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Review

Seroprevalence of *Coxiella burnetii* in Human and Animal Populations in Türkiye: Meta-Analysis

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ABSTRACT

This study aims to reveal *Coxiella burnetii* by examining the studies reporting Q fever seroprevalence in humans and animals in the last 25 years in Türkiye. In this study, based on PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), various databases were searched between January 1997 and October. 2022. A literature review was carried out using data analyses performed using the IBM SPSS Version 25.0 statistical package program and Comprehensive Meta-Analysis (CMA) program. Overall prevalence of *C. burnetii* in humans was 22.78% (95% CI: 16.43%-29.12%), overall prevalence in animals was 13.49% (95% CI: 10.04-16.93%) was detected. The mean prevalence of *C. burnetii* in sheep was 19.1%±10.88, 10.46±6.39% in cattle, 15.21±10.01% in studies including cattle and sheep together, 11.17±10.74 in cattle, sheep and goats, and 12.4%±1.15% in sheep and goats. As a result of this study, it was determined that the prevalence of Q fever in humans in Türkiye is high in those dealing with animals, women who had a miscarriage, and infertile individuals. Although it is known that this disease is seen in Türkiye, there are not enough case reports in the literature. Detailed studies on Q fever in humans and animals need to be conducted. Further studies are needed to evaluate Q fever risk factors and prevalence data together within the scope of One Health approach.

Keywords: Cattle, *Coxiella burnetii*, Infertility, Miscarry, Q fever

Introduction

Q fever is a zoonotic disease caused by the intracellular Gram-negative bacterium *C. burnetii* [1]. *C. burnetii* has been accepted as a biological weapon because of its extremely high contagiousness, resistance to harsh environmental conditions and causing severe diseases in humans, and is listed as a Category B biological warfare agent by the Center for Disease Control and Prevention [2]. Although Q fever was first discovered in 1937, this microorganism has come to the fore again in recent years due to the potential of the etiologic agent *C. burnetii* to be used as a bioterrorism weapon and the changes reported in epidemiology in Europe [3].

C. burnetii infects humans and a wide variety of wild and domestic animals. The most common sources of transmission of the agent to humans are farm animals such as sheep, goats and cattle [4]. *C. burnetii* is spread to the environment through infected animals' urine, feces, milk, and birth products [5]. Inhalation of infectious aerosols or contaminated dust-containing bacteria is the leading way of contracting the disease in humans, and it has been stated that a single inhaled microorganism can cause clinical disease [6]. However, consuming raw or unpasteurized milk and dairy products, contact through the skin and mucous membranes, tick bites, blood transfusion, sexual intercourse and transmission through the placenta are the main sources of *C. burnetii* infection [7].

C. burnetii has two different antigenic phases, phase I and phase II, depending on the changes that occur in the organism during *in vitro* culture. In the early stages of infection, antibodies against phase II antigens are formed. However, if the infection continues for a longer period of time, antibodies against phase I antigens predominate in the organism. Although these antibodies are not used in animals, they are used to distinguish acute from chronic infections in humans [1]. The diagnosis of Q fever is made by detecting antibodies to *C. burnetii* using complement fixation, indirect fluorescent antibody (IFA), immunofluorescence, Enzyme Linked Immunosorbent

Assay (ELISA), or agglutination tests. The IFA technique has been recommended as the gold standard method [4].

Q fever is mostly asymptomatic except for some conditions that cause miscarriage, stillbirth, endometritis or infertility [7]. The disease is divided into acute and chronic Q fever in humans. Acute Q fever often causes non-specific liver damage; chronic Q fever causes endocarditis. It has been reported that the mortality rate in patients with acute *C. burnetii* infection generally varies between 1% and 2.4% [8]. This study aims to reveal the seroprevalence of *C. burnetii* by examining the studies reporting Q fever seroprevalence in humans and animals in the last 25 years in Türkiye.

Material and Methods

Literature Search and Research Strategies

This systematic review and meta-analysis were conducted based on the PRISMA guidelines [9]. From January 1997 to October. 2022, a literature review was conducted for studies examining the prevalence of Q fever infection in humans and animals in Türkiye. The study evaluated original scientific studies published in English and Turkish languages in national and international databases (PubMed, Embase, Scopus, Google Scholar, Web of Science and Turkish Medline) between January 1997 and October 2022.

For all English and Turkish population-based studies reporting the prevalence of Q fever in Türkiye, in all electronic databases, "Q fever prevalence in Türkiye", "*Coxiella burnetii* prevalence in Türkiye", "*C. burnetii* prevalence in Türkiye", "*Coxiella burnetii* and Türkiye" and "*C. burnetii* and Türkiye" Various combinations of "key terms" have been used. Three authors did scanning and collection of related articles. Publications for inclusion in the study were evaluated independently, and scientific consensus by the authors agreed upon inconsistencies.

Inclusion and Exclusion Criteria

The inclusion criteria for the study consisted of all original articles with a sample size of more than 30, which reported the prevalence of *C. burnetii* and Q fever in English and Turkish.

Studies with less than 30 samples and not reporting the total number of patients or subjects, studies that do not state positive and/or negative results, studies that do not report the method used for the research, reviews that do not contain original data, theses, case reports/series, letters to the editor, articles whose full text could not be reached, inconsistent data, and congress papers were not included in the study within the framework of exclusion criteria.

The PICOS model was applied for the eligibility criteria [10]. P (Population): "The sample group consists of humans and animals in which Q fever seroprevalence was investigated in Türkiye", I (Intervention): "Prevalence investigation of *C. burnetii* by serological methods"; C (Comparison): "Research articles that study Q fever seroprevalence in the general population or in humans and animals with certain risk factors"; O (Outputs): "A research article should specify the prevalence rate of *C. burnetii* in animals and humans, the characteristics of the sample group, and the serological method studied", S (Study): "This study was planned as a meta-analysis. Research articles published in Turkish or English were included".

Data Collection and Quality Assessment

During the pre-reading process, the titles and abstracts were evaluated, and the full texts of the studies that the authors found appropriate by consensus were reached. Study data; such as the type of study, sample size, clinical characteristics of the sample group, place and time of the study, type of antibody, and seroprevalence of the disease were collected in spreadsheets. Antibodies tested in animal (sheep, goat and cattle) and human studies were grouped as phase I/phase II and IgG/IgM.

Statistical Analysis

The data obtained from the literature review were recorded in Microsoft Excel tables. Mean, standard deviation, frequency etc. The values were analyzed with the help of the IBM SPSS Version 25.0 statistical package program. Meta-analyses were performed using the Comprehensive Meta-Analysis (CMA) program. Effect sizes and heterogeneity (I^2 and Q) of selected studies were

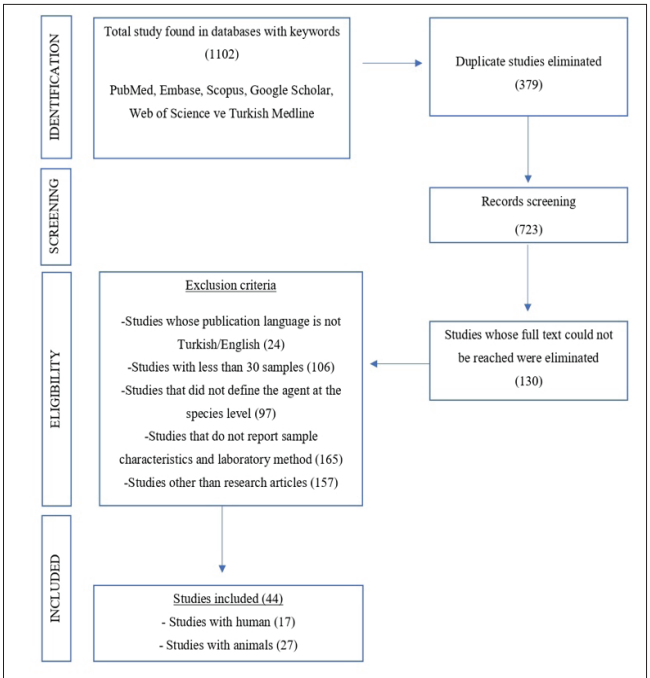

Fig 1. Flowchart of meta-analysis

calculated in CMA, and forest and funnel plots were used to assess publication bias. The heterogeneity in meta-analyses refers to the variation in the results of the selected studies.

Interpretation of I^2 can be misleading as it depends on multiple factors. The values reported in the guidelines for the interpretation of the I^2 value are as follows:

- 0-40%: insignificant,
- 30-60%: moderate heterogeneity,
- 50-90%: may represent substantial heterogeneity,
- 75-100%: considerable heterogeneity.

Results

As a result of the literature review, 1102 studies were found. After 379 repetitive studies were excluded, 723 were reserved for full-text review. The full text of 130 articles has been reached. Among these, studies whose publication language is not Turkish or English (n=24), containing less than 30 samples (n=106), not defining

Table 1. *Characteristics of studies with sample animals included in the meta-analysis [11-34]*

Study	City	Type of Animals	Characteristics of Samples	Phase	Antibody	Number of Sample (n)	Prevalence (%)	Method
Ozgur et al.[11]	Istanbul+Thrace	Cattle	Infertilite			144	9.72	ELISA
Cetinkaya et al.[12]	Multicenter	Cattle + sheep	Normal	Phase II	IgG	827	8.1	IFA
Kalender-1 [13]	Multicenter	Sheep	Normal	-	IgG	227	11.01	IFA
Kalender-2 [13]	Multicenter	Sheep	Abortus	-	IgG	184	38.59	IFA
Seyitoglu et al.-1 [14]	Erzurum	Cattle	Normal	-	-	177	5.65	ELISA
Seyitoglu et al.-2 [14]	Erzurum	Cattle	Abortus	-	-	53	22.64	ELISA
Kirkan et al.[15]	Aydin	Cattle	Normal	-	-	138	4.35	PCR
Ceylan et al.[16]	Multicenter	Cattle + sheep	Normal	Phase II	IgG	184	10.87	ELISA
Karaca et al.[17]	Van	Sheep	Normal	-	-	465	21.08	ELISA
Kilic et al.[18]	Multicenter	Alley Cat	Normal	Phase II	IgG	143	4.9	ELISA
Kennerman et al.[19]	Multicenter	Sheep	Normal	Phase I, Phase II	IgG	743	20.32	ELISA
Arserim et al.[20]	Diyarbakir	Cattle + sheep + cow	Normal	Phase II	IgG	1896	25.63	ELISA
Gazyagci et al.[21]	Konya	Cattle	Normal	Phase II	IgG	322	12.42	IFA
Kucukkalem et al.[22]	Erzurum	Cattle	Abortus	-	-	100	6	PCR
Gunaydin et al.[23]	Multicenter	Cattle + sheep + goat	Normal	-	-	152	7.24	PCR
Parin et al.[24]	Aydin	Cattle + sheep + goat	Normal	Phase I	IgG	600	23.33	ELISA, PCR, IFA
Gulmez et al.[25]	Kars	Cattle + sheep	Normal	-	-	600	26.67	ELISA+PCR
Kilic et al.-1[26]	Multicenter	Sheep	Abortus	-	IgG	350	16	ELISA
Kilic et al.-2[26]	Multicenter	Sheep	Normal	-	IgG	171	7.6	ELISA
Ozkaraca et al.[27]	Multicenter	Cattle	Abortus	-	-	70	1.43	PCR, IHC
Gunaydin and Pekkaya et al.[28]	Afyon	Cattle	Normal	Phase I, Phase II	IgG	92	8.7	ELISA
Karagul et al.[29]	Multicenter	Sheep + goat	Normal	-	-	832	13.22	ELISA
Gulhan et al.[30]	Samsun	Cattle	Normal	Phase I, Phase II	IgG	184	15.76	ELISA
Kilicoglu et al.[31]	Multicenter	Cattle + sheep + goat	Abortus	-	-	270	2.96	PCR
Serifoglu Bagatir et al.[32]	Multicenter	Sheep + goat	Normal	Phase I, Phase II	IgG	1045	11.58	ELISA
Malal et al.[33]	Multicenter	Cattle	Normal	-	-	1114	18.4	ELISA
Ates Kalkan et al.[34]	Multicenter	Cattle	Normal	-	-	200	10	ELISA

-: Unspecified, ELISA: Enzyme-Linked ImmunoSorbent Assay, IFA: Indirect Fluorescent Antibody test, PCR: Polymerase Chain Reaction, IHC: Immunohistochemistry

Table 2. *Characteristics of studies with human samples included in the meta-analysis* [11,14,35-47]

Study	City	Characteristics of Samples	Phases	Antibody	Number of Samples (n)	Prevalence (%)	Male (n)	Female (n)	Age Range (years)	Method
Ozgur et al.[11]	Istanbul+Thrace	Individuals with infertility	-	-	50	22	-	-	-	ELISA
Berberoglu et al.[35]	Multicenter	Normal people	Phase II	IgG	339	7.08	172	167	1-65	ELISA
Sertpolat et al.[36]	Izmir	Farmers, butcher, employee andtradesmen	Phase II	IgG	303	39.27	256	47	18-79	IFA
Eyigor et al.[37]	Aydin	Veterinarians, celebs, butcher	Phase I, Phase II	IgG	92	42.39	85	7	17-63	ELISA, IFA
Seyitoglu et al.[14]	Erzurum	Farmers	-	-	92	19.57	-	-	-	ELISA
Buke et al.[38]	Izmir	Besiciler	Phase II	IgG	96	25	-	-	15-70	IFA
Karabay et al.[39]	Bolu	People living in rural areas	Phase II	IgG	293	20.82	128	165	2-82	IFA
Berktas et al.[40]	Multicenter	Farmers, slaughterhouse workers, butcher	Phase II	IgG	552	36.59	348	204	17-63	ELISA
Arserim et al.[20]	Diyarbakir	Farmers	Phase II	IgG	90	6.67	-	-	18-45	ELISA
Gunal et al.[41]	Tokat	Normal people	Phase II	IgG, IgM	53	35.85	37	16	18-65	IFA
Eyigor et al.[42]	Aydin	Miscarriage women and their husbands	Phase I, Phase II	IgG, IgM	62	40.32	31	31	21-64	ELISA, IFA, PCR
Gunal et al.-1[43]	Multicenter	Normal people	Phase II	IgG, IgM	36	11.11	0	36	-	IFA
Gunal et al.-2[43]	Multicenter	Miscarriage women	Phase II	IgG, IgM	64	15.63	0	64	-	IFA
Cikman et al.[44]	Erzincan	Breeders, normal people	Phase II	IgG	368	8.7	130	238	1-99	ELISA
Erturk et al.[45]	Multicenter	Normal people	Phase I, Phase II	IgG	440	19.09	219	221	8-85	ELISA
Arabaci et al.[46]	Multicenter	Veterinarians, celebs, slaughterhouse butcher, farmers, laboratory workers	Phase I, Phase II	IgG	600	27.17	428	172		ELISA, IFA
Kirecci et al.[47]	Kahramanmaras	Veterinarians, celep andslaughterhouse butcher	Phase II	IgG	40	10	34	6	20-60	ELISA

-: Unspecified, ELISA: Enzyme-Linked ImmunoSorbent Assay, IFA: Indirect Fluorescent Antibody test, PCR: Polymerase Chain Reaction

the agent at the species level (n=97), not reporting the sample characteristics and laboratory method (n=165), and non-research articles (n=157) were eliminated *(Fig. 1)*. Forty-four research papers were included, 27 of which were animal studies and 17 were human studies. The characteristics of the included studies are shown in *Table 1* and *Table 2*.

Findings of Studies with Animal Samples

In the literature review conducted without any date limitation, 27 studies were identified between 1997-2021 that met our inclusion criteria. Of the 27 studies, 55.6% (95% Confidence Interval (CI): 7.14-17.14%) were multicenter, 18.5% (95% CI: 4.14-28.66%) were in the Eastern Anatolia Region and the rest were from other regions as shown in *Table 1* [10-33] made in the provinces. 18.5% of the studies were performed with Phase II, 14.8% with Phase I + Phase II antibodies, and 51.9% with IgG antibodies, and the antibody type studied in 13 studies was not specified. Considering the methods in which antibodies were tested, the ELISA method was used in 59.3% of the studies, the IFA method was used in

14.8% of the studies, and the other methods are listed in *Table 1* [11-34].

The general prevalence of *C. burnetii* in animals was 13.49% (95% CI: 10.04-16.93%), with the most common being 26.67% in Kars and 25.63% in Diyarbakir. Of the animal species, cattle were studied most frequently, with 40.7% (95% CI: 6.16-14.75%) and sheep at 22.2% (95% CI: 7.67-30.52%). The mean prevalence of *C. burnetii* in sheep was 19.1%±10.88, 10.46±6.39% in cattle, 15.21±10.01% in studies including cattle and sheep together, 11.17±10.74 in cattle, sheep and goats, and 12.4%±1.15% in sheep and goats. The prevalence rates of other animal groups are shown in *Table 1* in detail.

Findings of Studies with Human Samples

In the literature review conducted without any date limitation, 17 studies were found between 1997 and 2019 that met our inclusion criteria. Six of the 17 studies were multicenter, four were conducted in the Aegean Region, and the rest were conducted in other provinces as shown in *Table 2* [11,14,35-47]. Of the studies, 11 (64.7%) were performed with Phase II, four (23.5%) with Phase I + Phase II antibodies, 11 (64.7%) with IgG, and four (23.5%) with IgM + IgG antibodies. The ELISA method was used in 47.1% of the studies, and the IFA method was used in 35.3%. The others are shown in *Table 2*.

The general prevalence of *C. burnetii* in humans was found to be 22.78% (95% CI: 16.43-29.12%), and the most common rates of 42.39% and 40.32% were found in Aydın and İzmir provinces. Men constituted 53.51% of the general sample. *C. burnetii* prevalence was the highest, respectively; it was determined that individuals engaged in animal husbandry (30.82%±13.61), women with miscarriage (27.97±17.45%), infertile individuals (22%), normal population (18.28±12.73) and breeders (17.5±10.6). There was no statistically significant difference between prevalence rates and characteristics of individuals (P>0.55).

Meta-Analysis of Included Studies

Random effect (REX) and fixed effect (FEX) models were used to calculate the effect size of the studies. Based on the analysis performed at the 95% confidence interval, studies in animals and humans showed significant heterogeneity (I^2 values 92.25% and 92.85%, respectively; P<0.05). The REX model was used in this study to calculate the effect size of the studies. According to the effect size analysis performed at the 95% CI, the effect size of the animal studies was found to be 0.041, and it was found to be low effective. Since the value was close to zero, the effect size of the generalized *C. burnetii* prevalence in animal studies was found to be negligible. The effect size coefficient of human studies was found to be 0.212, and it was found to be moderately effective.

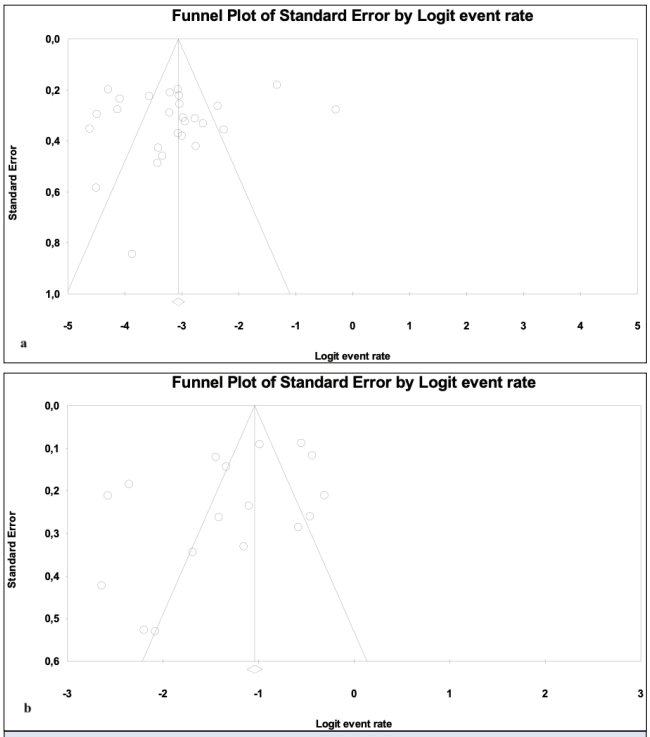

Fig 2. a- Funnel plot of studies involving animals, **b**- Funnel plot of studies that included humans

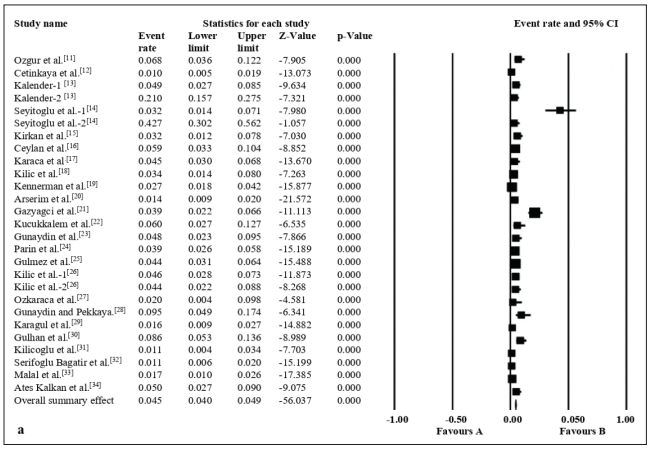

Fig 3. a- Forest plot of studies that included animals [11-34]; **b**- Forest plot of studies that included humans [11,14,35-47]

As can be seen from the funnel plot in *Fig. 2-a*, it was observed that 12 of the studies with animal samples included in the meta-analysis were between the axes, four were on the axis line, and 11 were off the axes. For

this reason, 11 studies in the meta-analysis were not included in calculating the overall effect size, but 16 studies contributed to calculating the overall effect size coefficient. In the funnel plot in *Fig. 2-b*, it is seen that eight studies with human samples included in the meta-analysis were between the axes, and nine were outside the axes. *Fig. 2-a* it can be said that the graphs in *Fig. 2-b* are not asymmetrical; therefore, no bias was detected.

Fig. 3-a and *Fig. 3-b* shows the forest plot of the prevalence rates of *C. burnetii* reported in the studies included in the meta-analysis. It is seen that a study investigating prevalence in animals in *Fig. 3-a* and three studies investigating prevalence in humans in *Fig. 3-b* have P values greater than 0.5 (not statistically significant) and intersect with the 0.5 line.

Discussion

This systematic review and meta-analysis study reports the seroprevalence of Q fever among humans and animals in Türkiye. The results of our study showed that the overall prevalence of *C. burnetii* in Türkiye was 22.78% (95% CI: 16.43-29.12%) in humans. In seroprevalence studies with people included in this meta-analysis, the lowest rate was 6%, and the highest rate was 42.39%. El-Mahallawy et al.[5] reported the rate of Q fever seropositivity as 10% in China in their systematic reviewbetween 1989 and 2013. In a systematic review study conducted in Kenya, the seroprevalence of *C. burnetii* was found to vary between 3% and 35.8% in humans [48]. The prevalence of *C. burnetii* obtained in our study was found to be higher than in other studies in the literature. The highest prevalence rate, respectively, is expected to be detected in livestock workers, women who have had a miscarriage, and infertile individuals. However, the rates between countries may vary depending on the differences in environmental, social, cultural and economic conditions, the exposure of people living in each region to animals and the differences in the infection levels of these animals.

The findings of this study showed that the average prevalence of *C. burnetii* across all studies was 30.45% in butchers, 26.51% in farmers, 14.43% in livestock breeders and 6.5% in veterinarians.In a study conducted in South Korea in 2022, the seroprevalence of *C. burnetii* was found to be 7.9% in people working in veterinary services [49]. Ricco et al.[50] reported an average pooled seroprevalence of 44% in workers, most of whom were agricultural workers, in their meta-analysis study. Subgroup estimates found an average of 2.8% for forest rangers, 49.2% for animal breeders, and 73.7% and 75.9% for slaughterhouse workers and veterinarians, respectively. Woldeyohannes et al.[51] reported the *C. burnetii* seroprevalence rate in slaughterhouse and slaughterhouse workers between 4.7% and 91.7% in their meta-analysis of 19 studies. The findings of this meta-analysis show similar results to other reviews and original studies in the literature.

Of the studies included in this meta-analysis, 11 (64.7%) were performed with Phase II, four (23.5%) with Phase I + Phase II antibodies. In a meta analysis study by Mobarez et al.[7] in Iran, the prevalence of *C. burnetii* IgG phase I and II antibodies in humans was reported to be 19.80% and 32.86%, respectively. In a study conducted to detect *C. burnetii* antibodies among slaughterhouse workers and veterinarians in Canada, antibodies against Phase II *C. burnetii* were detected in 49.0% of veterinarians and 35.0% of slaughterhouse workers. Antibodies against Phase I *C. burnetii* antigens were detected in 30.0% of veterinarians and 14.5% of slaughterhouse workers [52]. In a study by Ali et al.[53] in Pakistan, 25 serum samples (8.4%) were found to be seropositive for Q fever, 17 were positive for Phase I, and 21 of them were positive for phase II antibodies. As in the findings of our study and other studies compared in the literature, Phase II antibodies were mostly used for diagnosis. This is because the antibody titer against Phase II antigens in acute Q fever is higher than that against Phase I antigens.

ELISA was used in 11 of the human studies included in this meta-analysis, IFA was used in nine, and PCR was used in one. It was found that ELISA was used in 18 of the animal studies, PCR was used in seven and IFA tests were used in five. Ricco et al.[50] reported that three of the studies they included in the meta-analysis used IFA, three used ELISA, and one used the complement fixation test (CFT). Woldeyohannes et al.[51] stated that in their meta-analysis of studies measuring the prevalence of C. burnetii in slaughterhouses and slaughterhouse workers, seven of the studies used the CFT method, five used the ELISA method, and two used the IFA method. It has been observed that the most common methods used in seroprevalence studies are ELISA and IFA tests. In particular, the IFA technique is accepted as the reference method in the diagnosis of Q fever by many centers. IFA is a guide in the diagnosis of both acute and chronic Q fever. It is known that the IFA test is the gold standard in the diagnosis of *C. burnetii*. Advantages of this method: it requires a very small amount of antigen and can detect IgG, IgM and IgA antibodies against Phase I and Phase II *C. burnetii* [54]. However, they also have disadvantages such as the need for experienced personnel, lack of standardization between laboratories, not being suitable for large-scale seroprevalence research, and not being able to be automated [55].

As a result of this study, it was determined that the general prevalence of *C. burnetii* in animals in Türkiye was 13.49% (95% CI: 10.04-16.93%). The mean prevalence of *C. burnetii* in sheep was 19.1±10.88, 10.46±6.39% in cattle, 15.21±10.01% in studies including cattle and sheep,

11.17±10.74 in cattle, sheep and goats, and 12.4%±1.15% in sheep and goats. Mobarez et al.[7] found an average of 31.97% seroprevalence of *C. burnetii* in goats in their meta-analysis study in Iran. Q fever seropositivity in goats; was reported to vary between 12% in Africa, between 20% and 46% in a systematic review in Kenya, and between 0.8% and 60.6% in a systematic review made in China [5,39,56]. In this meta-analysis, *C. burnetii* seroprevalence rates in goats were found to be similar to the data in the literature. Guatteo et al.[57] made a review of studies conducted worldwide on the prevalence of *C. burnetii* in domestic ruminants. The review found that the seroprevalence of *C. burnetii* infection at the individual and herd level was 15-20% (prevalence rates depending on the individual and herd level are 20-37.7%, respectively)in many countries, regardless of species, and the prevalence in cattle was found to be higher than that in sheep (15-25% prevalence depending on individual and herd level in sheep and goats, respectively). In the meta-analysis of studies conducted by Rabaza et al.[58] reporting the herd-level prevalence of *C. burnetii* in cattle, the pooled prevalence rate was reported as 37.0% (min. 25.2%-max. 49.5%) in America, Europe, and Asia countries. Nokhodian et al.[59] found the cumulative seroprevalence of Q fever in animals to be 27% in their systematic review including 27 studies. They reported that this prevalence rate was 33% in goats, 27% in sheep and 17% in cattle. In this meta-analysis, *C. burnetii* seroprevalence rates in sheep, goats and cattle were found to be similar to the data of other meta-analysis and systematic review studies around the world. Differences in prevalence rates; it may be caused by different climatic conditions, geographical location, sample size of the study and the time period in which it was conducted, animal species for prevalence screening, serological methods and cut-off values of laboratory tests.

Conclusion

As a result of this study, it was determined that the prevalence of Q fever in humans in Türkiye is high in those dealing with animals, women who had a miscarriage, and infertile individuals. *C. burnetii* is known to cause abortion in animals. When the data obtained are evaluated, it can be concluded that *C. burnetii* may also be associated with miscarriage in humans. The seroprevalence findings in animals reveal that Q fever is common among sheep, goats and cattle and that a surveillance strategy should be applied for this zoonosis. Although it is known that this disease is seen in Türkiye, there are very few case notifications in the literature. In addition to seroprevalence findings, there is a lack of data on the pathogenesis and molecular biology of the disease, and further studies are needed. It is important to carry out detailed studies on Q fever risk factors in humans and animals and to evaluate these factors together within the scope of the One Health approach. Effective vaccination programs should be applied to individuals and animal herds, especially in the risk group dealing with herds of animals.

Highlight Keypoints

o It was determined that the prevalence of Q fever in humans in Türkiye is high in those dealing with animals, women who had a miscarriage, and infertile individuals.

o The seroprevalence findings in animals reveal that Q fever is common among sheep, goats and cattle and that a surveillance strategy should be applied for this zoonosis.

o Effective vaccination programs should be applied to individuals and animal herds, especially in the risk group dealing with herds of the animal.

o More studies are needed to carry out detailed studies of Q fever in humans and animals and to evaluate risk factors and prevalence data together within the scope of the One Health approach.

Availability of Data and Materials

The datasets analyzed during the current study are available from the corresponding author (E.P. Kahraman Kilbas) upon reasonable request.

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Conflict of interest

The authors declare that they have no conflict of interest.

Author Contributions

IHC and EPKK designed the study. IK performed the literature review and wrote the article. IHC reviewed and revised the manuscript. All authors have read and accepted the final version of the manuscript.

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