



AKADÉMIAI KIADÓ

Acta Microbiologica et  
Immunologica Hungarica

68 (2021) 1, 14–19

DOI:

10.1556/030.2021.01310

© 2021 Akadémiai Kiadó, Budapest

## ORIGINAL RESEARCH PAPER



\*Corresponding author.  
Tel.: +90 553 3496680;  
fax: +90 216 3360565.  
E-mail: [dr.neslihan.cicek@gmail.com](mailto:dr.neslihan.cicek@gmail.com)



# *Bartonella henselae* IgM seropositivity in both adult and pediatric patients with diverse clinical conditions in Turkey

NESLIHAN ARICI<sup>1\*</sup> , SEBAHAT AKSARAY<sup>2</sup> and  
HANDAN ANKARALI<sup>3</sup>

<sup>1</sup> Haydarpasa Research and Training Hospital, Microbiology Laboratory, T.C. University of Health Sciences, Istanbul, Turkey

<sup>2</sup> Department of Medical Microbiology, Faculty of Medicine Hamidiye, T.C. University of Health Sciences, Istanbul, Turkey

<sup>3</sup> Department of BioStatistic, Faculty of Medicine, Medeniyet University, Istanbul, Turkey

Received: October 2, 2020 • Accepted: December 4, 2020

Published online: March 2, 2021

## ABSTRACT

*Bartonella henselae* is the causative agent of cat scratch disease (CSD). In this study, we aimed to investigate the clinical data of patients with suspicion of CSD and delineate current epidemiological features.

A total of 785 patients with suspected CSD were included in the study. *B. henselae* IgM antibody was determined by indirect fluorescent antibody (IFA) test using a commercial kit (Euroimmun, Germany). Sex, age, clinical pre-diagnosis and animal contact information of the patients were obtained from hospital electronic database records.

Seventy-eight (9.9%) of 785 samples were seropositive. Out of 78 patients, 46 with animal contact data were further analyzed. Of these patients, 56% were male, and 41% were under 18 years of age. Seropositivity was more commonly observed in fall and winter. The most common finding was lymphadenitis (63%). Thirty-five patients (76%) had a previous history of animal contact (cat/dog). Of the 46 seropositive patients, 78.3, 15.2, 4.4, and 2.1% had titers of 1:80, 1:160, 1:320, and 1:640, respectively.

Our study confirms that CSD is not rare in Turkey. Thus, it should always be considered in the differential diagnosis of patients presenting with lymphadenopathy in all age groups, particularly children. Questioning of cat exposure should never be neglected, especially in areas with intense population of stray cats, such as Istanbul.

## KEYWORDS

*Bartonella henselae*, cat scratch disease, Turkey

## INTRODUCTION

*Bartonella henselae*, a gram negative bacillus, is the causative agent of cat scratch disease (CSD), which typically presents with self-limiting lymphadenitis, but may also lead to more serious clinical manifestations such as neuroretinitis, encephalitis, and fever of unknown origin [1]. Epidemiologic studies from different countries show that CSD has a worldwide distribution [2–7]. Although CSD occurs mainly in children and adolescents, it may cause disease in all age groups [6–8]. Transmission to humans can result from a scratch or bite from an infected cat, as well as from exposure to cat fleas. Even if cats are the main reservoir for *B. henselae*, some cases of CSD have occurred after exposure to dogs [7]. Due to difficulty of the culture, serologic testing for the presence of antibodies to *B. henselae* by indirect fluorescent antibody (IFA) test is a widely accepted diagnostic procedure for laboratory diagnosis of cat scratch disease [2].

The epidemiology and clinical characteristics of the CSD in Turkey is poorly defined. In this study, we aimed to investigate the clinical data of patients with suspicion of CSD retrospectively and delineate current epidemiological features. Although there are some publications investigating the seroprevalence of *B. henselae* in adults in our country, this study is the first large-scale study including both pediatric and adult patient groups with different clinical conditions [9, 10].

## METHODOLOGY

Between May 2014 and October 2019, a total of 785 patient samples with suspicion of CSD were sent to our central laboratory in Istanbul. The demographic data, clinical characteristics and history of animal contact of the patients were collected from electronic medical records. Out of 78 seropositive patients, thirty-two patients with no animal contact information were excluded from the study and the remaining 46 patients were further examined. Pre-diagnoses of patients were classified into three groups as lymphadenitis/lymphadenopathy (LAP), ocular symptoms (neuroretinitis, iridocyclitis e. g) and other (encephalitis, fever of unknown origin, etc.). The presence of *B. henselae* IgM antibody in serum samples was determined by indirect fluorescent antibody (IFA) test using a commercial kit (Euroimmun, Germany). After the samples were diluted 1:80, 1:160, 1:1320, 1:640, and 1:1280 in phosphate-buffered saline PBS-Tween buffer (provided in the test kit), the IFA assay was conducted following the manufacturer's protocol. Positive and negative controls were also used. Immunofluorescence was observed using an fluorescence microscope at magnifications of 40× and 200×. A titer of  $\geq 1/80$  was considered to be positive for *B. henselae* IgM.

### Statistical analysis

Statistical analyses were conducted using the Statistical Package for the Social Sciences version 22.0 for Windows (Armonk, NY: IBM Corp, USA). Descriptive statistics were computed as mean, standard deviation (SD), count and percent frequencies according to types of the variables. Fisher-Freeman-Halton exact test was used and P values  $< 0.05$  were accepted as statistically significant.

Ethic statement: Not requirement. The study was a retrospective observational study and was conducted in accordance with the Declaration of Helsinki (2008).

## RESULTS

Overall, 78 (9.9%) of the 785 patients had positive titers of antibody to *B. henselae*. The epidemiological and clinical features of the 46 positive-IFA cases, whose demographic data were available were further analyzed. Table 1 shows the demographic and clinical data of the 46 IFA-positive cases. The patients' ages ranged from 2 to 88 years (mean:

31.3 years); 19 (41%) were under 18 years of age. There were 26 males (56%) (14 children, 12 adults) and 20 females (44%) (5 children, 15 adults). The majority of samples (73.9 %,  $n = 34$ ) to be tested for the presence of *B. henselae* were sent in the fall and the winter. Thirty-four patients (73.9 %) had a previous history of contact with a cat, and 1 (2.1%) had a history of contact only with a dog. When the history of animal contact and age were compared, the positivity rate was found to be significantly higher in patients under the age of 18 and negativity rate in those above the age of 18 ( $P = 0.049$ ) (Table 2). The most common symptom was lymphadenitis/lymphadenopathy (LAP) ( $n = 29$ , 63%). When the age and pre-diagnoses were compared, in the group  $\geq 18$  age, pre-diagnosis of both "eye symptoms" and "other symptoms" were found significantly higher than in the group of  $< 18$  age, whereas the pre-diagnosis of "lymphadenitis/lymphadenopathy" was significantly higher in the group  $< 18$  age ( $P = 0.001$ ) (Table 3). The frequency of eye symptoms and other systemic disorders (encephalitis, fever of unknown origin, e.g.) was found to be 21.7 % ( $n = 10$ ), and 15.3% ( $n = 7$ ), respectively. Of these 46 seropositive patients, 78.3% (36/46), 15.2% (7/46), 4.4% (2/46), and 2.1% (1/46) had titers of 1:80, 1:160, 1:320, and 1:640, respectively (Table 4).

## DISCUSSION

Information on the clinical features of *B. henselae* infection in Turkey has been limited to clinical case series [10–17]. To our knowledge, this is the first study in our country to report the prevalence of antibodies to *B. henselae* in patients with suspected CSD and their different clinical conditions (Table 1). In studies investigating the age distribution of CSD cases, it is seen that the CSD is most commonly a disease of children and young adults [1–3]. But some studies have suggested that CSD may be more widespread in adults than previously recognized [4, 5, 18]. Compatible with this finding, there are also several case reports of adult patients with CSD in Turkey [10, 12, 14, 15, 17]. In the present study, 59% of the seropositive patients were above the age of 18, while 41% were under the age of 18. Studies conducted by Sun et al. [19] and by Vilibic-Cavlek et al. [20] showed similar results suggesting that *Bartonella* infection may occur in various age groups. Besides, we observed no significant difference in the IgM seropositivity between males (47.4%) and females (41.5%), consistent with other published studies [7, 18, 21].

Seasonal distribution: Although the disease occurs throughout the year, there is a seasonal trend in temperate climates, with the highest number of cases occurring in the fall and the winter [1, 6]. In our study 72% (34/46) of samples to be tested for the presence of *B. henselae* were sent between September and March, compatible with data from previous studies [5, 6, 18]. Many authors considered that seasonal changes in animal reproductive behavior or flea seasonality may be an explanation for this seasonal preference [1, 6, 20].

Table 1. The demographic and clinical data of the seropositive patients ( $n = 46$ )

No	Sex	Age (year)	Clinical findings	<i>Bartonella henselae</i> IgM (IFA*-Titer)	Animal contact
1	female	2	Lymphadenopathy	1/80	Positive (stray cat)
2	male	2	Lymphadenitis	1/80	Positive (stray cat)
3	male	5	Lymphadenopathy	1/80	Positive (stray cat)
4	female	7	Lymphadenopathy	1/80	Positive (stray cat)
5	male	7	Lymphadenopathy	1/80	Positive (stray cat)
6	male	8	Lymphadenitis	1/80	Positive (stray cat)
7	male	9	Lymphadenopathy	1/80	Positive (stray cat)
8	male	9	Lymphadenitis	1/80	Positive (stray cat)
9	female	10	Lymphadenopathy	1/80	Positive (stray cat)
10	male	10	Lymphadenopathy	1/80	Positive (stray cat)
11	male	12	Lymphadenopathy	1/80	Positive (stray cat)
12	male	14	Lymphadenopathy	1/80	Positive (stray cat)
13	male	15	Lymphadenitis	1/80	Positive (stray cat)
14	female	16	Lymphadenitis	1/80	Negative
15	male	16	Lymphadenopathy	1/80	Positive (stray cat)
16	female	17	Lymphadenitis	1/160	Positive (stray cat)
17	male	17	Lymphadenitis	1/80	Positive (stray cat)
18	male	17	Lymphadenitis	1/80	Positive (stray cat)
19	male	17	Lymphadenitis	1/80	Negative
20	female	20	Iridocyclitis	1/80	Negative
21	female	22	Lymphadenopathy	1/80	Positive (stray cat)
22	female	22	Iridocyclitis	1/80	Negative
23	female	29	Lymphadenitis	1/160	Positive (stray cat)
24	male	30	Lymphadenitis	1/320	Positive (stray cat)
25	male	32	Neuroretinitis	1/160	Positive (stray cat)
26	male	34	Fever of unknown origin	1/160	Negative
27	female	35	Uveitis	1/80	Negative
28	female	36	Lymphadenitis	1/320	Positive (stray cat)
29	male	38	Neuroretinitis	1/640	Positive (domestic cat)
30	male	39	Soft tissue swelling	1/80	Positive (stray cat)
31	female	40	Lymphadenitis	1/80	Positive (stray cat)
32	female	45	Lymphadenitis	1/80	Positive (stray cat)
33	male	45	Pruritus	1/160	Positive (stray cat)
34	male	45	Lymphadenopathy	1/80	Positive (stray cat)
35	male	45	Lymphadenopathy	1/160	Positive (stray cat)
36	female	48	Breast mass	1/80	Positive (domestic dog)
37	male	48	Iridocyclitis	1/80	Positive (stray cat)
38	female	49	Scleritis	1/80	Negative
39	female	50	Myopathy	1/80	Positive (domestic cat)
40	female	61	Lymphadenitis	1/80	Negative
41	female	63	Iridocyclitis	1/80	Negative
42	male	63	Undetermined eye infection	1/80	Positive (stray cat)
43	male	66	Dermatitis	1/80	Positive (stray cat)
44	female	68	Encephalopathy	1/160	Positive (domestic cat)
45	male	70	Optic nerve disorder	1/80	Negative
46	female	88	Lymphadenitis	1/80	Negative

\*IFA: Indirect fluorescent antibody.

Table 2. Comparison between history of animal contact and age

		<18 age		≥18 age		Total n
		n	%	n	%	
History of animal contact	Positive	17	89.5	18	66.7	35
	Negative	2	10.5	9	33.3	11
Total		19	100.0	27	100.0	46

 $P = 0.049$ .

Animal contact: It is suggested that CSD can result from a scratch or bite from an infected cat, from exposure to cat fleas, as well as from contact with a dog [4, 22–24]. In a study conducted in Istanbul, where the present study was performed, Diren et al. [25] found that the prevalence of *B. henselae* bacteremia in pet and stray cats is 28.1%. They concluded that the presence of long-term bacteremia in both stray and house cats increases the risk of infecting humans. In our study, 73.9% ( $n = 34$ ) of seropositive



Table 3. Distribution of clinical pre-diagnoses by age

		<18 age		≥18 age		Total n
		n	%	n	%	
Pre-diagnoses	Lymphadenitis/LAP*	19	100.0	10	37.0	29
	Eye diseases	0	0.0	10	37.0	10
	Other <sup>#</sup>	0	0.0	7	25.9	7
Total		19	100.0	27	100.0	46

\*LAP: Lymphadenopathy.

<sup>#</sup>Other: e. g.: fever of unknown origin, encephalopathy.

$P = 0.001$

Table 4. Summary of clinical findings observed in 46 seropositive patients

Features	Number (%)
Age	
<18	19 (41%)
≥18	27 (59%)
Sex	
Male	26 (52%)
Female	20 (48%)
Animal contact	
Cat	34 (73.9%)
Dog	1 (2.1%)
None	11 (24%)
Pre-diagnoses	
Lymphadenitis/lymphadenopathy (LAP)	29 (63%)
Eye diseases (e.g.: neuroretinitis)	10 (21.7%)
Other (fever of unknown origin, encephalopathy)	7 (15.3%)
Titer	
1:80	36 (78.3%)
1:160	7 (15.2%)
1:320	2 (4.4%)
1:640	1 (2.1%)

patients had a previous history of contact with a cat (mostly stray cats), which was similar to the results reported by Tsukara et al. and Ulug et al. [10, 18]. Consistent with some cases of CSD reported after exposure to dogs [7, 23, 24], we also found a history of contact with a dog in an adult patient (2.1%). When the history of animal contact and age were compared, the positivity rate was found to be significantly higher in patients under the age of 18 ( $P = 0.049$ ) (Table 2).

Symptoms and prediagnosis: Infection with *B. henselae* results in disease syndromes with varied severity ranging from lymphadenopathy only (typical CSD) to systemic involvement (atypical CSD) [1]. Similarly, in our study, preliminary diagnoses of seropositive patients, which may also be considered as clinical findings, showed a broad spectrum, from typical to atypical CSD. The clinical features of CSD in pediatric patients differed considerably from those in adult patients. It was statistically significant that, while

none of the pediatric patients had pre-diagnosis of atypical CSD, regional lymphadenopathy was present in 100% of pediatric patients, compared with only 37% of adult patients ( $P = 0.001$ ) (Table 3). Chaudhry et al. [3] and Asano et al. [8] also reported higher rates of *B. henselae* infection in children with lymphadenopathy as compared to adults. In general, when all seropositive patients were evaluated, LAP was also the most common symptom (63%) in all age groups, compatible with other studies [4, 7, 18, 26].

From 10 to 25% of CSD cases may develop atypical manifestations such as neuroretinitis, encephalitis, endocarditis, and fever of unknown origin [22, 27]. Similar to some studies [4, 21] in which the incidence of atypical CSD was reported to be high (21–24%), the frequency of atypical symptoms (37%) was also high in our patients (Table 4). As part of atypical form, ocular manifestations of CSD include Parinaud's oculoglandular syndrome, neuroretinitis, optic neuritis, uveitis and focal retinochoroiditis [6, 15, 28]. Available data regarding ocular manifestations of *Bartonella* infection in Turkey are shown, that *B. henselae* can be a causative agent in different ophthalmology conditions [12–15, 17]. In our study, 21.7% ( $n = 10$ ) of the seropositive patients had ophthalmological symptoms and this high percentage suggests that ophthalmologists in our province are well aware of this zoonosis. In accordance with the studies mentioned above [6, 15, 28], the clinical findings of these patients with eye involvement are diverse and include iridocyclitis/uveitis ( $n = 4$ ), neuroretinitis ( $n = 2$ ), optic nerve disorder ( $n = 1$ ), uveitis ( $n = 1$ ), scleritis ( $n = 1$ ), and undetermined eye infection ( $n = 1$ ). While six of these ten patients had no history of contact with any animal, it was particularly noteworthy that two patients with neuroretinitis had a previous cat contact and both had high titers (1:160 and 1:640). In addition, it should be noted that there are cases of serologically proven *B. henselae* neuroretinitis in our country without a history of contact with cats or other animals, as Çeliker et al. emphasized in their studies [17].

The number of atypical CSD cases other than eye involvement is very limited in Turkey. These cases published in our country include fever of unknown origin, hepatosplenic CSD, breast mass, and acute transverse myelitis [10, 11, 13]. In this study, the atypical symptoms of other seropositive patients with suspected CSD were fever of

unknown origin ( $n = 1$ ), encephalopathy ( $n = 1$ ), pruritus ( $n = 1$ ), dermatitis ( $n = 1$ ), breast mass ( $n = 1$ ), myopathy ( $n = 1$ ), and soft tissue swelling ( $n = 1$ ). It was found remarkable, that four of these seven patients had animal contact (three with a cat and one with a dog), as well as high IgM antibody titers ( $\geq 1:160$ ).

Due to difficulty of the culture, serologic testing for the presence of antibodies to *B. henselae* is a widely accepted diagnostic procedure for laboratory diagnosis of cat scratch disease, avoiding invasive surgical diagnostic procedures [2, 3]. Vermeulen et al. [29] reported that the detection of *B. henselae* IgM antibodies by IFA in patients suspected of having CSD was highly confirmatory for the diagnosis, whereas the IgG test had no additional value in the diagnosis of CSD due to high seroprevalence in the general population and its low sensitivity. Therefore, it is considered that the detection of specific IgM in a patient is a significant indication of recent contact with *B. henselae* [29, 30]. We found that among 46 seropositive patients, 78.3%, 15.2%, 4.4%, and 2.1% had titers of 1:80, 1:160, 1:320, and 1:640, respectively (Table 4). However, besides its low sensitivity (60–74%), possible cross reactions with *Coxiella* and *Chlamydia* species cause difficulties in the assessment of IgM test [1, 22, 30]. Therefore, evaluation of IgM positivity with clinical findings and animal contact together, taking into account the positive and negative aspects of the test, would be more accurate for the final diagnosis.

This study had several limitations. First, we could not confirm the diagnosis of *B. henselae* infection with polymerase chain reaction (PCR) or culture. Furthermore, we could not obtain any information about the duration of the disease, and the treatment of the patients.

## CONCLUSION

Our findings suggest that both typical and atypical *B. henselae* infection is not rare in Turkey. Therefore, it should always be in the differential diagnosis of patients presenting with lymphadenopathy in all age groups, especially children. The clinical features of atypical CSD are diverse and may cause diagnostic difficulties. Clinicians should be aware about cat scratch disease and not to miss atypical cases by asking patients about animal contacts, especially in areas with intense population of stray cats, such as Istanbul.

Evaluation of IgM positivity with clinical findings and animal contact would be more accurate for the final diagnosis. Although this study provides a crucial epidemiological and serological information for *B. henselae* infection in both adult and pediatric patients in our country, further studies using different diagnostic methods are needed to determine the exact incidence.

## AUTHORS' CONTRIBUTIONS

Concept and Design: N.A, S.A, H.A.

Data Collection or Processing: N.A, S.A.

Analysis or Interpretation: N.A, S.A, H.A.

Literature Search: N.A.

Writing: N.A.

## ACKNOWLEDGEMENT

We would like to thank Prof. İlker İnanç Balkan (Istanbul University-Cerrahpasa, Medical Faculty, Infectious Disease and Clinical Microbiology, Istanbul, Turkey) for contributing to the study design.

## REFERENCES

1. Anderson BE, Neuman MA. *Bartonella* spp. as emerging human pathogens. Clin Microbiol Rev 1997; 10: 203–19.
2. Sander A, Posselt M, Oberle K, Bredt W. Seroprevalence of antibodies to *Bartonella henselae* in patients with cat scratch disease and in healthy controls: evaluation and comparison of two commercial serological tests. Clin Diagn Lab Immunol 1998; 5: 486.
3. Chaudhry R, Kokkayil P, Ghosh A, Bahadur T, Kant K, Sagar T, et al. *Bartonella henselae* infection in diverse clinical conditions in tertiary care hospital in north India. Indian J Med Res 2018; 147: 189–94.
4. Murakami K, Tsukahara M, Tsuneoka H, Iino H, Ishida C, Tsujino K, et al. Cat scratch disease: analysis of 130 seropositive cases. J Infect Chemother 2002; 8: 349–52.
5. Zangwill KM, Hamilton DH, Perkins BA, Regnery RL, Plikaytis BD, Hadler JL, et al. Cat Scratch Disease in Connecticut: epidemiology, risk factors, and evaluation of a new diagnostic test. N Engl J Med 1993; 329: 81.
6. Lamas C, Curi A, Bóia MN, Lemos ERS. Human bartonellosis: seroepidemiological and clinical features with an emphasis on data from Brazil – a review. Mem Inst Oswaldo Cruz 2008; 103: 221–35.
7. Tsuneoka H, Tsukahara M. Analysis of data in 30 patients with cat scratch disease without lymphadenopathy. J Infect Chemother 2006; 12: 224–6.
8. Asano T, Ichiki K, Koizumi S, Kaizu K, Hatori T, Fujino O. High prevalence of antibodies against *Bartonella henselae* with cervical lymphadenopathy in children. Pediatr Int 2010; 52: 533–5.
9. Aydın N, Bülbül R, Tellı M, Gültekin B. Seroprevalence of *Bartonella henselae* and *Bartonella quintana* in blood donors in Aydın province, Turkey. Mikrobiyoloji Bulteni 2014; 48: 477–83.
10. Uluğ M. Evaluation of cat scratch disease cases reported from Turkey between 1996 and 2013 and review of the literature. Cent Eur J Public Health 2015; 23: 170–5.
11. Atıcı S, Kadayıfçı EK, Karaaslan A, Topper MH, Celikel CA, Soysal A, et al. Atypical presentation of cat-scratch disease in an immunocompetent child with serological and pathological evidence. Case Rep Pediatr 2014; 397437.
12. Sahin O. Cat-scratch disease: unusual perivascular chorioretinal lesions. Med Hypothesis Discov Innov Ophthalmol 2014; 3(4).
13. Uluğ M, Aslan V, Arik D, Yilmaz N, Üstün M. Two cases of cat scratch disease: a rare zoonotic infectious disease. KLİMİK J 2014; 27: 78–81.





14. Ak R, Doganay F, Akoglu EU, Ozturk TC. A challenging differential diagnosis of optic neuropathy in ED: CSD. *BMJ Case Rep* 2015; bcr-2015-210252.
15. Oray M, Önal S, Koç Akbay A, Tuğal Tutkun İ. Diverse clinical signs of ocular involvement in cat scratch disease. *Turk J Ophthalmol* 2017; 47: 9–17.
16. Türker K, Çelebi B, Andaç Ş, Bulut P, Yalçın Ş, Dolhan S. A neglected bacteria with a case: *Bartonella henselae*. *Mikrobiyol Bul* 2017; 51: 286–92.
17. Celiker H, Kazokoglu H, Eraslan M, Cerman E, Karabas L. *Bartonella henselae* neuroretinitis in patients without cat scratch. *Jpn J Infect Dis* 2018; 71: 397–401.
18. Tsukahara M. Cat scratch disease in Japan. *J Infect Chemother* 2002; 8: 321–25.
19. Sun J, Fu G, Lin J, Song X, Lu L, Liu Q. Seroprevalence of *Bartonella* in Eastern China and analysis of risk factors. *BMC Infect Dis* 2010; 10: 121.
20. Vilibic-Cavlek T, Karlovic-Martinkovic D, Ljubin-Sternak S, Tabain I, Persic Z, Mlinaric-Galinovic G. High prevalence of *Bartonella henselae* and *Bartonella quintana* antibodies in Croatian patients presenting with lymphadenopathy. *Pol J Microbiol* 2012; 61: 315–17.
21. Brunetti E, Fabbi M, Ferraioli G, Prati P, Filice C, Sasseria D, et al. Cat-scratch disease in Northern Italy: atypical clinical manifestations in humans and prevalence of *Bartonella* infection in cats. *Eur J Clin Microbiol Infect Dis* 2013; 32: 531–4.
22. Celebi B. *Bartonella henselae* and its infections. *Mikrobiyol Bul* 2008; 42: 163–75.
23. Im JH, Kwon HY, Baek J, Durey A, Lee SM, Park YK, et al. Serologic study of *Bartonella henselae* in patients with acute undifferentiated febrile illness in Korea. *Vector Borne Zoonotic Dis* 2018; 18: 291–6.
24. Chomel BB, Kasten RW. Bartonellosis, an increasingly recognized zoonosis. *J Appl Microbiol* 2010; 109: 743–50.
25. Diren Sığircı B, Ilgaz A. Detection of the presence of *Bartonella henselae* in cats in Istanbul. *J Fac Vet Med Istanbul Univ* 2013; 39: 209–17.
26. Fiecek B, Chmielewski T, Lewandowska G, Tylewska-Wierzbowska S. Characteristics of *Bartonella spp.* infections in Poland in the years 2009–2012 identified in the laboratory of National institute of public Health-National Institute of Hygiene. *Przegl Epidemiol* 2013; 67: 637–40.
27. Windsor J. Cat-scratch disease: epidemiology, etiology and treatment. *Br J Biomed Sci* 2001; 58: 101–10.
28. Cunningham ET, Koehler JE. Ocular bartonellosis. *Am J Ophthalmol* 2000; 130: 340–9.
29. Vermeulen MJ, Herremans M, Verbakel H, Bergmans AM, Roord JJ, van Dijken PJ, et al. Serological testing for *Bartonella henselae* infections in the Netherlands: clinical evaluation of immunofluorescence assay and ELISA. *Clin Microbiol Infect* 2007; 13: 627–34.
30. Herremans M, Vermeulen MJ, Van de Kasstele J, Bakker J, Schellekens JF, Koopmans MP. The use of *Bartonella henselae*-specific age dependent IgG and IgM in diagnostic models to discriminate diseased from non-diseased in cat scratch disease serology. *J Microbiol Methods* 2007; 71: 107–13.