



# Epidemiological Analysis of Hepatitis B and C Viruses in Fallujah for Health Intervention and Disease Control

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## Abstract

Hepatitis virus infection poses a significant global health threat with various transmission routes, including sexual activity, intravenous contact, and mother-to-child transmission during delivery. Early infection may lead to chronic liver diseases such as cirrhosis and hepatocellular carcinoma. This study investigates the epidemiology of Hepatitis B and C viruses (HBV and HCV), considering demographic, geographic, and acquisition method variables. Analyzing hospital and health department visits in Fallujah from 2018 to 2021, 179 cases were identified. The research aims to pinpoint virus cases, identify susceptible age groups by location, gender, and infection type, and propose disease control methods in Fallujah. Results indicate 78.7% of positive cases were males, with higher prevalence in specific months and age groups (15-34 years old). This study contributes valuable insights for targeted intervention strategies.

**Keywords:** Hepatitis B and C viruses, Epidemiology, Demographic factors, Disease prevalence, Public health interventions

**Significance** | Investigating Hepatitis B and C in Fallujah revealed higher prevalence among males, aiding targeted interventions and public health initiatives.

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## Introduction

Hepatitis virus infections present a substantial threat to global public health, as they can be transmitted through various routes such as sexual activity, intravenous contact, and mother-to-child transmission during delivery. If not promptly addressed, these infections can lead to chronic liver conditions like cirrhosis and hepatocellular carcinoma. The chronic nature of Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) makes them particularly concerning due to their associated morbidity and mortality. In Fallujah, Iraq, hepatitis virus infections represent a significant public health challenge, pose a considerable public health burden. Viral hepatitis encompasses diverse infections caused by various viruses, such as hepatitis A, B, C, D, and E. While hepatitis A and E typically result in acute infections, hepatitis B, C, and D can progress to chronic conditions. This study focuses on the epidemiology of HBV and HCV infections in Fallujah, Iraq, examining demographic, geographic, and transmission method variables. Through an analysis of hospital and health department records from 2018 to 2021, the study aims to identify patterns of infection, vulnerable population groups, and propose targeted interventions to control the spread of these viruses.

Infections of the liver, such as those originating from hepatitis viruses, develop from various causes, including viral infections, alcoholic abuse, and diseases due to immune system malfunctions. Although there are many reasons why the liver may become infected, viral hepatitis continues to account for a significant portion of liver infections around the world. There are two

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particular types of viral hepatitis that concern healthcare professionals the most. Hepatitis B and hepatitis C are especially concerning because they can cause chronic infections and lead to severe liver disease. Although the rise of hepatitis B infections has started to slow down in some places due to vaccination programs, treatments or prevention strategies for hepatitis C remain a significant public health challenge.

Infection with HBV, a DNA virus in the Hepadnaviridae family, usually spreads through contact with infected blood or bodily fluids. In contrast, infection with HCV, a single-stranded RNA virus, commonly spreads through direct inoculation into the bloodstream. Both viruses can cause chronic hepatitis, which can develop into severe liver disease without proper treatment. However, recent progress in antiviral treatments, especially direct-acting antivirals (DAAs) for HCV, has significantly improved treatment results and brings promise for eradicating the diseases.

Liver infections encompass a wide range of illnesses caused by various factors, including viruses, bacteria, chemical toxins, and alcohol. However, viral hepatitis is a particularly significant global health issue, marked by liver inflammation and linked to different causes such as viral infections, alcohol misuse, and autoimmune diseases (World Health Organization [WHO], 2019). Viral hepatitis, caused by hepatitis A, B, C, D, and E viruses, presents a major challenge to public health on a global scale, leading to severe complications such as cirrhosis and hepatocellular carcinoma in both acute and chronic forms (CDC, 2020).

The Hepatitis A Virus (HAV) is a single-stranded RNA virus that belongs to the Picornaviridae family. It primarily spreads through the fecal-oral route via contaminated food or water (Coulepis et al., 1982; Coulepis et al., 1987). While acute HAV infection usually leads to a self-limited illness, it can sometimes result in fulminant liver failure, especially in older individuals (Rezende et al., 2003). Prevention strategies for HAV include vaccination and immunoglobulin administration to provide active and passive immunity, respectively (Cuthbert, 2001).

The Hepatitis B Virus (HBV), a type of DNA virus in the Hepadnaviridae family, is spread through contact with infected bodily fluids, typically through sharing needles, sexual contact, or from mother to child during birth (Ganem & Prince, 2004). While vaccination efforts have decreased the prevalence of HBV in developed areas, regions with high levels of infection still encounter difficulties due to mother-to-child transmission and early-life exposures (Jefferies et al., 2018). Antiviral drugs can help control HBV replication, but complete elimination of the virus remains challenging, requiring continued research into potential treatments (Fanning et al., 2019).

The Hepatitis C Virus (HCV), a single-stranded RNA virus from the Flaviviridae family, mainly spreads through direct bloodstream inoculation (Rosen, 2011; Armstrong et al., 2006). Persistent HCV

infection can result in advanced liver disease, such as fibrosis and cirrhosis, but recent enhancements in direct-acting antivirals have transformed treatment outcomes (World Health Organization, 2016). Additionally, Hepatitis D Virus (HDV) and Hepatitis E Virus (HEV) are part of the viral hepatitis landscape, with HDV depending on HBV for replication and HEV predominantly transmitting through fecal-oral and zoonotic routes, respectively (Rizzetto et al., 1977; Nimgaonkar et al., 2018).

The epidemiological patterns of HBV and HCV infections differ based on geographical and demographic factors, influenced by variables such as vaccination rates, healthcare systems, and socioeconomic status. Recognizing these trends is essential for implementing targeted control measures that are effective in specific local contexts. Through the analysis of surveillance data from Fallujah, this study seeks to provide important information on the occurrence, distribution, and contributing factors of HBV and HCV infections in the area.

This study not only examines the epidemiology of HBV and HCV infections, but also looks into potential interventions to reduce the spread of these viruses. It seeks to identify vulnerable age groups, high-risk transmission pathways, and changes in infection rates over time in order to guide public health efforts focused on prevention, diagnosis, and treatment. Ultimately, the objective is to lessen the impact of hepatitis virus infections in Fallujah and enhance the overall health status of the population.

Therefore, hepatitis virus infections, especially HBV and HCV, pose a major public health concern worldwide, including in Fallujah, Iraq. It is crucial to comprehend the epidemiology of these infections and implement specific interventions in order to control their spread and minimize the resulting illness and death. This research aims to provide important knowledge about the patterns of HBV and HCV infections in Fallujah, which could influence public health policies and practices.

## Materials and Methods:

**Study Design and Participants:** Between January 2018 and July 2021, this study was jointly carried out with the health departments of Fallujah governorate. A total of 25,403 individuals aged between 20 and 50 years and diagnosed with hepatitis were eligible to participate.

## Sample Collection

All participants had the blood sample for detailed investigation. All the samples have taken through proper procedure and sample were not contaminated and preserved properly. All the collections have been recorded in detail accurately. All the demographic of the patient as” age, male, female everything was properly noted, date of the collection all were noted in detail.

### Laboratory Equipment's and kits

A centrifuge was used for separation of serum or plasma from blood cells during blood collection. Manipulation of potentially infectious samples was done in biosafety cabinet for safety measures. Laboratory equipment was subjected to maintenance while following protocols. Qualitative Human Hepatitis B Antibody IgM (HCV IgM) ELISA kit (Cat.No:MBS023425) and Qualitative Human Hepatitis C Virus Antibody IgG (HCV-IgG) ELISA kit (Cat.No:MBS9303597) were obtained from MyBioSource, Inc.(USA) for the serological testing.

### Serological Tests

The enzyme-linked immunosorbent assay (ELISA) method was performed carefully to detect viral antibodies. Hepatitis B detection in patient's samples was analyzed by investigating IgG levels of the hepatitis B patients. Every step of the serological tests was conducted according to the standard operational procedures. The test results were recorded and analyzed systematically to get data bank of the findings. The ELISA kit used was meant for detection of hepatitis B virus surface antigen (HBsAg) in human blood plasma and has a Sensitivity of 0.10 IU/ml.

### ELISA assay

The ELISA test was carried out according to the directions provided by MyBioSource (2018). All reagents and samples were kept at room temperature (18°C-25°C). Each microplate well was labeled correctly for positive control, negative control, and specimen samples. The specified positive control wells were loaded with 50µl of positive control along with the assigned 50µl of negative control in the designated negative control wells and each of the 50µl of the specimens samples were added to assigned and appropriately labeled wells. After loading of all the reagents, the microplate was covered with the presented plate sealer and incubated at the recommended temperature for the given time. And, the contents of the wells were coughed out and thoroughly each well was washed using the provided wash buffer following the kit instruction.

The plate was then incubated under the specified conditions and the enzyme conjugate reagent was added to each well. This incubation was completed again under the specified conditions. After the incubation was completed the plate was washed once more, allowing all unbound substances to be removed, and then further incubated under the specified conditions. Finally the absorbency was measured at 450nm in a microplate reader, and the absorbancy values of the specimen samples were then compared to the values of the positive and negative controls.

### Statistical analysis

SPSS version 18 (IBM Corp, New York, NY, USA) was used for analyzing data using established Scissors-and-paste

methods(Snedecor and Cochran, 1989). The qualitative variables were demonstrated by frequency (percentage).

### Results and Discussion

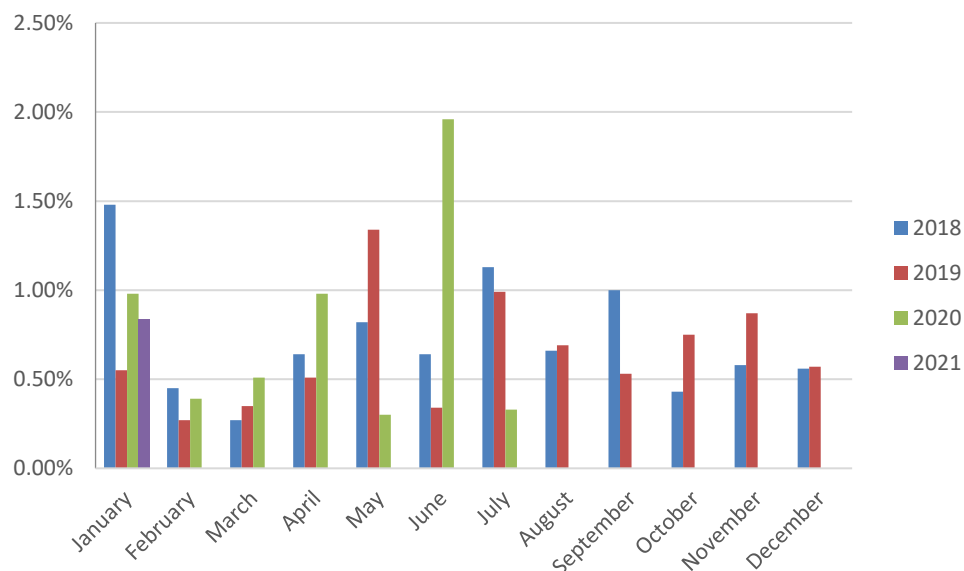
Hepatitis B and C viruses are common infectious pathogens that have multiple methods of transmission, such as person-to-person contact and transfusions of blood. The consequences of these infections are significant and can lead to conditions such as liver disease, and patients often require rigorous medical follow-up and potentially lifelong care. This cross-sectional study started in January 2018 and ended in August 2020 due to the COVID-19 pandemic. In January 2021, researchers collected 25,403 samples from the public immune deficiency laboratory center in Fallujah, Iraq. During this period, individuals testing positive for the viruses showed symptoms of liver disease, and medical tests were mandatory for marriage certificate applicants.

Out of 141 males, 179 of them were diagnosed with hepatitis (78%, 0.54%) of males that had hepatitis. Out of 141 females only 38 were diagnosed with hepatitis so the percentage is 21.13%. The hepatitis prevalence was statistically higher in males than in females. The age group of 35-52 years showed the least infection rate with 32.39%, 0.22% (58 positive out of 179) (Table 1). The infection rate for males aged 15 to 34 was higher than that of females in the same age group, which may have been due to health ignorance, neglect, or lack of respect in their daily activities, whether directly or indirectly, leading to exposure to the environment. In this research male had highest prevalence rate of about 64% and our finding is also same i.e. 64% and female prevalence rate was 35%. The study affirmed that males had a higher incidence of hepatitis B than females (Asif et al., 2022), consistent with the findings of this research (Asif et al., 2022).

The study results also showed that HBV had a significant effect, as it was shown that 167 samples were positive among the samples on which the test was conducted and the highest rates of infection were between the months (of January, July 2018, may, July in 2019, and June in 2020, also January in 2021, ranged between (9-14) Infected people per month, Figure (1) while HCV was the lowest infected among the positive results, as (Asif et al., 2022: Harris et al., 2015), destruction between two genders, males 7 (3.91%)while females 5 (2.79%).these percentages that distribution between males and females are considered high and an indication of the spread of the disease among the community. This outbreak may be attributed to bad dealings between persons of the community, as well as the weakness of the administration in treating such diseases, the spread of this disease including immigrants and unregulated migration to areas that completely clear from this disease and maybe they are the cause of the spreading epidemic, such as HBV, HCV as in a study (Asif et al., 2022 : Khan et al., 2013).

**Table 1.** Distribution of epidemiological characteristics among samples

Characteristics	Total Number	HBV and HCV	Positive percentage	Total percentage
Total	25403	179	100	0.70
Sex (positive sample)	179	B: 167	93.29	0.65
		C: 12	6.70	0.04
Male	141 (87.7%)	B: 134	74.86	0.52
		C: 7	3.91	0.02
Female	38 (21.2%)	B: 33	18.43	0.12
		C: 5	2.79	0.01
15 - 34 Years	121	B:113	63.12	0.44
		C: 8	4.46	0.03
35 -52 Years	58	B: 54	30.16	0.21
		C: 4	2.23	0.01


**Figure 1.** The spread of HBV and HCV infections and their detection over the course of months

The findings revealed a higher incidence of hepatitis among males compared to females, with 78% of males and 21.1% of females testing positive for the viruses. Notably, males aged 15 to 34 exhibited a higher infection rate than their female counterparts, potentially linked to a lack of concern for public health and safety in their daily activities. Further exploration into the impact of HBV demonstrated a significant effect, as indicated by 167 positive samples. The highest infection rates occurred during specific months, ranging between 9 to 14 infected individuals per month. In contrast, HCV exhibited a lower infection rate, affecting 3.91% of males and 2.79% of females. These percentages highlight a concerning distribution of the diseases within the community, suggesting potential contributing factors such as interpersonal interactions, inadequate disease management, and the influence of immigration and unregulated migration.

## Conclusion

In summary, the cross-sectional study conducted in Fallujah, Iraq, found a higher prevalence of Hepatitis B (HBV) in males, especially in the age range of 15 to 34. Conversely, Hepatitis C (HCV) showed lower infection rates. The findings indicate possible contributing factors to the spread of these diseases, such as gender disparities and potential implications of interpersonal interactions, inadequate disease management, and immigration. These results are consistent with previous research, highlighting the need for specific public health interventions and heightened awareness to reduce the impact of these infectious diseases.

## Author contribution

A.S.K., A.H.A., N.B.A., M.A.I., M.A.H. designed the study, analysed data, conducted laboratory experiments, and wrote the manuscript.

## Acknowledgment

None declared

## Competing financial interests

The authors have no conflict of interest.

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