Section: Microbiology

Original Research Article

ACUTE HEPATITIS A VIRUS INFECTION IN UTTARAKHAND: INSIGHTS INTO THE EVOLVING EPIDEMIOLOGY FROM A TERTIARY CARE CENTRE

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Received *: 20/05/2026*
Received in revised form *: 23/06/2026*
Accepted *: 07/07/2026*

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DOI: 10.70034/ijmedph.2026.3.109

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2026; 16 (3); 659-663

ABSTRACT

Background: Hepatitis A virus (HAV) remains one of the leading causes of acute viral hepatitis (AVH), particularly in developing countries where fecal–oral transmission is facilitated by inadequate sanitation and poor hygiene. India has traditionally been considered highly endemic for HAV; however, recent improvements in socioeconomic conditions have led to an epidemiological shift, with increasing susceptibility among older children and adolescents. Data on the epidemiology of HAV infection from Uttarakhand is limited. This study aimed to determine the seroprevalence of acute HAV infection among clinically suspected AVH cases and to describe its demographic and seasonal distribution in a tertiary care hospital in Uttarakhand.

Materials and Methods: A prospective cross-sectional study was conducted between January and December 2023 at the Department of Microbiology, Government Doon Medical College and Hospital, Dehradun. Consecutive patients presenting with clinically suspected AVH were enrolled. Serum samples were tested for anti-HAV immunoglobulin M (IgM) antibodies using the ARCHITECT® HAVAb-IgM chemiluminescent microparticle immunoassay. Demographic, clinical, laboratory, and seasonal data were analyzed descriptively.

Results: A total of 161 patients were included, comprising 104 (64.6%) males and 57 (35.4%) females. Anti-HAV IgM antibodies were detected in 83 (51.6%) patients, indicating acute HAV infection. Among seropositive cases, males accounted for 59.0% and females for 41.0%. The highest seropositivity was observed among children aged 11–15 years (90.0%), followed by those aged 6–10 years (84.2%) and 0–5 years (83.3%). No seropositive cases were identified among individuals older than 30 years. A seasonal increase in HAV cases was observed during the monsoon months, with the highest number of cases reported in July.

Conclusion: More than half of the patients with suspected AVH had evidence of acute HAV infection, with the greatest burden occurring among older children and adolescents. These findings support the evolving epidemiology of HAV in Uttarakhand and underscore the need for continued surveillance, improved sanitation, and consideration of targeted hepatitis A vaccination strategy for susceptible populations.

Keywords: Acute viral hepatitis, Anti-HAV IgM, Epidemiological transition, Hepatitis A virus, Seroprevalence.

INTRODUCTION

Hepatitis A virus (HAV) is one of the leading causes of acute viral hepatitis (AVH) worldwide and remains an important public health concern, particularly in low and middle-income countries. In highly endemic regions, more than 90% of children acquire HAV infection during early childhood. The

infection is asymptomatic in nearly 70% of children younger than six years, whereas approximately 70% of adolescents and adults develop symptomatic disease. In adults, HAV infection is associated with greater morbidity, with jaundice occurring in 40–70% of cases.[1] HAV is a small, non-enveloped, positive-sense single-stranded RNA virus measuring approximately 27–32 nm in diameter and belongs to the genus Hepatovirus within the family Picornaviridae.[2] HAV is primarily transmitted through the fecal–oral route via ingestion of contaminated food or water or through close person-to-person contact. Unlike hepatitis B and C viruses, HAV does not establish chronic infection or cause chronic liver disease. Acute HAV infection is generally self-limiting; however, severe complications such as fulminant hepatitis may rarely occur and can result in significant morbidity and occasional mortality. Globally, HAV is responsible for approximately 1.5 million clinically recognized cases each year, although the actual burden is believed to be substantially higher because of underreporting and the large proportion of asymptomatic infections.[3] The epidemiology of HAV varies considerably across different geographic regions and is strongly influenced by socioeconomic conditions, sanitation, and access to safe drinking water. Developing countries continue to experience a high burden of infection because of inadequate sanitation, overcrowding, and poor hygiene practices. India has traditionally been classified as a highly endemic country for HAV, where infection commonly occurs during early childhood and is often mild or asymptomatic.[4,5] However, improvements in sanitation, hygiene, and socioeconomic status over the past two decades have resulted in an epidemiological transition from high to intermediate endemicity in several parts of the country. Consequently, exposure to HAV is increasingly delayed until adolescence or adulthood, when infection is more likely to be symptomatic and associated with severe clinical outcomes.[6,7]

This changing epidemiological pattern has important public health implications and highlights the need for continuous surveillance and appropriate preventive strategies. Although hepatitis A vaccine is not currently included in India's Universal Immunization Programme (UIP), it is available through the private healthcare sector and is recommended for individuals at increased risk of infection and those residing in outbreak-prone areas.[8]

The clinical manifestations of acute hepatitis due to HAV are often indistinguishable from those caused by other hepatotropic viruses, making laboratory confirmation essential for diagnosis. Detection of immunoglobulin M antibodies against HAV (anti-HAV IgM) remains the standard serological marker of acute or recent infection. Anti-HAV IgM antibodies become detectable shortly before or at the onset of symptoms and generally persist for up to six months, although prolonged persistence beyond one year has occasionally been reported.

Despite the substantial burden of HAV infection in India, published epidemiological data from Uttarakhand remain limited, particularly from Dehradun district and the surrounding regions. Contemporary regional data are essential for understanding the changing epidemiology of HAV and for guiding public health interventions. Therefore, the present study was undertaken to determine the seroprevalence of acute HAV infection among patients presenting with clinically suspected AVH at a tertiary care teaching hospital in Dehradun, Uttarakhand, and to describe its demographic and seasonal distribution.

MATERIALS AND METHODS

Study Design and Setting: This hospital-based prospective, cross-sectional study was conducted over a period of 12 months, from January to December 2023, in the Department of Microbiology, Government Doon Medical College and Hospital (GDMC&H), Dehradun, Uttarakhand, India. GDMC&H is a 750-bed tertiary care teaching hospital that serves as a major referral centre for Dehradun and the adjoining districts of Uttarakhand.

Study Population: Patients of all age groups presenting to the outpatient departments or admitted to inpatient wards with clinically suspected AVH were screened for inclusion. An AVH case was defined as an individual presenting with an acute illness of less than 15 days' duration, characterized by the sudden onset of one or more symptoms such as fever, malaise, anorexia, nausea, vomiting, diarrhoea, abdominal pain, or headache, together with either jaundice or elevated serum alanine aminotransferase (ALT) levels (>100 IU/L) documented on at least two occasions one week apart, in the absence of pre-existing liver disease. [9] Patients with non-infectious causes of liver dysfunction, including obstructive jaundice, haemolytic jaundice, non-alcoholic fatty liver disease, autoimmune hepatitis, drug-induced liver injury (including antitubercular drug-related hepatotoxicity), and other hepatotoxin-induced liver diseases, were excluded from the study.

Sample Collection and Laboratory Testing: Venous blood samples (2–5 mL) were collected in plain (red-top) vacutainer tubes from all enrolled patients. Blood samples were centrifuged to separate serum, which was analysed immediately or stored at −20°C until testing. Detection of anti-HAV IgM antibodies was performed using the ARCHITECT® HAV Ab-IgM assay (Abbott Diagnostics, USA), a chemiluminescent microparticle immunoassay (CMIA) designed for the qualitative detection of IgM antibodies against HAV in human serum and plasma. The assay was performed according to the manufacturer's instructions and was used as an aid in the diagnosis of acute or recent HAV infection.

Data Collection: Demographic and clinical information was retrieved from the laboratory database and patients' medical records. Data collected included age, sex, clinical presentation, history of jaundice, and relevant laboratory investigations. Liver function test (LFT) parameters, including total bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), and alkaline phosphatase (ALP), were recorded whenever available. Information regarding previous hepatitis A vaccination was not consistently documented in patient records and was therefore not included in the analysis.

Statistical Analysis: Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). Categorical variables were summarized as frequencies and percentages. Descriptive statistics were used to analyse demographic characteristics, seroprevalence, age-wise distribution, sex distribution, and seasonal trends of HAV infection.

Ethical Considerations: The study was approved by the Institutional Ethics Committee of GDMC&H, Dehradun. Written informed consent was obtained from all study participants or their legally authorized representatives prior to sample collection, and patient confidentiality was maintained throughout the study.

RESULTS

A total of 161 patients with clinically suspected AVH were included in the study. Of these, 104 (64.6%) were males and 57 (35.4%) were females. [Figure 1]

Overall, 83 (51.6%) patients tested positive for anti-HAV IgM antibodies, indicating acute HAV infection, while 78 (48.4%) patients were seronegative. Among the seropositive patients, 49 (59.0%) were males and 34 (41.0%) were females. [Figure 2], demonstrating a male predominance among confirmed HAV cases.

Age-wise analysis revealed marked differences in anti-HAV IgM seropositivity. [Table 1] The highest seropositivity was observed in the 11–15-year age group, where 36 of 40 patients (90.0%) tested positive. High seropositivity was also observed among children aged 6–10 years (16/19; 84.2%) and 0–5 years (10/12; 83.3%). In contrast, seropositivity declined substantially among older age groups, with positivity rates of 33.3% (12/36) in individuals aged 16–20 years and 25.0% (9/36) among those aged 21–30 years. No anti-HAV IgM-positive cases were detected among patients aged >30 years.

Liver function test (LFT) abnormalities were documented in 37 (44.6%) of the 83 anti-HAV IgM-positive patients. Among these patients, 23 (62.2%) were females and 14 (37.8%) were males.

A distinct seasonal pattern of HAV infection was observed throughout the study period. [Figure 3] The number of laboratory-confirmed HAV cases increased during the monsoon months, with the highest positivity recorded in July, followed by a gradual decline in the subsequent months. Relatively few cases were detected during the winter and early summer months.

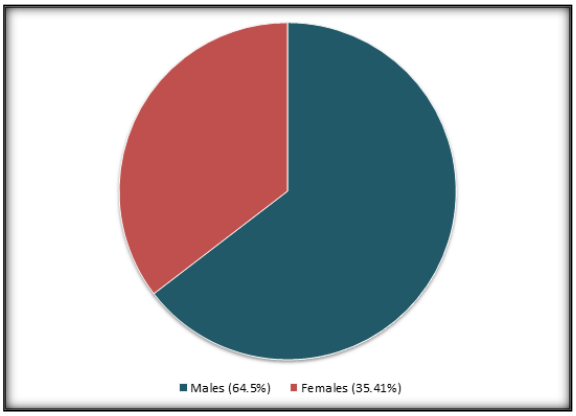

Figure 1: Gender distribution of patients with suspected acute viral hepatitis (*n*=161)

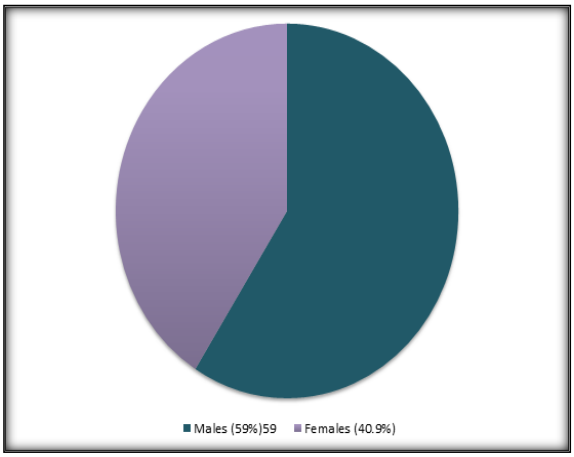

Figure 2: Sex distribution of anti-HAV IgM-positive patients (n=83)

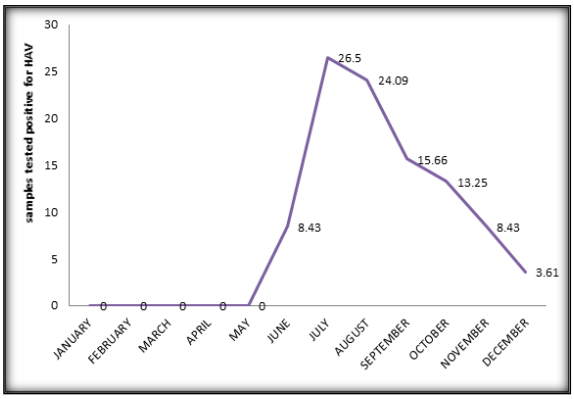

Figure 3: Monthly distribution of laboratory-confirmed hepatitis A virus infections during the study period

Table 1: Age-wise distribution of hepatitis A virus ELISA-positive cases (*n*=161)

Age (Years)	Total Number of Patients	Number of Reactive Patients (%)
0-5	12	10 (83.3)
6-10	19	16 (84.2)
11-15	40	36 (90.0)
16-20	36	12 (33.3)
21-30	36	9 (25.0)
31-40	9	Nil
41-50	2	Nil
51-60	5	Nil
>60	2	Nil

DISCUSSION

The present study demonstrates that hepatitis A virus (HAV) continues to be a major cause of acute viral hepatitis (AVH) among patients presenting to a tertiary care centre in Uttarakhand, with more than half of the clinically suspected AVH cases testing positive for anti-HAV IgM antibodies. An important observation was the predominance of infection among children and early adolescents, particularly those aged 11–15 years, together with a distinct seasonal increase during the monsoon months. These findings provide contemporary epidemiological data from a region where published information on HAV infection remains limited and have important implications for disease surveillance and preventive strategies.

The overall anti-HAV IgM seropositivity of 51.6% observed in the present study indicates that HAV remains a significant etiological agent of AVH in this region. Comparable studies from India have reported considerable variation in HAV seropositivity, ranging from approximately 8% to 75%, reflecting differences in geographical location, sanitation, socioeconomic conditions, study populations, and healthcare access.[8,10,11] Prakash *et al*. reported a substantially lower seropositivity of 7.93% among patients with acute viral hepatitis in Uttar Pradesh,[12] whereas Sarthi *et al*. documented a prevalence of 37.3% in central Karnataka.[13] Outside India, Karimi *et al*. reported an anti-HAV IgM seropositivity of 68.6% in Iran.[14] Published evidence on anti-HAV IgM seropositivity from Uttarakhand is scarce. Kalita *et al*. reported a seropositivity rate of 14.7% among patients presenting with acute viral hepatitis in Rishikesh, Uttarakhand.[15] In contrast, the present study demonstrated a higher anti-HAV IgM seropositivity, suggesting possible regional or temporal differences in HAV epidemiology, variations in patient selection, referral patterns, or differences in the study settings. This emphasizes the need for continued local surveillance to understand the burden of HAV infection across different parts of the country.

A key finding of the present study was the age distribution of HAV infection. Although HAV has historically been regarded as an infection acquired predominantly during early childhood in highly endemic settings, the highest seropositivity in our cohort was observed among children aged 11–15 years. Similar epidemiological transitions have been reported from several parts of India, where improvements in sanitation and socioeconomic conditions have delayed exposure to HAV, resulting in an increasing proportion of susceptible older children and adolescents.[7] Delayed acquisition of natural immunity increases the likelihood of symptomatic disease, thereby shifting the clinical burden to older age groups. The findings of the present study support this evolving epidemiological pattern and underscore the importance of periodic epidemiological surveillance to identify changes in population susceptibility.

Male patients accounted for a greater proportion of laboratory-confirmed HAV infections than females, a finding that is consistent with previous reports by Kumari *et al*. and Joon *et al*.[16,17] Although the underlying reasons for this sex difference cannot be determined from the present study, it may reflect differences in environmental exposure, healthcare utilization, or other behavioral and sociocultural factors. Since these variables were not specifically evaluated, further community-based studies are required to better understand the determinants of this observation.

A clear seasonal trend was also evident, with the highest number of HAV cases occurring during the monsoon months, particularly in July. Similar seasonal peaks have been documented in previous Indian studies.[16] Increased HAV transmission during the rainy season has been attributed to contamination of drinking water and food supplies following heavy rainfall, which facilitates fecal–oral transmission of the virus.[18] These findings reinforce the need for strengthening water quality monitoring, sanitation measures, and public health awareness, particularly during the monsoon season when the risk of enterically transmitted infections is greatest.

The changing epidemiology of HAV infection observed in the present study has important public health implications. As improvements in sanitation reduce early childhood exposure, a growing proportion of adolescents remain susceptible to infection, increasing the risk of clinically significant disease and outbreaks in older age groups. Continuous surveillance is therefore essential to monitor regional epidemiological trends and to generate evidence that can inform vaccination policies. Although hepatitis A vaccination is currently available through the private healthcare

sector in India, the present findings support consideration of targeted vaccination strategies for susceptible populations and high-risk settings in regions demonstrating a similar epidemiological transition.

The present study has several strengths. It provides recent epidemiological data on acute HAV infection from Uttarakhand, a region where published evidence remains limited, and laboratory confirmation was performed using a standardized chemiluminescent microparticle immunoassay. Nevertheless, certain limitations should be acknowledged. This was a single-centre hospital-based study with a relatively modest sample size, which may limit the generalizability of the findings. Data regarding prior HAV vaccination, socioeconomic characteristics, and environmental risk factors were not available and therefore could not be analysed. In addition, molecular characterization of circulating HAV strains was beyond the scope of the present study. Future multicentre studies incorporating larger populations, molecular epidemiology, and risk factor analysis would provide a more comprehensive understanding of the evolving epidemiology of HAV infection in this region.

CONCLUSION

The present study demonstrates that hepatitis A virus (HAV) remains an important cause of acute viral hepatitis in Uttarakhand, with the highest burden observed among older children and early adolescents. The predominance of infection in the 11–15-year age group supports the evolving epidemiology of HAV in India, characterized by a shift in susceptibility from younger children to older age groups.

These findings provide valuable regional epidemiological data and highlight the need for continued surveillance to monitor changing disease patterns. Strengthening sanitation, ensuring access to safe drinking water, and promoting hygiene remain essential for reducing HAV transmission. In addition, region-specific epidemiological evidence should be considered while formulating preventive strategies and vaccination policies. Further multicentric studies are warranted to better define the changing epidemiology of HAV infection and guide evidence-based public health interventions.

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