



# Seroepidemiological Survey of Crimean-Congo Hemorrhagic Fever Among Livestock in Southern Iran, Jahrom, 2015-2016

Manoochehr Shabani<sup>1</sup>, Heshmatollah Shakeri<sup>2</sup>, Mostafa Salehi-Vaziri<sup>3,4</sup>,  
 Kaveh Sadeghi<sup>5</sup>, Hossein Nasr Azadani<sup>5</sup>, Yousef Hosseini<sup>6</sup>, Abbas Ahmadi Vasmehjani<sup>7\*</sup>

<sup>1</sup>Zoonoses Research Center, Jahrom University of Medical Sciences,  
 Jahrom, Iran

<sup>2</sup>Infectious Disease and Tropical Medicine Specialist, Research Center for Social Determinants of Health,  
 Jahrom University of Medical Sciences, Jahrom, Iran

<sup>3</sup>Research Center for Emerging and Reemerging Infectious Diseases, Pasteur Institute of Iran, Tehran, Iran

<sup>4</sup>Department of Arboviruses and Viral Hemorrhagic Fevers (National Ref Lab),  
 Pasteur Institute of Iran, Tehran, Iran

<sup>5</sup>Department of Virology, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

<sup>6</sup>Student Research Committee, Hazrat-e Ali Asghar Hospital, Shiraz University of Medical Sciences, Shiraz, Iran

<sup>7</sup>Department of Microbiology and Immunology, Jahrom University of Medical Sciences, Jahrom, Iran

## ABSTRACT

Crimean-Congo Hemorrhagic Fever Virus (CCHFV) can efficiently replicate in livestock without causing recognizable clinical symptoms. In this regard, epidemiological studies would be necessary to determine the status of the disease and its risk factors in different geographical areas. This study was designed to evaluate the seroepidemiological situation of CCHF among livestock of Jahrom city in Fars province. Between 2015 and 2016, 240 livestock serum samples investigated for the presence of anti-CCHF IgG using ELISA assay. Forty-three (17.9%) samples were positive for CCHF virus IgG antibody. The highest seropositivity rate was observed among goats (69.8%). In addition, the highest infection rate was observed among animal older than 5 years. The results of this study indicate that the rate of CCHF in livestock from Jahrom city is lower than other parts suggesting that the risk of human transmission is low in this region. However, further research with bigger sample size is recommended to provide exhaustive information on CCHF circulation in this area.

**Key words:** Crimean-Congo hemorrhagic fever, Epidemiology, Jahrom, Iran

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**Corresponding author:** Abbas Ahmadi Vasmehjani

**e-mail** ✉: [ahvasmehjani@gmail.com](mailto:ahvasmehjani@gmail.com)

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## INTRODUCTION

Crimean-Congo hemorrhagic fever (CCHF) is one of the most important and the most widespread tick-borne viral disease of human beings in the world. So far, CCHF have been documented in more than 30 countries within Africa, Asia and Europe with an increased incidence of the disease in the last decade [1,2]. In nature, Ixodidae ticks (hard ticks), particularly ticks of the genus *Hyalomma* act as major reservoirs and vectors of CCHF virus [3]. CCHF virus can infect a wide range of vertebrate hosts including goats, cattle and sheep, but the infection seems to cause subclinical and asymptomatic but can be

viremic [4,5]. In contrast, CCHFV infection can produce a severe disease in human with a case fatality rate up to 50% [6].

Iran is an endemic region for CCHF and the disease has been detected in throughout the country Sistan-va-Balouchistan, Isfahan, Fars, Khuzestan are respectively the most heavily infected provinces [7]. Also according in recent data, we found that the highest incidence of CCHF occurred in the eastern parts of the country between 2006 and 2012 [8]. The data also indicated viremic livestock act as the main routes of CCHF virus transmission in Iran [2], as those are dangerous for transmission of CCHFV to human. In this regard, epidemiological studies would be necessary to determine the status of the disease and their risk factors in different geographical areas. Also previous studies were performed based on human cases and also animal reports [9-12].

In the study conducted by Farhadpour *et al.* about the prevalence of viral genome in ticks collected from livestock of Marvdasht of Fars, viral genome was observed in 4.5% of the ticks [9]. Also Rezai *et al.* report 5 cases of the disease in FATHABAD village (in Fars province) [13]. Therefore, there are published few data about CCHF in livestock in Fars province as the third most prevalence province. This study was designed to evaluate the seroepidemiological situation of CCHF among livestock of Jahrom city in Fars province.

**HIGHLIGHTS**

1. The seropositivity rate of CCHF in livestock from Jahrom city is lower than other parts.
2. In contrast to previous seroepidemiological studies on livestock in Iran, our data was indicated goats had higher rate.
3. The highest infection rate of CCHF was observed among animals older than 5 years.

**MATERIALS AND METHODS**

**Study population**

This study was carried out in Jahrom city, southern of Iran that is located 170 kilometers southeast of Shiraz, the capital of Fars Province. Jahrom has a geographical area of approximately 5768 km<sup>2</sup>, and is situated 1100 m above sea level. The province enjoys a moderate in mountains and generally tropical climate, with mean high and low temperatures of 35°C in the summer and 11°C in the winter that many tropical and sub-tropical plants are grown in Jahrom. Annual rainfall averages 150-200 mm, and its population is 209312, in 25,946 families.

Between 2015 and 2016, 240 blood samples of livestock were studied. Demographic characteristics of livestock have been represented in Table 1. With care of biosafety's principles and patient satisfaction, 5 ml blood sample was taken from each participant and followed by serum isolation by centrifugation at 3500 rpm for 5 minutes. The sera were stored at -80°C until analysis. Demographic characteristics of livestock (age, gender, livestock age) were collected.

**Table 1: Demographic features of livestock included in this study**

Variables	N (%)
<b>Gender</b>	
Male	85 (35)
Female	155 (65)
<b>Age groups (Years)</b>	
<3	29 (12.1)
3-5	59 (24.6)
>5	152 (63.3)
<b>Livestock</b>	
Goat	148 (61.7)
Sheep	63 (26.2)
Cattle	29 (12.1)
<b>Imported livestock</b>	

Yes	19 (7.9)
No	221 (92.1)

**Serological assay**

Sandwich enzyme-linked immunosorbent assay (ELISA) for the detection of IgG antibody against CCHF virus in cattle sera was performed using BDSL CCHF IgG Sandwich ELISA kit (Biological Diagnostic Supplies, Yorkshire, UK). All procedures were according to the manufacturer's instructions and all results fulfilled the three levels of internal quality controls as mentioned by the manufacturer.

**Statistical analysis**

Data were analyzed using SPSS 16. To compare qualitative variables, the chi-square test was used. Descriptive statistics (i.e., frequencies and percentages) were used to summarize the quantitative variables. The confidence interval of 95% for p-values smaller than 0.05 was considered.

**RESULTS**

In the present study, the frequency of anti-CCHF virus IgG antibody was analyzed in livestock in Jahrom city. The results showed that 43 out of 240 (17.9%) livestock were seropositive. As is represented in Table 2, the rate of seropositivity according to different livestock was as follows: 30 goats (69.8%), 8 sheep (18.6%) and 5 cows (11.6%). But the difference in seroprevalence values among the animal species was not statistically significant (P=0.42) (Table 2). As is shown in Table 3, the highest infection rate was observed among animal older than 5 years and the lowest infection rate was documented in livestock younger than 3 years. However, this difference was not statistically significant between different age groups (P=0.524).

**Table 2: The seropositivity rate of Anti-CCHF virus IgG in different livestock**

Anti CCHF virus IgG	Livestock			Total N (%)	P value
	Cattle	Sheep	Goat		
Positive N (%)	5 (11.6)	8 (18.6)	30 (69.8)	43 (100)	0.42
Negative N (%)	24 (12.2)	55 (27.9)	118 (59.9)	197 (100)	
Total N (%)	29 (12.1)	63 (26.2)	148 (61.7)	240 (100)	

**Table 3: The seropositivity rate of Anti-CCHF virus IgG based on livestock age**

Anti CCHF virus IgG	Age groups (Years)			Total N (%)	P value
	<3	3-5	>5		
Positive N (%)	3 (7)	11 (25.6)	29 (67.4)	43 (100)	0.524
Negative N (%)	26 (13.2)	48 (24.4)	123 (62.4)	197 (100)	
Total N (%)	29 (12.1)	59 (24.6)	152 (63.3)	240 (100)	

**DISCUSSION**

Livestock play an important role in the maintenance of CCHF virus and source of human infection. Seroepidemiological investigations are of great importance for determining the endemic regions and virus circulation. In addition, the presence of CCHF

virus antibodies in livestock is regarded as one of the main signals of CCHF risk for human infection and vague epidemics.

In this study, 17.9% of livestock had a history of CCHF infection that this rate was significantly lower than previous studies [12,14]. This finding suggests that the risk of human transmission is low in this region. But, recent data based on spatial analysis indicate that Shiraz, a center of Fars province, was obtained as a hotspot from 2011 to 2013 [8]. CCHF virus IgG seropositivity in livestock often parallels reports of CCHF patients in high-risk individuals with exposure to livestock (e.g., slaughterers) particularly in those who handle blood and organs from infected livestock [15-17]. Moreover, it is noteworthy that in some regions, despite the relatively high level of seropositivity among livestock, the rate of human infection is significantly low. This indicates that circulating of CCHF virus among animal hosts in this region as natural cycle was occur but other explanation for the low number of human cases reported from livestock high foci is adequate health care systems of these areas regarding CCHF. Also, low prevalence of human cases in a province does not necessarily imply that the virus circulation is not present there. For instance, in Ardabil city (northwestern Iran), one study indicated the seropositivity rate of 39% in livestock [12]. Albayrak *et al.* reported that anti-CCHF rate in goats and sheep was 85% and 66% respectively [18]. Similarly, in the research conducted by Tuncer *et al.* on domestic animals in Turkey, the highest rate of anti-CCHF was observed in goat (66%), followed by sheep (31.8%) and cattle (13%). Therefore, other factors including the differences in the virulence of circulating strains, local cultures and behaviors that can affect the rate of exposure to the virus, and the implementation of preventive measures among high risk groups may play a role in the rate of incidence of the disease.

On the other hand, having no report of human cases of CCHF cannot rule out the circulation of the virus in the same region. No effective surveillance system can lead to misdiagnosis or under reporting of the disease. In addition, the variation in genetics of human population has been considered as a factor that may cause various outcomes of infection with CCHF virus. Although strain AP92 from genotype Europe 2 has been indicated as virulent strain of CCHF virus in Greece, several cases of clinical diseases from Turkey, and two fatal cases from Iran causes by this strain were documented [19]. Also the difference was significant and implies that a probable cause for such difference can be the sensitivity of various species compared to others, its means animal hosts especially livestock have different prone to CCHF

infection. Moreover, since the cattle are taken to range more rarely compared to small ruminants, they are less exposed to ticks infection [19]. Tuncer *et al.* argued that there are epidemiological different patterns between animal hosts in endemic and non-endemic regions and there are specific species of different outbreaks in each region that can be specific to same area. Our data was indicated goats had a higher rate of infection than sheep, although the highest infection rate in sheep has been reported in Iran [20]. The role of small mammals in the transmission of CCHFV in Iran has not yet been adequately studied but our result indicates important role of goat as alternative source of CCHF infection against sheep in Iran. According to previous seroepidemiological studies on livestock in Iran [21], sheep has been considered as the main amplifying host of CCHF virus among livestock in Iran (Table 4), as the highest rate of CCHF infection has been observed among sheep [21,22]. In contrast, goats had higher rate of infection than sheep in this work. However, it should be mentioned that there is a bias in livestock included in this study, as the number of goats is more than two times higher than sheep and cattle. Therefore, other factors including the differences in the virulence of circulating strains, local cultures and behaviors that can affect the rate of exposure to the virus, and the implementation of preventive measures among high-risk groups may play a role in the rate of incidence of the disease.

Distribution of CCHF virus in neighboring countries such as Saudi Arabia is not well determined; however, episodes of CCHF as a result of trade and import of infected animals have been reported in this country [23]. In a study conducted in Jeddah port on imported livestock and people experiencing animal contact, CCHFV was observed in 0.8% of the individuals [24]. According to the research carried out in Oman on people having animal in home, 30.3% of non-Omani and 2.4% of Omani citizens were CCHFV positive [25]. Sixteen human cases of CCHFV were reported in Oman in 2015; all being infected *via* contact with slaughtered animals or infected livestock [23]. Therefore, all of the reports in neighboring countries indicate livestock can play a main role in CCHF virus circulation.

In agreement with the previous reports [10,14], seropositivity increased with the age of livestock in the current study. Also according to recent data, this disease can occur in all age groups, but there are lower rates in children and the elderly [26].

This finding suggests that the rate of exposure to the virus increases by livestock age. Although it is well established that Iran is endemic for CCHF, and the infection has been

detected in human, livestock and vectors in different parts of the country; to better understand the circulation of virus and the risk factors in different regions, regular and ongoing monitoring studies should be implemented through the country. Also, the distribution and transmission of the disease can be affected by a broad range of parameters, such as socioeconomic variables such as age [26]. Additionally, parameters such the age of the livestock can have a significant influence on the probability of disease incidence. Moreover, as the animals get old, the percentage of affected animals increased [27].

Despite this study had the several limitations, for example, low sample size, the bias in sampling and the uncertainty about whether livestock is imported or native, this study highlight the importance of the CCHF seroprevalence in all of endemic regions. The results of this study indicate that the rate of CCHF in livestock from Jahrom city is lower than other parts of Iran suggesting that the risk of human transmission is low in this region Also this study indicate Goat is important reservoir of CCHF circulation in this area.

**Table 4: The infection rate of CCHF virus among livestock of different parts of Iran**

Region	Year of Study	Seroprevalence	References
Isfahan	2002	Sheep: 76.9%	28
Ardabil	2004-2005	Sheep: 41.9%	12
		Cows: 30%	
		Goats: 33.3%	
Khorasan cities (Northeast)	2008	Sheep: 77.5%	29
		Goat: 46%	
Razavi Khorasan (Northeast)	2008	Cattle: 6.8%	10
Ardabil	2011	Sheep : 27.34%	14
Mazandaran	2012	Sheep: 3.7%	11
		Sheep: 88%	
Isfahan	2012	Goats: 4.9%	30
		Cows: 7.1%	
Mazandaran	2015	Sheep: 38.7%	31

### CONFLICT OF INTEREST

The authors' declares that they have no conflict of interest.

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