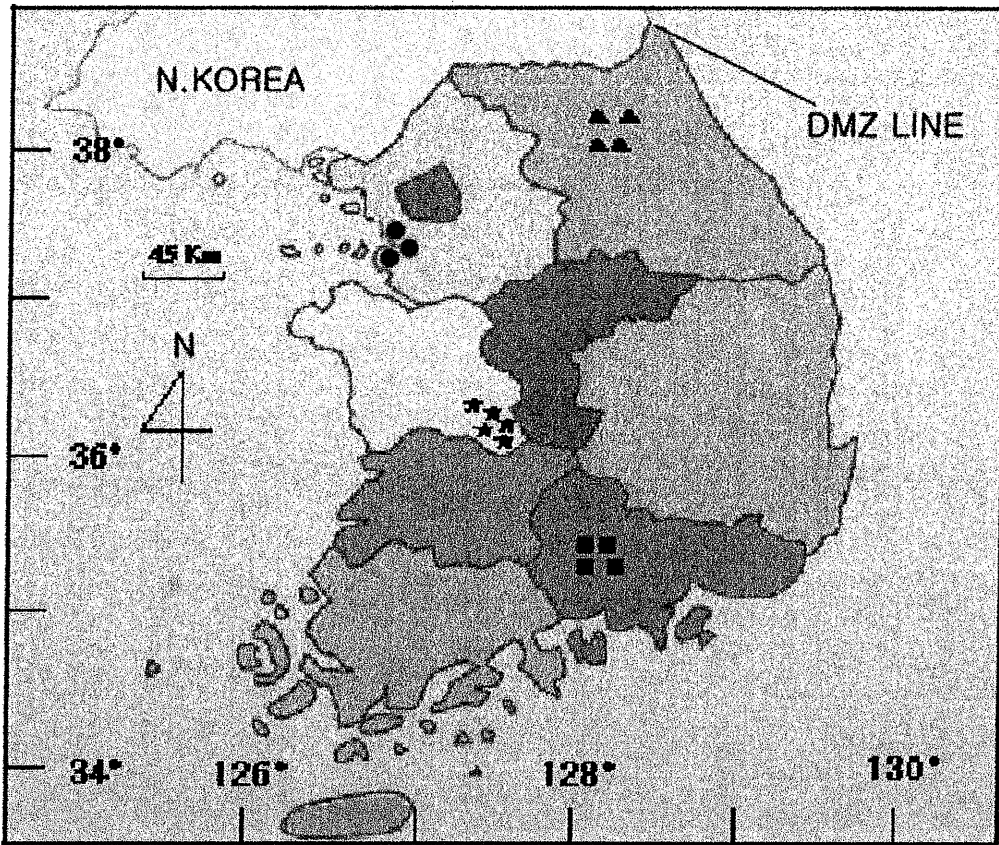


Fig. 1. Location of veterinary clinics of study area in South Korea.

- : Shoreline areas in Kyunggi province. ▲ : Mountain areas in Kangwon province.
- ★ : Urban areas in Chungnam province. ■ : Urban areas in Kyungnam province.