

# A cross-sectional study of sero-prevalence and risk factors of brucellosis and haemorrhagic fever in slaughterhouse staff in Ahvaz City, Iran; 2020

## Przekrojowe badanie seroprewalencji i czynników ryzyka brucelozy i gorączki krwotocznej u pracowników ubojni w irańskim mieście Ahwaz (2020 r.)

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Medical Studies/Studia Medyczne 2021; 37 (1): 7–15

DOI: <https://doi.org/10.5114/ms.2021.104995>

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**Key words:** fever, Ahvaz, Brucellosis, Crimean-Congo haemorrhagic.

**Słowa kluczowe:** gorączka, Ahwaz, bruceloza, krymsko-kongijska gorączka krwotoczna.

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### Abstract

**Introduction:** Malta fever and Crimean-Congo haemorrhagic fever comprise a major public health problem in developing countries and is endemic in Iran.

**Aim of the research:** To study sero-prevalence and risk factors of brucellosis and haemorrhagic fever in Slaughterhouse Staff in Ahvaz City, Iran; 2020.

**Material and methods:** This descriptive cross-sectional study was performed on 104 slaughterhouse staff in Ahvaz. First, a questionnaire containing demographic information and other required information was filled in at the workplace; after that, 10 ml of blood was taken from each person. To diagnose anti-Brucella IgG antibodies, ELISA and IBL kits were used, and CISF was used to diagnose ELISA and specific IgG detection. Finally, the data were entered into SPSS software version 23, and the significance level of the tests was considered to be less than 0.05.

**Results:** In this study, 14 subjects were not available and all were male. The sero-prevalence of Brucellosis and CCHF was 17% (17 people) and 7% (7 people), respectively. There was no significant difference between age factors, marital status, duration of employment, training, use of protective equipment, and type of job with prevalence rate of brucellosis and CCHF.

**Conclusions:** It seems that in order to reduce the incidence of these diseases in slaughterhouse staff, we need to review the training programs as well as the type and manner of use of personal protective equipment because there is a significant difference in the prevalence of this disease among trained people and people using personal protective equipment compared to untrained people and people not using personal protective equipment.

### Streszczenie

**Wprowadzenie:** Gorączka maltańska oraz krymsko-kongijska gorączka krwotoczna (CCHF) stanowią znaczący problem dla zdrowia publicznego w krajach rozwijających się. W Iranie choroby te mają charakter endemiczny.

**Cel pracy:** Analiza seroprewalencji i czynników ryzyka wystąpienia brucelozy i gorączki krwotocznej u pracowników ubojni w irańskim mieście Ahwaz w 2020 r.

**Materiał i metody:** Opisowe badanie przekrojowe przeprowadzono w grupie 104 pracowników ubojni w mieście Ahwaz. W pierwszej kolejności pracownicy wypełniali w miejscu pracy kwestionariusz w celu zebrania danych demograficznych i innych niezbędnych informacji. Następnie od każdej osoby pobrano 10 ml krwi. Przeciwciała anty-Brucella IgG oznaczano za pomocą zestawów ELISA i IBL, a w diagnostyce ELISA i swoistej detekcji przeciwciał IgG wykorzystano CISF. Dane wprowadzono do oprogramowania SPSS w wersji 23. Poziom istotności statystycznej dla wyników ustalono jako  $p < 0,05$ .

**Wyniki:** Grupa badana obejmowała wyłącznie mężczyzn. Dane dotyczące 14 osób nie były dostępne. Seroprewalencją brucelozy i CCHF wyniosła odpowiednio 17% (17 osób) i 7% (7 osób). Nie stwierdzono istotnej zależności pomiędzy wiekiem, stanem cywilnym, stażem pracy, poziomem przeszkolenia, stosowaniem środków ochrony i rodzajem wykonywanej pracy a częstością występowania brucelozy i CCHF.

**Wnioski:** W celu ograniczenia występowania analizowanych chorób u pracowników uboju niezbędny jest przegląd programów szkoleniowych oraz rodzaju środków ochrony indywidualnej i ich stosowania. Stwierdzono bowiem istotną różnicę w częstości występowania chorób między osobami przeszkolonymi i stosującymi środki ochrony indywidualnej a osobami nieprzeszkolonymi i niestosującymi takich środków.

## Introduction

The growing population of the world and the consequent increase in the need for animal resources to provide food has made human contact with animals unavoidable. In recent years, common diseases between humans and animals or zoonotic diseases have become very important. These diseases, in addition to being a serious threat to humans, are also important economically, politically, and even in relations between countries. In recent decades, most emerging and re-emerging diseases have been among these diseases. This issue is especially important in developing countries where people are continually in contact with livestock and livestock products [1].

A zoonosis is a disease that is naturally transmitted from animal to human. Zoonoses have been defined in different ways. In the 19<sup>th</sup> century Rudolf Virchow renamed the zoonoses as new common diseases between humans and animals, and defined them as infectious diseases that humans acquired from domestic animals, and ultimately made the definition more comprehensive; these diseases included diseases or infections that humans can acquire from domestic and wild animals or vice versa [2].

In other words, zoonoses include common infectious and parasitic diseases between humans and animals in which animals act as either the main host or as direct or intermediate carriers, and polluting the environment. However, in some cases, without natural transmission of the infection between humans and animals, the disease is transmitted from a common external source, such as water, soil, or plants. It is estimated that 60% of the approximately 1500 pathogens that can cause disease in humans are caused by zoonotic disease and that 70% of emerging and re-emerging diseases in recent years have been zoonoses. More than 300 types of zoonotic disease have been identified with various aetiologies that cause high morbidity and mortality in humans [2–4]. Research shows that zoonotic diseases cause the death of 2.2 million people per year around the world [2].

Zoonosis diseases can be transmitted to humans in a variety of ways, including milk and other raw and unpasteurized animal products, eating raw or undercooked meat, direct contact with an infected animal during childbirth or slaughter and butchering of livestock, and carriers such as insect bites or contact with the infected environment [5]. Controlling zoonotic diseases in livestock, especially those grown in the traditional way and in rural areas of developing countries, is difficult, and this problem causes a high prevalence of such diseases in those areas. In such ar-

reas, villagers sometimes supply their weak, sick, and barren livestock to traditional slaughterhouses to prevent losses [6].

Slaughterhouse workers, especially in traditional slaughterhouses, are at high risk of acquiring infected zoonotic diseases due to the nature of their work. Some of the diseases that are mainly transmitted in this way include: Brucellosis, Toxoplasmosis, Crimean-Congo haemorrhagic fever, Q fever, leptospirosis, hepatitis E, animal influenza, bovine tuberculosis, listeriosis, anthrax, erysipeloid, tularaemia, melioidosis, and glanders [7].

The number of slaughterhouse staff affected by zoonotic diseases is affected by factors such as staff knowledge and attitudes toward zoonotic diseases, the amount of personal protective equipment used during work, the slaughterhouse status (industrial or traditional), the prevalence rate of zoonotic diseases in the livestock of the area, and the frequency of contact with the animal [7].

Studies conducted in different parts of the country indicate a higher serum prevalence of zoonotic diseases in slaughterhouse staff than in the general population [7–11]. Transmissible diseases between animals and humans are originally from the group of bacteria, viruses, fungi, and parasites. The most common diseases between humans and animals in our country are Malta fever, leishmaniasis, rabies, peptic ulcer, hydatid cyst, leptospirosis, and Crimean-Congo haemorrhagic fever. On the other hand, for various reasons, the risk of other diseases such as mad cow, Rift Valley fever, bird flu, etc. should not be ignored. Awareness of the seroprevalence of zoonotic diseases in slaughterhouse staff for provincial health officials due to the provision of information regarding the level of observing of personal protection points among staff, observing the correct principles in the process of slaughtering and butchering livestock, and the prevalence rate of zoonotic diseases (Malta fever and Crimean-Congo haemorrhagic fever) in local livestock, are important. Also, determining the risk factors associated with these diseases will allow the use of instructions and methods to reduce contact and infection of staff.

## Aim of the research

According to the topics expressed, and because the prevalence of these diseases is different in various parts of the country, and a comprehensive study has not been done in this regard in Khuzestan province, we performed a study of the seroprevalence and risk factors of brucellosis and haemorrhagic fever in slaughterhouse staff in Ahvaz city, Iran; 2020.

## Material and methods

This research was a descriptive cross-sectional study that has been done on 81 slaughterhouse staff of Ahvaz and after coordination with Khuzestan Province Veterinary Organization in 2020 by simple random sampling.

The study entry criteria included working for at least 6 months in the slaughterhouse and direct contact with livestock and livestock products; the study exit criteria included working in animal husbandry or butchery in off-duty shifts of a slaughterhouse and being infected by zoonotic diseases before working in a slaughterhouse. For each participant, a questionnaire containing demographic information, including age, gender, marital status, duration of work at the slaughterhouse, use of protective equipment (mask, gown, boots, gloves, and face protector), type of activity in the slaughterhouse, and passing relevant training courses, was filled in at the workplace. After which 10 ml of blood was taken from each participant in the study, and the samples were immediately placed inside a cold box with a temperature of 4°C and transferred to the reference laboratory of the provincial health centre in the shortest possible time. In the laboratory, the serum was immediately separated and kept at -20°C until the relevant tests were performed, and then, by keeping the cold chain, it was sent to the laboratory of Pasteur Institute of Iran.

### Laboratory methods

#### *Diagnosis of anti-brucellosis antibodies*

The ELISA and IBL kit made in Germany was used to detect IgG anti-Brucella antibodies. Briefly, 1 ml of serum diluted to a ratio of 1 : 100 and washed with a buffer is adjacent to 100 ml of conjugate. The resulting mixture was incubated at room temperature for 30 min and then placed in the vicinity of tetramethylbenzidine (TMB) for 20 min. After adding a solution to stop the reaction, the light absorption was measured at a wavelength of 450 nm. Antibody activity was calculated through standard curves according to the guidelines of the manufacturer of the kit. All probable and confirmed cases with ELISA method were confirmed by tubular agglutination method (Pasteur Institute of Iran), which is the gold standard method for diagnosing Brucella. Positive and probable samples of serial dilution were prepared from 1 : 20 to 1 : 1280 and were mixed with tubular agglutination test antigen. After incubation for 24 h, titres of equal and more than 1 : 80 positive were considered [7].

#### *Serum diagnosis of Crimean-Congo haemorrhagic fever*

To diagnose CCHF have been used from ELISA and monitoring specific IgG. IgG detection phases include cutting the ELISA plates with mouse hyper-

immune serum, which is diluted in a ratio of 1 : 1000 with saline phosphate buffer and incubated at 4°C for 1 day and night. After the washing phases, the recombinant antigen was added, diluted with PBS in a ratio of 1 : 500. The plates were incubated at 37°C for 3 h. In the next phase, the marked animal immunoglobulin was added to the plates and stored for 1 h at 37°C. After performing 3 washing phases, the TMB reagent was added and the mixture was incubated for 15 min. Finally, the enzymatic reaction was completed by adding a stopping solution, and the light absorption of the plates was read by the ELISA reader at a wavelength of 450 nm [12].

### Ethical considerations

This study was performed after approval by the Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (code of ethics IRAJVMS. Rec.1398.351), and the information in the questionnaire was completely confidential. This study was conducted under the supervision of the Vice Chancellor in Health Affairs of Ahvaz Jundishapur University of Medical Sciences and with the permission of the Vice Chancellor. Before patients entered the study, their consent was obtained in writing in the questionnaire and no intervention or invasive action was conducted for the individual. Participation in this study was not dangerous for the individual. The cost of performing the required tests was borne by the researcher, and the patients did not pay any fees.

### Statistical analysis

In order to analyse the data, first the studied variables were described using descriptive statistics methods, including frequency distribution tables, graphs, and numerical indicators such as mean and standard deviation. Then, the relationship between qualitative variables with  $\chi^2$  test and the relationship between quantitative variables and correlation coefficient were investigated. Also, the comparison of the means of the 2 groups or more than 2 groups with independent *t*-tests and one-way analysis of variance were examined, respectively. The significance level was < 0.05. Data analysis was performed with SPSS software version 23.

### Results

In total, 104 people entered the study; information about 4 of them was not available and they were removed from the study.

The sex of all people was male. None of the people had a history of previous CCHF or brucellosis. Ninety-four (94%) people were married and 6 (6%) were single.

Out of 100 people working in the slaughterhouses of Ahvaz city, the job of 43 (43%) people were cleaners and workers at the slaughter and carcass location, 21 (21%) people were head cooks, 3 (3%) people were

**Table 1.** Demographic and background information of individuals

Variables	Marital status		Employment					Previous record of CCHF infection		Previous record of brucellosis infection		Trained		Use of protective equipment	
	Single	Married	Services	Head cooker	Driver	Working with waste	Administrative	Yes	No	Yes	No	Yes	No	Yes	No
Frequency	6	94	43	21	3	25	8	0	100	0	100	91	9	24	76
Percentage	6	94	43	21	3	25	8	0	100	0	100	91	9	24	76

**Table 2.** Seroprevalence of Brucellosis in the people under study based on age and time of employment

Variables	Negative serology	Positive serology	P-value
Mean age [year]*	39.43 ±11.38	40.12 ±8.55	0.780
Mean employment time [year]*	15.08 ±13.87	19.11 ±12.40	0.214

\*Mean ± SD.

**Table 3.** Seroprevalence of CCHF in the people under study based on age and time of employment

Variables	Negative serology	Positive serology	P-value
Mean age [year]*	39.11 ±78.04	36.71 ±8.93	0.418
Mean employment time [year]*	16.13 ±30.65	16.13 ±30.65	0.120

\*Mean ± SD.

meat carrier drivers, 25 (25%) people were waste adjustment and bone powder workers, and 8 (8%) people were veterinarians, statisticians, experts, or religious observers. Of these people, 9 (9%) people had no training about the disease and its transmission, but 91 (91%) people were trained. Seventy-six of them (76%) did not have protective equipment, and only 24 (24%) people used protective equipment (Table 1).

### Age

The mean age among the people with negative serology for brucellosis was 39.43 ±11.38 years, and in people with positive serology it was 40.12 ±8.55 years. There was no significant difference between people with positive serology and people with negative serology ( $p$ -value = 0.780) (Table 2). The mean age among people with negative serology for CCHF was 39.11 ±78.04 years, and among people with positive serology it was 36.71 ±8.93 years. There was no significant difference between people with positive serology and people with negative serology ( $p$  = 0.418) (Table 3).

### Duration of employment

The mean duration of employment in people with a negative serology for Brucellosis was 15.08 ±13.87 years, and in people with positive serology it was 12.40 ±19.11 years. There was no significant difference between the mean duration of employment in

people with positive serology and people with negative serology ( $p$  = 0.214) (Table 2).

The mean duration of employment in people with a negative serology for CCHF was 16.13 ±30.65 years, and in people with positive serology it was 9.9 ±29.92 years. There was no significant difference between the mean duration of employment in people with positive serology and people with negative serology ( $p$  = 0.120) (Table 3).

### Marital status

The seroprevalence of Brucellosis among married people was 18.9% (17 people), and in single people it was zero, but no significant difference was observed in this case ( $p$  = 0.587) (Table 4).

The seroprevalence of CCHF in married people was 6.7% (6 people), and in single people it was 16.6% (1 person), which did not show a significant difference ( $p$  = 0.373) (Table 5).

### Occupation

The seroprevalence of Brucellosis in the slaughterhouse workers and carcass location was 25.6% (10 people), in the head cooker it was 14.3% (3 people), in the drivers carrying meat it was zero, and in those who worked with skin and bones it was 16% (4 people). The veterinarians and supervisors also reported zero. There was no significant difference in this case ( $p$  = 0.371) (Table 4).

**Table 4.** Seroprevalence of Brucellosis in the people under study based on risk factors

Variables	Marital status		Occupation				Trained		Use of protective equipment		
	Single	Married	Services	Head cooker	Driver	Working with waste	Administrative	Yes	No	Yes	No
The seroprevalence of Brucellosis											
Frequency	0	17	10	3	0	4	0	16	1	5	12
Percentage	0	18.9	25.6	14.3	0	16	0	18.4	11.1	22.7	16.2
P-value	0.587		0.371				0.501		0.339		

**Table 5.** Seroprevalence of CCHF in the people under study based on risk factors

Variables	Marital status		Occupation				Trained		Use of protective equipment		
	Single	Married	Services	Head cooker	Driver	Working with waste	Administrative	Yes	No	Yes	No
The seroprevalence of CCHF											
Frequency	1	6	3	1	0	3	0	7	0	0	7
Percentage	16.7	6.7	7.7	4.8	0	12	0	8	0	20	9.5
P-value	0.373		0.775				0.490		0.151		

The seroprevalence of CCHF in the slaughterhouse workers and carcass location was 7.7% (3 people), in the head cook it was 4.8% (3 people), in the drivers carrying meat it was zero, and in those who worked with skin and bones it was 12% (3 people). The veterinarians and supervisors also reported zero. There was no significant difference in this case ( $p = 0.775$ ) (Table 5).

### Training

The seroprevalence of Brucellosis in people with a history of training was 18.4% (16 people), and in those who had no history of training it was 11.11% (1 person). There was no significant difference in this regard ( $p = 0.501$ ) (Table 4).

The seroprevalence of Brucellosis in people with training history was 8% (7 people), and in those who had no training history it was zero. There was no significant difference ( $p = 0.490$ ) (Table 5).

### Protective equipment

The seroprevalence of Brucellosis in people who used protective equipment was 22.7% (5 people), and in those who did not use protective equipment it was 16.2% (12 people). There was no significant difference in this regard ( $p = 0.339$ ) (Table 4).

The seroprevalence of CCHF in people who used protective equipment was zero, and in those who did not use protective equipment it was 9.5% (7 people).

There was no significant difference in this regard ( $p = 0.151$ ) (Table 5).

## Discussion

In this study, the seroprevalence of brucellosis and Crimean-Congo haemorrhagic fever in slaughterhouse workers was investigated. The seroprevalence of brucellosis was 17% and the seroprevalence of CCHF was 7%. Also, there was no significant difference regarding age, marriage, duration of employment, training, use of protective equipment, and type of job in the seroprevalence of brucellosis and CCHF.

### Brucellosis

The seroprevalence of brucellosis in the present study was 17%. In the study of Mangalgi *et al.* [13] the prevalence of brucellosis was 9.5% (the sample size of this study was 2337 people), and studies from Iran and Jordan reported rates of about 10% [14–16]. In the study of Nikokar *et al.* [17] the prevalence of brucellosis in slaughterhouse staff was 9.8% (the sample size of this study was 292 people). In the study of Esmaeili *et al.* [7] the prevalence of brucellosis in butchers and slaughterhouse staff was 7.9%. In the study of Karimi *et al.* [18] a higher prevalence was reported in slaughterhouse staff (20%). The sample size this study was 514 people, and considering that this study was performed about 20 years ago, the level of health and health education at that time was less than today; also 264 people in this

study were people from ordinary society. This rate was lower than similar studies conducted on butchers and slaughterhouse workers in Khorasan Razavi province in northeastern Iran (48%) [19] and the city of Kerman in southern Iran (58.6%) [10].

The seroprevalence of brucellosis shows significant differences between countries. The prevalence of brucellosis in slaughterhouse workers was 35% in Saudi Arabia [20], 37.6% in Algeria [21], 25.5% in India [22], 22% in Pakistan [23], 19.5% in Tanzania [24], 0.8% and in South Korea [25].

Overall, these studies show that butchers and slaughterhouse workers may face different levels of risk of infectious zoonotic diseases in different regions, which is probably due to differences in the rate of animal contamination, human lifestyle, and differences in the use of protective equipment.

Differences in the rate of prevalence of brucellosis among the population in different geographical areas and countries may be due to differences in animal disease, occupational contact, veterinary prevention measures, and social habits of different populations [26].

In the study by Al-Sekait *et al.* [20] (sample size 23,613) and Sumer *et al.* [27] (this study was performed on 750 elderly people), the level of contact with animals as one of the most important risk factors for get infected with Malta fever was reported. However, in the present study, there was no statistically significant difference in the level of positivity in different occupational groups exposed to contact. The reason for this discrepancy can be the difference between the statistical population of the mentioned studies and their sample size compared to the present study.

The mean age among people with positive serology was  $40.12 \pm 8.55$  years, which was not significantly different from people with negative serology. The relationship between increase prevalence of brucella antibodies and age in high-risk individuals was reported by Beheshti *et al.*, Nikokar *et al.*, and Ramos *et al.* [16, 17, 28]. In the study of Ramos *et al.* the age of people studied was divided into 5 categories: under 20 years, 21 to 30 years, 31 to 40 years, 41 to 50 years, and over 51 years; this categorization was not used in the present study. In the study of Nikokar *et al.* the age group of people studied was divided into 4 categories: under 25 years, 26 to 35 years, 36 to 45 years, and over 46 years, which again was not used in the present study. There was no significant difference between age and seroprevalence in our study. The reason for this difference could be due to the lower age of the people in the present study compared to other studies.

In this study, the seroprevalence of brucellosis in office staff (such as veterinarians) was not different from other people. However, in the study of Mangalgi *et al.* [13], brucellosis was more prevalent in veterinarians, especially in those who manipulated the foetus and placenta, and described the job as a risk factor. In

this study, people were divided into 6 groups: veterinarians, farmers, daily laborers, butchers, shepherds, and laboratory staff. Also, the sample size of this study was higher than in the present study (2337 people). Similar results were observed in the study of Ramos *et al.* [28] with the mentioned study. The sample size of this study was larger than the present study (645 people). In this study, individuals were divided into butcher groups, veterinarians, veterinary students, and local workers. The reason for this difference could also be due to differences in the classification of jobs in our study compared to other studies.

In the study of Nikokar *et al.* [17], a significant difference was observed regarding the duration of work. In this study, the duration of employment in individuals was divided into 3 categories: less than 10 years, 11 to 20 years, and more than 21 years, which did not exist in our study. Karimi *et al.* [18] also observed a significant relationship between Malta fever and duration of occupational exposure. However, there was no significant difference between the duration of work and the rate of test positivity in the present study. The reason for this difference could be due to the higher awareness of people with more work experience in our region than novice people, or the low sample size of the present study. Therefore, they are more careful in observing the principles of protection and have a lower prevalence rate than other studies.

In a study by Esmaeili *et al.* [7], there was no significant difference in the prevalence of brucellosis in the 2 groups of people who used protective equipment compared to those who did not. In this study, it was concluded that the use of preservatives is a factor in preventing brucellosis. The reason for the difference between this study and the study of Esmaeili *et al.* [7] can be due to the lower prevalence of this disease in our region.

### Crimean-Congo haemorrhagic fever

According to studies conducted since 1999, in many parts of Iran, several cases of Crimean-Congo haemorrhagic fever have been observed and reported, and paraclinical studies have also confirmed them [23].

The seroprevalence of CCHF in the present study was 7%. The seroprevalence of CCHF in slaughterhouse staff has been reported to be from 0.75% to 16.5% [12, 29].

In the study of Mukhtar [23], the main occupation of patients was livestock, shepherds, slaughterhouse workers, or butchers (38%); this amount and the superiority in the study of Saghafipour in Qom in 2011 and the study of Ebadi Azar in Mashhad in 2009 (31% of butchers and 38% of ranchers) and the study of Bazzi and Garzan in Zabol (25%) were consistent, which could indicate the prevalence and risk of further infection in these jobs and also the CCHF as an occupational disease [30–32].

In study by Wasfi *et al.* [33], the seroprevalence of CCHF in slaughterhouse staff was 5.2%. A similar prevalence was reported in high-risk populations in other indigenous countries: Mauritania 7% [34]; Greece 2/4% [35]; Kosovo 4% [36]; Bulgaria 2.8% [37]; Turkey 2.3% [38]; and Iran 12% [39].

In the Hadinia study, 362 people with CCHF were examined retrospectively, of whom 123 (34%) people were slaughterhouse staff, 103 (28.8%) people were butchers and farmers, 32 (9%) people were housewives, 7 (2%) people were students, 6 (1.9%) people were teachers, 4 (1.2%) were military personnel, and 87 (24%) were from other occupations [40]. In this retrospective study was observed that the majority of the affected population is slaughterhouse staff and butchers. This study is not comparable to our research, given that it was retrospective, but it is important to us that the predominant population with CCHF were staff of slaughterhouses and butchers.

A study conducted from 2011 to 2012 in Southeastern Bulgaria showed that 245 of the 751 human serums examined by IFA that 24 of subjects showed a positive headline, and it was also found that to be bitten by ticks, have contact with animals, and be residents of rural areas are the high risk factors for developing this disease [41].

In a previous study, dealing with ticks with bare hands is known as a common way and a risk factor for CCHF transmission [42].

About 73% of slaughterhouse staff did not use protective equipment in this study, which is very dangerous. However, in the present study, there was no significant difference in the positivity of CCHF between those who used protective equipment and those who did not use any equipment. This could be due to the low overall prevalence of CCHF in our region.

The mean age in present study among people with positive serology for CCHF was 36.71 years. The highest age prevalence of patients in Mokhtari's study [23] in both the probable and confirmed group was 31.40 years, which included 22.6% and 28.3%, respectively, in Saghaipour's study in Qom [30] in the age range of 15–35 years, 70.5%; in the Ebadi Azar study [31] in Mashhad 20–49 years old, 84% and in the Heidary study [43] in Mashhad the mean age was 31 years. In the present study, the mean age of people who had a positive serology for CCHF did not differ from those who had a negative serology.

Also, the type of job, training, and being married did not differ significantly regarding the prevalence of CCHF.

The duration of employment did not differ significantly with the prevalence of CCHF. The reason for this difference could be due to the small sample size as well as the low number of people with positive serology.

## Conclusions

It seems that in order to reduce the incidence of these diseases in slaughterhouse staff, we need to review the training programs as well as the type and method of using personal protective equipment, because there is a significant difference in the prevalence of this disease among trained people compared to untrained people; also, there was no significant difference between people who used personal protective equipment compared to people who did not use this equipment.

## Conflict of interest

The authors declare no conflict of interest.

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