Iran J Pathol. 2027;22(1):29–34 | ISSN 2345-3656 | MAIN SUBJECTS Infectious Diseases

Seroprevalence and HEV RNA Positivity of Hepatitis E Virus Among People Living with HIV in Northern Türkiye: A Single-Center Cross-Sectional Study

Hatice Köse[1*], **Melek Bilgin**[2], **Mehmet Hakan Taşkın**[2]

1. Department of Infectious Diseases and Clinical Microbiology, Samsun City Hospital, Samsun, Türkiye
2. Department of Medical Microbiology, Faculty of Medicine, Samsun University, Samsun, Türkiye

RECEIVED 11 Jun 2026 ACCEPTED 25 Jul 2026 PUBLISHED ONLINE 01 Oct 2026 DOI 10.22034/ijp.2026.2088276.3673

ABSTRACT

Background & Objective: Hepatitis E virus (HEV) is an important cause of acute viral hepatitis worldwide. In immunocompromised individuals, including people living with HIV (PLHIV), HEV may also cause chronic infection. This study aimed to determine HEV seroprevalence and HEV RNA positivity among HIV-positive individuals and investigate demographic and HIV-related laboratory variables.

Methods: A total of 180 HIV-positive adults who presented to Samsun City Hospital between February and May 2025 were included in the study. Anti-HEV IgM and IgG were analyzed using a commercial enzyme-linked immunosorbent assay (ELISA) kit, and HEV RNA was tested by real-time polymerase chain reaction (PCR). Demographic and laboratory data were collected retrospectively.

Results: The mean age of the participants was 46 ± 17 years, and 82.8% were male. Anti-HEV IgG positivity was detected in 8 patients (4.44%), and anti-HEV IgM positivity in 2 patients (1.11%). One participant (0.55%) had concurrent anti-HEV IgG and IgM positivity. HEV RNA was not detected in any sample. The overall HEV seroprevalence was 5.0% (9/180; 95% CI: approximately 1.8-8.1%). HEV seropositivity was not significantly associated with sex, HIV RNA status, CD4 count, or treatment-naive status. However, seropositivity was significantly higher in participants older than 60 years (p = 0.002).

Conclusion: This study demonstrated a 5% (9/180; 95% CI: approximately 1.8-8.1%) HEV seroprevalence among PLHIV in the Central Black Sea region of Türkiye. No HEV RNA was detected at the time of sampling, and no molecular evidence of active HEV infection was observed.

KEYWORDS Hepatitis E virus, HIV infections, Seroprevalence, Coinfection, Türkiye

Corresponding Information: Hatice Köse, Department of Infectious Diseases and Clinical Microbiology, Samsun City Hospital, Samsun, Türkiye, drhaticekose@hotmail.com

Copyright © 2027 The Author(s). This is an open-access article distributed under the terms of the CC BY 4.0, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Hepatitis E virus (HEV) is a non-enveloped, single-stranded RNA virus belonging to the *Hepeviridae* family. It is one of the most common causes of acute viral hepatitis globally, with a particularly high prevalence in areas such as sub-Saharan Africa, East Asia, and South Asia. While the majority of HEV infections are asymptomatic, certain cases can lead to severe clinical outcomes. The most prevalent genotypes causing human infection are HEV genotypes 1, 2, 3, and 4. Genotypes 1 and 2 are typically found in developing countries and are transmitted through contaminated water sources, being associated only with acute infections. Genotypes 3 and 4 are zoonotic, with transmission mainly occurring through the consumption of contaminated meat from infected animals, especially when raw or undercooked. Pigs are the primary reservoir, but rabbits, goats, sheep, deer, horses, cats, and dogs have also been identified as potential zoonotic sources. These genotypes are most commonly found in developed, non-endemic countries (1–3).

Although HEV infection is typically a self-limiting illness, chronic infection may develop in immunocompromised individuals, including solid organ and stem cell transplant recipients, people living with HIV (PLHIV), and patients with cancer or rheumatic diseases (4). Reported HEV seroprevalence rates among HIV-positive individuals vary widely by region, ranging from 1.5% to 38.7% in Europe, 3.6% to 19.2% in North and South America, 4.7% to 44.4% in East and Southeast Asia, and 8.3% to 70.9% in Africa (4). Although global studies have increasingly focused on HEV infection in HIV-positive populations, data from Türkiye remain extremely limited, with only two published studies reporting HEV seroprevalence rates of 4.0% and 3.9% (5, 6). This scarcity emphasizes a critical knowledge gap, notably regarding risk factors for HEV infection in this population.

This study aimed to evaluate HEV antibodies and HEV RNA among people living with HIV in Türkiye and to determine the prevalence of HEV seropositivity and its associations with demographic and HIV-related laboratory variables.

MATERIALS AND METHODS

Study design and patients: A total of 180 patients aged >18 years , who were admitted to Samsun City Hospital between February and May 2025 and had a confirmed HIV diagnosis, were included

in the study. The required sample size for prevalence estimation was calculated using OpenEpi (Version 3.01). Assuming an expected HEV seroprevalence of 4.45% based on prior regional estimates for the Black Sea region (7), a 95% confidence level, and a 5% margin of error, a minimum of 66 participants was required. As our study included 180 participants, the sample size was adequately powered for this estimation. No finite population correction was applied.

Demographic and laboratory data (including HIV RNA levels, CD4 counts, and treatment status) were obtained from medical records.

Ethical approval for the study was granted by the Samsun University Non-Interventional Clinical Research Ethics Committee (Decision No. 2025/2/6, dated 24 January 2025). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Laboratory analyses: Anti-HEV IgM and anti-HEV IgG antibodies were detected using commercial enzyme-linked immunosorbent assay (ELISA) kits: HEV IgM ELISA (catalog no. EVM.CE) and HEV IgG ELISA (catalog no. EVG.CE), according to the manufacturer's instructions (Dia.Pro Diagnostic Bioprobes S.r.l., Milan, Italy). According to the manufacturer, the sensitivity and specificity of both the HEV IgM and HEV IgG ELISA kits were reported to be 100%. Serum samples and ELISA kit components were prepared at room temperature prior to analysis. Control and patient samples were prepared using manufacturer-specified diluents. Serum was obtained by centrifugation of whole blood at 3000 rpm for 10 minutes and stored at −80°C until testing. Hemolyzed/lipemic samples were excluded. Duplicate testing was not performed. After incubation and washing, enzyme-conjugated antibodies and a chromogen/substrate solution were added to each well. The enzymatic reaction was terminated by adding sulfuric acid. Optical density values were measured at 450 nm using a NanoQuant Infinite M200 PRO microplate reader (Tecan Trading AG, Männedorf, Switzerland). Internal quality control (IQC) was performed for both HEV IgM and HEV IgG ELISA assays according to the manufacturer's instructions using the kit-provided blank, negative control, positive control, and, when applicable, calibrator. Assay validity, cut-off calculation, and interpretation of the sample-to-cut-off (S/Co) ratio were performed according to the assay-specific criteria defined by the manufacturer for each kit. Test results were evaluated semi-quantitatively using signal-to-cutoff (S/CO) ratios. For HEV IgG, S/CO values < 0.9 were interpreted as negative, values between 0.9-1.1 as equivocal, and values >1.1 as positive. For HEV IgM, results were considered negative if the S/CO was <1.0, equivocal between 1.0 and 1.2, and positive if >1.2. Equivocal results were observed in three samples for anti-HEV IgG. No equivocal results were detected for anti-HEV IgM. In this study, equivocal results were classified as negative.

For the detection of HEV RNA, total nucleic acids were extracted from serum samples using the Bosphore Nucleic Acid Extraction Versatile Spin Kit. The extracted RNA was subjected to reverse transcription and real-time PCR using the Bosphore Hepatitis E Detection Kit v1(Anatolia Geneworks, Türkiye). According to the manufacturer's specifications, the Bosphore Hepatitis E Detection Kit v1 has an analytical detection limit of 170 IU/mL. Amplification was performed on a Bio-Rad CFX96 Touch Real-Time PCR Detection System in a one-step protocol. The thermal cycling conditions were as follows: reverse transcription at 50 °C for 10 minutes, followed by 45 cycles of denaturation at 95 °C for 20 seconds and annealing/extension at 58 °C for 60 seconds. HEV-specific fluorescence was detected through the HEX channel, and internal control amplification was monitored using the Texas Red channel. Ct values were used for qualitative assessment for HEV RNA detection.

Statistical analysis: The normality of quantitative variables was assessed using the Shapiro–Wilk test. HIV-RNA and CD4 levels did not follow a normal distribution and were therefore reported as medians (Q1–Q3). Conversely, patient age exhibited a normal distribution and was expressed as mean ± standard deviation. Categorical variables were summarized as absolute frequencies and percentages. Associations between seropositivity (anti-HEV IgM and/or anti-HEV IgG) and patients' demographic or laboratory parameters were evaluated using the Pearson chi-square test. However, when the expected frequencies in any cell were less than 5, two sided Fisher's exact test was utilized. Additionally, a Bonferroni correction was applied to adjust for multiple comparisons, defining statistical significance as $p < 0.01$. All statistical analyses were conducted using SPSS software (version 27.0; IBM Corp., Armonk, NY, USA).

RESULTS

Of the 180 patients diagnosed with HIV-1 included in our study, 149 (82.8%) were male, and 31 (17.2%) were female. The mean (±SD) age of the patients was 46 ± 17 years. Median HIV viral load was 42.5 IU/mL with IQR (0-181). In 83 patients (46%), HIV RNA levels were found to be negative and below the detection limit (≤33 IU/mL). Median CD4 + T cell count was 499 with IQR (251-711). Of the patients, 23 (12.8%) were identified as treatment-naive.

The overall HEV seroprevalence was 5.0% (9/180; 95% CI: approximately 1.8-8.1%). Out of the 180 participants, 8(4.44%) were positive for HEV IgG antibodies, indicating exposure to HEV. HEV IgM antibodies were detected in 2 participants (1.11%), with 1 (0.55%) showing concurrent positivity for both IgG and IgM antibodies. HEV RNA was not detected in the population (Table1).

Table 1. HEV serological and RNA results among the study participants (N = 180)

HEV IgG positive	8 (4.44%)
HEV IgM positive	2 (1.11%)
HEV IgG positive / IgM negative	7 (3.88%)
HEV IgM positive / IgG positive	1 (0.55%)
HEV IgM positive / IgG negative	1 (0.55%)
HEV IgM negative / IgG negative	171 (95%)
HEV RNA positive	0 (0%)

Patients were categorized into two groups, seropositive and seronegative, for statistical analysis. Of these, 95% (n=171) were seronegative, the overall HEV seroprevalence was 5.0% (9/180; 95% CI: approximately 1.8-8.1%). No statistically significant associations were found between HEV seropositivity and gender, HIV RNA positivity, CD4 count or treatment-naive status. HEV seropositivity was significantly higher in patients older than 60 years ($p = 0.002$; OR = 10.0, 95% CI: 2.47–40.50). This association remained robust even after applying a Bonferroni correction for multiple comparisons (significance threshold $p < 0.01$). However, due to the very small number of overall

Table 2. Statistical significance of variables by HEV seropositivity

Variable	Seronegative Group (n=171) n (%)	Seropositive Group (n=9) n (%)	p *	OR (95% CI)
Sex				
Female	28 (90)	3 (10)	0.187	Reference
Male	143 (96)	6 (4)		0.39 (0.09–1.66)
Age (years)				
<60	152 (97)	4 (3)	0.002	Reference
≥60	19 (79)	5 (21)		10.00 (2.47–40.50)
HIV RNA				
≤33 IU/mL	77 (93)	6 (7)	0.305	Reference
>33 IU/mL	94 (97)	3 (3)		0.41 (0.10–1.69)
CD4 cells/mL				
<200	30 (97)	1 (3)	0.739**	-
200–499	56 (93)	4 (7)		-
≥500	85 (95)	4 (5)		-
Treatment Status				
Naive	22 (96)	1 (4)	1.000	Reference
Treatment-experienced	149 (95)	8 (5)		1.18 (0.14–9.91)

***p-values were calculated using a two-sided Fisher's exact test due to expected cell counts being less than 5. ****p-value derived from Pearson Chi-Square test.**
Note: Bonferroni correction was considered for multiple comparisons, setting the significance threshold to p < 0.01 (0.05/5). The association between age 60 and HEV seropositivity remained statistically significant (p = 0.002). However, due to the limited number of seropositive events, this finding should still be interpreted as exploratory, and multivariable analysis was not performed.

seropositive events (n = 9), multivariable regression analysis was not appropriate. Therefore, this age-related finding should be interpreted cautiously as an exploratory observation rather than a definitive independent risk factor (Table 2).

DISCUSSION

Hepatitis E, an acute inflammatory disease of the liver resulting from hepatitis E virus (HEV) infection, continues to pose a considerable global health burden. In 2021, HEV was estimated to cause nearly 19.47 million cases of acute hepatitis E and 3,450 deaths worldwide, corresponding to 5.4% of the global disability-adjusted life years attributable to acute hepatitis (8). Although HEV infection is generally a self-limiting disease, chronic infection can occur in immunocompromised individuals, including PLHIV (4).

Epidemiological data on HIV/HEV co-infection remain limited, and the findings from the few available reports show considerable variability across several geographical regions and immunoassays (9). It is reported to range from 1.5% to 38.7% in Europe, 3.6% to 19.2% in North and South America, 4.7% to 44.4% in East and Southeast Asia, and 8.3% to 70.9% in Africa (4).

At the time of diagnosis, HEV RNA and anti-HEV IgM antibodies are usually detectable, followed by the emergence of anti-HEV IgG antibodies. Serum anti-HEV IgM positivity is a key indicator of acute HEV infection, although these antibodies are generally detectable for only a short period, typically 3–4 months. In contrast, anti-HEV IgG antibodies persist longer; however, the exact longevity of this immune response has not been clearly established (2).

In people living with HIV, the immune response to HEV frequently differs from the typical seroconversion pattern observed in the general population (9). In such individuals, HEV RNA may persist for extended periods without seroconversion, or only transient IgG antibody responses may be detected, indicating a potential progression toward chronic infection (9). Chronic HEV infection is characterized by the persistence of HEV RNA in blood or stool for at least three months (2).

This is the third study assessing HEV seroprevalence among PLHIV in Türkiye. In the middle Black Sea region, we have shown an HEV seroprevalence of 5%(9/180; 95% CI: approximately 1.8-8.1%) (HEV IgG 4.4%, HEV IgM 1.1%). HEV RNA was not detected at the time of sampling, and no molecular evidence of active HEV infection was observed. Two participants were anti-HEV IgM positive; however, HEV RNA was negative in both cases. One participant was positive for both anti-HEV IgM and IgG, whereas the other was anti-HEV IgM positive but anti-HEV IgG negative. The aminotransferase levels (AST-ALT) of both participants were within normal ranges. However, IgM-positive samples were not retested, no additional confirmatory assay was performed, and follow-up samples were not available. Therefore, particularly considering the immunocompromised status of the study population, these findings may reflect resolving infection, false-positive IgM reactivity, assay cross-reactivity, or low-level or recently cleared viremia. Yaqoobi et al.(5), In their study carried out in Hatay province (Mediterranean region) with 101 HIV-positive individuals, they reported an HEV IgG seropositivity rate of 3.96%, while neither HEV IgM nor HEV PCR positivity was detected. In a study conducted by Öz et al.(6) In Sakarya province (Marmara region), involving 126 HIV-positive individuals, an HEV IgG seropositivity rate of 4% and reported, and all HEV IgG-positive cases were negative for HEV IgM. The prevalence of HEV infection among PLHIV is known to vary significantly across regions, a variation that may reflect underlying differences in environmental risk factors, nutritional habits, agricultural practices, and the presence of zoonotic reservoirs (9). Based on the findings of these studies, it can be concluded that the HEV seroprevalence among HIV-positive individuals in the Marmara, Central Black Sea, and Mediterranean regions is similar, at approximately 4% (5, 6). However, to interpret the results appropriately, it is necessary to consider the HEV seroprevalence

among healthy individuals or specific risk groups at the national level.

In a review compiling 53 studies investigating HEV seroprevalence in Türkiye, the mean seroprevalence among healthy individuals was reported as 9.52%, with regional variations of 4.45% in the Black Sea region, 5.85% in the Marmara region, 8.15% in the Mediterranean region, and 17.15% in Southeastern Anatolia. Higher seropositivity rates were observed in risk groups; for example, the seroprevalence was reported to be 45% among chronic hepatitis C patients in Gaziantep and 25.7% among patients with cryptogenic cirrhosis in Istanbul (7). Studies conducted in Türkiye have shown regional differences in HEV seroprevalence, with particularly higher seropositivity rates reported in Southeastern Anatolia among both healthy individuals and risk groups. Therefore, larger-scale studies are needed, including these regions, to investigate HEV seroprevalence and chronic hepatitis E infection among HIV-positive individuals.

Globally, studies investigating HEV seropositivity among HIV-positive individuals have reported variable results. In Greece, Antonopoulou et al.(9), In a study involving 696 participants, HEV IgG positivity was observed in 16.5%, IgM positivity in 8.6%, and HEV RNA positivity in 2.3% of cases, with no evidence of chronic HEV infection. Moreover, they reported that HEV seroprevalence varied across the country, ranging from 5.1% to 48.4% across five hospitals. In a study conducted in Portugal involving 299 individuals, HEV IgG seroprevalence was 25.4%, while no HEV RNA was detected (10). In Iran, HEV IgG seropositivity has been reported at 18.4%, HEV IgM at 4.6%, and HEV RNA positivity at 8% (11). In the Central African Republic, a study involving 200 patients reported HEV IgG seroprevalence of 68% and IgM positivity of 7.5% (12). In China, a study of 770 patients reported an HEV IgG seroprevalence of 44.4% and an IgM positivity rate of 0.78% (13). Based on these studies, HEV seroprevalence among HIV-positive individuals appears to vary considerably, not only between countries but also across different regions within the same country. Therefore, awareness of regional seroprevalence data may be beneficial for clinicians in the management and follow-up of patients.

In our study, we investigated the statistical relationship between HEV seropositivity and variables including gender, age, HIV RNA positivity, CD4 count, and treatment status. No statistically significant association was found between HIV–HEV co-infection and gender, consistent with some previous studies (3, 14–16). However, other studies have reported a higher prevalence of co-infection among males (12, 13, 17, 18). Our study demonstrated that HEV seropositivity was significantly more prevalent among participants aged 60 years or older than among those younger than 60 (p=0.002). A review of the literature shows that, consistent with our findings, some studies have reported an increase in seroprevalence with advancing age (5, 14, 15), whereas others have demonstrated no significant association between age and seroprevalence (12, 13, 16, 17, 19). It has been suggested that seropositivity may increase with age among individuals engaged in risky behaviors, such as consumption of contaminated water or undercooked meat, or contact with zoonotic reservoirs. The higher HEV seropositivity observed in older participants may be partly explained by cumulative lifetime exposure.

No significant difference in HEV seroprevalence was found between the HIV RNA–positive and HIV RNA–negative groups. Studies in the literature show that there is no significant difference between HIV RNA levels and HEV seroprevalence (5, 17, 20).

There was no statistically significant association between CD4 count and HEV seropositivity in our study. The literature contains conflicting findings on the association between CD4 count and HEV seropositivity. While some studies have demonstrated higher seropositivity rates in individuals with low CD4 counts (13, 19, 21), others have reported no significant difference (5, 12, 15, 16, 17, 20, 22). However, in contrast to these findings, Kenfak Foguena et al. (23) reported that individuals with CD4 counts between 100–350 cells/mm^3 had a 4.7-fold higher HEV seroprevalence than those with CD4 counts below 100 cells/mm^3. All these findings suggest that the relationship between CD4 count and HEV seropositivity remains inconclusive, with varying results reported in the literature.

In our study, HEV seroprevalence did not differ significantly between ART-naive and ART-experienced individuals, a finding consistent with those reported by Debes et al. (21). Likewise, multiple studies have demonstrated that neither ART regimen nor treatment duration significantly affects HEV seroprevalence (15, 17).

Chronic hepatitis E cases are defined by the persistence of detectable HEV RNA for at least three months (24). Chronic HEV infection is rarely observed among HIV-infected patients, with estimated prevalence rates ranging from 0% to 0.5% (17). It is well established that chronic hepatitis E infection may lead to rapid progression to cirrhosis, and the primary risk factor associated with this progression is a CD4 cell count of less than 200 cells/mm^3 (24, 25).

In our study population, no HEV RNA positivity or no molecular evidence of active HEV infection was detected. As no HEV RNA was detected in our study, genotyping could not be performed. Türkiye has previously been reported as an endemic country for HEV genotypes 1 and 2; however, these findings were based on outdated data (2). Balaban et al. (26) reported HEV genotype 3 viremia in one patient with acute hepatitis and in one renal transplant recipient. Therefore, immunosuppressed individuals in Türkiye may be infected with HEV genotypes that have the potential to progress to chronic infection and are thus considered to be at significant risk. In a study conducted in the United States, chronic hepatitis E was identified in 0.05% of cases. The patient remained HEV PCR-positive for 4 years and had a CD4 count of less than 200 cells/mm^3 at the time of diagnosis (27). In a study conducted in France, the prevalence of chronic hepatitis E infection was reported to be 0.5%. The patient had a CD4 count of <50 cells/mm^3, remained HEV RNA positive for 10 months, and did not develop anti-HEV IgG seroconversion during this period (16). In the study conducted by Antonopoulou et al., which included 696 HIV-positive individuals, HEV RNA positivity was detected in 2.3% of the participants; however, no cases of chronic HEV infection were identified (9). Filipe et al (10) reported a high HEV seroprevalence (25.4%); however, no cases of chronic HEV infection were identified. In the study by Rivero-Juárez et al (22), which included 845 HIV-positive individuals, anti-HEV IgG seropositivity was observed in 11.9%, while HEV RNA positivity was detected in 0.23%; however, no cases of chronic HEV infection were identified.

In people living with HIV, the seroprevalence of hepatitis E varies according to geographic region and individual risk factors

(9). Since chronic hepatitis E infection can rapidly progress to cirrhosis, preventing HEV exposure should be a priority. Therefore, patients should be counseled to avoid consuming undercooked meat and contaminated water, as well as contact with zoonotic reservoirs. In immunosuppressed individuals with unexplained abnormal liver function tests, in line with EASL recommendations, both serological tests and nucleic acid testing (NAT) should be performed (24) .

Our study has several limitations. This was a single-center cross-sectional study conducted in the Central Black Sea region of Türkiye. Therefore, the findings may not be generalizable to all people living with HIV in Türkiye, especially considering that HEV seroprevalence may vary between different regions of the country. Larger multicenter studies including broader patient populations from different geographical regions are needed. The study population was predominantly male, and selection bias cannot be excluded. Only nine participants were HEV seropositive, which may have limited the statistical power to detect significant associations. Therefore, the association between older age and HEV seropositivity should be interpreted cautiously. Finally, detailed HEV exposure-related variables, including dietary habits, animal contact, rural residence, travel history, blood transfusion history, and water source, were not collected.

CONCLUSION

This study found a 5%(9/180; 95% CI: approximately 1.8-8.1%) HEV seroprevalence among people living with HIV in a region of northern Türkiye, with no molecular evidence of active HEV infection detected. This prevalence is in line with prior reports from Türkiye and suggests that overall HEV exposure in the HIV-positive population is low and comparable to the general population. Older age was associated with higher HEV seropositivity, indicating that cumulative exposure or age-related risk factors may play a role. Larger multi-center studies are needed to better explain the epidemiology of HEV throughout various regions of Türkiye and to inform evidence-based guidelines on HEV surveillance in HIV-positive patients.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Conflict of interest

The authors declare no conflict of interest.

Data Availability

The datasets generated and analyzed during the current study are not publicly available due to institutional privacy policies, but are available from the corresponding author on reasonable request.

Ethics Approval

This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Samsun University Non-Interventional Clinical Research Ethics Committee (Decision No. 2025/2/6, dated 24 January 2025). Medical research on human participants must be carried out according to the World Medical Association Declaration of Helsinki. Written informed consent was obtained from all participants.

Authors' Contributions

Conceptualization: [Köse H]; Methodology: [Köse H, Bilgin M, Taşkın M.H]; Investigation: [Köse H]; Writing – Original Draft Preparation: [Köse H]; Writing – Review & Editing: [Köse H, Bilgin M, Taşkın M.H]. All authors have read and agreed to the published version of the manuscript.

Declaration of AI Use

The authors used ChatGPT only for language editing and grammatical refinement during the preparation of this manuscript. No artificial intelligence tool was used for data analysis, interpretation of results, or generation of scientific content. The authors have reviewed and approved the final manuscript and take full responsibility for its accuracy and integrity.

REFERENCES

1. Dienstag JL. Viral hepatitis. Bennett JE, Dolin R, Blaser MJ, editors. 2020:1548-1582.
2. Aslan AT, Balaban HY. Hepatitis E virus: epidemiology, diagnosis, clinical manifestations, and treatment. World J Gastroenterol. 2020;26:5543-5560. [DOI:10.3748/wjg.v26.i37.5543] [PMCID:PMC7545399] [PMID:33071523]
3. Shahriarirad R, Erfani A, Rastegarian M, Zeighami A, Arefkhah N, Ghorbani F, et al. Seroprevalence of anti-hepatitis E antibodies and antigens among HIV-infected patients in Fars Province, southern Iran. Virol J. 2020;17:109. [DOI:10.1186/s12985-020-01384-0] [PMCID:PMC7368745] [PMID:32680534]
4. Alexandrova R, Tsachev I, Kirov P, Abudalleh A, Hristov H, Zhivkova T, et al. Hepatitis E virus (HEV) infection among immunocompromised individuals: a brief narrative review. Infect Drug Resist. 2024;17:1021-1040. [DOI:10.2147/IDR.S449221] [PMCID:PMC10948336] [PMID:38505248]
5. Yaqoobi H, Önlen Y, Çabalak M, Demir T. Investigation of hepatitis E virus seroprevalence and chronic hepatitis E infection in HIV-positive patients. Viral Hepatitis J. 2024;30. [DOI:10.4274/vhd.galenos.2024.2024-1-2]
6. Oz S, Altındiş M, Toptan H, Köroğlu M, Karabay O. Investigation of hepatitis E seroprevalence in HIV-positive patients by a novel enzyme-linked fluorescent assay test. Clin Lab. 2020;66(7). [DOI:10.7754/Clin.Lab.2019.191122] [PMID:32658412]
7. Sezgin O, Yaraş S, Tezcan Ülger S, Aslan G, Tiftik EN. The prevalence of hepatitis E virus infection in the adult Turkish population: a systematic review of the literature and prevalence study in blood donors in Mersin province. Turk J Gastroenterol. 2021;32(9):782-789. [DOI:10.5152/tjg.2021.20870] [PMCID:PMC8975503] [PMID:34609308]
8. Hepatitis E. In World Health Organization. 2026. https://www.who.int/news-room/fact-sheets/detail/hepatitis-e. Accessed 22 Jan 2026
9. Antonopoulou N, Schinas G, Kotsiri Z, Tsachouridou O, Protopapas K, Petrakis V, et al. Testing hepatitis E seroprevalence among HIV-infected patients in Greece: the SHIP study. Pathogens. 2024;13:536. [DOI:10.3390/pathogens13070536] [PMCID:PMC11280285] [PMID:39057763]
10. Filipe R, Prista-Leão B, Silva-Pinto A, Abreu I, Serrão R, Costa R, et al. Hepatitis E in a Portuguese cohort of human immunodeficiency virus-positive patients: high seroprevalence but no chronic infections. Health Sci Rep. 2022;5:e624. [DOI:10.1002/hsr2.624] [PMCID:PMC9121181] [PMID:35601036]
11. Zahedi MZ, Shafieipour S, Hayatbakhsh Abassi MM, Pourjamali N, Nakhaie M, Charostad J, et al. Higher risk of chronic hepatitis E virus infection in patients with human immunodeficiency virus-1: an Iranian cross-sectional study. Iran J Pathol. 2023;18:125-133. [DOI:10.30699/IJP.2023.551657.2870] [PMCID:PMC10439753] [PMID:37600571]
12. Sibiro Demi, Manirakiza O A, Komas A, N P. Seroprevalence of hepatitis E virus infection among people living with HIV in the Central African Republic. Open Forum Infect Dis. 2018;5. [DOI:10.1093/ofid/ofy307] [PMCID:PMC6291416] [PMID:30568981]

13. Zhou S, Ren L, Xia X, Miao Z, Huang F, Li Y, et al. Hepatitis E virus infection in HIV-infected patients: a large cohort study in Yunnan province, China. China. J Med Virol. 2018;90:1121-1127. [DOI:10.1002/jmv.25060] [PMID:29457639]

14. Lin KY, Lin PH, Sun HY, Chen YT, Su LH, Su YC, et al. Hepatitis E virus infections among human immunodeficiency virus-positive individuals during an outbreak of acute hepatitis A in Taiwan. Hepatology. 2019;70:1982-1902. [DOI:10.1002/hep.30771] [PMID:31100186]

15. Abravanel F, Lhomme S, Fougère M, Saune K, Alvarez M, Péron JM, et al. HEV infection in French HIV-infected patients. J Infect. 2017;74:310-313. [DOI:10.1016/j.jinf.2016.12.004] [PMID:27998748]

16. Kaba M, Richet H, Ravaux I, Moreau J, Poizot-Martin I, Motte A, et al. Hepatitis E virus infection in patients infected with the human immunodeficiency virus. J Med Virol. 2011;83. [DOI:10.1002/jmv.22177] [PMID:21837786]

17. Rivero-Juarez A, Lopez-Lopez P, Frias M, Rivero A. Hepatitis E infection in HIV-infected patients. Front Microbiol. 2019;10:1425. [DOI:10.3389/fmicb.2019.01425] [PMCID:PMC6608679] [PMID:31297100]

18. Scotto G, Grisorio B, Filippini P, Ferrara S, Massa S, Bulla F, et al. Hepatitis E virus co-infection in HIV-infected patients in Foggia and Naples in southern Italy. Infect Dis. 2015;47:707-713. [DOI:10.3109/23744235.2015.1049658] [PMID:25994453]

19. Debes JD, Pisano MB, Lotto M, Ré V. Hepatitis E virus infection in the HIV-positive patient. J Clin Virol. 2016;80:102-106. [DOI:10.1016/j.jcv.2016.05.006] [PMID:27243210]

20. Parfieniuk-Kowerda A, Jaroszewicz J, Łapiński TW, Łucejko M, Maciaszek M, Świderska M, et al. High prevalence of anti-HEV antibodies among patients with immunosuppression and hepatic disorders in eastern Poland. Arch Med Sci. 2018;17:675-681. [DOI:10.5114/aoms.2018.79958] [PMCID:PMC8130492] [PMID:34025837]

21. Debes JD, Martínez Wassaf M, Pisano MB, Isa MB, Lotto M, Marianelli LG, et al. Increased hepatitis E virus seroprevalence correlates with lower CD4+ cell counts in HIV-infected persons in Argentina. PLoS One. 2016;11:e0160082. [DOI:10.1371/journal.pone.0160082] [PMCID:PMC4965084] [PMID:27467394]

22. Rivero-Juarez A, Frias M, Lopez-Lopez P, Berenguer J, García F, Macias J et al, et al. Hepatitis E 3ra Genotype Infection in people living with HIV in Spain. HIV in Spain. Front Microbiol. 2020;11:564486. [DOI:10.3389/fmicb.2020.564486] [PMCID:PMC7945038] [PMID:33716992]

23. Kenfak-Foguena A, Schöni-Affolter F, Bürgisser P, Witteck A, Darling KE, Kovari H, et al. Hepatitis E virus seroprevalence and chronic infections in patients with HIV, Switzerland. Switzerland. Emerg Infect Dis. 2011;17:1074-1078. [DOI:10.3201/eid/1706.101067] [PMCID:PMC3358194] [PMID:21749774]

24. European Association for the Study of the Liver. European Association for the Study of the Liver. EASL Clinical Practice Guidelines on hepatitis E virus infection. J Hepatol. 2018;68:1256-1271. [DOI:10.1016/j.jhep.2018.03.005] [PMID:29609832]

25. Gómez Torres KM, Estévez Escobar M, Lozano Serrano AB. Ribavirin monotherapy for the treatment of chronic hepatitis E in an immunosuppressed patient. Rev Esp Enferm Dig. 2021;113:386-387. [DOI:10.17235/reed.2020.7266/2020] [PMID:33222484]

26. Balaban HY, Aslan AT, Akdoğan-Kittana FN, Alp A, Dağ O, Ayar ŞN, et al. Hepatitis E virus prevalence and associated risk factors in high-risk groups: a cross-sectional study. Turk J Gastroenterol. 2022;33:615-624. [DOI:10.5152/tjg.2022.21493] [PMCID:PMC9404861] [PMID:35879919]

27. Kuniholm MH, Ong E, Hogema BM, Koppelman M, Anastos K, Peters MG, et al. Acute and chronic hepatitis E virus infection in Human Immunodeficiency Virus -infected United States women. Hepatology. 2016;63:712-720. [DOI:10.1002/hep.28384] [PMCID:PMC4764464] [PMID:26646162]