EPIDEMIOLOGY OF *TOXOPLASMA GONDII* INFECTION OF STRAY CATS IN BANGKOK, THAILAND

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Abstract. The objective of this study was to investigate the epidemiology of toxoplasmosis in stray cats in Bangkok. Sera were collected during 2006 and examined by Sabin-Feldman dye test. Five hundred sixty-four male and 926 female cats in and around monasteries from 50 districts were collected. *Toxoplasma gondii* was detected in 72 (4.8%) of 1,490 cats. The prevalence was significantly higher in females (5.6%) than in males (3.6%). Cats more than 5 years old had the highest infection rate (5.1%). Fifty-six percent (28/50) of areas were positive for *T. gondii* in cats. Our results show *T. gondii* is widespread in stray cats in Bangkok. It is essential to control the number of stray cats in order to reduce the transmission of toxoplasmosis to animals and humans.

Key words: *Toxoplasma gondii*, Sabin-Feldman dye test, stray cats, Thailand

INTRODUCTION

Toxoplasmosis is a zoonosis that affects both animals and humans worldwide. This disease is of economic importance in regard to animal reproduction, and has become a public health concern since it leads to abortions and neonatal complications in humans. Toxoplasmic encephalitis has been reported as a cause of death in immune compromised individuals with AIDS (Luft *et al*, 1984). In Thailand, 21.3% of HIV-seropositive and 13.1% of HIV-seronegative pregnant women have been reported to be positive for *T. gondii* antibodies (Chintana *et al*, 1998). Among HIV-seropositive individuals with *T. gondii* antibodies, 43.2% exhibit clinical symptoms and signs of *T. gondii* involving the eyes and central nervous system (Sukthana *et al*, 2001).

Cats play an important role in the spread of toxoplasmosis because they are the only animals that excrete resistant oocysts into the environment (Silva *et al*, 2001). Although the disease is also transmitted transplacentally or by ingesting the meat of *T. gondii*-infected animals, there is

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evidence that *T. gondii* infection is not maintained in the environment in the absence of cats (Munday, 1972; Wallace *et al*, 1972; Dubey *et al*, 1997). In Bangkok, large numbers of stray cats are found roaming the streets, fresh markets, public places and Buddhist monasteries (Jittapalapong *et al*, 2003). These stray cats act as sources of many zoonotic diseases, such as rabies, cat-scratch disease, ehrlichiosis and toxoplasmosis.

The standard diagnosis of toxoplasmosis in cats is based on coprological diagnosis. However, the results are difficult to interpret since oocysts of *T. gondii* in cat feces are usually few in number (Dubey and Beattie, 1988). The latex agglutination test (LAT) is widely used for the serological diagnosis of toxoplasmosis. Serological studies in Thailand have shown widespread *T. gondii* infection: 1.2-4.6% of humans (Sukthana *et al*, 2001), 11% of cats (Jittapalapong *et al*, 2007), 9.4% of dogs (Jittapalapong *et al*, 2007), 27.9% of goats (Jittapalapong *et al*, 2005), 4.9% of rodents (Jittapalapong *et al*, 2006), 4-22.3% of dairy cows in northeastern Thailand (Jittapalapong *et al*, 2008), 15.4% of captive felids (Thiangtham *et al*, 2006) and 25.6% of elephants (Tuntasuvan *et al*, 2001). Serological surveys are good indicators of the occurrence of *T. gondii* infection in cats because serologically positive cats probably shed oocysts (Dubey and Thulliez, 1989). However, the LAT has limited detection since it was designed as a screening test with limited specificity (Dubey *et al*, 1997). Of the few available serodiagnostic methods, the Sabin-Feldman dye test is the gold standard test (Reiter-Owona *et al*, 1999) for detecting *T. gondii* (IgG) antibodies. In the present study, the prevalence of *T. gondii* in stray cats in the Bangkok metropolitan areas was investigated using the Sabin-Feldman dye test.

MATERIALS AND METHODS

Study areas

Stray cat were selected by simple randomization. Blood was sampled from 10 stray cats from each of three monasteries per district; 15 to 30 cats were sampled form each district depending on the number of monasteries. All 50 districts in Bangkok were sampled.

Samples

A total of 1,490 blood samples were collected from March to May, 2006. The animals were gently restrained, and 3 to 5 ml of blood was drawn from the jugular vein, sera were separated and stored at -40ºC until used. Each cat was thoroughly examined and searched for ectoparasites. The age, sex, health status and environmental condition were recorded. Health condition criteria were as follows: good condition: healthy, invisible crest of ileum, no dehydration, no clinical signs of disease including normal mucous membranes; poor condition: unhealthy, visible crest of ileum, weak, dehydrated, purulent ocular or nasal discharge, or clinical signs of illness observed. Environmental conditions were also classified as good: monastery grounds were clean with good administration of animal habitation; poor: dirty, disordered monastery grounds and poor administration with left over food.

Sabin-Feldman dye test

All sera samples taken from cats were kept at 4°C until used. *Toxoplasma* IgG antibody was determined from each serum sample using the Sabin-Feldman dye test (Sabin and Feldman, 1948) which is highly specific and sensitive, and is regarded as the reference method for the serodiagnosis of toxoplasmosis. A value of >4 IU or a titer of at least 1:16 was taken as the threshold for positivity as recommended by Reiter-Owona *et al* (1999). One hundred

microscopic fields were examined before reporting the sample as negative.

Statistical analysis

Chi-square and Number Cruncher Statistical System (NCSS) version 2000 (Number Cruncher Statistical System LLC, Kaysville, Utah, USA) programs were used to assess differences in the prevalence and intensity of infection. Analysis was also undertaken to investigate environmental variables correlated with infection patterns, as determined by the probability that individual cats were infected. A p-value ≤ 0.05 was considered significant.

RESULTS

Toxoplasma gondii antibodies were detected in 72 (4.8%) of 1,490 cat blood samples. The prevalence of *T. gondii* infection was highest in cats >5 years old (5.1%) (Table 1). Stray cats at 6-years old had the highest percentage of positives (6.8%) among the age groups (Table 2). The proportion of females (5.6%) testing positive for *T. gondii* antibodies was not significantly higher than that of males (3.6%) (p > 0.05).

The prevalence of *T. gondii* by district is shown in Fig 1. The districts showed variations in the rate of *T. gondii*-positive cat blood samples. Fifty-six percent (28/50) of the districts examined had *T. gondii*-positive cat blood samples.

Fig 1–Distribution of *T. gondii* infection in stray cats in 50 districts of Bangkok, Thailand. Shaded districts are those with *T. gondii* infected cats.

DISCUSSION

The prevalence of *T. gondii* in cats varies depending on type (stray or domestic), age, method of testing and geographic location (Dubey *et al,* 2002). Maruyama *et al* (2003) found 5.4% of pet cats in Japan were positive for *T. gondii*. In our study, stray cats positive by Sabin-Feldman dye test (4.8%) were fewer than pet cats by latex agglutination (LAT) (23.1%) (Nishikawa *et al,* 1989), hospitalized cats by hemagglutination test (57.5%) (Sriwaranard *et al,* 1981) or stray cats by LAT (11%) (Jittapalapong *et al,* 2007) in Thailand. These variations may be due to differences in the technique, the environmental, and the sample size (Dubey and Beattie, 1988). The present study examined samples collected from all districts in Bangkok. The data show *T. gondii* infection in cats is prevalent in 56% of Bangkok districts. The prevalence of *T. gondii* in cats was found to vary depending on the area, number of monasteries, density of animals in the district and the

Table 1
Factors associated with *T. gondii* infection in stray cats, Bangkok Thailand.

Factors	No. of positive (%)/ No. of sample	Odds ratio (95 CI)	*p*-value	Chi-square	df
Age group			0.911	0.1851	2
<3 years	26/573 (4.5)	1			
3-5 years	35/703 (5.0)	1.10 (0.66-1.85)			
>5 years	11/214 (5.1)	1.14 (0.55-2.35)			
Sex			0.071	3.264	1
Male	20/564 (3.6)	1			
Female	52/926 (5.6)	1.62 (0.96-2.74)			
Health			0.788	0.073	1
Good	68/1,396 (4.9)	1			
Poor	4/94 (4.3)	0.87 (0.31-2.43)			1
Environment			0.004	8.276	
Good	53/853 (6.2)	1			
Poor	19/637 (3.0)	0.46 (0.27-0.79)			
Total	72/1,490 (4.8)				

Table 2
Prevalence of *T. gondii* infection in stray cats by age.

Age (in years)	Number positive/ Number of samples	Percent positive
1	7/138	5.1%
2	17/405	4.2%
3	17/414	4.1%
4	19/310	6.1%
5	7/149	4.1%
6	5/74	6.8%
Total	72/1,490	4.8%

economic status of people living in that area.

In Japan, no significant difference was observed in the seroprevalence of *T. gondii* by sex of the cat (Maruyama *et al*, 2003). In our study the rate of positive female cats was not significantly higher than male cats (p=0.071). Most cats in Thailand are raised either outdoors or both outdoors and indoors. The prevalence of *T. gondii* infection in indoor cats is normally lower than in outdoor cats (Dubey and Beattie, 1988). Stray cats are infected by eating infected rodents (Dubey and Beattie, 1988) or through oocyst contamination of the environment. Since infected stray cats are capable of shedding oocysts in public places (Jittapalapong *et al*, 2003), other animals and humans may become infected due to contamination of the environment.

This study emphasizes the potential role of stray cats as a source of toxoplasmosis transmission to humans in Bangkok. This information is important for public health, because cats are one of the most popular pets in Bangkok and frequently come into close contact with humans (Frenkel *et al*, 1995). These cats may contaminate the environment, thus exposing humans, and particularly children, to possible *T. gondii* infection.

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