Seroprevalence of *Toxoplasma gondii* antibodies in stray cats and dogs in the Bangkok metropolitan area, Thailand

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Abstract

Cats and dogs are the most popular pet animals worldwide. Cats are the natural reservoir of *Toxoplasma gondii* and excrete the resistant oocyst to environments. On the other hands, dogs play a role in the mechanical transmission of the parasite. Stray cats and dogs in the Bangkok metropolitan area are becoming a public concern because there is a considerable increase in their number annually. These facts indicate the risk of mechanically spreading zoonoses including toxoplasmosis to humans since human acquire the infection from infected mammals, either directly or indirectly. In the present study, the presence of *T. gondii* antibodies was examined in 592 cats and 427 dogs from October 2001 to September 2002 by using a latex agglutination test. *T. gondii* antibodies were detected in 65 (11.0%) of the 592 cats and 40 (9.4%) of the 427 dogs. The antibody titers in the positive animals ranged from 1:64 to 1:2048. Seroprevalence was significantly higher in female cats than in male cats. The present study suggested that *T. gondii* was widespread in the stray animals in the Bangkok metropolitan area; therefore, it is essential to control the number of stray cats and dogs in order to reduce the transmission of toxoplasmosis to animals and humans.

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1. Introduction

Toxoplasmosis is a zoonosis that affects both animals and humans worldwide. This disease is of economic importance with regard to animal production, and it 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% HIV-seropositive and 13.1% HIV-seronegative pregnant women have been reported to be positive for *Toxoplasma gondii* antibodies (Chintana et al., 1998). Among the HIV-seropositive individuals with *T. gondii* antibodies, 43.2% exhibited clinical symptoms and signs involving the eyes and the 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 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). Dogs also play a role in the...
mechanical transmission of oocysts to humans (Lindsay et al., 1997), although unlike cats, they do not display clinical signs and the transformation of the stages of the organism does not occur in dogs. The oocysts can be mechanically shed or transported by dogs, thereby contaminating the environment.

In Bangkok, large numbers of stray cats and dogs are found roaming the streets, fresh open markets, public places, and Buddhist monasteries (Jittapalapong et al., 2003). These stray cats and dogs act as sources of many zoonotic diseases such as rabies, cat-scratch disease, ehrlichiosis, and toxoplasmosis.

The latex agglutination test is now widely available as a useful tool for the serological diagnosis of toxoplasmosis. 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). In the present study, the seroprevalence of T. gondii in stray cats and dogs in the Bangkok metropolitan area was investigated by using a latex agglutination test.

2. Materials and methods

2.1. Animals

From October 2001 to September 2002, 592 stray cats and 427 stray dogs were captured in Buddhist monasteries by monastery caretakers and our staffs after receiving the permission of the Buddhist monks. Blood samples of animals were collected from 41 and 38 districts, respectively, of the Bangkok metropolitan area comprising of a total of 50 districts. Before sample collection, the general condition of cats and dogs were examined thoroughly, and the sex of the individual was noted. Cats were restrained by administering an intramuscular injection of ketamine (10 mg/kg) and xylazine (1–2 mg/kg). Blood samples were collected from the jugular or saphenous veins of cat and dogs, respectively. The blood samples were immediately sent to the Department of Parasitology, Faculty of Veterinary Medicine, Kasetsart University, and were centrifuged at 500 × g for 15 min. The separated sera were stored at −20 °C until analysis.

2.2. Serological assay

The presence of T. gondii antibodies was analyzed by the latex agglutination test (LAT) kit (Toxocheck-MT; Eiken Chemical Company, Tanabe, Tokyo, Japan). This test was evaluated as a screening serologic test for toxoplasmosis in animals (Tsubota et al., 1977a,b).

The procedure described in a previous report (Maruyama et al., 2003) was followed accurately. Briefly, 25 μl of latex agglutination buffer was added to each well of a U-shaped 96 well cluster plate. Then 25 μl of 1:8 diluted sera was mixed with the buffer in the first well. Serial two-fold dilutions were performed in all wells and the final 25 μl was discarded. Then 25 μl of T. gondii-antigen-coated latex beads were added to each well. The plate was shaken gently and then incubated at room temperature overnight. The cut-off titer for this test was 1:64 according to the manufacturer’s instructions in the kit and the end point was decided in each positive sample.

The results obtained were analyzed by the chi-square test, and the level of significance was set at p < 0.05.

3. Results

T. gondii antibodies were detected in 65 (11.0%) of the 592 cat blood samples. The proportion of females (13.7%) testing positive for T. gondii antibodies was significantly higher than that of males (7.4%) (p < 0.05). The antibody titers in the positive cats varied from 1:64 in five cats to 1:2048 in four cats (Table 1).

In dogs, 40 (9.4%) of the 427 blood samples were seropositive; no significant difference was observed between the sexes. The antibody titers of the positive samples ranged from 1:64 in fourteen dogs to 1:2048 in one dog (Table 2).

The seroprevalence of T. gondii according to districts is shown in Table 3. The districts showed variations in

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. examined</th>
<th>No. (%) positive</th>
<th>No. (%) of samples showing the antibody titers at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:64</td>
</tr>
<tr>
<td>Male</td>
<td>256</td>
<td>19 (7.4)</td>
<td>0</td>
</tr>
<tr>
<td>Female</td>
<td>336</td>
<td>46 (13.7)a</td>
<td>5 (1.5)</td>
</tr>
<tr>
<td>Total</td>
<td>592</td>
<td>65 (11.0)</td>
<td>5 (0.8)</td>
</tr>
</tbody>
</table>

a Statistically significant from the rate of male.
the rate of *T. gondii*-positive cat blood samples; 58.3% districts in the western area and 75% in eastern and northern areas of Bangkok showed positive samples. On the other hand, 25% districts in the eastern area and 75% in the western area had *T. gondii*-positive dog blood samples. In total, 65.9% (27/41) and 47.4% (18/38) of the districts examined had *T. gondii*-positive cat and dog blood samples, respectively; however, this data did not show any statistical significance.

### 4. Discussion

The seroprevalence of *T. gondii* in cats varied depending on their type (stray or domestic), age, method of testing, and geographic location (Dubey et al., 2002). Maruyama et al. (2003) showed that 5.4% of the pet cats in Japan were positive for *T. gondii*. In the present study, the prevalence of our seropositive stray cats (11.0%) was lower than that of pet cats (23.1%) reported by Nishikawa et al. (1989) and hospitalized cats (57.5%) by Sriwaranard et al. (1981) in Thailand. This variation is probably related to differences in the timing of the studies, the environmental conditions responsible for the dissemination of *T. gondii* infection (Dubey and Beattie, 1988), and the distribution of samples. As compared to previous studies, the present study examined samples collected from various districts in Bangkok and geographically covered more than 80% of Bangkok. The present data on cats showed that *T. gondii* infection was prevalent in approximately 66% of the Bangkok metropolitan area. The seroprevalence of *T. gondii* in cats and dogs was found to vary depending on the area, number of monasteries, density of the animal in each district, and the economic status of the population.

Most cats in Thailand are raised either outdoors or both outdoors and indoors. Since infected stray cats shed oocysts around public places (Jittapalapong et al., 2003), healthy animals and humans may get infected due to the contaminated environment. This study also reinforces the role of stray cats as one of the potential sources of toxoplasmosis transmission to humans in Bangkok.

The prevalence of *T. gondii* is known to be higher in stray dogs as compared other dogs (Riemann et al., 1978; Fan et al., 1998; Ali et al., 2003). In the present study, the prevalence of *T. gondii* infection in stray dogs was found to be 9.4%. This rate was relatively lower than those of other Asian countries; for example, the proportion to the prevalence of *T. gondii* in dogs was 5.5–6.0 times higher in Iran (Ghorbani and Hafizi, 1983), 4.2 times higher in Taiwan (Fan et al., 1998), 4.7 times higher in Japan (Ohsima et al., 1981), and 6.4 times higher in Trinidad and Tobago (Ali et al., 2003), respectively. However, the seroprevalence observed in this study differed from that in a previous report in which the positivity was 6.6% based on the analysis of 150 stray dogs from Bangkok (Nishikawa et al., 1989). The prevalence of infected dogs mostly depended on the population of stray cats and dogs that act as mechanical vectors for toxoplasmosis (Lindsay et al., 1997).

### Table 2

Prevalence of *T. gondii* antibody and the titers in stray dogs in Bangkok metropolitan area

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. examined</th>
<th>No. (%) positive</th>
<th>No. (%) of samples showing the antibody titers at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1:64</td>
</tr>
<tr>
<td>Male</td>
<td>174</td>
<td>17 (9.8)</td>
<td>8 (4.6)</td>
</tr>
<tr>
<td>Female</td>
<td>253</td>
<td>23 (9.1)</td>
<td>6 (2.4)</td>
</tr>
<tr>
<td>Total</td>
<td>427</td>
<td>40 (9.4)</td>
<td>14 (3.3)</td>
</tr>
</tbody>
</table>

### Table 3

Prevalence of *T. gondii* antibody in stray cats and dogs in four Bangkok metropolitan areas

<table>
<thead>
<tr>
<th>Area</th>
<th>No. of district</th>
<th>District for cat sample</th>
<th>District for dog sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. examined</td>
<td>No. (%) positive</td>
<td>No. examined</td>
</tr>
<tr>
<td>East</td>
<td>4</td>
<td>3 (75.0)</td>
<td>4</td>
</tr>
<tr>
<td>West</td>
<td>15</td>
<td>7 (58.3)</td>
<td>12</td>
</tr>
<tr>
<td>South</td>
<td>12</td>
<td>5 (55.6)</td>
<td>6</td>
</tr>
<tr>
<td>North</td>
<td>19</td>
<td>12 (75.0)</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>27 (65.9)</td>
<td>38</td>
</tr>
</tbody>
</table>

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pets and come in close contact with humans. It has been reported that the risk of *T. gondii* exposure in children due to contact with juvenile or young dogs is greater than in the case of contact with cats (Frenkel et al., 1995). Since many stray dogs are found in public areas in Bangkok, they may contaminate the environment and thus expose humans, particularly children, to *T. gondii* infection.

In this study, the sex of dogs was not significantly associated with seroprevalence, as has been reported by other researchers (Dubey, 1985; Ali et al., 2003). On the other hand, the rate of seropositive female cats was significantly higher than that of seropositive male cats. In Japan, no significant differences were observed in the seroprevalence of *T. gondii* in both the sexes of cats (Maruyama et al., 2003). The gender-based differences in seroprevalence between stray dogs and cats in Thailand are presently unclear. Although stray dogs are infected by eating infected rodents (Dubey, 1985) or through oocysts contaminating the environment, further studies are required to determine sources of *T. gondii* infection in dogs.

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References


