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Original Article

Q. fever among staff workers and goats in slaughterhouses at Dhamar city, Yemen

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ABSTRACT

The study was conducted to determine the *Coxiella burnetii* antibodies among staff workers (Veterinarians &Butchers) and goats in slaughterhouses at Dhamar city. 250 blood samples were collected from staff workers and 263 samples from goats and tested. Staff worker's sera samples were screened for IgG antibodies against *C. burnetii* phase I & II antigen by ImmunoDOT assay; while, in goat, by-Goat Anti-Q Fever ELIZA test. The results revealed that, out of 250 staff workers, 13(5.2%) showed the presence of antibodies against *C. burnetti* in their sera samples. The distribution of Seroprevalence rate of *C. burnetii* antibodies among the staff workers according to their demographic characteristics was as following: The higher rate was recorded (3.20 %) in age group of 31-40Yrs, 4.0% in workers had between 6 to 10 years of experience; 3.6% in Butchers and 1.20 % in March (spring season). The common symptoms in patients were flu-likes, fever, chest pain, endocarditis and hepatitis. The results of logistic regression confirmed the results of chi square analyses and revealed that there is a significant association between the seroprevalence of *C. burnetii* infection and the characteristics/risk factors of staff workers such occupation (OR=4.822; 95%CI: 1.363-17.064; P=0.015); symptoms (OR=1.820; CI: 1.345-2.463; P=0.000); whereas, no with Age, experience and seasons risk factors. In goats' study, out of 263 sera samples tested, 23(8.57%) showed seropositivity for *C. burnetii* antibodies. The results of logistic regression showed that there is a significant association between the seroprevalence of *C. burnetii* antibodies and the characteristics/variables of goats such sex (OR=0.029; 95%CI: 0.007-.123; P=0.000); season (OR= 0.265; CI:0 .812-1.059; P=0.000), source of animal (OR=1.38; CI: 1.005-1.894; P=0.046) and ticks presence (OR=5.70; CI: 13.661-111.534; P=0.000): whereas, no with Age, breed and slaughterhouses localities factors. The results of Pearson`s correlation analysis revealed that strong association (r= 0.243; P= 0.000) between Seroprevalence of *C. burnetii* antibodies and relative humidity; while, no with temperature and rainfall (precipitation). In conclusion, seroprevalence of *C. burnetii* antibodies are prevalent among staff workers in slaughterhouses and goats at study areas. Research regarding spread of this pathogen within a country and its control is necessary.

INTRODUCTION

Query' fever or Q. fever was first observed in slaughterhouses workers in Brisbane, Queensland, Australia in 1933. It was initially described by Derrick as a self-limiting febrile illness of unknown etiology (Parker et al., 2006; Pexara et al., 2018). Q fever is a zoonotic infection caused by *Coxiella burnetii*, an obligate intracellular, Gram-negative organism (Klemmer et al., 2018; Abdullah et al., 2019; Epelboin et al., 2023).

Q fever is widespread in livestock and its seroprevalence had increased in recent years. Q fever can persist in a herd causing great financial losses on the long term. The main source of infection is domestic ruminants (cattle, sheep and goats) which represent the main reservoir for pathogen that infect wide variety of hosts such as mammals, birds, fish, reptiles and arthropod (Porter et al., 2011; Abdullah et al., 2019).

In human, the airborne pathway is the main

mode of transmission. The infection is usually caused by inhalation of infectious aerosols directly from birth fluids or via inhalation of dust contaminated by dried placental material, birth fluids and excreta of infected animals (Tissot-Dupont and Raoult 2008). The people at highest risk are veterinary surgeons, stock people, transport drivers and abattoir workers. The organism is highly resistant to desiccation and can infect individuals working with hides, fleece, food-processing chain, consuming contaminated milk products or bones of infected animals. Furthermore, transmission of infection via ticks, lice or fleas has been demonstrated (Shakespeare, 2009; Roest et al., 2013).

The clinical manifestations of Q fever in human and animal are highly variable and range from asymptomatic or mild disease with complete recovery to a variety of clinical signs such as acute flu-like illness, pneumonia, hepatitis and chronic endocarditis (Abed and abdul-Husien, 2010; Maurin and Raoult, 1999, Nielsen et al., 2013). In animals, reproductive problems can occur including abortion, stillbirth, retained placenta, infertility, and weak newborns (Angelakis and Raoult, 2010, Gwida et al., 2014; Woldehiwet, 2004; Waag and Fritz, 2012; Pexara et al., 2018).

Lipopolysaccharide (LPS) is the main *Coxiella burnetii* antigen and is found in two different phases on the bacterium surface. The phase I antigen is the complete form of LPS and is linked to the virulence. The phase II antigen is the truncated form that is obtained after several passages in cell culture, and it is the result of gene deletion and consequent loss of sugars from LPS (Toman et al., 2012; Anderson et al., 2013; Mioni et al., 2020). There are different serological tests available for Q fever diagnosis including Indirect FluorescentAntibody Tests (IFAT), Enzyme linked Immunosorbent Assays (ELISA) and complement Fixation Tests (CFT) (Wegdam-Blans et al., 2012; Mioni et al., 2020).

The Q fever is worldwide in distribution and can be considered severe public health problem in many countries (Porter et al., 2011).The disease has been reported in neighboring countries for example: Somalia (Botros et al., 1995), Oman (Scrimgeour et al., 2000), United Arab Emirates (Chaber et al., 2012), Saudi Arabia (Almogren et al., 2013), Ethiopia (Gumi et al., 2013; Khadem-Rezaiyan et al., 2023). In Yemen, the Q fever infection is exist in the country particularly in rural areas where livestock breeders consequently exposed and keep close contact with the livestock and their byproducts(Gray et al., 1999; Badi et al., 2019).

Considerable number of sero-epidemiological studies have been carried out in different parts of world on Q fever infection and it`s seroprevalence and they reported infection rate between 2% to 65% or more in human (Schimmer et al., 2014, Van den Brom et al., 2013, Vanderburg et al., 2014), and between 21.6 % and 75 % in animals(Abed and abdul-Husien, 2010, Cetinkaya et al., 2000, Gwida et al., 2014, Klaasen et al., 2014; Badi et al., 2019; Deressa et al., 2020; Khadem-Rezaiyan et al., 2023).

Despite the presence of Q fever in human and animals in Yemen (Badi et al., 2019), little is known about its current seroprevalence and geographic distribution. Therefore; the main objective of this study was to estimate the seroprevalence and associated risk factors of Q fever in staff workers and goats in slaughterhouses at Dhamar.

MATERIALS AND METHODS

Study areas

This cross sectional study was conducted between 2016-2019 in Dhamar city, Governorate of Dhamar, Yemen. Dhamar is located south of Sana`a, the capital of Yemen. The governorate is divided into 12 administrative districts, with Dhamar City as the capital of the governorate (Abbas et al. 2018; NIC 2021). The annual mean of temperature, relative humidity and rainfall is 26.41°C, 59.29% and 71.29.2 mm, respectively. According to the last Census in 2004, the total population of the governorate is about 1,330,108, which is expected to be 3,311,033 in 2034 (Abbas *et al*. 2018). Agriculture is the main activity in the area (AlShaibani et al., 2024).

Staff workers` Study

Study subjects

The study was conducted in slaughterhouses of Dhamar city to determine the sero-prevalence of Q. fever infections (*Coxilla burnittii*) among 250 Veterinarians and butchers. The slaughterhouses targeted were Dhamar central, western and northern slaughterhouses in the city between the period 2016 and 2019. The general bio-information of each worker as Age, duration of practicing work, symptoms and occupation were collected using questionnaires.

Size of sample

The sample size was calculated according previous studies (Vilibic-Cavlek et al., 2012; Whitney et al., 2009; Mohabbati et al., 2017) considering 21% expected prevalence and 95% confidence interval with a 5% desired absolute precision using the following formula: $N=(Z)^2P(1-P)/d^2$, *where, (p) expected prevalence and (Z) 95% confidence interval (Z= 1.96) and (d) a 5% desired absolute precision.* Accordingly, the size of sample is 255. However, the five case were excluded due to data bias.

Collection of data and samples

Using a questionnaire, demographic data such as age, experience, occupation were collected from each worker. For serological screening, five ml of blood samples in venouject tubes were taken from each individual. The blood tubes were transported under cool conditions to the Public health laboratory, Faculty of Agriculture and Veterinary Medicine, University of Thamar, Dhamar Yemen, for processing and testing for Q fever antibodies. In laboratory, the blood was centrifuged for 5-10 min at 1000 × g and the sera were stored at -20°C prior to the serological testing (Sabzevari et al., 2021). The clinical signs (symptom) were identified by clinical examination and reviewing the clinical records of all patients who had acute Q fever diagnosed during study.

Testing of sera samples

The sera samples of participants were tested for detecting IgG phases I and II, IgM antibodies of *C*. *burnetii*: using ImmunoDOT strip (GENBIO, San Diego, C A, USA) technique. The ImmunoDOT test procedure and results interpretation were performed according to the procedure of Manufacturer's instructions.

Goats`study

Study population

The study animals were indigenous and exotic goat breeds of both sex and different age brought to the abattoirs for slaughtering from districts around the Dhamar city.

Sample Size and Sampling Method

Since the prevalence of *Coxiella burnetii* in goats in Dhamar city as well Yemen has not been documented, the samples size was calculated according to previous studied (Ruiz-Fons et al., 2010; Vanderburg et al., 2014; Obaidat and Kersh, 2017) considering 22% expected prevalence rate, 95% confidence interval (CI) and 5% desired absolute precision using keys given by Thrusfield (2006). Accordingly, the sample size were 264 animals.

Collection of samples

Blood samples (5 ml) were collected from the jugular veins of goats. Blood samples were collected using disposable needles (18 and 19 gauges), labelled with necessary information and brought to public health laboratory, Faculty of Agriculture and Veterinary Medicine, Thamar University and private laboratory. Blood samples were then stored at room temperature for one hour to allow clotting. After then serum was liquated into cryo-vials and stored at -20 ℃ until tested.

Serological testing

Goat anti-Q Fever ELIZA kit, (Bioassay Technology Laboratory, Yangpu Dist. Shaghai China) was used to detect IgG antibodies to *Coxiella burnetii* infection following the manufacturer's instructions.

Statistical analysis

Data obtained from this study were loaded into Microsoft Excel spreadsheet and summarized by using Tables and line graphs. Descriptive and other statistical analyses were performed by using SPSS version 21 for Windows. (Version 21; SPSS Inc., Chicago, IL, USA). Chi square, logistic regression analyses were used to examine the relationship between seropositivity and explanatory variables. Pearson`s Correlation analysis was used to assess the association between the seropositivity and meteorological data. P value less than 0.05 (at 5% level of significance) was considered significant in all analysis.

RESULTS AND DISCUSSION

Seroprevelence of *Coxiella burnetii* infection on staff workers

The results revealed that, out of 250 staff workers, 13(5.2%) showed the presence of antibodies against *Coxiella burnetti* in their sera samples. Furthermore, 4.4% and 0.8% showed seropositivity for Phase-I & Phase-II and Phase-I respectively (Table 1).

Table 1. Seroprevalence of *Coxiella burnetii* antibodies among staff Workers in slaughterhouses of Dhamar city (n=250)

Reaction Type	No. of Subjects	Seropositive %	P value
Positive (Phase-I&II)	11	4.4	0.000
Positive (Phase-I)	2	0.8	
Overall	13	5.2	

These results in agreement with findings of Badi et al., (2019) who early studied the *C. burnetti* infection among workers and butchers in slaughterhouses at Dhamar with similar techniques. However, the seroprevalences rate was lower than findings of Tozer et al., (2011) in Australia ;Vilibic-Cavlek et al., (2012) in Croatia; Khalifa et al., (2016) in Egypt; El-Mahallawy et al. (2016) in China; Mohabbati et al. (2017_ Sabzevari et al., (2021); in Iran, Abbass et al. (2020) in Egypt; Bwatota et al. (2022) in Africa and Khadem-Rezaiyan et al. (2023) in Iran, who reported the seroprevalence rates as: 5.2%, 27.5%, 23.3%; 25% ; 19.80%, 17%, 53.3%, 15% and 56% respectively using Eliza and molecular techniques for detection of *C. burnetti* antibodies. In Europe, Georgiev et al. (2013) reported that the seroprevalence of C. *burnetti* antibodies *as* 12.2 to 24.0% in the Netherlands, 22.0% in Germany and 38.0% in Bulgaria. However, the seroprevalence rate was higher than rate reported by Anderson et al. (2009) in Unites States of America (3.1%). The consistent or discrepancies between the results of this study and above studies could be attributed to varieties in ecologic, social, cultural, behavioral and economic conditions and also levels of animal's infections, which affect the exposures of people in each of the regions of the world (Khalili et al., 2014; Mohabbati et al., 2017).

The results of this study also showed that out of 250 staff workers tested, 4.4% and 0.8% had phase I &II antibodies and phase I antibodies, respectively (Table 1). In human, serological assay may detect antibodies as phase II and phase I for *C. burnetii.* Phase II antibodies are more prevalent during acute infection, while chronic infection is characterized by a predominantly phase I antibody response (Forrnier et al., 1998; Khalili et al., 2014; Mioni et al., 2020). The IFA results are the most specific and sensitive for phase II and phase I IgG antibodies and, to a lesser extent, also for the phase II and phase I IgM antibodies (Setiyono et al., 2005).

The distribution of seroprevalence rate of *Coxiella burnetii* antibodies among the participants according to their demographic characteristics are presented in Table 2. As shown, the higher seroprevalence rate was recorded in age group of 31-40Yrs old (3.20 %); whereas, the lower rate in age group of ≥ 41yrs and above old(0.80%). These results are partially in agreement with findings of Sabzevari et al. (2021) who reported that people with an age of >40 years are more likely to be being infected with *Coxiella burnetii* than under 40 years old; however, our results are in contrast with findings of Whitney et al. (2009) who reported the high of infection in people or staff workers in age groups of >45 years. The differences in seroprevalence rate among different age groups may be attributed to the longer exposure to infection during their lifetime (Cardeñosa et al., 2006).

The occupational years' experience of participant was one of risk factor in this study investigated. Seropositive cases were higher (4.0%) in staff workers had between 6 to 10 years of occupational experience; whereas, the lower cases (1.2%) had between the 1<5 years of experience years as shown in Table 2. These results in parallel with findings of Cook et al., (2021). Who cited that, time worked in the slaughterhouse ranged from 0 to 59 years with a mean time of 10 years. This could be explained that slaughterhouses staff workers have a high risk of getting *Coxiella burnetii* seropositive because of long term contact with potentially infected livestock. In other studies, contact with livestock is described as an important risk factor for seropositivity (Dorko et al., 2008; Whitney et al., 2009).

On the basis of occupation, the seroprevalence rate of *Coxiella burnetii* antibodies in different categories of slaughterhouses` staff workers are depicted in Table 2. As shown, seroprevalence of *Coxiella burnetii* antibodies were recorded as 3.6% and 1.6% in butcher and veterinarians. These results are in agreement with findings of Chu et al. (2017) and Khadem-Rezaiyan et al. (2023). Based on the current results and aforementioned findings, it seems clear that the study group, people in contact with animals, are at a growing risk of acquiring Q fever infection. Many studies reported higher rates of Q fever seropositivity among slaughterhouses workers who come into direct contact with livestock than among those who do not (Chu et al., 2017).

It is known that there are regional variations

in the predominant presenting clinical signs of Q fever in human (Raoult et al., 2005). It has been suggested that the clinical form could be related to differences in the infecting strain, the inoculation dose, host factors, or the route of infection (Maurin and Raoult, 1999; Jado et al., 2012). Pneumonia is predominating in cases acquired by inhalation of infectious aerosol particles; whereas, hepatitis is predominating in cases acquired by ingestion of contaminated dairy products (Marrie et al., 1996). In our study, the distribution of Seroprevalence of *Coxiella burnetii* antibodies according to symptoms among participants are presented in Table 2. The symptoms showed by slaughterhouses workers were Flu-likes (0.80%), fever (0.40%), chest pain (0.80%), endocarditis (0. 4. %) and hepatitis (0.40%); whereas, 2.80% of participant showed no symptoms. The results of current study are in line with findings of Espejo et al., (2014) who studied the clinical presentation of acute Q fever in human in Spain and reported similar results or more. Moreover, Njeru et al. (2016) cited that Q fever in human may present as a flu-like illness with symptoms such as headache, myalgia, and/or atypical pneumonia. Symptoms such as hepatitis and endocarditis may be long lasting in chronic cases.

The effect of seasons (Month variation) in the distribution Seroprevalence of *Coxiella burnetii* antibodies among participants are presented in Table 2. As shown the more cases of Q fever were recorded during the months of spring (March) and winter (October-December) season. These findings are partially in line with findings of Espejo et al. (2014) who suggested that an increased number of cases of Q fever during the colder months may be attributed to a possible relationship between clinical presentation and seasonal factors. It is conceivable that during the cold and winter, viral infections increase the susceptibility of the respiratory mucosa to *C. burnetii*. Statistically, the chi square analysis revealed that there were significant differences between seropositivity of *Coxiella burnetii* and Occupation (P= 0.028) and Symptoms(p=0.000) characteristics/factors; whereas, no with age, time worked or experience and season factors.

The results of logistic regression confirmed the results of Chi square and showed that there is a significant relationship between the seroprevalence of *Coxiella burnetii* infection and the characteristics/risk factors of staff workers such occupation (OR=4.822; 95%CI: 1.363-17.064; P=0.015); symptoms (OR=1.820; CI: 1.345-2.463; P=0.000): whereas, no with age, work experience and seasons risk factors/ (Table 3).

Seroprevalence of *Coxiella burnetii* infection in goats

Q fever is a zoonotic infectious disease caused by *Coxiella burnetii*, with a worldwide distribution. It is an emerging public health threat as it causes reproductive failures and production losses in domestic ruminants (Shome et al., 2019). Animals can carry the infection for several years or lifelong, shedding the organism in various secretion and excreta, with increasing public health risk to animal farmers, veterinarians, abattoir workers and consumers of animal products (Zangue et al., 2022). This study was conducted to determine the seroprevalence rate and risks factors of *Coxiella burnetii* in goat's slaughterhouses in Dhamar city, Yemen.

The results of enzyme-linked immunosorbent assay (ELISA) used to screen serum samples for Q fever collected from goats are presented in Table 4. As shown, out of 263 sera samples tested, 23(8.75%) showed seropositivity for *Coxiella burnetii* antibodies in goats. These results are in agreement with previously studies of (Georgiev et al., 2013 in the Netherlands; 7.8%; Ullah et al., 2019 in Pakistan, 7.7%), and higher than seroprevalence rate reported by (Haider et al., 2015 in Bangladesh, 0.76%; Klemmer et al., 2018 in Egypt; 6.8%; Pape et al., 2019 in Greece, 6.6%) and lower than seroprevalence rate reported by Klaasen et al. (2014) in Gambia (24.2%), Ezatkhah et al (2015) in Iranian goats (22.4%), Obaidat and Kersh, (2017) in Jordan(56.0% Abushahba et al., (2017) at El Minya Governorate, Egypt(28.20%), Abbass et al., (2020) in Assiut, Egypt (53.3%). The differences among seropositivity rates of *Coxiella burnetii* in goats among different countries may be attributed to the extensive husbandry system, breeding, in close contact with others species of animals, wildlife, presence of ticks and different diagnostic tools used (ELISA) with each having different specificity and sensitivity.

The distribution of seroprevalence of *Coxiella burnetii* antibodies in goats according to risk factors or characteristics are presented in Table 4. As shown, the higher seroprevalence rate of *Coxiella burnetii* antibodies was in age groups of 6-10 months old (4.94%); whereas, lower rate in goats'

group of less than 5< months (1.52%) as presented in Table 4. The results of this study are accordance with studies of (Ibrahim et al., 2020; Bwatota et al., 2022) who reported that higher risk of exposure is in older age groups animals. Moreover, pathogen contact rate tends to increase with age simply as a consequence of a higher probability of contact with life span, a feature that herein was observed for sheep and goats (Ruiz-Fons et al.,2010).

The results of risk factor identification among animals showed that males (6.08%) were at significantly at high risk of infection with *Coxiella burnetii* compared to females (2.66%) as depicted in Table 4. These results are in contrast with findings reported by Abushahba et al., (2017) who reported the rate as 14.28% and 31.25% for males and females respectively. The reason for higher seroprevalence rate of *Coxiella burnetii* among males could be attributed to that, the laws in Yemen limited or prohibited slaughtering of female's animals to safe generations. Therefore, higher rate of Q. fever recorded in males.

The results of present study revealed that, higher seroprevalence rate of *Coxiella burnetii* antibodies was recorded in indigenous breeds (7.50 %) compared to exotic breeds (2.66%) as indicated in Table 4. Previously, studies indicate that Q fever is common in all breeds of farm animals, with different rate of seroprevalence. The differences here could be partly attributed to differences in management and prevailing climatic conditions, and genetic factors. (Jarelnabi et al, 2018). In addition, the higher infection in indigenous breeds may due to the decrease importing animals from neighboring countries during ongoing aggression war against Yemen.

Considering the effect of slaughterhouses location on distribution *Coxiella burnetii* antibodies in goats, the seroprevalence rare recorded in central slaughterhouse was 5.32%; whereas, the lower rate recorded in western slaughterhouse (1.90%) of Dhamar city. The difference in seroprevalence rate could be explained in view of Vanderburg et al., (2014) who suggested that, that management, geography and climate could be potential reasons for the differences in seroprevalences at different regions.

In current study, the higher seroprevalence of *Coxiella burnetii* antibodies in goats was recorded in spring and autumn seasons (3.04%) and the lower rate in summer season (2.66%). These results are in line with view of Swai et al., (2005) who suggested that seroprevalence of *Coxiella burnetii* antibodies could be due to the breeding system in the study areas, the animals are generally crossed in the dry season (October to March) so that the birth takes place during the rainy season and the female can benefit from the quality grass in order to feed her newborn. The onset of the rainy season leads to the development of ectoparasites and ticks in particular, which are vectors of *C. burnetii*.

Anss district was the important sources for goats slaughtering in slaughterhouses (4.18%) of Dhamar compared to other districts as presented in Table 4. These results are in parallel with findings of Klaasen et al., (2014) who reported different seroprevalence rate of *Coxiella burnetii* among animals brought from different localities of district/city for slaughtering in slaughterhouses in Gambia. Since, these animals might originate from entirely different populations with different Management system.

In this study, there were strong association (P<0.0) between the presence of tick and seroprevalence of *Coxiella burnetii* as presented in Table 4. The results of this study are in consistent with findings reported by Norlander, 2000; Hussain et al., 2022 who studied *Coxiella burnetii* in bovine in Pakistan. Furthermore, they cited that, ticks are considered major reservoirs of *Coxiella burnetii* and are responsible for the transmission of coxiellosis to domestic and wild animals.

Statistically, the chi square analysis revealed that there are significant differences between seropositivity of *Coxiella burnetii* and sex (P= 0.000), seasons (P=0.000), source of animals (0.036) and tick's presence (P=0.000); whereas, no significant differences with age, breed and location of slaughterhouses (Table 4). The results of univariate logistic regression showed that there is a significant association between the seroprevalence of *Coxiella burnetii* antibodies and the characteristics /variables of goats such sex (OR=0.029; 95%CI: .007-.123; P=0.000); season (OR=0.265; CI: .812-1.059; P=0.000), Source of animal (OR=1.38; CI: 1.005-1.894; P=0.046) and ticks presence (OR=5.70; CI: 13.661-111.534; P=0.000): whereas, no with Age, breed and location of slaughterhouses (Table 5).

The association between mereological data and seroprevalence of *Coxiella burnetii* antibodies in goats also were investigated in this study as depicted in Figure.4 The results of correlation analysis revealed that there were strong association (r= .243; P=.000) between seroprevalence of

Coxiella burnetii antibodies and relative humidity; while, no with temperature and rainfall (precipitation). These results are partially in agreement with findings of Nusinovici et al. (2015) and Bwatota et al. (2022) who cited that, data environmental factors including temperature, wind speed, precipitation, and solar radiation were all positively associated with *Coxiella burnetii* seropositivity in dairy cattle.

Conclusion: It could be concluded from this study that, seroprevalence of *Coxiella burnetii* antibodies prevalent among staff worker's in slaughterhouses at Dhamar. Seroprevalence of *Coxiella burnetii* antibodies among staff workers in slaughterhouses in Dhamar is influenced by occupation factor in human; whereas, in goats by sex, season, source of animals and presence of ticks in study area. An epidemiological control programme should be put in place to minimize *Coxiella burnetii* infection and its effects on staff workers in slaughterhouses and community as well. Further studies on the seroprevalence of *Coxiella burnetii* antibodies among population of Dhamar city. The attention of veterinary and public health authorities is requires using One-Health approach in order to control *Coxiella burnetii* infection occurrence and save human lives.

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ETHICS CONSIDERATION

This study was approved by the Faculty of Agriculture and Veterinary medicine, Thamar University, Dhamar. Before commencing the experiment, Oral consent was obtained from staff workers who showed consent to participate in the study after explanation the purpose of the study.

CONFLICTS OF INTEREST

The authors of this article declare that no conflict of interest regarding to this article.

FINANCIAL SUPPORT

The Authors did not receive any funds for this study.

Table 2. Distribution of Seroprevalence of *Coxiella burnetii* antibodies according to characteristics of participants(n=250)

Characteristic	Categories	No. of seropositive Subjects	Seropositivity %	P Value
Age	20-30Yrs	3	1.20	0 .131
	31-40Yrs	8	3.20	
	41& above	2	0.80	
Experience	1<-5Yrs	3	1.20	0.068
	6-10Yrs	10	4.00	
	11 and above	0	0.00	
Occupation	Veterinarian	4	1.60	0.028
	Butchers	9	3.60	
Symptoms	flulike	2	0.80	0.000
	fever	1	0.40	
	chest pain	2	0.80	
	Endocarditis	1	0.40	
	Hepatitis	1	0.40	

Continue Table 2.

Month Variation	Jan	0	0.00	0.831
	Feb	1	0.40	
	Mar	3	1.20	
	April	1	0.40	
	May	2	0.80	
	Jun	0	0.00	
	Jul	0	0.00	
	Aug	1	0.40	
	Sep	2	0.80	
	Oct	1	0.40	
	Nov	1	0.40	
	Dec	1	0.40	

Table 3. Results of logistic regression analysis for risk factors associated with Seroprevalence of *Coxiella burnetii* antibodies among staff workers in slaughterhouses at Dhamar city(n=250)

Risk factor	Categories	No. of positive Subjects	Seropositive %	OR	95%	P value
Age	20-30Yrs	3	1.20	0.532	0.249-1.138	0.104
	31-40Yrs	8	3.20			
	41& above	2	0.80			
Experience	1<-5Yrs	3	1.20	0.833	0.364-1.907	0.666
	6-10Yrs	10	4.00			
Occupation	Veterinarian	4	1.60	4.822	1.363-17.064	0.015
	Butchers	9	3.60			
Symptoms	flulike	2	0.80	1.820	1.345-2.463	0.000
	fever	1	0.40			
	chest pain	2	0.80			
	Endocarditis	1	0.40			
	Hepatitis	1	0.40			
	Asymptom	7	2.80			
Month Variation	Jan	0	0.00	0.949	0.796-1.131	0.558
	Feb	1	0.40			
	Mar	3	1.20			
	April	1	0.40			
	May	2	0.80			
	Jun	0	0.00			
	Jul	0	0.00			
	Aug	1	0.40			
	Sep	2	0.80			
	Oct	1	0.40			
	Nov	1	0.40			
	Dec	1	0.40			

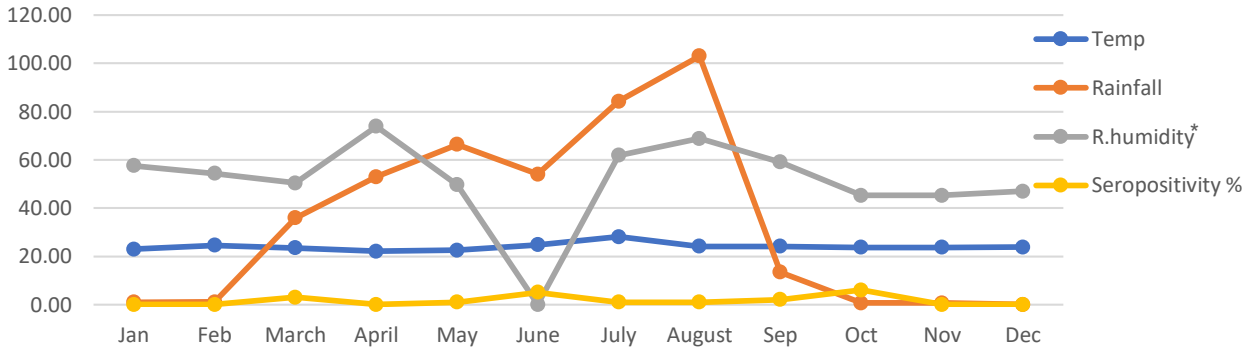

Fig. 1. Correlation of *Coxiella burntii* seropositivity in goats with weather conditions in Dhamar city

Table 4. Overall Seroprevalence of *Coxiella burnetii* antibodies and according to characteristics of Goats (n=263)

Characteristic	Categories	No. of seropositive animals	Seropositivity %	P Value
Age	5<Months	4	1.52	0.889
	6-10M	13	4.94	
	11M &above	6	2.28	
Sex	Male	16	6.08	0.000
	Female	7	2.66	
Breed	Indigenous	15	5.70	0.082
	Exotic	7	2.66	
	hybrid	1	0.38	
Slaughterhouses	Central	14	5.32	0.079
	Eastern	4	1.52	
	Western	5	1.90	
Season	Winter	0	0.00	0.000
	Spring	8	3.04	
	Summer	7	2.66	
	Autumn	8	3.04	
Source of animal	AlHada	8	3.04	0.036
	Anss	11	4.18	
	Anis	0	0.00	
	Myfaa Ans	2	0.76	
	Rousaba	2	0.76	
Ticks' presence	Yes	13	4.94	0.000
	No	10	3.80	
Overall prevalence	263	23	8.75	

Table 5. Results of logistic regression analysis for risk factors associated with *Coxiella burnetii* infection in Goats(n=263)

Risk factor	Categories	No. Seropositive animals	Seropositivity %	OR	95% CI	*P* value
Age	5<Months	4.0	1.52	1.146	0.584-2.25	0.692
	6-10M	13	4.94			
	11M &above	6.0	2.28			
Sex	Male	16	6.08	0.029	0.007-.123	0.000
	Female	7.0	2.66			
Breed	Indigenous	15	5.70	0.921	0.492-1.723	0.797
	Exotic	7.0	2.66			
	Hybrid	1.0	0.38			
Slaughterhouses	Central	14	5.32	1.128	0.659-1.930	0.660
	Eastern	4.0	1.52			
	Western	5.0	1.90			
Season	Winter	0.0	0.00	0.265	0.812-1.059	0.000
	Spring	8.0	3.04			
	Summer	7.0	2.66			
	Autumn	8.0	3.04			
Source of animal	AlHada	8	3.04	1.38	1.005-1.894	0.046
	Ans	11	4.18			
	Anis	0	0.00			
	Myfaa Ans	2	0.76			
	Rousaba	2	0.76			
Ticks presence	Yes	13	4.94	39.034	13.66-111.53	0.000
	No	10	3.80			

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الحمى المجهولة بين العاملين والماعز في مسالخ مدينة ذمار، اليمن

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الملخص

اجريت الدراسة في الفترة ما بين 2016 الى 2019م، لتحدد مدى انتشار الاجسام المضادة *لبكتيريا Coxilla burnettii*المسببة للحمى المجهولة بين العاملين (الجزارين و الأطباء البيطريين) والماعز في المسالخ في مدينة ذمار، اليمن. تم جمع 250عينة دم من العاملين والاطباء البيطريين القائمين على فحص اللحوم في مختلف مسالخ ذمار، استخدم الاختبارات المصلية المناسبة للكشف عن الاجسام المضادة من نوع IgG، IgM لبكتيريا *C.burnettii*. كشفت النتائج وجود الاجسام المضادة للحمى المجهولة في امصال العاملين والأطباء البيطريين بنسبه كلية (5.2%). أظهرت نتائج الدراسة ان نسبة انتشار الإصابة كانت مرتفعة في الاعمار ما بين 31-40 سنة (3.20%)مقارنة بالأعمار التي تزيد عن 41 سنه بمعدل (0.80%)، وفي العاملين بحسب فترة عملهم ما بين 6-10سنوات مقارنه بالأخرين والذين كانت فتره عملهم اقل من خمس سنوات. وفي العمال بحسب الوظيفة بنسبة 3.6% مقارنة بالأطباء البيطريين التي كانت بنسبة 1.6%، لوحظت فروق معنوية بين نسبه الاصابة وعامل الخطورة بحسب الوظيفة او نوع العمل(P =0.028) . كما لوحظ فروق معنوية بين العلامات السريرية ونسبة الإصابة(P=.000). في دراسة الماعز، استخدم الاختبار المناعي غير المباشر ELISAللكشف عن الاجسام المضادة من نوع IgG لبكتيريا *C. brunetti*. في دم 263 حيوان من الماعز من كلا الجنسين. اوضحت النتائج وجود اجسام مناعية من نوع IgG المضادة لبكتريا *C burnitti* في 23عينة من مصل الماعز وبنسبة 8.75 % من العدد الكلي للعينات المفحوصة، وكانت نسبة الاصابة في الذكور (6.08%) مقارنة بالإناث (2.66%). لوحظت فروق معنوية بين نسبة انتشار الاصابة بين الجنسيين (P=0.001). اظهرت نتائج تحليل الانحدار ان هناك فروق ذات دلالة إحصائية بين نسبة الإصابة وجميع عوامل الخطورة المتمثلة في مصدر الحيوان والموسم ووجود القراد مع استثناء عامل العمر والسلالة وموقع المسلخ. نستنتج من هذه الدراسة ان عدوى الحمى المجهولة منتشرة بين عمال المسالخ والماعز في منطقة الدراسة، وعليه يجب مكافحة المرض والسيطرة عليه لمنع حدوث الإصابة وتقليل الخسائر الاقتصادية في الانسان والحيوان.

الكلمات المفتاحية: الحمى المجهولة، العاملين في المسالخ، الماعز، ذمار، اليمن

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