ABSTRACT: Toxoplasma gondii and Bartonella spp. are zoonotic pathogens of cats. Feline immunodeficiency virus (FIV) and feline leukemia virus (FeLV) are related to human immunodeficiency virus and human leukemia virus, respectively, and these viruses are immunosuppressive. In the present study, the prevalence of antibodies to T. gondii, Bartonella spp., FIV, as well as FeLV and Dirofilaria immitis antigens was determined in sera from feral cats (Felis catus) from Cairo, Egypt. Using a modified agglutination test, antibodies to T. gondii were found in 172 (95.5%) of the 180 cats with titers of 1:5 in 9, 1:10 in 9, 1:20 in 3, 1:40 in 5, 1:80 in 5, 1:160 in 15, 1:320 in 22, and 1:640 or higher in 104. Thus, 57.4% had high T. gondii titers. Antibodies to Bartonella spp. were found in 105 (59.6%) of 178, with titers of 1:64 in 45, 1:128 in 39, 1:256 in 13, 1:512 in 3, 1:1,024 in 4, and 1:2,048 in 1 cat. Antibodies to FIV were detected in 59 (33.9%) of 174 cats. Of 174 cats tested, antigens to FeLV, and D. immitis were detected in 8 (4.6%) and 6 (3.4%) cats, respectively. The results indicate a high prevalence of T. gondii, Bartonella spp., and FIV infections in cats from Cairo, Egypt. This is the first report of Bartonella spp., and D. immitis infections in cats in Egypt.

RESULTS
Antibodies to T. gondii were found in 172 (95.5%) of the 180 cats; 57.4% had high T. gondii titers (Table I). Antibodies to Bartonella spp. were found in 105 (59.6%) of 178, with titers of 1:64 in 45, 1:128 in 39, 1:256 in 13, 1:512 in 3, 1:1,024 in 4, and 1:2,048 in 1 cat. Antibodies to FIV were detected in 59 (33.9%) of 174 cats. Of 174 cats tested, antigens to FeLV and D. immitis were detected in 8 (4.6%) and 6 (3.4%) cats, respectively. The distribution of T. gondii MAT titers with respect to concurrent infections is shown in Table I.

DISCUSSION
The high (95%) prevalence of T. gondii in cats in the present study is probably related to the lifestyle of these cats; all cats were feral and very wild. Although we do not have data on their age, they were mostly likely adults. This seroprevalence was higher than 58.8% of 177 cats from Cairo (indirect fluorescent antibody test, IFA) reported by Aboul-Magd et al. (1988), 18.4% of 114 cats from Gharbia (indirect hemagglutination test, IHA) by Abu-Zakham et al. (1989), and 57.7% of 97 cats (latex agglutination test).
The prevalence of *Bartonella* spp. infections in the present study was also high (59%), and 104 (57%) cats had both *T. gondii* and *Bartonella* spp. antibodies. The *Bartonella* assay performed here used *B. henselae* antigens. However, it appears that antibodies to *B. henselae* and *B. clarridgeiae* are also detected in the assay. Thus, it cannot be stated with certainty which *Bartonella* species infected the cats. Each of these agents is thought to be transmitted by fleas, *Ctenocephalides felis*. *Bartonella* spp. DNA was found in fleas collected from rats in Egypt (Loftis et al., 2006). To our knowledge, this is the first report of *Bartonella* spp. infections in cats from Egypt.

The assay used here cannot distinguish FIV antibodies induced by natural infection from those induced by vaccination (Levy et al., 2008). However, the FIV vaccine is not available in Egypt, and so it is likely these results reflect natural FIV infection. The FIV seroprevalence rate was approximately 4 times the seroprevalence for FeLV. FIV is transmitted primarily by biting and FeLV by passive contact (Levy et al., 2008). The higher FIV seroprevalence likely reflects the feral nature of the cats. *Dirofilaria immitis* is known to be present in dogs in Turkey (Yaman et al., 2009) and Iran (Azari-Hamidian et al., 2009), and the positive test results in cats reflect exposure to infected mosquitoes. To our knowledge, this is the first report of *D. immitis* infection in any animal in Egypt.

There is a considerable variability with respect to *T. gondii* prevalence and concurrent infections. There could be many reasons for this observation, including different serological tests, cutoff titers, and types of cats surveyed (Dubey et al., 2009). Witt et al. (1989) and Childs et al. (1994) tested stray and pets cats from Baltimore, Maryland, and found that 14.7% had *Bartonella* spp., 2.4% had FIV, and 15.2% were seropositive to *T. gondii*; all 3 infections were higher in older cats. Both the magnitude of *T. gondii* titer and the seroprevalence were higher in FIV-infected cats (Witt et al., 1989). Dorny et al. (2002) reporting on Ghent, Belgium, also reported similar findings in stray cats; the FIV-infected cats were more likely to be seropositive for *T. gondii* and with higher antibody titers, but the seroprevalence of *T. gondii* was too high (70.2%) in this population of cats to make an accurate assessment. In the study reported by Nutter et al. (2004) from North Carolina, all infections were higher in stray cats than in pets. Maruyama et al. (1998, 2003) did not find a positive association among *T. gondii*, *Bartonella* spp., and FIV infections in cats in Japan.

Recently Akhtardarash et al. (2010) reported seroprevalences of 32.1% for *T. gondii*, 19.2% for FIV, and 14.2% for FeLV in 140 cats from Iran, and seropositivity for all 3 infections was higher in older cats. In general FIV and FeLV infections are higher in stray male cats. Unfortunately, data for sex and age for cats in the present study were not available. Nevertheless, we were able to definitively document FeLV, FIV, and *D. immitis* infections in cats in Egypt for the first time.

**ACKNOWLEDGMENTS**

The *Bartonella* spp. ELISA was performed by Arianne Morris in the Center for Companion Animal Studies at Colorado State University, Fort Collins, Colorado. The authors thank IDEXX Laboratories for donating the SNAP Feline Triple test kits used in this study and the Center for Companion Animal Studies donors (www.csuets.colostate.edu/companion) for the *Bartonella* spp. ELISA reagents and technical support to complete these assays.

**LITERATURE CITED**


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**Table I. Concurrent infections in *Toxoplasma gondii*-infected cats from Egypt.**

<table>
<thead>
<tr>
<th>MAT titer</th>
<th><em>Toxoplasma gondii</em></th>
<th><em>Bartonella</em> spp.</th>
<th>FeLV Ag</th>
<th>FIV Ab</th>
<th><em>Dirofilaria immitis</em> Ag</th>
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<tbody>
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<tr>
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<tr>
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<td>4</td>
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<td>8</td>
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