Iran J Public Health, Vol. 55, No.1, Jan 2026, pp.143-150

Original Article

Retrospective Evaluation of Hepatitis B Prevalence and Viral Load Pattern among Patients in Mogadishu, Somalia

Bashiru Garba [1,2,3], Shukri Hussein Mohamud [4], Hafida Abdullahi Samatar [4], Najib Isse Dirie [1,5], Abdirahman Khalif Mohamud [6], Mohamed Hussein Adam [1,2], Jihaan Hassan [1,7], Fartun Abdullahi Hassan Orey [7], Hodo Aideed Asowe [8], Jamal Hassan Mohamoud [1,2], Mohamed Mustaf Ahmed [6]

1. *SIMAD Institute for Global Health, SIMAD University, Mogadishu, Somalia*
2. *Department of Public Health, Faculty of Medicine, & Health Sciences, SIMAD University, Mogadishu, Somalia*
3. *Department of Veterinary Public Health & Preventive Medicine, Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto, Nigeria*
4. *Diagnostic Laboratory, Dr. Sumait Hospital, Faculty of Medicine and Health Sciences, SIMAD University, Mogadishu, Somalia*
5. *Department of Urology, Faculty of Medicine, and Health Sciences, SIMAD University, Mogadishu, Somalia*
6. *Department of Medicine, Faculty of Medicine, & Health Sciences, SIMAD University, Mogadishu, Somalia*
7. *Department of Pediatrics, Faculty of Medicine, & Health Sciences, SIMAD University, Mogadishu, Somalia*
8. *Department of Nursing and Midwifery, Faculty of Medicine, and Health Sciences, SIMAD University, Mogadishu, Somalia*

***Corresponding Author:** Email: garba.bashiru@simad.edu.so

(Received 12 Aug 2025; accepted 02 Nov 2025)

Abstract

Background: Hepatitis B is an infection of the liver caused by the hepatitis B virus. The infection is characterized by acute and chronic illness, that often lead to liver cirrhosis, and death. In this study, we determined the proportion of patients with hepatitis B infection in Mogadishu and evaluated their hepatitis B viral DNA.

Methods: A retrospective hospital-based descriptive study was conducted between July 2022 and October 2023 to collect data from all patients sent to the Dr. Sumait Hospital, Mogadishu, Somalia for hepatitis B DNA detection and viral load determination.

Results: Among the 406 patients studied in a clinical setting, 54.4% tested positive for hepatitis B virus (HBV) infection. The cohort predominantly consisted of males (62.8%) and individuals aged 30-39 years (32.8%). Age and sex were significantly associated with HBV positivity, with higher odds observed in older age groups with a 2.62 times higher risk of infection (95%CI=1.447-4.750) for the individuals aged between 30-39 years old, 3.19 times greater (95%CI=1.671-6.114) for those age group between 40-49 years old, and 3.13 times greater (95%CI=1.670-5.870) for those age group above 50 years. It should be noted that these findings are based on a clinical cohort and therefore may not represent the prevalence of HBV in the general population.

Conclusion: This study highlights a high proportion of HBV infection among clinical patients with known or suspected HBV infection in Mogadishu, with significant associations between age, sex, and infection risk. Further population-based studies are needed to assess the true burden of HBV in the general population in Somalia.

Keywords: Hepatitis B virus; Liver cirrhosis; Hepatocellular carcinoma; Real-time PCR; Somalia

DOI: https://doi.org/10.18502/ijph.v55i1.20980

Introduction

Hepatitis B is a viral infection associated with acute and chronic liver diseases. This disease is a major global public health problem, with the Western Pacific and Africa having the highest burden of infection(1,2). Approximately 296 million individuals are estimated to be affected by the virus, resulting in 820,000 deaths due to hepatocellular carcinoma and liver cirrhosis (3). The disease has shown some dynamic epidemiological features, where previously endemic locations are reporting a decrease in prevalence, which is attributed to improvements in socioeconomic status, antiviral treatment, and vaccine uptake (4–6). However, countries with a low prevalence are beginning to record higher cases due to the increased migration of people from endemic countries (4).

Similar to most African countries, viral hepatitis, particularly hepatitis B virus (HBV), is considered an important public health problem in Somalia. It is endemic and has a relatively high prevalence rate (7). However, high-quality epidemiological data on hepatitis in Somalia is inadequate. Similarly, information regarding viral load patterns is unavailable. This is despite the importance of viral load patterns for guiding treatment decisions. HBV viral load levels of HBV DNA correlate with the severity of infection and are usually associated with a significantly increased risk of developing liver cirrhosis and hepatocellular carcinoma (4). Available data have shown that high HBV viral load is a significant predictor of HCC development of hepatocellular carcinoma (8,9). Among the various treatment strategies for recurrent HCC, altering the HBV load via targeted treatment is the only option.

Furthermore, HBV DNA level is the key prognostic marker for disease progression and a primary guide for treatment decisions. Large cohorts, including REVEAL-HBV, show a clear dose response between viral load and risks of cirrhosis and hepatocellular carcinoma, independent of ALT or HBeAg (10,11). Clinical guidelines use HBV DNA thresholds to determine treatment eligibility, monitor response, and detect virologic breakthrough; high maternal HBV DNA also informs peripartum prophylaxis to reduce mother-to-child transmission (12–14). In Somalia's resource-limited context, defining local viral load distributions will identify high-risk patients, prioritize antiviral therapy, and provide objective program metrics, directly addressing current evidence gaps.

According to the Risk Evaluation of Viral Load Elevation and Associated Liver Disease/Cancer-Hepatitis B Virus (REVEAL-HBV), the incidence of liver cirrhosis tends to increase based on HBV DNA levels, from 5% when the viral load is not detectable (< 300 copies/mL) to 36% when the viral load is above 106 copies/mL (10,11). In other words, the progression of liver disease to cirrhosis among hepatitis B–infected individuals strongly correlate with the HBV viral load, regardless of the serum levels of the alanine aminotransferase enzyme of the hepatitis B e antigen. Similarly, the risk of developing hepatocellular carcinoma is proportional to the circulating HBV levels.

Addressing this important public health challenge would require primary epidemiological data on HBV status and viral load patterns, which could serve as a guide for the government and other healthcare service providers to control and manage the infection. However, as highlighted earlier, there are only a few published studies on the epidemiology of HBV in Somalia, all of which were based on serological assays. In addition, data on the incidence and determinants of cirrhosis and hepatocellular carcinoma in patients with HBV infection are lacking. Polymerase chain reaction–based methods, including real-time quantitative PCR, are highly sensitive techniques that can objectively detect and measure serum HBV DNA levels, which can help determine disease progression depending on the HBV DNA levels (12–14). HBV DNA is a quantitative virologic marker that determines the HBV replication level. Many studies have shown that HBV DNA levels can explain the severity of infection and extent of liver injury and fibrosis to a large extent. It has also proven to

be a useful marker for evaluating response to antiviral treatment (13). In this study, we examined the prevalence of HBV infection among patients in Mogadishu and determined the viral pattern in HBV-positive patients.

Materials and Methods

Ethical approval

The study was conducted in compliance with the approval and recommendations granted by the ethics review board of the SIMAD University, Mogadishu, Somalia (Ref. No.: 2022/IM-RSU/FMHS/FR18/P049). All the patients/parents and guardians of the research subjects were informed about the study's objectives, and their informed verbal consent was obtained before enrollment as approved by the ethics review board. To preserve anonymity under verbal consent, no names, signatures, phone numbers, or other direct identifiers were recorded. Each participant was assigned a unique study ID; the consent confirmation was documented by ID, date/time, and interviewer initials (and an independent witness where required), without any personal identifiers. All identifiable participants' information were made anonymous and only willing participants were enrolled without any coercion.

Inclusion and exclusion criteria

Inclusion criteria were all individuals requesting for HBsAg test, regardless of symptom status or treatment history. Patients whose records were missing, or incomplete were also excluded.

Patients and samples

This study used a descriptive retrospective approach. All patients referred for HBV diagnosis by PCR at Dr. Sumait Hospital, Mogadishu, Somalia, regardless of their serological status (positive or HBsAg screening test), were included. For each case, only patient records, including age, sex, HBV DNA status, and viral load, were included.

The laboratory records of all 406 patients who satisfied the inclusion criteria and underwent HBV DNA PCR test between July 2022 and October 2023. A Google form was used to enter the patient's data, results, and viral load status, and an Excel sheet was retrieved and exported into IBM SPSS version 27.0; (IBM Corp., Armonk, NY, USA)) for analysis. The incidence rates of HBV infection were determined for age and sex variables, whereas positive infection rates were analyzed based on serum HBV DNA levels. Chi-square analysis was used to determine any association between HBV DNA levels (less than 20, 20-2000, 2001-20,000, and >20,000 IU/mL).

Nucleic acid extraction

Viral DNA was isolated from whole blood samples of patients using the GeneProof Pathogen-Free DNA Isolation Kit (GeneProof, Brno, Czech Republic), according to the manufacturer's protocol. Briefly, template DNA was extracted from 200 µl of whole blood using the spin column technique. Prior to DNA extraction, 5 µl of GeneProof internal extraction control was added to the blood sample.

Real time PCR detection and quantification of HBV DNA

HBV detection entails the amplification of a specific conserved DNA sequence of the HBV P-gene and determination of its presence, as indicated by FAM fluorophore fluorescence growth. Quality control was achieved with the aid of a positive Internal Control detected in the HEX fluorescence channel. In addition, the RT-PCR Master Mix contains uracil-DNA-glycosylase, which helps to avoid errors due to contamination of the PCR products. PCR was performed on a LineGene 9600 thermocycler (Bioer, China) in a 50 µl reaction volume. The qPCR program consisted of two steps: holding at 37 °C for 2 min and 95 °C for 1 min, followed by 45 cycles of annealing, extension, and a final extension at 95°C for 5 s, 60 °C for 40 s, and then 70 °C for 20 s.

Results

Socio-demographic characteristics

Overall, 406 participants were included in this study, of which 255 (62.8%) were male and 133 (32.8%) were age group 30-39 years. In addition,

223 (54.4%) participants were positive for hepatitis B virus infection, of whom 154 of the positive respondents were male and 70 were aged 30-39 years. Chi square analyses indicated that participant age and sex were significantly associated with HBV infection. Importantly, this patient sample represents a clinical cohort, and thus the infection rates observed here cannot be extrapolated as general population prevalence (Table 1).

Table 1: Socio-demographic characteristics between HBV-infected and non-infected

Characteristics	HBV infection		Total n (%)	χ2	*P*-value
	Positive n (%)	Negative n (%)			
Gender				8.274	0.004*
Male	154 (60.4)	101 (39.6)	255 (62.8)		
Female	69 (45.7)	82 (54.3)	151 (37.2)		
Age				19.342	<0.001*
< 29	66 (75.0)	22 (25.0)	88 (21.7)		
30-39	70 (52.6)	63 (47.4)	133 (32.8)		
40-49	40 (46.0)	47 (54.0)	87 (21.4)		
>50	47 (48.0)	51 (52.0)	98 (24.1)		

Association between age and gender with HBV positivity.

The age and sex of the participants were significantly associated with hepatitis B virus (HBV) infection based on positivity in univariate and multivariate logistic regression analyses. Crude and adjusted analyses were performed to examine the association of age and gender with HBV positivity. Crude positivity proportions were higher among males (Table 1). However, in multivariable logistic regression adjusting for age, females showed significantly higher odds of HBV infection compared to males (Table 2). This suggests potential confounding by age or other variables. Similarly, the odds of hepatitis B virus infection were 2.62 times higher (95%CI=1.447-4.750) for individuals aged–30-39 years old, 3.19 times greater (95%CI=1.671-6.114) for those age group–40-49 years old, and 3.13 times greater (95%CI=1.670-5.870) for those aged > 50 years (Table 2).

Table 2: Association between age and gender with HBV positivity

Characteristics	OR (95%CI)	P-value	OR (95%CI)	P-value
Gender				
Male	1			
Female	1.81(1.206-2.722)	0.004*	1.66 (1.096-2.530)	0.017
Age(yr)				
< 29	1		1	
30-39	2.70 (1.496-4.873)	0.001	2.62 (1.447-4.750)	0.001
40-49	3.52 (1.857-6.690)	<0.001	3.19 (1.671-6.114)	<0.001
>50	3.25 (1.743-6.078)	<0.001	3.13 (1.670-5.870)	<0.001

Hepatitis B virus (HBV) infection viral load

Of the 223 hepatitis B virus (HBV)-infected patients in this study, 30.3% had a viral load between 20-2000IU/mL, 11.6% had a viral load less than 20 IU/mL, 7.6% had a viral load of 20000 IU/mL, and only 5.40% had a viral load between 2001-20000IU/mL.

Among the HBV-infected patients, 31 (13.9%) had a viral load of ≥2,000 IU/mL, which is a key threshold for treatment consideration according

to international guidelines such as EASL and NICE. The remaining 192 patients (86.1%) had viral loads below this threshold.

Table 3 summarizes the proportions of HBV-infected patients by viral load categories (IU/mL), reflecting the range of viral replication activity in this clinical cohort. The majority (30.3%) of patients had viral loads between 20 and 2,000 IU/mL, indicating low to moderate viral presence. A smaller fraction exhibited high viral loads, with 7.6% exceeding 20,000 IU/mL and 5.4% falling between 2,001 and 20,000 IU/mL, which may represent individuals at greater risk of disease progression and candidates for treatment. Additionally, 11.6% had very low viral load levels under 20 IU/mL, potentially reflecting controlled or inactive infection.

Table 3: Distribution of hepatitis B viral load levels among infected patients in Mogadishu, Somalia (N=223)

HBV Viral Load (IU/mL)	Number of Patients (approx.)	Percentage (%)
> 20,000	223 x 7.6% = 17	7.6
2,001 - 20,000	223 x 5.4% = 12	5.4
20 - 2,000	223 x 30.3% = 68	30.3
< 20	223 x 11.6% = 26	11.6

In addition, the chi-square analysis to establish whether any association existed between the two variables analyzed showed that only age (P <0.004) was significantly associated with the viral level (Table 4).

Table 4: Association between age, gender, and viral load

Variables	Viral level			Total n (%)	χ2	P-value
	Low viral load n (%)	Moderate n (%)	High viral load n (%)			
Gender					3.669	0.162
Male	113 (73.4)	19 (12.3)	22 (14.3)	154 (69.1)		
Female	57 (82.6)	3 (4.3)	9 (13.0)	69 (30.9)		
Age					19.167	0.004
< 30	39 (59.1)	10 (15.2)	17 (25.8)	66 (29.6)		
30-39	60 (85.7)	4 (5.7)	6 (8.6)	70 (31.4)		
40-49	31 (77.5)	6 (15.0)	3 (7.5)	40 (17.9)		
>50	40 (85.1)	2 (4.3)	5 (10.6)	47 (21.1)		

Note: Low viral load = 0-5,000; Moderate viral load = 5,000-250,000; High viral load = >250,000

Discussion

This 15-months hospital-based retrospective study offers a unique opportunity to evaluate the prevalence of chronic HBV infection and to understand the viral load pattern among patients in Mogadishu, Somalia. This study provides valuable data regarding HBV carriers in Mogadishu, which constitutes a significant risk to all susceptible individuals, especially in densely populated regions.

The results of this study revealed that 54.4% of the patients were positive for hepatitis B virus DNA, indicating a very high infection rate in Mogadishu. This may not represent the true state of HBV infection in the study location, because most of the patients enrolled in the present study are known to be HBV-positive and are currently undergoing treatment. Hence, the recommendation for the HBV DNA test is to monitor treatment and viral load levels rather than to determine the presence of infection. Furthermore, since the study population is composed of individuals seeking healthcare

services, these results should not be interpreted as reflecting HBV prevalence in the wider community. Clinical cohorts often have higher rates of infection due to referral patterns or symptomatic presentation. Therefore, while our findings emphasize risk factors such as age and sex among this group, further population-based studies are needed to determine the true prevalence and inform public health interventions. Notwithstanding, the study also found that a fairly good number of patients are ignorant of their HBV status; hence, these groups undergo the test to determine their status. Varying prevalence levels of HBV have been reported in Somalia, ranging from 7.3% among 16 patients undergoing hemodialysis, 18.9% pooled prevalence according to a systematic report and meta-analysis, and 11.8% and 23% among the general and nomadic populations, respectively (15,16). It may not be an exaggeration to assume that the HBV prevalence is high in Somalia, especially because the recommendations of the WHO require that individuals in the general population with Hepatitis B surface antigen seroprevalence between 2-5% should be offered HBsAg testing, and preventive and treatment services should be provided. Despite the high HBV seroprevalence, none of these services are readily available to people in the country. However, this is not uncommon in countries facing humanitarian crises because reports have shown that refugees, asylum seekers, and internally displaced persons are among the highest-risk individuals and traditionally face many barriers in seeking healthcare (17).

A preponderance of males among HBV-infected individuals with detectable viral loads was also observed in this study. Although the reason is not clear, this finding can be attributed to the ratio of male to female patients enrolled in the study, with twice as many males as females. This agrees with many other studies, including those by Iregbu and Nwajiobi-Princewill, who reported that male have a higher HBV viral load than female (18). Another possible explanation could be that males are more finically buoyant; hence, they can afford to go for tests compared to their female counterparts, who may be constrained by low financial resources (19). This notion is also supported by the World Bank report that indicated that Female labour force participation is far lower than men's in Somalia (≈20.9% women vs 47.1% men in 2024), indicating reduced earning power and economic autonomy for women.

The age range with the highest incidence of HBV infection was 30-39 years old. This is similar to the 31–40 and 30–39 years reported for Abuja and Lagos, Nigeria, respectively(18,19). Age is an important factor that determines whether a patient with HBV infection develops chronic disease. Although individuals of all ages are at risk of developing the disease, the risk is higher among adults exposed to many risk factors. This is true for the age group 30-50 years with some studies reporting that the log-likelihood of having HBV is 6.67 times more than younger individuals (20). However, contrasting studies have found that older carriers have less infection and viral load than younger carriers because older carriers tend to clear HBeAg (21). Notwithstanding, this discrepancy can be attributed to other factors, including differences in behavioral and cultural practices (20).

In Somalia, tests for the evaluation of HBV DNA levels in HBV-positive patients are generally not available in most public and private healthcare institutions. This gap is consistent with our recent report from Mogadishu, which also highlights the high clinical burden of hepatitis B and the practical importance of access to hepatitis B virus DNA testing to inform patient management (22). Therefore, the assessment is based on serological screening and serum ALT levels, which are not very efficient in detecting acute infections. This study identified several patients with a high HBV viral load. The results showed that 7.6% of patients had a viral load above 20,000 IU/mL, whereas 5.4% had a viral load between 2001 and 20,000 IU/ml. The EASL 2017 Clinical Practice Guidelines on the management of hepatitis B virus infection recommend treatment for HBV DNA levels >2,000 IU/ml in addition to elevated levels of ALT (4). Similarly, the National Institute for Health and Care Excellence (NICE) recommends that HBV viral load values of 2.0×10^3–2.0×10^4

IU/ml are critical cut-off points for commencement of treatment, in addition to age and ALT levels (23). In this study, patients aged <30 years had the highest viral load (>20,000 IU/mL), followed by 30-39 years, with 40-49 years comprising patients with the lowest viral load. The surprisingly high number of patients aged <30 years with the highest viral load could be due to the relatively naïve immune system in this age group and the different clinical disease courses that characterize this age group (23,24). This highlights the need for routine vaccination against HBV infection (23).
This study has some limitations, including the retrospective nature of the study, which does not permit the study of a large pool of determinant variables that could provide useful clinical information, as well as the lack of representativeness of the samples. Hence, caution must be taken not to extrapolate the findings to the general population. Notwithstanding, the information generated from this study will benefit the scientific community and clinicians with relevance to patient management and emphasize the need to make HBV DNA viral load determination a routine assessment for HBV patients so that treatment decisions can be properly guided.

Conclusion

The study reports a high rate of detectable hepatitis B viraemia in patients tested in Mogadishu, including many whose viral loads meet or exceed treatment thresholds. It highlights the urgent need in Somalia for wider hepatitis B testing and vaccination, better access to viral load monitoring for clinical decision-making, and robust population-based studies to accurately determine the community burden.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

This study was supported in part by grant SIMAD-CRD-2023 from the SIMAD University, Mogadishu, Somalia, through the Center for Research and Development.

Conflict of interest

The author(s) report no conflicts of interest in this work.

References

1. Hsu YC, Huang DQ, Nguyen MH (2023). Global burden of hepatitis B virus: current status, missed opportunities and a call for action. *Nat Rev Gastroenterol Hepatol,* 20(8): 524-537.
2. Tripathi N, Mousa OY (2023). Hepatitis B. Treasure Island (FL): StatPearls Publishing; 2025 Jan.
3. World Health Organization (2023). Hepatitis B. Accessed: 21 Nov 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/hepatitis-b
4. Lampertico P, Agarwal K, Berg T et al (2017). EASL 2017 clinical practice guidelines on the management of hepatitis B virus infection. *J Hepatol*, 67(2): 370-398.
5. Coppola N, Alessio L, Gualdieri L, et al (2015). Hepatitis B virus, hepatitis C virus and human immunodeficiency virus infection in undocumented migrants and refugees in southern Italy, January 2012 to June 2013. *Euro Surveill*, 20(35): 30009.
6. Hampel A, Solbach P, Cornberg M, et al (2016). Aktuelle seroprävalenz, impfstatus und prädiktiver wert der leberenzyme für hepatitis B bei flüchtlingen in deutschland. *Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz*, 59(5): 578-583.
7. Jeele MOO, Addow ROB, Adan FN, Jimale LH (2021). Prevalence and risk factors associated with hepatitis B and hepatitis C infections among patients undergoing hemodialysis: a single-centre study in Somalia. *Int J Nephrol*, 2021: 1555775.

8. Sherman M (2009). Risk of hepatocellular carcinoma in hepatitis B and prevention through treatment. *Cleve Clin J Med*, 76(Suppl 3): S6-S9.
9. Chen CJ, Yang HI, Su J, et al (2006). Risk of hepatocellular carcinoma across a biological gradient of serum hepatitis B virus DNA level. *JAMA*, 295(1): 65-73.
10. Iloeje UH, Yang HI, Su J, et al (2006). Predicting cirrhosis risk based on the level of circulating hepatitis B viral load. *Gastroenterology,* 130(3): 678-686.
11. Nita ME, Gaburo N, Cheinquer H, et al (2009). Patterns of viral load in chronic hepatitis B patients in Brazil and their association with ALT levels and HBeAg status. *Ann Hepatol*, 8(4): 339-345.
12. Krajden M, McNabb G, Petric M (2005). The laboratory diagnosis of hepatitis B virus. *Can J Infect Dis Med Microbiol,* 16(2): 65-72.
13. Riaz MN, Faheem M, Anwar MA, et al (2016). PCR-based molecular diagnosis of hepatitis virus (HBV and HDV) in HCV infected patients and their biochemical study. *J Pathog*, 2016: 3219793.
14. Chen P, Xie Q, Lu X, Yu C, et al (2017). Serum HBeAg and HBV DNA levels are not always proportional and only high levels of HBeAg most likely correlate with high levels of HBV DNA: a community-based study. *Medicine (Baltimore),* 96(33): e7766.
15. Bile KM, Aden A, Lindberg G, et al (1987). Epidemiology of hepatitis B in Somalia: inference from a cross-sectional survey of serological markers. *Trans R Soc Trop Med Hyg*, 81(5): 824-828.
16. Lee C, Emeto TI, Walsh N (2023). Prevalence of hepatitis B virus amongst refugees, asylum seekers and internally displaced persons in low- and middle-income countries: a systematic review. *J Viral Hepat,* 30(1): 4-18.
17. Iregbu K, Nwajiobi-Princewill P (2016). Viral load pattern among hepatitis B surface antigen-positive patients: laboratory perspective and implications for therapy. *Ann Med Health Sci Res*, 6(2): 95-9.
18. Okwuraiwe A, Salu O, Onwuamah CK, Amoo OS, Odunukwe NN, Audu RA (2011). Experience with hepatitis B viral load testing in Nigeria. *Afr J Clin Exp Microbiol*, 12(3): 101-105.
19. Mohammed H, Eshetie A, Melese D (2022). Prevalence of hepatitis B virus and associated risk factors among adult patients at Dessie referral and Kemise general hospitals in northeastern Ethiopia. *Health Sci Rep*, 5(3): e e659.
20. Zhang H, Li Q, Sun J, Wang C, Gu Q, Feng X, et al (2011). Seroprevalence and risk factors for hepatitis B infection in an adult population in Northeast China. *Int J Med Sci,* 8(4): 321-331.
21. Garba B, Mohamud AA, Mohamed FH, et al (2026). Prevalence, risk factors, and viral load quantification of HBV infection among hospital patients: a cross-sectional investigation in Mogadishu, Somalia. *PLoS One*, 21(1): e0340800.
22. Yu SJ, Kim YJ (2014). Hepatitis B viral load affects prognosis of hepatocellular carcinoma. *World J Gastroenterol,* 20(34): 12039-12044.
23. Jonas MM, Block JM, Haber BA, et al (2010). Treatment of children with chronic hepatitis B virus infection in the United States: patient selection and therapeutic options. *Hepatology*, 52(6): 2192-2205.
24. Lemoine M, Eholié S, Lacombe K (2015). Reducing the neglected burden of viral hepatitis in Africa: strategies for a global approach. *J Hepatol*, 62(2): 469-476.