ASPI | Afarand Scholarly Publishing Institute; Turkey
ISSN: 2008-2630 *Iranian Journal of War & Public Health* 2024;16(2):207-213. 10.58209/ijwph.16.2.207

Epidemiology of Crimean-Congo Hemorrhagic Fever in Iraq from 2021 to 2023

ARTICLE INFO

Article Type
Descriptive Study

Authors
Motashar F.M.[1]* *BSc*
Rashid B.A.[1] *MSc*
Sajem K.G.[2] *PhD*
Akef I.R.[3] *CABMS, CM*

How to cite this article
Motashar FM, Rashid BA, Sajem KG, Akef IR. Epidemiology of Crimean-Congo Hemorrhagic Fever in Iraq from 2021 to 2023. Iranian Journal of War & Public Health. 2024;16(2):207-213.

[1]Department of Community Health Techniques, College of Health and Medical Techniques, Middle Technical University, Baghdad, Iraq
[2]Department of Community Health Nursing, Balad Technicqal Institute, Middle Technical University, Baghdad, Iraq
[3]Communicable Disease Control Center, Baghdad, Iraq

***Correspondence**
Address: Pharmacy College, Al-Mustaqbal University, In front of the University of Babylon-Hilla, Babylon, Iraq. Postal Code: 51001 Medical City, Al-Amal National Hospital for Cancer Treatment, Iraq. Postal Code: 10001-10090
Phone: +964 (78) 10347456
Fax: -
eac0044@mtu.edu.iq

Article History
Received: April 11, 2024
Accepted: September 2, 2024
ePublished: September 15, 2024

ABSTRACT

Aims The aim of the study is to identify the disease's trend over the months and years, and the demographic and environmental factors of the patients, in which Crimean Congo Hemorrhagic Fever is an infectious zoonotic tick-borne disease that causes non-hemorrhagic and hemorrhagic symptoms, has been present in Iraq since 1979, but its prevalence has greatly increased since 2021.

Instrument & Methods In this retrospective cross-sectional study, 957 confirmed patients from all over Iraq (except the Kurdistan region) from 2021 to 2023 were included. The study was conducted from October 2023 to March 2024, and the data were collected from the Iraqi Communicable Disease Control Center.

Findings The trend of cases has elevated in 2021, 2022, and 2023 as 19, 374, and 564 cases, respectively, with a peak during May, June, and July. The age of most patients ranged from 20-49 years, with a mean of 35.8±15.3 years and a higher percentage of males (58.3%). Most patients lived in rural areas (45.6%) and were from south Iraq, particularly Dhi Qar governorate (33.3%). Occupationally, the housewives recorded the higher exposure (35.7%). The higher environmental risk factor was the exposure to raw or uncooked meat (58.7%). The case fatality rate was 16.5%.

Conclusion The disease has a seasonal trend, and most Crimean Congo Hemorrhagic Fever patients were males of economically active age living in rural areas in the south of Iraq. Contact with animals and their products was the higher environmental risk factor, and housewives recorded higher occupational exposure.

Keywords Crimean Congo Hemorrhagic Fever; Risk Factors; Epidemiology; Case; Iraq

CITATION LINKS

[1] Current status of Crimean-Congo haemorrhagic fever ... [2] Good Medical Entomology Laboratories Practices ... [3] Seroepidemiological and molecular investigations of ... [4] Epidemiological aspects of Crimean-Congo ... [5] Crimean-Congo haemorrhagic ... [6] Risk of Crimean Congo haemorrhagic fever virus ... [7] Dengue infection: Global importance, immunopathology and ... [8] An update on Crimean Congo hemorrhagic ... [9] Seroprevalence of Crimean Congo hemorrhagic fever virus ... [10] Worldwide epidemiology of Crimean-Congo ... [11] Epidemiology of Crimean-Congo hemorrhagic fever (CCHF) in Africa—underestimated ... [12] A Systematic Review of Treatment Strategies Including ... [13] Crimean-Congo hemorrhagic fever virus in tortoises and Hyalomma ... [14] Crimean-Congo hemorrhagic fever virus in tortoises and ... [15] Crimean-Congo haemorrhagic ... [16] Evaluation of seroprevalence and clinical and laboratory findings of ... [17] Seroepidemiological studies of Crimean-Congo hemorrhagic ... [18] Epidemiological profile of Crimean-Congo hemorrhagic fever ... [19] Large outbreak of Crimean-Congo haemorrhagic ... [20] Crimean-Congo hemorrhagic fever ... [21] Crimean-Congo hemorrhagic fever among health care ... [22] Knowledge level about Crimean-Congo hemorrhagic fever ... [23] Transmission dynamics and vaccination strategies for ... [24] A prospective prediction tool for understanding ... [25] Upsurge of Crimean-Congo hemorrhagic fever during ... [26] Prevalence of Crimean Congo hemorrhagic fever ... [27] Laboratory features of 160 CCHF confirmed cases in Zabol ... [28] The effect of climate variables on the incidence of Crimean ... [29] Risk factors for Crimean-Congo Haemorrhagic Fever ... [30] Crimean-Congo Hemorrhagic Fever (CCHF) in Afghanistan ... [31] Crimean Congo hemorrhagic fever serosurvey in humans for ... [32] Determination of seroprevalence and risk factors of Crimean-Congo ... [33] Alarming update on incidence of Crimean-Congo ... [34] The 2022 Crimean-Congo hemorrhagic ... [35] Evaluation of epidemiological, clinical, and laboratory ... [36] Crucial parameter of the outcome in ... [37] Prevalence and phylogenetic analysis of ... [38] Molecular assay on detection of ... [39] Clinical and laboratory features of Crimean-Congo ...

Copyright© 2024, the Authors | Publishing Rights, ASPI. This open-access article is published under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License which permits Share (copy and redistribute the material in any medium or format) and Adapt (remix, transform, and build upon the material) under the Attribution-NonCommercial terms.

Introduction

According to the World Health Organization's (WHO) Eastern Mediterranean Region (EMRO), Crimean Congo Hemorrhagic Fever (CCHF) is endemic, with occasional outbreaks and human cases in several countries in this region [1].

Acute tick-borne zoonotic sickness is caused by the Crimea-Congo virus [2], which belongs to the Nairoviridae family, and since 1979, there has been an endemic spread of the CCHF in Iraq [3]. Asymptomatic cases comprise 60-90% of cases of CCHF, and the proportion of asymptomatic or subclinical cases is higher in regions where the disease is particularly endemic. The residual 10-40% will initially have a fever, headaches, and exhaustion, followed by gastrointestinal symptoms. Severe cases may progress to bleeding, shock, and multiorgan failure [4].

CCHF is a serious public health concern due to its high mortality rate and potential to cause significant outbreaks. The virus is primarily transmitted to humans through the bites of infected Hyalomma ticks or contact with the blood or tissues of infected animals [5]. The transmission cycle of the virus is complex, involving various wild and domestic animals that serve as reservoirs, making control efforts difficult. Many infected animals show no clinical symptoms, allowing the virus to spread undetected within livestock populations. Clinically, CCHF presents a wide range of symptoms, which complicates early diagnosis as the initial signs often resemble those of other viral infections. Common symptoms include fever, severe headache, muscle pain, gastrointestinal issues like nausea and vomiting, and bleeding tendencies such as petechiae and ecchymosis. In severe cases, the disease can progress rapidly, leading to multi-organ failure and a sharp decline in the patient's health [6, 7]. The case fatality rate varies from 10% to 40%, depending on factors such as patient demographics and access to healthcare. CCHF is endemic in regions across Africa, Europe, Asia, and the Middle East, with primary risk factors including occupational exposure among healthcare workers, veterinarians, and individuals working closely with livestock [6-8].

Surveillance and preventive measures are essential to manage outbreaks where the virus is prevalent. Preventive strategies primarily focus on reducing tick exposure through personal protective measures such as wearing long sleeves and insect repellents. Public health initiatives also aim to educate at-risk populations on safely handling animals and blood products [21]. Despite these efforts, no specific antiviral treatment exists for CCHF, leaving supportive care as the primary means of managing the disease [9]. In high-risk areas, a multifaceted approach is crucial for effective prevention [6-10].

Raising awareness about CCHF risks and preventive measures is vital for reducing transmission. Educational campaigns should focus on livestock handlers, healthcare professionals, and the general public, informing them about safe practices when handling animals or blood products [11]. In addition, robust surveillance systems are needed to monitor tick populations and detect potential outbreaks. Regular assessments can identify high-risk areas and enable timely interventions and control measures [12]. Maintaining livestock health through regular veterinary care and tick control measures can also reduce the risk of transmission from animals to humans. This includes treating animals with acaricides and isolating infected livestock to prevent further spread [11-13].

In healthcare settings within endemic regions, strict infection control measures are critical. Facilities should adopt isolation protocols for suspected cases and ensure that healthcare staff are trained in properly using personal protective equipment (PPE), as hospital-acquired infections have contributed to past outbreaks [14]. Continued research into antiviral therapies, vaccines, and more effective treatment protocols is necessary to improve outcomes for CCHF patients. While supportive care remains the cornerstone of treatment, exploring potential antiviral drugs like ribavirin or other new therapies could significantly enhance patient management [11-13]. By implementing these comprehensive strategies—from community engagement and surveillance to improved healthcare protocols and research—endemic regions can significantly reduce the risks associated with CCHF and protect public health.

Although it varies by region and even within epidemics, the case fatality rate (CFR) of disease outbreaks is typically as high as 40% [15].

Since Hyalomma ticks are the primary vector for CCHF, their geographic distribution coincides with that of the disease; Therefore, higher rates of CCHF disease are found in areas where Hyalomma tick densities are present [16]. In 2016, a sero-study was conducted in Iraq, Iran, and Turkey to investigate the disease's animal hosts. The results showed that 20-30% of the animals tested positive, with goats having the highest percentage (50%) of positive animals [17].

Since Al-Yarmouk Hospital saw the first cases of CCHF in 1979, the health authorities have documented occasional occurrences and epidemics. In 1979, 10 cases and seven deaths were documented, making it the most notable outbreak. There were several documented cases in Halabja City, in the Iraqi province of Sulaimani, in 1980. According to published studies, the number of yearly confirmed cases varied between 0 and 6 cases each year between 1980 and 2009. In 2010, 11 verified cases were recorded across three weeks, with a 36% case fatality rate [1]. During the 2018 epidemic, there were ten confirmed cases; Eight of these resulted in death [18]. However, in four years

(2008, 2014, 2016, and 2017), no instances of CCHF have been reported. The number of cases began to rise in 2021, when 19 cases were verified by laboratories [19].

The spread of zoonotic diseases to humans is influenced by several factors, such as changing environmental conditions, rising levels of international trade, increased human mobility, and migration from rural to urban and suburban areas, along with the animals living there that are thought to be the disease's hosts [20].

Comprehensive cooperation and coordination among health, animal, and transport sectors must be achieved to control these disease hosts and vectors. This facilitates early diagnosis and detection to prevent the further spread of the disease [21, 22].

This study aimed to identify the seasonal trend of the disease over the study months and years, the demographic and environmental factors of the patients, the most prominent signs and symptoms, and the interval between their onset and hospital admission.

Instrument and Methods

This Cross-sectional epidemiological study collected retrospective data about the confirmed CCHF patients from the Communicable Diseases Control Center in Baghdad, Iraq. The study included 957 confirmed CCHF patients from Iraq (except for the Kurdistan region) for three years (2021, 2022, and 2023).

The demographic data (age, gender, living place, occupation, and ...) were extracted from the patients' profiles.

The consent of the Iraqi Ministry of Health, Department of Public Health, Communicable Diseases Control Center, Baghdad, Iraq, was obtained for collecting data, which was used for research purposes only while maintaining the privacy of the patient's information.

Data was analyzed using descriptive statistical methods in SPSS 22 software.

Findings

In 2021, 19 confirmed CCHF cases were recorded between July and December, with a peak of 6 cases during September. In 2022, 374 cases were recorded from March to December, with a peak of 102 cases during May. Furthermore, the highest number of cases was recorded in 2023, with 564 cases during the twelve months of that year, with a peak of 140 cases in July, which follows Eid Al-Adha (Figure 1).

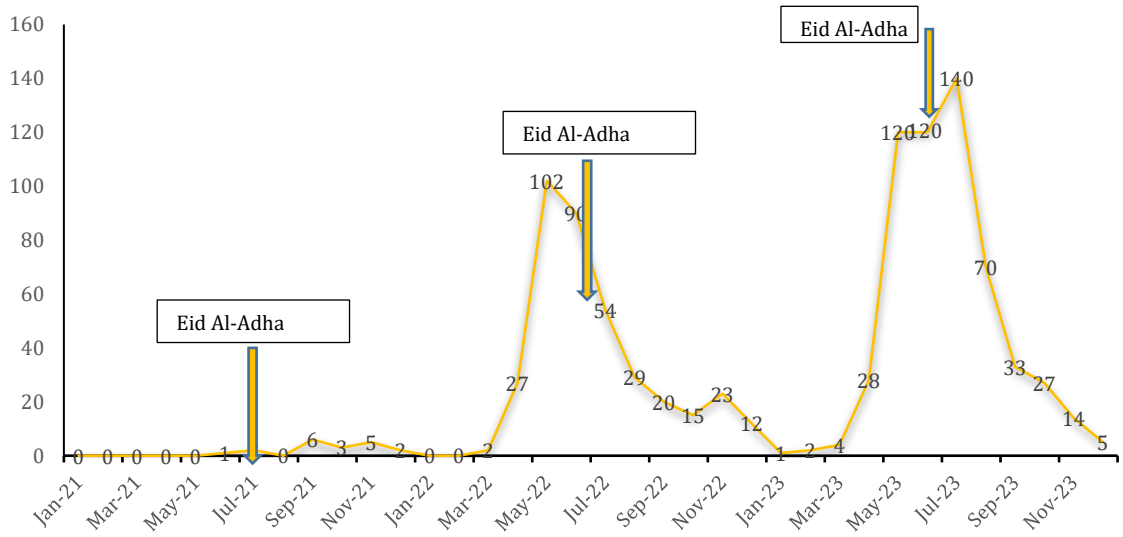

Figure 1. The seasonal trend of CCHF

The mean age of 957 patients was 35.8±15.3 (0-90 years). Male patients comprised 58.3% of the total, while female patients comprised the remaining 41.7%. Dhi Qar had the largest percentage of patients (33.3%), while Al Anbar had the lowest percentage (0.3%). Housewives had the largest percentage (35.7%) among the study population's occupations, while veterinarians had the lowest percentage (0.2%; Table 1).

It was discovered that rural areas had the highest rate (45.6%), urban areas were second with 41.3%, sub-urban areas were 10.8%, and slum regions had the lowest rate (2.3%).

Fever was reported in 96.9% of the patients, but only 14.0% had nose bleeding.

Furthermore, in 2023, conjunctival hyperemia was identified in 41 (7.3%) cases out of 564 patients, and it was introduced to the list of signs after updating the unified form for detecting CCHF disease (Table 2).

If confirmed, the duration between the beginning of symptoms and hospital admission for diagnosis and treatment varied from 0 to 15 days, with a mean of 3.9±2.5 days.

Three days after the commencement of symptoms, most cases (17.9%) were admitted to the hospital (Table 3).

Table 1. Distribution of the study population according to their demographic characteristics (n=957)

Parameter	Classes	Frequency (%)
Age (years)	<20	140 (14.6)
	20-29	213 (22.3)
	30-39	226 (23.6)
	40-49	176 (18.4)
	50-59	113 (11.8)
	≥60	89 (9.3)
Gender	Female	399 (41.7)
	Male	558 (58.3)
Governorate	Ninewa	24 (2.5)
	Kirkuk	18 (1.9)
	Salah ad Din	12 (1.3)
	Diyala	24 (2.5)
	Wasit	65 (6.8)
	Al Anbar	3 (0.3)
	Baghdad/Rusafa	70 (7.3)
	Baghdad/Karkh	47 (4.9)
	Babil	47 (4.9)
	Holy Karbala	28 (2.9)
	Al Najaf Al Ashraf	22 (2.3)
	Al Qadisiyyah	41 (4.3)
	Al Muthana	56 (5.9)
	Dhi Qar	319 (33.3)
	Maysan	76 (7.9)
	Al Basra	105 (11.0)
Occupation	Farmer	8 (0.8)
	Butcher	133 (13.9)
	Housewife	342 (35.7)
	Student or government worker	167 (17.5)
	HCW	7 (0.7)
	In contact with animals	70 (7.3)
	Private work	165 (17.2)
	Retired or no job	63 (6.6)
	Veterinarian	2 (0.2)

The majority of patients (58.7%) had contact with raw or undercooked meat, followed by those who had animals in their homes (52.0%) and those who had slaughtered an animal (45.9%). Those bitten by a tick had a lower epidemiological exposure (18.7%), while those who had direct contact with a similar CCHF case had (3.6%).

Table 2. Specific clinical features among the study population (the numbers in parentheses are percentages)

Clinical features	Present	Absent
Fever	927 (96.9)	30 (3.1)
B.O. injection sites	252 (26.3)	705 (73.7)
B.O. gums	162 (16.9)	795 (83.1)
B.O. nose	134 (14.0)	823 (86.0)
B.O. body orifices	188 (19.6)	769 (80.4)
Ecchymosis	179 (18.7)	778 (81.3)

Table 3. The interval from symptoms onset to hospital admission

The interval from symptoms onset to admission (days)	Frequency (%)
0	68 (7.1)
1	82 (8.6)
2	137 (14.4)
3	170 (17.9)
4	147 (15.4)
5	145 (15.2)
6	76 (8.0)
7-15	127 (13.3)

Note: 5 cases were excluded as they did not have signs or symptoms

3379 samples were taken from animals within 50 meters of the patient's homes; *Hyalomma anatolicum* accounted for 92% of the samples, while *Hyalomma marginatum* comprised 8%. Most patients (82.8%) were cured, while 16.5% died (CFR) while at the hospital. However, 0.7% were discharged on their initiative.

Discussion

Except for patients from the Kurdistan Region, 957 positive RT-PCR Crimean-Congo Hemorrhagic Fever patients from throughout Iraq were included in this study for 2021, 2022, and 2023. Every year, more cases agree with Alhilfi *et al.* [19]. The COVID-19 pandemic restrictions and resource shortage in 2020 and the spring of 2021 prevented the veterinary department from carrying out their scheduled spraying and dipping campaigns, which in turn led to an increase in the tick population. The increased temperature and decreased humidity also made it easier for Hyalomma tick nymphs to molt into adults, which could be the reason for the sharp increase between 2021 and 2022. While the weather-related rationale indicated above may account for the increase from 2022 to 2023. Tick resistance to the applied insecticide is another likely explanation. Last but not least, the lack of water in water bodies caused a drought, which in turn caused people to migrate from rural to semi-urban or city centers. They brought animals that carried ticks, which changed the ticks' breeding grounds to areas where people were more likely to encounter them. As a result, the number of cases of CCHF rose. The cases are higher during May, June, and July, suggesting a seasonal trend inconsistent with Vesga *et al.* [23] and Ak *et al.* [24]. This is most likely because ticks can find more prospective hosts in the summer when more humans and animals typically spend time outside. Tick activity, particularly that of Hyalomma species, is increased by warmer temperatures, as is the potential host population. Summer is the optimal season for the growth and activity of Hyalomma ticks, which prefer warmer, drier weather. This leads to higher encounter rates with hosts, including people and animals. Islamic holidays, particularly Eid Al-Adha, may also be contributing factors to the increase in cases because of customs involving animal sacrifice. According to Baghdadi *et al.* [25] and Zia *et al.* [26], these animals may become infected.

This study participants' ages ranged from 1 day to 90 years. They also had a mean and standard deviation of 35.8±15.3 years, which was in line with the results of Owaysee Osquee *et al.* [27] with 32.86±13.67 and Nili *et al.* [28], who discovered that the mean age and SD were 31.90±13.59. According to Alhilfi *et al.* [19], the patients' ages ranged from 8 months to 99 years. Over half of the patients (58.3%) were men. The current study was supported by two other studies by Atim *et al.* [29] and Qaderi *et al.* [30] with 80% and

72.6% respectively. In contrast, two studies by Mourya *et al.* [31] and Çıtıl *et al.* [32] reported that the females comprised 52% and 54.9% of the study sample, respectively. These findings may have a scientific explanation. Whereas CCHF can strike anyone at any age from both sexes, it typically strikes those who are economically or occupationally engaged because of occupational exposure.

The distribution of CCHF cases indicates larger percentages in the country's southern governorates, supporting the findings of Alhilfi *et al.* [19] that the south had a higher case count. Furthermore, Dhi Qar governorate had the largest number of cases documented, 319 instances (33.3%), which is in line with findings from earlier research by Atwan *et al.* [33] with 120 cases and Al Salihi *et al.* [34] with 47 cases (48%). These results may be due to higher rural areas, environmental exposure, and animals in the country's south. CCHF has greater distribution (45.6%) in rural areas among urban, suburban, and slums, as reported by Karakecili *et al.* [35], who found that 94.2% of his sample lived in a rural location, and Mustafa *et al.* [18], who discovered that 90% of his study participants were from rural areas. The increased exposure to tick breeding grounds and the disease's animal host could be the cause.

Surprisingly, among other occupations, housewives reported the highest number of instances (35.7%). This is in agreement with Çıtıl *et al.* [32] of 47.9% of housewives, but not with Mustafa *et al.* [18], who claimed that animal owners had the highest percentage (40%). According to a different study, farmers or livestock owners comprised 77.2% of the sample [35]. The most plausible scientific explanation for the current study's findings is that the women handled raw or undercooked meat with their bare hands and without caution because they were either unaware of the proper handling procedures for uncooked meat to prevent illness or aware of them but chose not to follow them.

When compared to Mustafa *et al.* [18], who recorded the same clinical features (except for the bleeding from the nose) in Iraq for the 2018 epidemic in the percentages (100, 0, 10, 90, 20, and 60%), the present study recorded the most significant pre-hemorrhagic (fever and conjunctival hyperemia) and hemorrhagic (bleeding from injection sites, bleeding from gums, bleeding from nose, bleeding from body orifices, and ecchymosis). The lower percentages in the current study, as compared to the previous study, may indicate that people are likely becoming more aware of the illness and making more attempts to confirm the diagnosis and receive the necessary medical attention and management. According to the results, fever is the most common clinical feature that almost all patients experience. This finding is consistent with Owaysee Osquee *et al.* [27], who found that 99.4% of the patients in their study had fever. The time delay between the onset of sickness and hospital admission ranged from 0 to 15 days, with a mean and standard deviation of 3.9±2.5 days. Hasanoglu *et al.* [36] in Turkey reported 1-10 days with a mean of 3.7 days, while Qaderi *et al.* [30] in Afghanistan concurred with the current study by reporting the range of days as 1-13 days with a mean of 4.8 days.

The following percentages were found in the environmental risk factors; 52, 45.9, 18.7, 58.7, and 3.6%. Mustafa *et al.* [18] also looked at these environmental factors, reporting results of 50%, 0%, 30%, 50%, and 0%. The discrepancy in the number of cases (957 patients in the current study, compared to 10 patients in the other study) may cause the agreement with two elements and disagreement with three. According to the current study, the two types of tick vectors implicated in transmitting the CCHF virus in Iraq are *H. anatolicum* (92%) and *H. marginatum* (8%). These findings are consistent with those reported by Shahid *et al.* [37] and Salehi-Vaziri et al. [38], who reported that among other species in Pakistan and Iran, *H. anatolicum* accounted for 48% and 34.11%, and *H. marginatum* for 30.2% and 14.34%, respectively. *However, H. anatolicum's* dominance over *H. marginatum* might be attributable to the latter species' low tolerance for harsh climate conditions.

While only 16.5% of research participants died (CFR), the majority of CCHF patients (82.8%) who were included in the study survived. This is consistent with the findings of Cevik *et al.* [39], wherein 85.1% of study participants experienced a cure and 15.9% died. This suggests that patients receive appropriate medical care. Additionally, 7 (0.7%) patients of the present study participants were released on their initiative, having a vague fate. There was a minor delay in data collection due to the large size of the study population from the whole country. Comprehensive campaigns are required, as well as the use of social media, to raise public awareness of the CCHF source of infection, method of transmission, and preventative and control measures for all individuals, but notably for those who are at risk, especially before the start of the season. Regular inspection of the facilities used for the slaughter of animals to stop haphazard or illegal slaughterhouses by substituting with standard typical facilities. For additional study and research about the potential ones in Iraq, the intended authorities must be aware of the potential resistance for the utilized insecticides because some affordable herbal acaricides and repellents do little to no environmental impact.

Conclusion

CCHF trend has significantly increased from 2021 to 2023. The disease also exhibits a seasonal trend, with an increase in cases during the summer and a decrease or even disappearance during the cooler months. Males of all occupations comprise the majority of the study population, although housewives are the largest category in terms of

occupation. The majority of patients have contact with animals or animal products of slaughtering.

Acknowledgements: I want to thank my colleagues in the Ministry of Health, Public Health Department, and CDC staff for their cooperation and precious help, especially Senior M.T.C.H. Saad Hadi Saleh. Thanks to the Ministry of Agriculture, Veterinary Department, and Epidemiology section for their cooperation and advice.

Ethical Permissions: The consent of the Iraqi Ministry of Health, Department of Public Health, Communicable Diseases Control Center, Baghdad, Iraq, was obtained for collecting data used for research purposes only while maintaining the privacy of the patient's information.

Conflicts of Interests: There were no conflicts.

Authors' Contribution: Motashar FM (First Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (25%); Rashid BA (Second Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (25%); Sajem KG (Third Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (25%); Akef IR (Fourth Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer/Statistical Analyst (25%)

Funding/Support: This study was not funded.

References

1- Al-Abri SS, Abaidani IA, Fazlalipour M, Mostafavi E, Leblebicioglu H, Pshenichnaya N, et al. Current status of Crimean-Congo haemorrhagic fever in the World Health Organization Eastern Mediterranean Region: Issues, challenges, and future directions. Int J Infect Dis. 2017;58:82-9.

2- Sharma S, Kumawat R, Singh SK. Good Medical Entomology Laboratories Practices (GMELP) in India: A concept note. J Commun Dis. 2022;54(1):150-5.

3- Abdiyeva K, Turebekov N, Dmitrovsky A, Tukhanova N, Shin A, Yeraliyeva L, et al. Seroepidemiological and molecular investigations of infections with Crimean-Congo haemorrhagic fever virus in Kazakhstan. Int J Infect Dis. 2019;78:121-7.

4- Portillo A, Palomar AM, Santibáñez P, Oteo JA. Epidemiological aspects of Crimean-Congo hemorrhagic fever in Western Europe: What about the future?. Microorganisms. 2021;9(3):649.

5- Ergönül Ö. Crimean-Congo haemorrhagic fever. Lancet Infect Dis. 2006;6(4):203-14.

6- Fanelli A, Buonavoglia D. Risk of Crimean Congo haemorrhagic fever virus (CCHFV) introduction and spread in CCHF-free countries in southern and Western Europe: A semi-quantitative risk assessment. One Health. 2021;13:100290.

7- Kularatne SA, Dalugama C. Dengue infection: Global importance, immunopathology and management. Clin Med. 2022;22(1):9-13.

8- Appannanavar SB, Mishra B. An update on Crimean Congo hemorrhagic fever. J Glob Infect Dis. 2011;3(3):285-92.

9- Ricco M, Baldassarre A, Corrado S, Bottazzoli M, Marchesi F. Seroprevalence of Crimean Congo hemorrhagic fever virus in occupational settings: Systematic review and meta-analysis. Trop Med Infect Dis. 2023;8(9):452.

10- Belobo JT, Kenmoe S, Kengne-Nde C, Emoh CP, Bowo-Ngandji A, Tchatchouang S, et al. Worldwide epidemiology of Crimean-Congo Hemorrhagic Fever Virus in humans, ticks and other animal species, a systematic review and meta-analysis. PLoS Negl Trop Dis. 2021;15(4):e0009299.

11- Temur AI, Kuhn JH, Pecor DB, Apanaskevich DA, Keshtkar-Jahromi M. Epidemiology of Crimean-Congo hemorrhagic fever (CCHF) in Africa—underestimated for decades. Am J Trop Med Hyg. 2021;104(6):1978.

12- Kouhpayeh H. A Systematic Review of Treatment Strategies Including Future Novel Therapies in Crimean-Congo Hemorrhagic Fever. Int J Infect. 2021;8(2):e113427.

13- Kar S, Rodriguez SE, Akyildiz G, Cajimat MN, Bircan R, Mears MC, et al. Crimean-Congo hemorrhagic fever virus in tortoises and Hyalomma aegyptium ticks in East Thrace, Turkey: potential of a cryptic transmission cycle. Parasites Vectors. 2020;13:1-3.

14- Fletcher TE, Gulzhan A, Ahmeti S, Al-Abri SS, Asik Z, Atilla A, et al. Infection prevention and control practice for Crimean-Congo hemorrhagic fever—A multi-center cross-sectional survey in Eurasia. PloS one. 2017;12(9):e0182315.

15- WHO. Crimean-Congo haemorrhagic fever [Internet]. Geneva: World Health Organization; 2022 [cited 2023, 8 August]. Available from: https://www.who.int/news-room/fact-sheets/detail/crimean-congo-haemorrhagic-fever

16- Gürbüz E, Ekici A, Ünlü AH, Yılmaz H. Evaluation of seroprevalence and clinical and laboratory findings of patients admitted to health institutions in Gümüşhane with suspicion of Crimean-Congo hemorrhagic fever. Turk J Med Sci. 2021;51(4):1825-32.

17- Spengler JR, Bergeron É, Rollin PE. Seroepidemiological studies of Crimean-Congo hemorrhagic fever virus in domestic and wild animals. PLoS Negl Trop Dis. 2016;10(1):e0004210.

18- Mustafa AH, Lami F, Khaleel HA. Epidemiological profile of Crimean-Congo hemorrhagic fever, Iraq, 2018. MedRxiv [Preprint]. 2023 [cited 2024, 2 May]. Available from: https://www.medrxiv.org/content/10.1101/2023.11.22.23298722v1

19- Alhilfi RA, Khaleel HA, Raheem BM, Mahdi SG, Tabche C, Rawaf S. Large outbreak of Crimean-Congo haemorrhagic fever in Iraq, 2022. IJID Reg. 2023;6:76-9.

20- Jasim HS, Ali MK. Crimean-Congo hemorrhagic fever: A systematic review. Haya Saudi J Life Sci. 2024;9(3):54-62.

21- Celikbas AK, Dokuzoğuz B, Baykam N, Gok SE, Eroğlu MN, Midilli K, et al. Crimean-Congo hemorrhagic fever among health care workers, Turkey. Emerg Infect Dis. 2014;20(3):477-9.

22- Taqi FMM, Noori TA, Shaker EM. Knowledge level about Crimean-Congo hemorrhagic fever among a sample of medical students in Mosul City, Iraq. Rawal Med J. 2023;48(3):614-7.

23- Vesga JF, Clark MHA, Ayazi E, Apolloni A, Leslie T, Edmunds WJ, et al. Transmission dynamics and vaccination strategies for Crimean-Congo haemorrhagic fever virus in Afghanistan: A modelling study. PLoS Negl Trop Dis. 2022;16(5):e0010454.

24- Ak Ç, Ergönül Ö, Gönen M. A prospective prediction tool for understanding Crimean-Congo haemorrhagic fever

dynamics in Turkey. Clin Microbiol Infect. 2020;26(1):123.e1-7.
25- Baghdadi GA, Aakef IR, Abdulraheem Y. Upsurge of Crimean-Congo hemorrhagic fever during Eid-Al-Adha period 2023 in Iraq. Al-Rafidain J Med Sci. 2024;7(1):72-7.
26- Zia A, Khalil AT, Alam N, Khan AQ, Khan MA, Yosafzai Y, et al. Prevalence of Crimean Congo hemorrhagic fever in Khyber Pakhtunkhwa, Pakistan. Travel Med Infect Dis. 2024;59:102722.
27- Owaysee Osquee H, Pourjafar H, Taghizadeh S, Haghdoost M, Ansari F. Laboratory features of 160 CCHF confirmed cases in Zabol of Iran: A 10-year study. J Infect. 2017;74(4):418-20.
28- Nili S, Khanjani N, Jahani Y, Bakhtiari B. The effect of climate variables on the incidence of Crimean Congo Hemorrhagic Fever (CCHF) in Zahedan, Iran. BMC Public Health. 2020;20(1):1893.
29- Atim SA, Ashraf S, Belij-Rammerstorfer S, Ademun AR, Vudriko P, Nakayiki T, et al. Risk factors for Crimean-Congo Haemorrhagic Fever (CCHF) virus exposure in farming communities in Uganda. J Infect. 2022;85(6):693-701.
30- Qaderi S, Mardani M, Shah A, Shah J, Bazgir N, Sayad J, et al. Crimean-Congo Hemorrhagic Fever (CCHF) in Afghanistan: A retrospective single center study. Int J Infect Dis. 2021;103:323-8.
31- Mourya DT, Yadav PD, Gurav YK, Pardeshi PG, Shete AM, Jain R, et al. Crimean Congo hemorrhagic fever serosurvey in humans for identifying high-risk populations and high-risk areas in the endemic state of Gujarat, India. BMC Infect Dis. 2019;19(1):104.
32- Çıtıl R, Eğri M, Önder Y, Duygu F, Bulut YE, Yaşayancan Ö, et al. Determination of seroprevalence and risk factors of Crimean-Congo Haemorrhagic Fever (CCHF) in the endemic region in Turkey: A population-based cross-sectional study. J Trop Med. 2021;2021:9945089.
33- Atwan Z, Alhilfi R, Mousa AK, Rawaf S, Torre JDL, Hashim AR, et al. Alarming update on incidence of Crimean-Congo hemorrhagic fever in Iraq. IJID Reg. 2024;10:75-9.
34- Al Salihi KA, Younise H, Zuhair Mahmoud Z, Hussain T. The 2022 Crimean-Congo hemorrhagic fever outbreak in Iraq. Austral J Vet Sci. 2024;56(1):35-40.
35- Karakecili F, Cikman A, Aydin M, Binay UD, Kesik OA, Ozcicek F. Evaluation of epidemiological, clinical, and laboratory characteristics and mortality rate of patients with Crimean-Congo hemorrhagic fever in the northeast region of Turkey. J Vector Borne Dis. 2018;55(3):215-21.
36- Hasanoglu I, Guner R, Carhan A, Kocak Tufan Z, Yagci-Caglayik D, Guven T, et al. Crucial parameter of the outcome in Crimean Congo hemorrhagic fever: Viral load. J Clin Virol. 2016;75:42-6.
37- Shahid MF, Yaqub T, Ali M, Ul-Rahman A, Bente DA. Prevalence and phylogenetic analysis of Crimean-Congo hemorrhagic fever virus in ticks collected from Punjab province of Pakistan. Acta Trop. 2021;218:105892.
38- Salehi-Vaziri M, Vatandoost H, Sanei-Dehkordi A, Fazlalipour M, Pouriayevali MH, Jalali T, et al. Molecular assay on detection of Crimean Congo Hemorrhagic Fever (CCHF) virus in ixodid ticks collected from livestock in slaughterhouse from South of Iran. J Arthropod Borne Dis. 2020;14(3):286-92.
39- Cevik MA, Erbay A, Bodur H, Gülderen E, Baştuğ A, Kubar A, et al. Clinical and laboratory features of Crimean-Congo hemorrhagic fever: Predictors of fatality. Int J Infect Dis. 2008;12(4):374-9.