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ORIGINAL ARTICLE

Seroprevalence of Brucellosis in Individuals Engaged in Animal Husbandry in Erzurum Region

Erzurum Yöresinde Hayvancılıkla Uğraşan Kişilerde Brusella Seroprevalansı

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ABSTRACT

Objective: Brucellosis is one of the most common zoonotic diseases in our country and the world. This study investigated the seroprevalence of brucellosis in individuals who were engaged in animal husbandry in Erzurum region, were over 18 years of age, or did not have any clinical complaints of brucellosis.
Materials and Methods: Our study was conducted on 271 volunteers engaged in livestock farming in 20 districts of Erzurum province between 2020 and 2021. Brucella antibodies were investigated in blood samples using ELISA IgG, ELISA IgM, Rose Bengal, and Standard tube agglutination tests. A questionnaire was administered to the participants to investigate the risk factors of brucellosis.
Results: The mean age of the participants was 43.6 ± 15.7.2 years (min:18, max:90), and there were 137 male (50.6%) and 134 female (49.4%) particpants. Seropositivity was detected with ELISA IgG in 40 of 271 participants (14.8%). Seropositivity was detected in the ELISA IgM test in 2 of these 40 participants (0.7%). Seropositivity was found in 46 participants (17%) in the Rose Bengal and 29 individuals in the STA test. According to the serology results, ELISA IgG positivity was higher in male participants compared to female participants (ratio=1.6). Among pet owners, ELISA IgG seropositivity was found higher than the participants who did not have pets (ratio=1.9). In the evaluation based on educational status, the rate of seropositivity was slightly higher in the participants who were illiterate and had a poor level of education.
Conclusion: In our study, it was determined that the prevalence rate obtained by ELISA IgG was consistent with previous studies conducted in the region. No significant relationship was observed between the serology results of the participants and their gender and educational status. On the other hand, the positivity of ELISA IgG results was higher among the participants who had pets, and there was a significant relationship at the margin.

Keywords: Brucella seroprevalence, Brucellosis, ELISA, Erzurum region, Rose Bengal, Serology.

ÖZ

Amaç: Bruselloz dünyada ve ülkemizde en sık görülen zoonotik hastalıklardan birisidir. Bu araştırma Erzurum bölgesinde hayvancılıkla uğraşan ve bruselloz açısından herhangi bir klinik şikayeti olmayan 18 yaş üstü kişilerde brusella seroprevalansını araştırma amacıyla yapılmıştır.
Yöntem: Çalışmamız 2020-2021 yıllarında Erzurum ilinin 20 ilçesinde hayvancılık faaliyetlerinde bulunan 271 gönüllü kişi üzerinde yürütüldü. Alınan kan örneklerinde Brusella antikorları; ELISA IgG, ELISA IgM, Rose Bengal ve Standart Tüp aglütinasyon testleri kullanılarak araştırıldı. Bruselloz açısından risk faktörlerini araştırmak amacıyla katılımcılara anket formu dolduruldu.
Bulgular: Katılımcıların yaş ortalaması 43.6±15.7.2 yıl (min:18, maks:90) ve erkekler 137(%50.6), kadınlar ise 134 (%49.4) kişi idi. Çalışmamıza katılan 271 kişinin 40'ında ELISA IgG ile seropozitiflik saptanmıştır (%14.8). Bu 40 kişiden iki kişide aynı zamanda ELISA IgM seropozitifliğine rastlanmıştır (%0.7). Rose Bengal ile 46 kişide (%17), STA yöntemi ile 29 kişide seropozitiflik bulunmuştur. Seroloji sonuçlarına göre erkeklerde, kadınlara göre ELİSA IgG pozitifliği yüksek bulunmuştur (oran=1,6). Evcil hayvan besleyenlerde, evcil hayvanı olmayanlara göre ELİSA IgG seropozitifliği daha yüksek bulundu (oran=1,9). Eğitim durumuna göre yapılan değerlendirmede okur yazar olmayan ve eğitim seviyesi düşük olan katılımcılarda seropozitiflik oranı biraz daha yüksek bulunmuştur.
Sonuç: Çalışmamızda ELISA IgG ile belirlenen prevalans oranı bölgemizde daha önce yapılmış çalışmalarla uyumlu bulundu. Çalışmamızda cinsiyet ve öğrenim durumu ile katılımcıların seroloji sonuçları arasında anlamlı bir ilişki gözlenmedi. Fakat evcil hayvana sahip katılımcılarda ELISA IgG sonuçlarının pozitifliği daha yüksek ve sınırda anlamlı ilişki söz konusuydu.

Anahtar Kelimeler: Brusella seroprevalansı, Bruselloz, ELISA, Erzurum, Rose Bengal, Seroloji

Introduction

Brucellosis, which is caused by the bacteria of Brucella species, is one of the significant zoonotic diseases threatening public health today. Despite the low mortality rate of the disease, the prevalence is high in society. The World Health Organization reports 500,000 new cases of brucellosis per year (1). According to the data of the Ministry of Health, the number of cases in Türkiye was 6457 in 2017 (2). It is mandatory to report brucellosis (3). In a study conducted in the provinces of Diyarbakir, Sanliurfa, Gaziantep, Van, Erzurum, Kahramanmaras, Mersin, and Hatay in the Southeastern Anatolia, Eastern Anatolia, and Eastern Mediterranean regions of Türkiye using 7458 serum samples for determining the seropositivity of brucellosis, the seropositivity rate was found as 1.3%. These results suggest that the number of brucellosis cases is higher than the number reported by the Ministry of Health (4).

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The primary risk group for exposure to brucellosis infections consists of individuals engaged in animal husbandry activities or working in the units that produce and process animal products, veterinarians tasked with protecting animal health, and animal health technicians. Individuals, who do not deal directly with livestock but consume animal products, such as white cheese, cream, and butter may be exposed to varying rates of risks depending on the preparation process of the product consumed, as well as the company that produces the product (5).

In diagnosing brucellosis, the gold standard is isolating and identifying Brucella species through culture from various clinical specimens. Nevertheless, it is time-consuming and also very risky for laboratory workers. Therefore, it is mostly diagnosed based on serological tests (6).

This study investigated the seroprevalence of brucellosis among individuals over 18 years of age who were engaged in animal husbandry in Erzurum region and did not have any clinical complaints of brucellosis, using ELISA and Rose Bengal method and to examine possible risk factors for brucellosis.

Material and Methods

Our research was conducted in Erzurum (Aşkale, Aziziye, Çat, Hasankale, Hınıs, Horasan, İspir, Karaçoban, Karayazı, Köprüköy, Narman, Pazaryolu, Tortum, Oltu, Olur, Palandöken, Şenkaya,Tekman, Uzundere and Yakutiye districts) between December 2020 and April 2021 and was a cross-sectional study conducted on 271 individuals, covering all districts and representing the population engaged in animal husbandry. Since the target audience of our study was individuals engaged in animal husbandry, the number of persons to represent a district was projected according to the population residing in the villages of that district.

In our study conducted on a voluntary basis, a questionnaire was administered to individuals engaged in animal husbandry or their families. Participants were asked various questions that were thought to pose a risk for brucella such as age, gender, and habits of consuming dairy products. In the study, 10 ml of blood was taken from the participants and delivered in the cold chain to the laboratory, where the study would be conducted, as soon as possible. Blood samples were centrifuged at 3000 rpm for 10 minutes. The serum samples obtained were placed in labeled Eppendorf tubes and stored at -40 oC until the ELISA, RB, and STA test studies were performed.

In the ELISA method, NovaLisa Brucella IgG and NovaLisa Brucella IgM (NOVATEC, Germany) kits were used for the samples according to the recommendations of the manufacturer to determine Brucella antibodies in serum samples. In the evaluation of Brucella IgG and IgM results in the ELISA technique, values greater than >11 NTU (NovaTec Units) were considered positive.

The "Rose Bengal Lam Test Antigen" used in our study was from Pendik Veterinary Control and Research Institute (Istanbul). The antigen of this test was prepared from the B. abortus S99 strain, standardized with Brucella antiserum, and obtained using Rose-Bengal stain. At the end of the test, the result was considered positive if there was coarse agglutination or aggregation formation, and negative if there was no aggregation, agglutination formation or homogeneous appearance.

In the Standard Tube Agglutination (STA) test, a test antigen prepared from B abortus S99 antigen and standardized with Brusella antiserum was used. The Standard Tube Agglutination method was employed for the serum samples found positive in the Rose-Bengal test. In the visual evaluation of the results after incubation, the condition that the antigens subsided and were observed as blue dots was considered a negative result, and if there was no brucella antibody in the serum of the patient, while the clarification of the fluid in the tube and the widespread agglutination at the bottom were considered a positive result. In the evaluation of this test, titers ≥1/160 and above were considered positive for the Brucella antibody.

Statistical Analysis

Our study data were evaluated using SPSS 22 (SPSS Inc., Chicago, IL, USA) package software. Among the numerical variables with non-normal distribution, age was expressed using the median (minimum, maximum). In addition, the variables with non-normal distribution were analyzed using the Mann-Whitney U test. The results obtained by processing the data were statistically evaluated at the 95% ($p<0.05$) significance level and the $\chi 2$ test was used to evaluate the categorical data.

Ethics Committee Approval

The approval required for our study was obtained from Ataturk University, Faculty of Medicine, Clinical Research Ethics Evaluation Commission on 07.05.2020 at the meeting numbered 04 with Decision Number 50.

Results

The study was conducted with 271 volunteers from 20 different districts of Erzurum. The mean age of the participants was 43.6 ± 15.7 years (min: 18, max: 90). There were 137 male and 134 female participants. The distribution of serology results according to the age, gender and educational status of the volunteers are presented in Table 1. In our study, no significant relationship was observed between the serology results of the participants and their gender or educational status ($p>0.05$).

There were 236 participants engaged in cattle husbandry (87.1%) and 35 in small cattle husbandry (12.9%). Among the participants, 79.0% used mixed milking methods for their animals, which were manual or using a machine, while 21% used only machines. On the other hand, 97% of them consumed milk after boiling and 3% raw (without any treatment). Among the participants, 74.9% boiled milk to produce cheese, while 11.1% produced cheese without boiling, and

Table 1. Distribution of the serology results of the participants according to gender and educational status

	ELISA IgG			Rose Bengal		
Variables	Negative	Positive	p value	Negative	Positive	p value
Age [n (Q_1-Q_3)]	42.0 (28.0-52.0)	46.5 (35.8-61.8)	0.176	42.0 (29.0-55.0)	44.0 (27.0-49.0)	0.875
Gender						
Male [n (%)]	112 (81.8)	25 (18.2)	0.124	111 (81.0)	26 (19.0)	0.420
Female [n (%)]	119 (88.8)	15 (11.2)		114 (85.1)	20 (14.9)	
Education status						
Illiterate [n (%)]	37 (78.7)	10 (21.3)	0.599	36 (76.6)	11 (23.4)	0.582
Primary school [n (%)]	97 (85.8)	16 (14.2)		94 (83.2)	19 (16.8)	
Middle/High School n(%)]	92 (87.6)	13(12.8)		89 (84.8)	16 (15.2)	
University [n (%)]	5 (85.2)	1 (16.7)		6 (100.0)	0 (0)	

Table 2. Distribution of serology results of participants according to various risk factors

	ELISA IgG			Rose Bengal		
Variables	Negative	Positive	p value	Negative	Positive	p value
Awareness about Brucellosis						
Yes [n (%)]	171 (85.1)	30 (14.9)	1.000	168 (83.6)	33 (16.4)	0.713
No [n (%)]	60 (85.7)	10 (14.3)		57 (81.4)	13 (18.6)	
Having a pet						
Yes [n (%)]	55 (76.7)	16 (23.3)	0.05	54 (76.1)	17 (23.9)	0.096
No [n (%)]	176 (88.0)	24 (12.0)		171 (85.5)	29 (14.5)	
History of Brucellosis (him/her/self/in the family)						
Yes [n (%)]	30 (81.1)	7 (18.9)	0.456	27 (73.0)	10 (27.0)	0.098
No [n (%)]	201 (85.9)	33 (14.1)		198 (84.6)	36 (15.4)	
History of blood and tissue transplantation						
Yes [n (%)]	11 (100)	0 (0)	0.377	11 (100)	0 (0)	0.220
No [n (%)]	220 (84.6)	40 (15.4)		214 (82.8)	46 (17.7)	
Hunting activity						
Yes [n (%)]	10 (83.3)	2 (16.7)	0.693	10 (83.3)	2 (16.7)	1.000
No [n (%)]	221 (85.3)	38 (14.7)		215 (83.0)	44 (17.0)	
Contact with wild animals						
Yes [n (%)]	13 (81.3)	3 (18.8)	0,714	13 (81.3)	3 (18.8)	0.531
No [n (%)]	218 (84.5)	37 (14.5)		212 (83.1)	43 (16.9)	
Type of Husbandry						
Cattle [n (%)]	203 (86.0)	33 (14.0)	0.319	202 (85.6)	34 (14.4)	0.007
Small cattle [n (%)]	28 (80.0)	7 (20.0)		23 (65.7)	12 (34.3)	
Milking method						
Manual or using a machine [n (%)]	184 (86.0)	30 (14.0)	0.530	177 (82.7)	37 (17.3)	1.00
Machine [n (%)]	47 (82.5)	10 (17.5)		48 (84,2)	9 (15.8)	
Milk consumption						
Raw [n (%)]	7 (77.8)	2 (22.2)	0.625	7(77.8)	2 (22.2)	0.652
After boiling [n (%)]	224 (85,5)	38 (14.5)		218 (83.2)	44 (16.8)	
Use of milk in cheese production						
Raw [n (%)]	23 (76.7)	7 (23.3)	0.300	23 (76.7)	7 (23.3)	0.440
After boiling [n (%)]	171 (84.2)	32 (15.8)		169 (83.3)	34 (16.7)	
Storing period of cheese						
< 3 months [n (%)]	105 (79.5)	27(20.5)	0.082	104 (78.8)	28 (21.2)	0.098
≥ 3 months [n (%)]	89 (88.1)	12 (11.9)		88 (87.1)	13 (12.9)	
Raw meat consumption habit						
Yes [n (%)]	9 (90.0)	1 (10.0)	1.000	6 (60.0)	4 (40.0)	0.07
No [n (%)]	222 (85.1)	39 (14.9)		219 (83.9)	42 (16.1)	

14% did not produce cheese. Prior to consuming cheese, 56.7% of the participants stored cheese for less than three months, while 43.3% stored it for three months or longer. When raw meat consumption habits were questioned, 3.7% of the participants answered "yes". While 74.2% of the volunteers had information about brucellosis, 25.8% did not have any information. The frequency of participants who reported owning a pet was 26.2%. While 13.7% of the participants had a history of brucellosis themselves or in their families, 86.3% had no history, 4.1% had a history of blood or tissue transplantation, and 5.9% had a history of contact with wild animals. Among the participants, 4.4% were engaged in hunting.

According to the animal husbandry activity the participants engaged in, the frequency of the participants who were positive in the ELISA IgG and Rose-Bengal Tests was higher in small cattle farmers compared to cattle farmers (20%; 34.3%, respectively). Nevertheless, no significant relationship was observed between the husbandry type and ELISA IgG test results; however, there was a significant relationship between the husbandry type and the Rose-Bengal test results (p=0.319, p=0.007, respectively). The distribution of serology results of the participants according to some risk factors for brucellosis and the p-values were presented in Table 2.

Serological findings of Brucellosis were investigated in the blood samples of the participants using ELISA, Rose-Bengal, and Tube Agglutination methods. Seropositivity was detected with ELISA IgG in 40 of the 271 participants (14.8%). Two of the 40 participants with positive results in the ELISA test were also detected to have ELISA IgM seropositivity (0.7%). In our study, seropositivity was detected with Rose-Bengal in 46 (17%) of 271 particpants. The STA method was administered to 46 participants who were seropositive in the Rose-Bengal test, and seropositivity was found in 29 participants.

In our study, 271 samples were tested with both ELISA IgG and Rose Bengal techniques. The comparison of the results was presented in Table 3. In our study, when the ELISA IgG test was accepted as the reference method, the sensitivity of the Rose Bengal test was calculated as 80%, its specificity as 93.9%, the positive predictive value as 69.6%, the negative predictive value as 96.4%, and the accuracy value of the test as 91.9%.

In our study, 46 serum samples evaluated as positive with the Rose-Bengal test method were studied using the Standard Tube Agglutination method. As a result of this study, 29 serum samples were found positive in titration values of 1/160 and above with the STA method. The 17 serum samples that were positive in the Rose-Bengal test were evaluated as negative with STA.

Among the districts where the study was conducted, the highest seropositivity rate was detected by ELISA IgG in the Şenkaya district (38.5%) and no seropositivity was detected in any of the participants from Pazaryolu, Narman, and Karacoban districts.

Table 3. Comparison of the ELISA and Rose-Bengal results

Tested	ELISA IgG positive	ELISA IgG negative	Total
Rose Bengal positive	32	14	46
Rose Bengal negative	8	217	225
Total	40	231	271

Discussion

In our country, brucellosis is a common infection among humans and animals. The disease is more common in Southeastern Anatolia, Eastern Anatolia, and Central Anatolia regions compared to other regions (7). In the province of Van region, Ceylan et al. reported 27.2% seropositivity with the STA test and 26.7% with the Rose Bengal test (8). In the Mediterranean region, Çaylak et al. (9) found seropositivity with the Rose-Bengal test at a rate of 2.4% among risky occupational groups in Mugla province. In many studies conducted on brucellosis in the Eastern Anatolia Region, the seropositivity rate was reported between 2-22% (10). In addition, the prevalence of Brucellosis in Erzurum province was reported as 19.5% according to the 2017 Brusella incidence map of the Ministry of Health (2). In our study, 14.8% positivity was found with ELISA and 17% positivity with the Rose-Bengal test among the participants engaged in animal husbandry. The seropositivity rate obtained in our study was consistent with other studies conducted in our region.

Despite it has been reported that brucellosis is more common among males compared to females due to occupational risk, especially in countries with low incidence, no gender difference has been reported in the regions where the disease is endemic. Many studies conducted in our country reported no big differences in terms of gender (3, 11). In our study, ELISA IgG seropositivity was 62.5% in males and 37.5% in females. This result has been attributed to the fact that most men are engaged in animal husbandry in our region. In spite of this result, some studies have reported that brucellosis is more common among females compared to males in our country (11, 12).

Brucellosis cases, in which family members are affected together, have been reported in areas where brucellosis is endemic (3). In some studies, seropositivity has been reported between 13-20% in the family members of individuals diagnosed with brucellosis, and the rate of development of acute brucellosis has been reported between 10-12% (13). In their study, Taner et al. (14) observed that 28% of the patients were infected by a source within the family, and 48% of the patients had a history of living in rural areas. In the study by Ataman et al.(15), 70 (37.4%) of the patients reported that Brucellosis was present in their family and 92 (45.5%) in the region where they lived. In our study, seropositivity was found higher (27%) with the ELISA IgG method in individuals with a history of Brucellosis or history in their families. It was considered that the reason was the exposure of family members to common risk factors (infected dairy products, contact with sick animals, etc.).

In the study conducted by Gültekin, (16) seropositivity was reported in 29.4% of illiterate patients, 43.5% of primary school graduates, 13% of secondary school graduates, 8.2% of high school graduates, and 5.9% of university undergraduates or graduates according to the education status of the patients. In our study, ELISA IgG was found positive in 21.3% of illiterate participants, 14.2% of primary school graduates, 12.8% of secondary and high school graduates, and 16.7% of university graduates or students. Nevertheless, no correlation was found between education level and seropositivity rate in participants.

Brucellosis can usually be transmitted to humans by consuming milk and dairy products from infected animals and contact with sick animal via various body fluids such as pregnancy material and urine. It is reported that the transmission of brucellosis in our country is generally caused by cheese, butter and cream produced from raw milk (17). In the study conducted by Özer et al. (18), it was reported that 58% of the patients had a history of consuming fresh cheese and raw milk. In their study, Taşova et al. (19) reported that 37% of the patients were infected by direct animal contact or contact with various products obtained from animals, and 63% of the cases were related to the consumption of fresh cheese. In our study, it was determined that two (22.2%) of 40 samples were positive with the ELISA IgG technique had consumed raw milk, 28 (16.5%) had consumed cheese that had been stored less than three months, three (18.8%) had contacted wild animals, and 16 (23.3%) owned a pet. Seropositivity was statistically significant at the margin among the participants who had pets.

In the literature, the consumption of milk and dairy products or products prepared from dairy products obtained from sick animals has been shown as the leading risk factor for brucellosis. Today, an infected product produced in distant regions and other geographies can easily be placed on our tables due to the changes in transportation and marketing conditions. In other words, it is now much more difficult to understand which of the various foods prepared from the dairy products we consume are from outside the region and which are local. For this reason, there are some difficulties in investigating the numerical data on brucellosis and the possible risk factors regionally. It is also a matter to consider how effectively the data obtained reflects the region.

The definitive diagnosis of brucellosis is made by microbiological methods. Isolation of the agent by culture method varies between 15-70% depending on the type of Brucella, the number of bacteria in the blood, the duration of the disease, the technique used, the duration of incubation, and whether the patient has been treated with antibiotics before. Therefore, serological diagnostic techniques come to the fore in brucellosis. Although many techniques that can produce the results in a short time and are easy to apply and economical can be used in the diagnosis of Brucellosis with high sensitivity and specificity, the most common methods worldwide are the Rose-Bengal and STA techniques (20, 21).

Nevertheless, these two techniques also have some negative aspects. For instance, the Rose-Bengal test technique may cause false-positive results due to cross-reactions, while the STA test may cause false-negative results as it cannot detect IgA and IgG type antibodies, known as blocking antibodies (incomplete), and especially seen in chronic patients (22). In their study which compared the serological test methods in brucellosis, Arabacı et al. (23) found the sensitivity of the Rose-Bengal test as 48.1% and the sensitivity of the ELISA IgG test as 65.6%. In the study by Güzelant et al. (24), the sensitivity and specificity of the Rose-Bengal test was determined as 94% and 97%, respectively. In our study, when ELISA IgG was taken as a reference, the sensitivity and specificity of the Rose-Bengal test were 80% and 93.9%, respectively. The Rose-Bengal test was negative in 8 participants (3%) with positive ELISA IgG results in our study. In 14 participants (5.2%) who were positive in the Rose-Bengal test, a negative result was obtained with ELISA IgG.

Two of the 14 participants with positive results in the Rose-Bengal test and negative ELISA IgG results were positive at low titer (1/40 and 1/80) with STA. It is evaluated that the positivity in low titers may have stemmed from false positivity due to cross-reactions. When the Rose Bengal test is used alone in the diagnosis, the clinical form of Brucellosis cannot be differentiated and may be quite insufficient in the follow-up and evaluation of the treatment due to the persistence of positivity for a long time after treatment (25). The most common serological method used in the confirmation of brucellosis is STA. The presence of seroconversion or ≥1/160 titer values accompanied by clinical findings is important in the diagnosis of the disease (21).

In our study, samples were tested at high dilutions to prevent false negatives that may be caused by the prozone phenomenon in the STA method. In the study by Aydın (26), the sensitivity of STA was found as 88.9%, and its specificity as 76.5% when the ELISA method was accepted as a reference. In our study, the STA technique was used in 46 serum samples found positive with the Rose-Bengal test, a common screening test, and positivity was found at 1/160 titers in 29 of them. The sensitivity and specificity could not be calculated since the STA method was not employed in all samples tested with the Rose-Bengal test.

The ELISA method is a fast method with high specificity and reliability used for diagnosing brucellosis. The ELISA technique has many advantages, such as it produces quantitative and objective results, it is not affected by blocking antibodies, it is easy to administer, and it enables mass screenings (27). In many studies conducted with the ELISA test for diagnosing brucellosis, this technique has been reported to be the most appropriate method for detecting acute cases. In a new infection, the specific IgM antibody levels were found high in 99% of the cases. In all chronic cases, IgG-type antibodies are identified (28). Nevertheless, some studies reported poor sensitivity in ELISA IgM tests used for Brucella(29, 30). In the study of Welch et al. (31), which compared anti-Brusella IgG

and IgM tests with agglutination, the accuracy of the IgG test was found as 56% and the accuracy of the IgM test as 77%. In Türkiye, the study of Kalem et al. (32) found the sensitivity and specificity of ELISA IgG as 92.8% and 79.7%, respectively; and the sensitivity and specificity of ELISA IgM as 100% and 89%, respectively.

Seropositivity was detected with ELISA IgG in 40 of the 271 participants of our study (14.8%). Two of these 40 participants also had seropositivity of ELISA IgM (0.7%). As a result of the study, two people whose tests were positive for ELISA IgM were informed and referred to the hospital infection clinic.

Conclusion

In our study, the prevalence rate (14.8%) found with ELISA IgG was similar to the results of previous studies on brucella in our region. Even though it was observed that seropositivity was higher among males compared to females and among the participants who received primary school education compared to the participants with other educational statuses according to both tests, no significant relationship was observed between the serology results of the participants and their genders or educational status ($p>0.05$). On the other hand, the positivity rate of ELISA IgG results was found higher and significant at the margin in participants who owned pets ($p=0.05$).

Rose-Bengal has been evaluated as a method that can be used for screening for Brucellosis in endemic areas due to its advantages such as producing quick results, being economical, having high sensitivity, and not requiring advanced laboratory conditions.

Conflict of Interest

No conflict of interes was declared by the Authors.

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Author Contributions

Study concept and design: M. U., A. Y., and S. Ç.; analysis and interpretation of data: M. U., S. Y., and A.Y.; drafting of the manuscript: M.U., and S. Ç.; critical revision of the manuscript for important intellectual content: M. U., A. Y., and S. Ç.; statistical analysis: M. U., S. Y., and A.Y.

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