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Original article

Seroprevalence and risk factors of hepatitis A virus infection in Zakho City, Kurdistan region, Iraq: A population-based study

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Abstract. *Background and aim:* Hepatitis A virus (HAV) is a major cause of acute hepatitis globally, with higher burden in low- and middle-income countries. Iraq is considered hyperendemic, yet limited regional data are available, particularly from Zakho city. This study aimed to evaluate the seroprevalence of HAV and identify associated risk factors in the general population of Zakho. *Methods:* A cross-sectional study was conducted in Zakho from February 1 to March 1, 2025. A multistage random sampling approach was used to select 391 participants. Information was collected through structured self-administered questionnaires, and blood samples were tested for HAV IgG. *Results:* The average age of participants was 33.53 ±13.34 years; 65% were male, and 93.9% lived in urban areas. The overall HAV seroprevalence was 34.5%, with the highest rates found in individuals aged 20–29. No significant associations were found concerning gender (p = 0.772), age (p = 0.095), or water source (p = 0.295). However, handwashing habits were significantly related to HAV status (p = 0.026). *Conclusions:* The lower HAV prevalence in Zakho compared to national statistics indicates improvements in sanitation and hygiene. Nevertheless, proper hand hygiene remains critical, underscoring the importance of targeted public health education.

Key words: hepatitis A virus (HAV), seroprevalence, risk factors, Iraq, population-based study

Introduction

Liver disease is most often caused by viral hepatitis, which is a global health concern (1). Viral hepatitis refers to the inflammation of the liver caused by viruses, which include 5 main types, Hepatitis A, B, C, D, and E (2). Infection with hepatitis viruses impacts low- and middle-income countries such as Iraq, a resource limited nation with many individuals remain unvaccinated due to absence of robust vaccination programs. Hepatitis A Virus (HAV) is a common disease, infecting 1.4 million people, annually (3). It is transmitted through feco-oral route by ingestion of contaminated water or food, particularly in low- and middle- income countries with inadequate sanitation and poor personal hygiene (2,4). The incubation period is typically 14-28 days, with symptoms including fever, loss of appetite, diarrhea, nausea, abdominal discomfort, dark urine, and jaundice (2). The disease

ranges from mild to moderate among adults, children are usually asymptomatic. Although it does not cause chronic liver disease, it can cause acute liver failure and significant morbidity particularly among older age (5). The treatment is mainly supportive however, the hepatitis A vaccine plays a key role in reducing the prevalence, with many countries reporting declines due to widespread immunization efforts (3). HBV and HCV have been studied thoroughly in Iraq (6-10), while other hepatitis types such as Hepatitis A remain less studied (11). Meanwhile Iraq is considered hyperendemic for hepatitis A, with a seroprevalence of 96.4% and a rising infection rate, as reports show that HAV cases increased threefold between 2009 and 2014 (11,12). HAV vaccine is not part of the expanded national vaccination program in Iraq and there are no protocols for the use of hepatitis A immunoglobulin therapy. Recognizing the significance of hepatitis A and being less explored in the region, this research aimed to provide deeper insight into seroprevalence of HAV infection and its risk factors in Zakho city, Kurdistan Region, Iraq.

Patients and Methods

Study design

A population-based study was conducted in Zakho City from February 1 to March 1, 2025. Zakho City is located in the Kurdistan Region in northern Iraq, near Turkish border, and has a population size of 400 000 inhabitants. The participants were selected using a multi-step sampling technique. Initially, we employed AI to randomly identify six districts within Zakho City. Subsequently, families were randomly chosen through a random number generator. To establish the sample size, we applied a population proportion of p = 0. 5, as the actual value was unknown. This approach aimed to optimize the sample size. The preliminary sample size was calculated at 384 participants using a formula intended for an infinite population.

Data collection

The data for this study was collected using a self-administered questionnaire that was delivered to the house of participants by volunteer students. Data were obtained only from individuals older than 18 years of age. This questionnaire encompassed questions about demographic characteristics, including age, sex, location, marital status, and employment situation. Later sections evaluated personal and family histories related to HAV infection, water supply sources, and hygiene practices, with a focus on handwashing habits. Respondents were also asked about gastrointestinal symptoms, such as stomach pain, nausea, vomiting, and related concerns. The survey featured both categorical and continuous data, including the number of people living in the home.

Blood samples

Blood samples were taken from 391 participants who agreed to participate in the study. Each individual had their blood drawn by laboratory personnel in the participants home with a needle and a 5-cc syringe to obtain 5 mL. The samples were spun in a centrifuge at 1500 rpm for 3 minutes to separate the serum from the blood and were kept at −20°C until additional analysis.

Assessment of HAV IgG

Hepatitis A IgG antibodies were measured using the electrochemiluminescence immunoassay (ECLIA) method on the Cobas e411, a fully automated immunoassay analyzer (HITACHI, Roche Diagnostics, Tokyo, Japan), in accordance with the manufacturer's instructions. Participants with a cutoff index (COI) greater than 1.0 were classified as non-reactive (negative for HAV-specific antibodies), whereas those with a COI of 1.0 or less were classified as reactive (positive for HAV-specific antibodies). Participants with positive results were informed.

Statistics

Data were organized, coded, and cleansed using Microsoft Excel Professional Plus 2024 before being transferred to IBM SPSS Statistics (Version 25) for a range of analyses. Descriptive statistics were utilized to compute values, percentages, means ± standard deviation (SD). A t test was performed to investigate the

correlation with age and family number. Chi-square and Fisher's exact tests were performed where appropriate, with a p-value of <0.05 considered statistically significant.

Ethics

The Scientific and Ethics Committee of the College of Medicine at the University of Zakho approved the study protocol (JAN2025/UOZEA46). Before including participants in the study, informed consent was obtained from each individual.

Results

Demographic characteristics of study participants

A total of 391 participants were included in the study with an average age of 33.53 (± 13.341). Approximately, two-thirds of the participants were male (254; 65%), and one-third were female (137; 35%). Participants were predominantly based inside the city (367; 93.9%), and 24 (6.1%) were based outside of the city. In this study, 232 (59.3%) participants were married. Participants families mostly consisted of 4 – 6 members (182; 46.5%) followed by 7 – 9 members (116; 29.7%). Regarding hand washing, most of the participants only occasionally washed their hands (96; 24.6%), followed by before eating (79; 20.2%), after toilet, before and after handling food (90; 23%), and after handling food (43; 11%). As for water source, most of the participants water source was tap water (192; 49.1%) and filtered water (108; 27.6%). Majority of the participants had no previous history of HAV infection (375; 95.9%), no family history of HAV infection (360; 92.1%) and no history of jaundice (336; 85.9%) (Table 1).

Seroprevalence and risk factors of hepatitis A

The seroprevalence of hepatitis A was 34.5%. The highest prevalence was observed among individuals aged 20–29, with subsequent lower rates noted in older age groups (Figure 1). Hepatitis A seropositivity was slightly higher among males (35%) and single

Table 1. Participants characteristics

Characteristics	Number (%)
Age (Mean/S. D)	33.53 (± 13.341)
Gender	
Male	254 (65%)
Female	137 (35%)
Residency	
Urban	367 (93.9%)
Rural	24 (6.1%)
Marital status	
No	159 (40.7%)
Yes	232 (59.3%)
Previously diagnosed with HAV	
No	375 (95.9%)
Yes	16 (4.1%)
Family history of HAV	
No	360 (92.1%)
Yes	31 (7.9%)
Number of family members	
1 – 3	39 (10%)
4 - 6	182 (46.5%)
7 – 9	116 (29.7%)
10 and more	54 (13.8%)
Water source	
Bottle	70 (17.9%)
Filter	108 (27.6%)
Tap	192 (49.1%)
Well	14 (3.6%)
Other & Multiple Sources	7 (1.8%)
Hand washing	
After eating food	43 (11%)
After using toilet	40 (10.2%)
Before eating, after using the toilet	36 (9.2%)
Before and after eating, after toilet	90 (23%)
Before eating	79 (20.2%)
Never	1 (0.3%)
Occasionally	96 (24.6%)
Ever had jaundice	
No	336 (85.9%)
Yes	54 (13.8%)
Hepatitis A IgG	
Positive	135 (34.5%)
Negative	256 (65.5%)

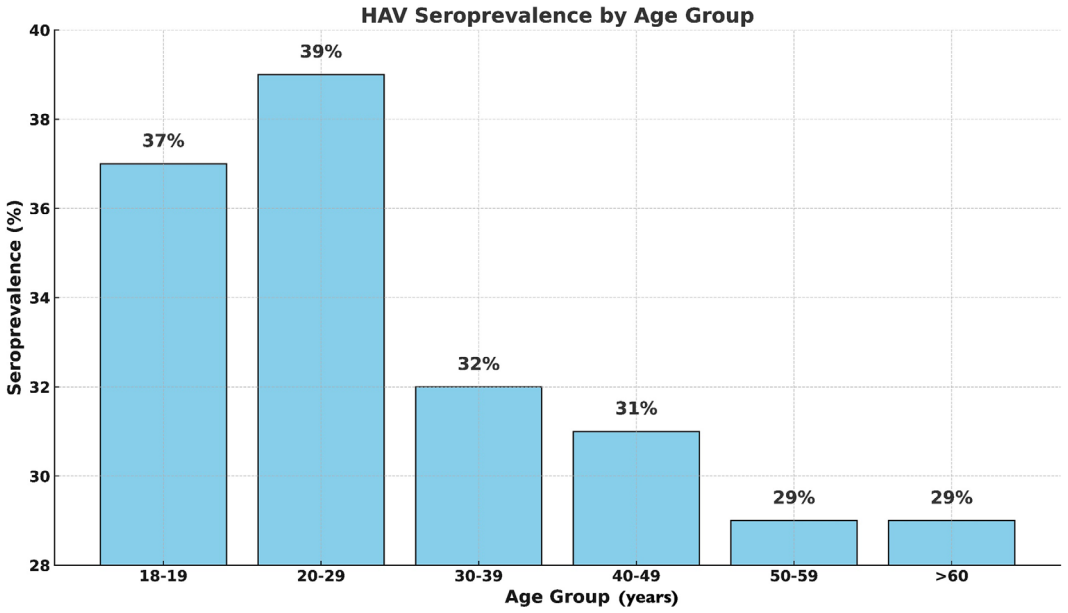

Figure 1. Seroprevalence of hepatitis A among age categories.

participants (36.5%) compared to females (33.6%) and married (33.2%) participants. Regarding water source, hepatitis A was highest among those who drank from wells (42.9%) and multiple resources (42.9%). Meanwhile those who washed their hands before handling food (48.1%) was the highest compared to their counterparts. Many factors were analyzed for potential association with HAV infection with most factors showing no association such as age (T-test p value = 0.095), gender (chi-square p value = 0.772), residency (chi-square p value = 0.752), marital status (chi-square p value = 0.502), history of HAV infection (chi-square p value = 0.145), water source (chi-square p value = 0.295), and family member (T-test p value = 0.444). However, only hand washing showed a significant association with HAV infection (chi-square P value = 0.026) indicating that poor or inconsistent handwashing is significantly associated with increased HAV infection (Table 2).

Discussion

This cross-sectional study is the first to determine the seroprevalence of HAV in Zakho City, Iraq. The overall HAV seroprevalence in our study population was 34.5% compared to recent findings from a study conducted in 2022 in Duhok, a city northern Iraq (68.3%), in Kerbala, a city southern Iraq, (61.7%) and findings from a study conducted in 2011 in Iraq which reported 96.4% seroprevalence of HAV (12-14). The difference in the results among these studies might be related to the different dates / years at which the study was performed. As only inadequate measures for vaccination have been put in place in Iraq, the lower prevalence observed in Zakho compared to earlier reports of Iraq in 2011 is attributed to the improvements in sanitation, access to clean water, and public health initiatives implemented in recent years. WASH (Water, Sanitation and Hygiene) initiatives are developed by the United Nations and other international organizations aimed at improving infrastructure, hygiene awareness, and healthcare support in the region to improve health outcomes. (15) However, a possible explanation for the lower prevalence as compared to Duhok could be because that Duhok is a major city being more crowded than Zakho. Additionally, being the major city, Duhok hosts more refugee from Syria and Mosul which was a war-torn city in Iraq. A study from Lebanon showed that the cities closer to war affected areas showed a surge in HAV trend due to poot sanitation in refugee camps. (16) Our results were also

Table 2. Risk factors associated with hepatitis A

Variable	Negative HAV	Positive HAV	P Value
Gender			
Male	165 (65%)	89 (35%)	0.772
Female	91 (66.4%)	46 (33.6%)	
Residency			
Rural	15 (62.5%)	9 (37.5%)	0.752
Urban	241 (65.7%)	126 (34.3%)	
Marital Status			
Single	101 (63.5%)	58 (36.5%)	0.502
Married	155 (66.8%)	77 (33.2%)	
Family history HAV			
No	232 (64.4%)	128 (35.6%)	0.145
Yes	24 (77.4%)	7 (22.6%)	
Hand washing			
After eating food	24 (55.8%)	19 (44.2%)	0.026
After using toilet	24 (60%)	16 (40%)	
Before eating, after using toilet	29 (80.6%)	7 (19.4%)	
Before and after eating, after toilet	65 (72.2%)	25 (27.8%)	
Before eating	41 (51.9%)	38 (48.1%)	
Occasionally	72 (70.5%)	30 (29.4%)	
Never	1	0	
Water source			
Bottle	43 (61.4%)	27 (38.6%)	0.295
Filter	65 (60.2%)	43 (39.8%)	
Tap	136 (70.8%)	56 (29.2%)	
Well	8 (57.1%)	6 (42.9%)	
Multiple	4 (57.1%)	3 (42.9%)	

lower than those reported in neighbouring countries such as Iran (90.8%), and Turkey (87.3%) (17,18). Notably, our findings were comparable to a study conducted in Jordan (38.3%) (19). There is a public program dealing with infectious diseases where main duties are education and vaccination, however, HAV is not a major concern. A recent study investigated the clinical profile of HAV in the country and found that the most frequent symptoms in descending order to be: jaundice, abdominal pain, vomiting, fever, and anorexia (20). The highest prevalence was observed among individuals aged 20–29, with subsequent lower rates noted in older age groups. In contrast to previous studies, where they mostly noted a high prevalence of HAV among the elderly (12,13,17). One possible explanation for our findings is the increased exposure due to travel, or shared living conditions in dorms. After reaching 30 years of age, seroprevalence steadily declines, reaching its lowest point among individuals aged 70 and above. This unexpected drop among older adults may be due to smaller sample sizes or waning antibodies. It is been proven that the concentration of IgM and IgG antibodies reduce with aging as the result of immunosenescence but the exact effects has not been measured on Anti-HAV antibodies in elderly individuals (21). Notably, the 18–19 age group has relatively low seroprevalence, likely resulting from reduced natural exposure in recent years and insufficient vaccination coverage into the routine immunisation program. These findings indicate a transition from high to moderate HAV endemicity, as improved sanitation reduces early-life exposure. However, the accumulation of susceptible individuals among younger and middle-aged populations increases the likelihood of outbreaks, emphasizing the need for targeted vaccination strategies and the possible integration of HAV vaccines into routine immunization program. No significant association was found between gender and HAV infection in our study. This aligns with previous research reporting similar findings. This suggests that gender may not be a key factor of susceptibility (13,14,18,19). However, some studies have observed higher rates in males (12,17), and others in females (22). Our study observed no significant association with marital status to HAV. However, a study conducted in Iran observed that married participants were significantly more at risk for HAV (18,23). Interestingly, participants with a family history of HAV had a lower seroprevalence than those without a family history although the difference was not statistically significant. This may indicate greater awareness due to prior exposure and suggests a potential association that could be clarified in larger studies. Although unsanitized water is a known risk factor for hepatitis A, our study did not find a significant association. This may suggest that the participants in our study were infected through other routes such as through traveling,

unhygienic practices or food sanitation as our study noted that handwashing was a significant protective factor and those who washed their hands before food and after using the toilet were least infected with HAV. Proper hand washing is a well-known factor associated with hepatitis A. A meta-analysis observed that as the virus is able to survive 2 months on dry surfaces to several hours on individuals' hands, infection can occur through direct contact with other individuals or by contacting contaminated objects highlighting the importance of proper hand washing (24). Educational campaigns should be implemented in high schools and universities, targeting individuals aged 20–29, as this group showed the highest prevalence in our study. The campaign should emphasize proper handwashing techniques and hygienic practices, given their critical role in preventing infection. This study has limitations. First, its cross-sectional design prevents assessment of causality between risk factors and HAV seropositivity. Second, the sample was limited to individuals residing in Zakho City, which may not fully represent the broader population of the Kurdistan Region or Iraq. Third, the study did not include participants under 18 years of age, potentially omitting a key demographic in evaluating current transmission dynamics and vaccine coverage.

Conclusions

This study is the first to report the seroprevalence of hepatitis A virus in Zakho City and demonstrates a marked shift toward moderate endemicity, with an overall seroprevalence of 34.5%. The highest prevalence was found in the age group of 20–29, whereas the rates among both the elderly and youngest adults were surprisingly low. This suggests changing exposure patterns likely due to improved sanitation, enhanced hygiene practices, and reduced transmission during childhood. Although no significant correlation was identified between HAV infection and either gender or marital status, maintaining proper hand hygiene was acknowledged as a protective factor. The results of this study emphasize the changing epidemiology of HAV in the region and point to an increasing vulnerability among young adults.

Ethic Approval: The Scientific and Ethics Committee of the College of Medicine at the University of Zakho approved the study protocol (JAN2025/UOZEA46). Before including participants in the study, written informed consent was obtained from each individual.

Conflict of Interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Authors Contribution: NRH, IAN: Concept framework; AIM, MRA, DHM, NMRI, ZSMS: Methodology; HJA, SAI, DA: Analysis and interpretation of results; DA, MDA, PSA, AMS, SIY: Initial draft preparation; SSM, AHS, YSY, RSA, NMM: Manuscript review and revision. All authors have reviewed and approved the final version of the manuscript.

Declaration on the Use of AI: We used ChatGPT to randomly identify six districts out of all districts within Zakho City in the methods section.

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