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Prevalence and impact of Hepatitis B Virus (HBV) in Lashkar Gah City, Afghanistan: a case study

Abstract. Hepatitis B Virus (HBV) remains a critical public health issue in Lashkar Gah City, Afghanistan, necessitating a focused investigation into its prevalence, clinical implications, and management, this case study research aimed to evaluate HBV prevalence across different demographic groups and regions, assess the incidence of chronic infections, and analyze diagnostic and treatment strategies. The study also identified gaps in public health approaches and proposed targeted interventions. 100 diagnosed patients were investigated, data were collected from two key hospitals Bost University Private Hospital and Helmand Provincial Infectious Disease Treatment Hospital and three laboratories. A structured 24-question multiple-choice survey was completed by 100 healthcare specialists, including psychologists, neurologists, and medical doctors. Analysis using IBM SPSS Statistics software revealed a significant male predominance in HBV cases (99%) and higher prevalence in densely populated areas (96%) and warmer climates (92%). In 72% cases, it was chronic, 63% patients had on slight symptoms and 87% cases have long lived with the condition. Nausea, vomiting, and jaundice were the common clinical symptoms reported in 94% of the cases. These results indicate that enhanced diagnostic measures, prevention practices, and population health awareness programs are most required, and the case study also brings significant contributions to the epidemiological role of HBV in Lashkar Gah City and proposes practical recommendations to be addressed by medical workers and decision-makers to advance the management of the disease and lighten the health-related burden on the population.
Key words: Hepatitis B Virus (HBV), Prevalence, Epidemiology, Chronic HBV, Lashkar Gah, Afghanistan.

Introduction

Hepatitis B virus (HBV) is a DNA virus with a lipid coat introduced by the *Hepadnaviridae* family. A particular antigen, at first called the "Australia antigen," was first found in the serum of an Indigenous Australian to identify the virus. Later, it was proven that this antigen is connected to HBV in those with hepatitis and visualized by electron microscope in 1970. It encompasses a diminutive (3.2 kb) covalently closed circular DNA (cccDNA) within its genome. This cccDNA is transcribed into four distinct transcripts (3.5 kb, 2.4 kb, 2.1 kb, and 0.7 kb), which encode polymerase, HBcAg, HBeAg, HBsAg (L, M, S surface proteins), and HBx, each playing a pivotal role in the HBV lifecycle and hepatocellular damage [1-3]. Prasidthrathsint and Stapleton (2019) highlight that viral hepatitis is a global affliction driven by five principal viruses: Hepatitis A, B, C, D, and E. It causes inflammation of the liver and has a possibility of developing to a chronic infection leading to cirrhosis and hepatocellular carcinoma (HCC) [4, 5].

Recent studies throughout Afghanistan have illuminated significant demographic disparities in the prevalence of HBV. A retrospective analysis carried out in Kabul between March and September 2023 demonstrated that 63.6% of 217 HBsAg-positive participants exhibited chronic infection, with an almost equal gender distribution (50.7% male, 49.3% female) and a pronounced concentration among individuals over 45 years old (44.2%) [6]. In Herat, a hospital-based case-control investigation identified male gender and younger age as statistically significant risk factors ($p < 0.05$), with male patients experiencing notably lower quality-of-life scores [7]. A mass screening initiative in Jalalabad encompassing more than 17,000 individuals revealed an HBV prevalence of 1.93%, with the highest incidence observed among those aged 31-40 and a male predominance [8]. Pediatric seroprevalence

assessments from Kabul and Mazar-e-Sharif recorded an HBsAg positivity rate of 3.6% among children, markedly elevated in those older than six years, with prevalence increasing from 0.65% in the 1-10 age group to 8% in the 11-20 cohort [9].

Serological markers are an important role in determining the infected patients, assessing the phases of the infection as well as monitoring the progress of antiviral therapies [5]. And Abbott ARCHITECT/ Alinity HBsAg assay results in the improvement of recognizing prior acute, late acute and occult Hepatitis B infections by 36.4%, 10.9%. And extends detection duration beyond that of existing assays [10]. This prototype HBsAg assay is anticipated to hold significant diagnostic value [11-13]. And a longitudinal analysis spanning 15 years on HBV genomes conducted in Guangxi, China, revealed that mutations may revert to their original wild type during natural infection. This finding suggests that healthcare professionals should be circumspect when forecasting long-term outcomes based on these mutations alone [14]. A study evaluates the prevalence of HIV, HCV, and HBV among pregnant women in Anyigba, Nigeria, revealing a notably high prevalence of HIV relative to the lower prevalence of HCV and HBV [15-17]. An investigation into the efficacy and potential adverse effects of administering hepatitis B immunoglobulin (HBIG) to pregnant women during their third trimester revealed that HBIG significantly diminished the transmission of HBsAg and HBV-DNA from mother to child [18]. And a study disseminated by the Cochrane Hepato-Biliary Group assessed the efficacy of tenofovir-based antiviral combination therapies in mitigating the transmission of HBV from mother to child among HIV-positive pregnant women co-infected with HBV [19, 20]. And HBV represents a severe hepatic pathology that can be transmitted via horizontal transmission or from mother to infant [21]. And Chronic HBV infection disrupts hepatic metabolic pathways, leading to reduced levels of cholesterol and triglycerides, and a diminished incidence of hepatic steatosis. The contributing factors to hepatic steatosis include elevated ALT levels, increased BMI, male sex, and old age [22, 23]. And HBV affects approximately 350-500 million people globally, often leading to HCC [24-26].

Furthermore, a computational spatial whole-cell model has been developed to investigate the HBV infection cycle in hepatocyte cells. This model forecasts infection dynamics, explores virus-host and drug interactions, and is adaptable for examining other viral pathogens [27]. A phase III clinical trial conducted in Thailand is evaluating the efficacy and safety of administering maternal tenofovir disoproxil fumarate (TDF) to prevent mother-to-child transmission of HBV, monitoring 328 mother-infant dyads up to six months of age [28, 29]. A cross-sectional analysis revealed a moderate prevalence of Hepatitis B and C virus infections among pregnant women at Felege Hiwot Referral Hospital in Ethiopia [30], a case-control study in Indonesia identified that genetic polymorphisms in HLA-DP and the presence of isolated anti-HBc are critical predictors of occult hepatitis B infection (OBI) among blood donors [31-34]. And the HBV poses a significant global health challenge, inflicting liver disease and impacting over 257 million individuals worldwide. Although an efficacious vaccine exists, contemporary treatments face difficulties due to enduring viral reservoirs, substantial viral load, and compromised immune responses [35]. HBV represents a significant global health threat, being a leading contributor to mortality due to its association with cirrhosis and HCC. The rise in chronic HBV infections can be attributed to various factors, including viral genotypes and co-infection with other blood-borne pathogens [36].

Consequently, current diagnostic techniques encompass both serological and molecular methodologies. The identification of novel biomarkers, such as HBcrAg and HBV RNA, is imperative for the proficient management of infections. HBV is classified into 10 genotypes and 30 subtypes, with genotyping being advised for pegylated interferon therapy to enhance treatment outcomes [37]. HBV reactivation (HBVr) represents a significant challenge within the framework of immunosuppressive drug treatment, where virological and host factors interact in a rather complex way. Sakamoto et al. (2020) conducted a comprehensive study that analyzed serum samples from both HBVr and acute hepatitis B (AHB) patients, revealing a significantly higher prevalence of genotype B among those with HBVr. The research highlighted an increased frequency of mutations throughout the HBV genome, particularly in the envelope region, in HBVr patients compared to their AHB counterparts. The study also observed a notable prevalence of the S3N amino acid substitution in the envelope protein and mutations at G1896A and G1899A in the precore region among HBVr patients. By employing ultradeep sequencing, the research study isolated some of the most key virological factors related to HBVr, thus providing useful information on the methodologies of the development of HBVr and probable system through which the disease may be managed and

controlled more easily [38-40]. The purpose of the research will be to address the knowledge gap on the prevalence of HBV and practices associated with the diagnosis of HBV in the City of Lashkar Gah. In addition, the study intends to build evidence-based plans for treating, preventing and controlling HBV. The useful understanding gained is expected to guide and reinforce the setup and execution of major public health plans, ensuring better healthcare outcomes in Lashkar Gah City and contributing to broader efforts to combat HBV at the local and global levels.

Materials and methods

Research Design

This study employed both descriptive and explanatory research design from May 1, 2024, until August 25, 2024. A descriptive study was used to overview the clinical and laboratory diagnosis of HBV in Lashkar Gah City. The investigation was carried out in Lashkar Gah City using data from two major hospitals (Bost University Private Hospital and Helmand Provincial Infectious Disease Treatment Hospital) and three laboratories (Lamar, Kainat, and Rana Medical Laboratories). A multidisciplinary team of 100 specialists, including psychologists, neurologists, and medical doctors, collaborated on the study. IBM SPSS Statistics (Version 25) software facilitated data analysis.

Sampling Technique

Purposive sampling for HBV in this study involved selecting specialists in HBV diagnosis and treatment in Lashkar Gah City. The sample was gathered at appropriate intervals, focusing on individuals with at least two years of experience in diagnosing or treating HBV patients. Only those who expressed interest in the study and consented to share their information were included. Participants who lacked prior experience with HBV or had not worked in the field within the last two years were excluded. As a result, the research was conducted exclusively with professionals who possessed the most up-to-date knowledge and expertise in the field.

Data Screening

The HBV study containing the data screening procedure was exhaustive and suitable in supporting the accuracy and reliability of the subsequent statistical analysis. This consisted of checking the distribution of the data to ascertain that the parametric tests would have met assumptions. It also involved determining and rectifying any statistical mistakes or aberrant values which is very important in preserving the integrity of the findings, as outliers can distort the results. This process made it clear that there was complete response on questions on the questionnaire, and any missing data issues that might cause bias or investigational results to lose some power. These procedures were critical in maximizing the accuracy and reliability of the data before carrying out the statistical analysis.

Sampling Technique and Size

The sample size for this investigation was calculated using Yamane's formula (1967), and an anticipated error rate of 0.10. Given the specific population of healthcare professionals in the selected hospitals and laboratories, the sample size was calculated as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n is the sample size,

N is the population size,

e is the precision and reliability level.

Applying this formula to the study:

$$n = \frac{100}{1 + 100(0.10)^2} = \frac{100}{1+1} = \frac{100}{2} = 50$$

With a population size of 100 and a 10% margin of error.

Data Source and Data Acquisition Procedure

The method of gathering primary data presented was a structured questionnaire that was given to medical professionals, psychologists, neurologists and other healthcare practitioners of various hospitals and laboratories that were selected. The questionnaire consisted of 24 multiple-choice questions focused on the clinical and laboratory diagnosis of HBV. Participants were given sufficient time during their work hours to complete the questionnaire and submit their responses. SPSS software was used to analyze the data and generate results. Because healthcare professionals worked with HBV patients regularly, they were able to support thorough and combined use of both clinical and laboratory tests for diagnostics.

Research Variables

Dependent Variable

Prevalence of HBV infection: This variable refers to the incidence rate of HBV infection among

various demographic groups in Lashkar Gah City. The prevalence of HBV is influenced by factors such as socioeconomic status, healthcare access, and population density, all of which are linked to the spread of infectious diseases [41, 42].

Independent Variables

Age group: The prevalence of HBV is strongly correlated with specific age groups, with certain groups being more vulnerable to infection. Younger individuals, particularly those with compromised immune systems, are at higher risk.

Gender: Research indicates a gender disparity in HBV prevalence, with men often being more vulnerable to chronic HBV infections due to biological and social factors [43]. In countries like Afghanistan, cultural practices, healthcare-seeking behavior, and occupational exposures contribute to differing HBV infection rates between genders [44].

Geographical Conditions: Environmental factors such as climate and altitude can impact the transmission and prevalence of HBV. Warmer climates, like Lashkar Gah's hot and arid conditions, can facilitate the transmission of blood-borne diseases, particularly due to factors like population migration and limited healthcare services [45]. This climatic influence may contribute to increased HBV transmission and incidence in the region.

Clinical Symptoms: In adults, the disease caused by acute hepatitis B starts with such non-specific symptoms as anorexia, nausea, emesis, abdominal discomfort, darkened urine, pale stools, and jaundice; and, in severe cases, it can progress into hepatic encephalopathy, ascites, gastrointestinal hemorrhage (due to esophageal varices), coagulopathy, or opportunistic infections [46]. Understanding the clinical symptoms specific to Lashkar Gah could help improve diagnostic and therapeutic strategies.

Diagnostic assays: As observed in our survey, ELISA and RT-PCR were the primary modalities utilized in the diagnosis of HBV in hospitals and diagnostic laboratories all over Lashkar Gah City. The availability of these assays exemplifies their accessibility and diagnostic effectiveness in the area as part of a regular pattern. ELISA serves as a potential primary screening system to the hepatitis B surface antigens and RT-PCR serves to give a superior sensitivity when it comes to identification of HBV DNA thus making the system capable of classifying the least accurate cases of a chronic disease. These methodologies are also reliable in detection of cases and making therapy interventions, regardless of underdeveloped laboratory infrastructure [47].

Epidemiological Data Analysis

The data collected from the questionnaire were analyzed using IBM SPSS Statistics (Version 25). The primary goal of the analysis was to explore how different variables influenced the incidence and progression of HBV within the studied population. The results provided insights into the most affected age groups, gender distribution, and the effectiveness of laboratory diagnostic tests and treatment protocols for HBV in Lashkar Gah City. Analyzing the data this way gave new insights about the causes of HBV in the region which were valuable when formulating new healthcare policies.

Clinical and Laboratory Diagnosis of HBV in Lashkar Gah City

Diagnostic tests for HBV infection: The primary laboratory tests for diagnosing HBV infection in Lashkar Gah City include the HBsAg test and the CBC. The HBsAg test is overwhelmingly preferred, accounting for 97% of diagnostic cases. The CBC is used much less frequently, only in 3% of the cases. This indicates a strong reliance on HBsAg testing as this population's standard diagnostic method for HBV.

Common diagnostic test for HBV infection: The HBsAg test is consistently identified as the most commonly employed diagnostic test for HBV infection, with a usage rate of 95%. Blood glucose tests are seldom used, with a rate of 5%. This further confirms the critical role of the HBsAg test in the laboratory diagnosis of HBV, underscoring its reliability and importance in detecting the virus Table 1, 2.

Table 1 – HBV clinical and laboratory diagnosis in Lashkar Gah (2022-2023)

Laboratory	Time Period	Test Name	Total Tests	Positive/ Negative Tests	Company/ Method	Sensitivity	Specificity	Accuracy
LEMAR	2022.01.01 – 2022.12.31	PCR HBV (Quantitative) Real Time	92	Positive (+)	One Step HBsAG Rapid Test (01FK10,01FK11) Method of STANDARD DIAGNOSTICS (SD), INC. Republic of Korea	~97%	~98%	~97.5%
LEMAR	2022.01.01 – 2022.12.31	HBS-Ag (ICI)	1164	Positive (+)	One Step HBsAG Rapid Test (01FK10,01FK11) Method of STANDARD DIAGNOSTICS (SD), INC. Republic of Korea	~97%	~98%	~97.5%
LEMAR	2022.01.01 – 2022.12.31	Hepatitis B surface antigen (ELISA)	2	Positive (+)	One Step HBsAg Rapid Test (01FK10,01FK11) Method of STANDARD DIAGNOSTICS (SD), INC. Republic of Korea	~97%	~98%	~97.5%
LEMAR	2023.01.01 – 2023.12.29	PCR HBV (Quantitative) Real Time	96	Positive (+)	One Step HBsAG Rapid Test (01FK10,01FK11) Method of Standard Diagnostics (SD), INC. Republic of Korea	~97%	~98%	~97.5%
LEMAR	2023.01.01 -2023.12.29	HBV-Ag (ICI)	901	Positive (+)	One Step HBsAg Rapid Test (01FK10,01FK11) Method of STANDARD DIAGNOSTICS (SD), INC. Republic of Korea	~97%	~98%	~97.5%
RANA	2023.01.01 – 2023.12.29	HBV-Ag (ICI)	474	Positive (+)	One Step Hepatitis B Surface Antigen Test Cassette (Serum/ plasma) (ICT[*1]) and RDT[*2] Methods of Healgen Scientific Limited Liability Company [B20183-04] USA	~98%	~99%	~98.5%
KAINAT	2023.01.01 -2023.11.09	HEPATITIS B SURFACE AG	274	Positive (+)	One Step Hepatitis B Surface Antigen Test Cassette (Serum/ plasma)(ICT) and RDT Methods of Healgen Scientific Limited Liability Company [B20183-04] USA	~98%	~99%	~98.5%

Cumulative Data insight:
1. Total Tests Conducted: LEMAR (2022): 1258 tests (92 + 1164 + 2), LEMAR (2023): 997 tests (96 + 901), RANA (2023): 474 tests, and KAINAT (2023): 274 tests.
2. Overall Total Tests: 3003 tests across all laboratories.
3. Average Tests per Lab: Average Tests per Year (LEMAR): (1258 + 997)/2 ≈ 1127.5 tests per year and Overall Average Tests per Lab: 3003/3 ≈ 1001 tests per lab.
4. Percentage of Tests Conducted: LEMAR (2022): (1258/3003)* 100 ≈ 41.9%, LEMAR (2023): (997/3003)* 100 ≈ 33.2%, RANA (2023): (474/3003)* 100 ≈ 15.8% and KAINAT (2023): (274/3003)* 100 ≈ 9.1%.
Summary:
- LEMAR Laboratory: Conducted a total of 2255 tests over the two years, indicating a high testing capacity.
- RANA and KAINAT Laboratories: Conducted fewer tests but contributed significantly to the overall testing efforts.
Testing Methods and Performance:
- LEMAR Laboratory: Uses One Step HBsAG Rapid Test with high sensitivity (~97%), specificity (~98%), and accuracy (~97.5%).
- RANA and KAINAT Laboratories: Use One Step Hepatitis B Surface Antigen Test Cassette with higher sensitivity (~98%), specificity (~99%), and accuracy (~98.5%).
[*1]Immunochromatographic Test
[*2]Rapid Diagnostic Test

Table 2 – Overview of molecular findings from HBV DNA Quantification via Real-Time PCR in Lashkar Gah City

Parameter	Details
PCR HBV (Quantitative) Real Time	
HBV DNA	Detected
Viral Load	6,904,273 IU/mL
Detection Limit	Up to 120 Copies/mL or 20 IU/mL
Method	CFX 96-Biored RT-PCR
Amplification and Detection	Conducted simultaneously using Mini Opticon-Biored RT-PCR and kits from Roboscreen
Controls Applied	Positive, Negative, and Internal Controls
Interpretation	HBV DNA was extracted from patient plasma and amplified using Real-Time PCR.
Comments	Amplification and detection were performed simultaneously using advanced real-time thermo-optical analyzer.
	A quick, sensitive, specific, and reproducible method was established for detecting and quantifying HBV DNA.
	The procedure can analyze the viral load in plasma and serum samples in a range of 26.124 IU/mL to 4 10 IU/mL
	The methodology will be accurate and reliable in terms of diagnostic and clinical management of HBV in Lashkar Gah City

Results and discussion

The HBV infection in Lashkar Gah City has been shown to have a substantial rate of prevalence and clinical effect among various demographical groups of patients and across healthcare facilities. A total of 100 diagnosed patients, 44% of whom were found in Helmand Provincial Infectious Disease Treatment Hospital and 36% at Bost University private hospital, were investigated in this research; the rest were in three private labs: RANA Medical (12%), Kainat Medical (5%), and Lamar Medical (3%). Information was gathered through a multiple-choice questions. Structured item survey and analyzed using the SPSS program to control diagnosis, symptoms and the treatment practice (Figure 1).

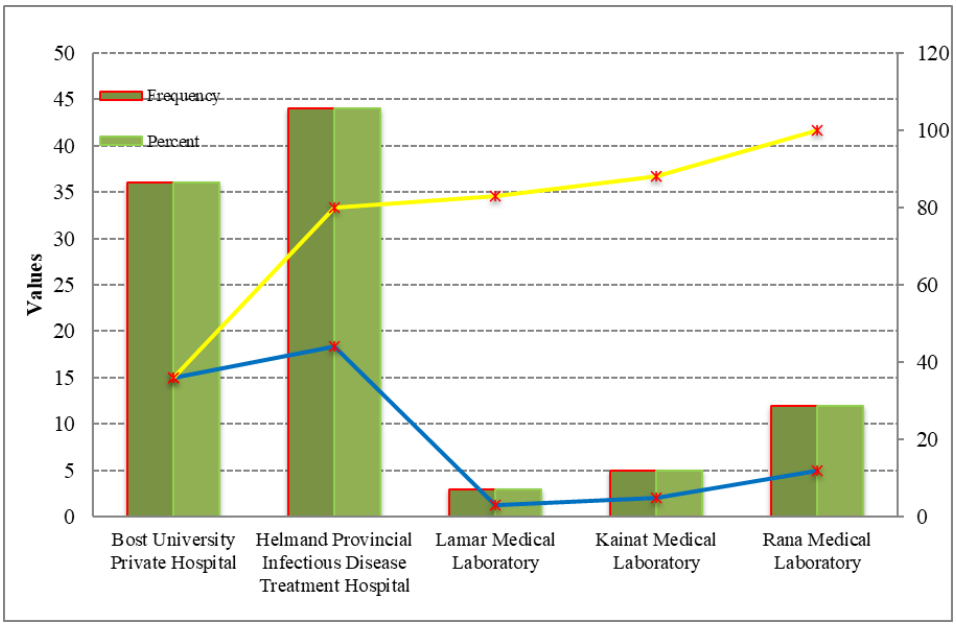

Figure 1 – Statistical overview of hospital and laboratory patient data

However, the incidence of HBV infection in Lashkar Gah varies considerably depending on the demographics of the population and the geographic location of the area. About 56% of people under the age of 5 are infected with the virus, making them the age group with the highest frequency of the disease among all age groups. The incidence of this condition declines with age, with 41% of instances occurring in those older than 16 years old. When it comes to the distribution of gender, the data reveals a striking contrast, as the majority of people who are infected with HBV are males (99%), while only 1% of people are females. A higher percentage of the infection is found in high-density areas (96%) compared to low-density areas (4%) when it comes to the distribution of the infection among regions. There is also a significance for geographical conditions, with the spread of HBV being substantially higher in hot regions (92%) compared to cold areas (8%). The prevalence of chronic HBV infection in the region is 63%, which represents a significant burden for communities there. Seventy-two per cent of people who have chronic HBV infection are impacted at a level of 24 per cent, while sixteen per cent are affected at a level of 75 per cent. There is an 87% duration rate, which indicates that the majority of chronic HBV infections continue to exist for several years. An overview of these observations can be seen in (Figure 2). In this case, the figure 1 indicates that the highest frequency of HBV infection occurs in children under 5 years old (56%), which is a critical finding for the case study.

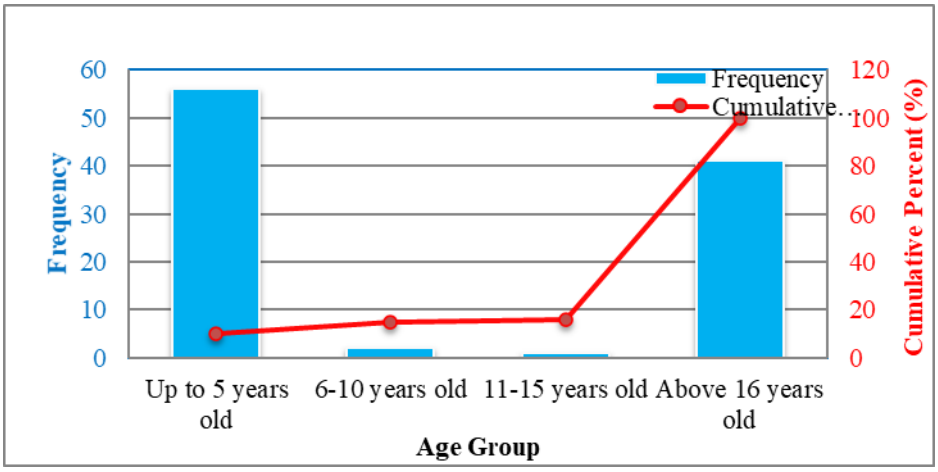

Figure 2 – Breakdown of HBV Infection by Age among those surveyed (Lashkar Gah City n =100)

After analyzing the conducted survey and the epidemiological context, the following data were obtained in accordance with research standards, the epidemiological breadth of HBV infection illuminates its evolution and repercussions. HBV infection incubates for weeks in 60% of cases and months in 34%. After the acute phase, 78% of people develop chronic hepatitis B, with 15% developing HCC and 7% cirrhosis. Nausea, vomiting, and jaundice are the main symptoms of HBV infection in 94% of patients. Joint discomfort and weariness are rare symptoms recorded in 2% of patients. Most people (63%), especially youngsters (62%), have few clinical symptoms. In 95% of cases, the HBsAg test is utilised to diagnose the disease, whereas the CBC is used in 3%. Disease burden varies by age and gender. Chronic infection prevalence is 63%, and previous infections are 45%. Perinatal infections are 48%, and early childhood infections are 44%, indicating high transmission rates. Only 10% of adolescents and adults have high-level infections. Treatment and management strategies focus on medicine, which 46% of respondents found useful. Many (50%) advocate combining treatments for disease management. The structured item was included in the survey to classify the level of prevalence based on perceived endemicity in order to measure the distribution of HBV infection within Lashkar Gah. It used this three-tier system, which is high, medium, and low, to identify the local differences in the infection burden of different population groups and healthcare access points. This stratification

reflects in the resultant data which provide a more specific epidemiological profile that reflects the local contextual dynamics. Figure 3 shows the prevalence level of HBV in Lashkar Gah City: 58% of cases are classified as high prevalence, 20% as medium, and 22% as low. Figure 4 shows the overall prevalence of HBV infection, where chronic infections are the most common at 63%, adolescent/adult infections at 54%, perinatal infections at 48%, past infections at 45%, and early childhood infections at 44% (Figure 5).

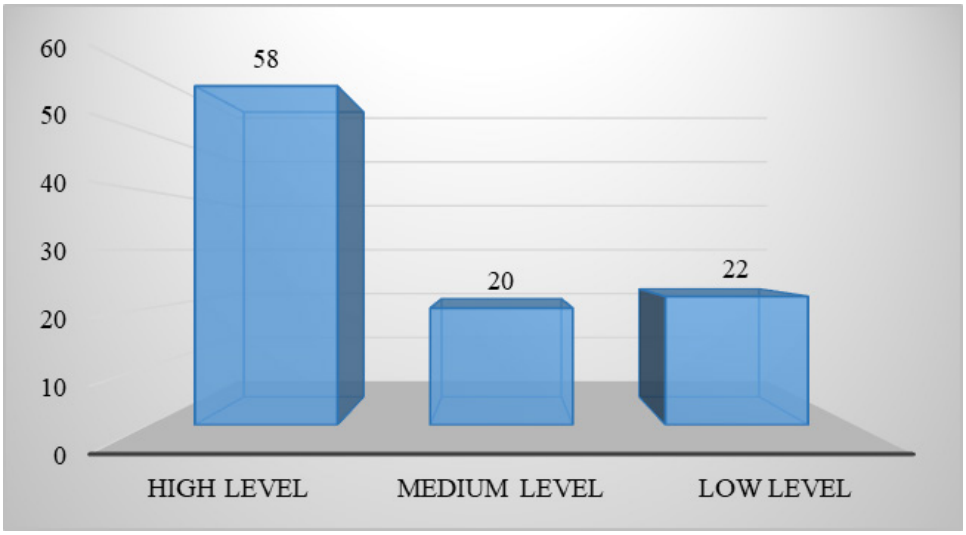

Figure 3 – Prevalence level of HBV in the Lashkar Gah City distributed into high, medium, and low

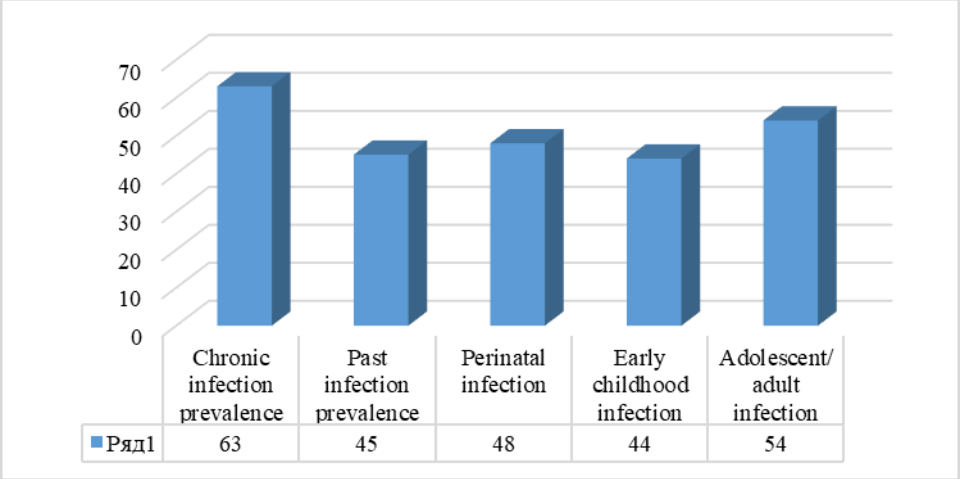

Figure 4 – HBV infection type distribution based on characteristics of endemic samples in the Lashkar Gah City

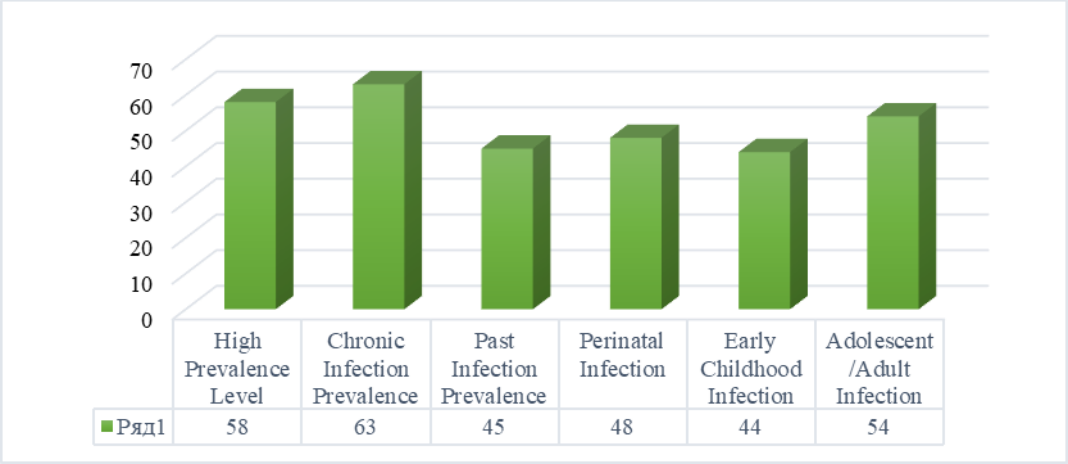

Figure 5 – Overall distribution of various HBV infection types as identified in the study in the Lashkar Gah City

Demographic and Epidemiological Profile of the Population in Lashkar Gah City

It is male predominant in the etiology of the disease with 99% and 1% again in males and females, respectively, implying that there might be underlying socio-cultural, behavioural and biological causes. HBV is mostly localized in high density regions as 96% of cases are encountered, whereas only 4% is in low density regions. This implies that the large number of people can support transmission due to optimal contact between people and maybe inferior health maintenance.

The disease burden of chronic HBV is high with 72 percent severity of those affected being in level 25 percent and 12 percent at level 50 percent and 16 percent at level 75 percent. This makes it vital to have proper managing and treatment approaches. Moreover, the chronicity of HBV deserves special consideration because 87 percent of cases are chronic, indicating the necessity of permanent medical follow-up. It has an incubation period that varies with 60 percent on several weeks, 34 percent several months and 6 percent longer periods, which leaves a variable factor on the actual time symptoms appear and are determined. It was found that HBV infection in Lashkar Gah City is most prevalent among very young children and older adolescents/adults, exhibits a striking male predominance, is concentrated in densely populated and hot regions, and poses a significant chronic burden on the affected population, table 3 organizes the data from the study into clearly defined categories, highlighting the key findings related to age, gender, geography, chronicity, and the incubation period of HBV infection in Lashkar Gah City.

Table 3 – HBV infection in Lashkar Gah city by different categories

Category	Subgroup/Description	Percentage (%)
Age Group Prevalence	Children under 5 years old	56%
	6-10 years old	2%
	11-15 years old	1%
	Individuals over 16 years old	41%
Gender Distribution	Male	99%
	Female	1%
Geographical Distribution	High-density areas	96%
	Low-density areas	4%
Regional Conditions	Hot regions	92%
	Cold regions	8%

Continuation of the table

Category	Subgroup/Description	Percentage (%)
Chronic HBV Infection Severity	Severity level 25%	72%
	Severity level 50%	12%
	Severity level 75%	16
Duration of Chronic HBV Infection	Long-term (87% duration)	87%
Incubation Period	Several weeks	60%
	Several months	34%
	Extended period	6%

Clinical Manifestations and Symptoms of the Population in Lashkar Gah City

HBV infection in Lashkar Gah City causes nausea, vomiting, and jaundice in 94% of patients. Only 2% of people complain of joint discomfort and tiredness, while 4% claim shortness of breath and chest pain, these symptoms suggest that this population's first HBV symptoms are gastrointestinal and hepatic problems. HBV infection causes minor clinical signs in 63% of cases. Based on survey data from Lashkar Gah City, 63% of HBV-infected individuals reported minimal or absent clinical manifestations. Moreover, 24% indicated symptomatic presentation in roughly 10% of cases, whereas 11% noted moderate symptom occurrence in approximately half of instances. Only 2% reported consistently experiencing clinical symptoms. These findings imply that a considerable proportion of HBV cases may be asymptomatic or exhibit mild symptomatology, potentially impeding prompt detection and timely clinical diagnosis. About 62% of HBV-infected children had few clinical signs. 25% of children have symptoms 10% of the time, and 12% have symptoms 50%. Only 1% of children always have symptoms. The generally low symptoms in the infected population suggest that children, like adults, have a subclinical or mild version of the disease. HBsAg test is of fact a very effective and a popular method of detecting HBV infection as it forms a majority of about 97% of diagnostic procedures employed in the laboratory. These serologic markers are HBsAg that is the initial to occur in acute infection and whose presence is absolute expert regarding active HBV infection hence; it is sensitive and specific when utilized in screening. By contrast, the CBC, sometimes used on average (3%) to supplement general clinical evaluation, has no HBV-specific application or value as a diagnostic measure. Therefore, HBsAg testing use was greatly prevailing in our study which is within international clinical practices and guarantees the diagnosing quality of HBV candidates. In Lashkar Gah City, HBsAg testing is the main HBV diagnostic method. HBsAg is the most prevalent HBV test, utilised in 95% of cases. Few blood glucose tests are performed 5%. Blood glucose is also used in HBV patients to test liver-related metabolic disbalance and check comorbidity conditions like diabetes to properly evaluate the condition and manage it successfully in the clinical setting. This highlights the relevance of HBsAg testing in this region's HBV clinical diagnosis. Up to 65% of children have HBV for years. Up to 15% of children have the infection for months, while 15% have distinct phases. Up to 5% had the infection for weeks. This suggests that children's infections last a long time and require long-term medical care. With 60% of persons having HBV over different periods, infection duration varies. Around 26% have had the infection for years, and 10% for months. Only 4% had the infection for weeks. This variance in adult infection duration shows that HBV is persistent and requires individualised care. HBV infection in Lashkar Gah City mostly causes nausea, vomiting, and jaundice, with few other symptoms. Both children and adults have subclinical or mild illness presentations, making early detection difficult. The HBsAg test is the primary diagnostic tool used in the region treatment protocols (Figure 6).

Case Studies

In Lashkar Gah City, the impact of HBV is deeply felt, not only on a public health level but also through the personal struggles of affected individuals and their families. Anecdotal data combined with case studies can have a significant contribution to the understanding of the lived experiences of the people affected by HBV, both demonstrating the social and healthcare needs of this population.

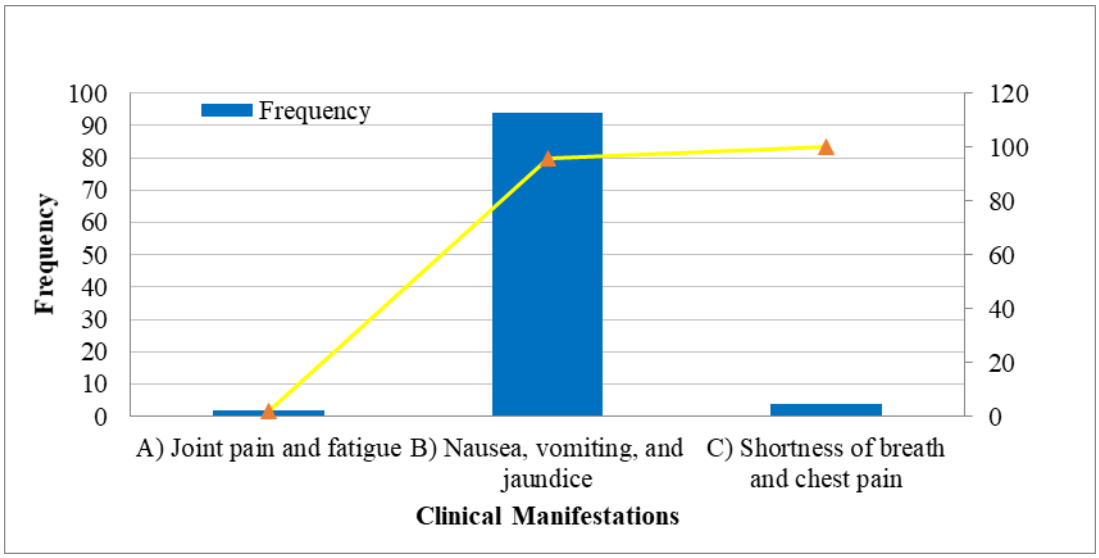

Figure 6 – The initial and acute clinical manifestations of HBV infection are the early indicators of the body's response to the virus.

1. Case Study – A Narrative of a Chronic HBV patient

Ezatullah, a 38-year-old male patient arrived in Lashkar Gah with more than 5-year-old C-HBV. The symptoms identified that led to his diagnosis of the virus included fatigue, jaundice, and nausea. His experience started with inability to get medical attention easily because there were not many resources in the area. Ezatullah spent some months attending the local clinics before being finally referred to the Helmand Provincial Infectious Disease Therapy Hospital. His treatment alternatives were also limited because of limited supply of antiviral medications at the hospital and absence of special care. The situation in the case of Ezatullah presents the problem of living with chronic HBV in a resourceous poor environment and the significance of access to prompt medical care.

The disease is also a major source of social stigma in the case of Ezatullah, as it is not only a health challenge. The result was the social isolation of his family as most people in their neighborhood thought that HBV was very contagious and therefore people with it were believed to have poor personal hygiene. Ezatullah experienced a number of difficulties obtaining employment because of the wrong image about his condition. When people are socially stigmatized about the HBV, they tend to avoid any treatment knowing that they will be looked down and discriminated by other members of the society. The case of Ezatullah reflects on the importance of improved education on public health to struggle against these misperceptions and decrease the stigmatism of HBV.

2. Case Study The Story of a Chronic HBV Patient, effect on the life of a Child

Amina, a 4-year-old girl, was detected with HBV in a screening process in her local health care facility in Lashkar Gah. Her mother did not know about the virus until she was surprised to find that her daughter had developed HBV since they did not get proper vaccination because of the lack of resources. The diagnosis was especially grim because Amina had a chronic infection that would need management over the long-term and such kind of provision was not easily available in the city. She had a mild jaundice and tiredness and her parents were concerned about her.

The situation of Amina stresses the role of vaccination in the prevention of HBV spread especially in susceptible populations such as children. The inability of her mother to get proper treatment to Amina emphasizes the lack of a better healthcare infrastructure in Lashkar Gah where specialized healthcare facilities and antiviral drugs are not easily accessible. In addition, family members of Amina were emotionally traumatized since they had an uncomfortable future without knowing how to control her condition in the long run. The case demonstrates the important role of early diagnosis of the disease and long-term care of children infected with HBV, which can overcome adverse health effects.

Anecdotal Evidence: The Problems of Healthcare Providers

The problem is that healthcare professionals in Lashkar Gah have little resources at their disposal and the healthcare infrastructure is not sufficient to help them find solutions to diagnosing HBV and treating it properly, as Dr. Ali, a general practitioner at Bost University Private Hospital, demonstrated. Dr. Ali describes the cases when patients came to the hospital with already developed stages of HBV infection only to realise that they did not have access to the tools of diagnosis or the curing antiviral drugs. In other patients, chronic liver diseases or cirrhosis were already evident before they availed themselves to the doctor, which was currently caused by a long-term un-diagnosed HBV infection, yet no therapy had been previously saved.

According to Dr. Ali, health professionals tend to be in a rut of attempting to treat a large number of patients without sufficient resources to do so. To make matters worse, there is little supply of vaccines, particularly among the at-risk groups such as pregnant women. In addition, the fact that there is no sustained professional education in HBV governance, not including a coordinated approach to mobilizing communities toward the development of the public health scenario, complicates the task of managing it effectively.

A Deeper Insight on Societal Influence Awareness using the Public Healthers Perspective.

Most urban settlements in the Lashkar Gah have a huge difference of awareness on HBV transmission and prevention. According to anecdotal evidence, most individuals are ignorant of the fact that the infection may either be contracted through injection sharing, unprotected intercourse, or mother to baby contraction during birth. Farida, one of the community leaders, expressed her frustrations on misconceived knowledge by many families in her community on the fact that HBV is transmitted through casual contact such as hugging and sharing food. This myth makes people fail to take proper preventative measures which in many cases could lead to the prevention of the disease e.g. by vaccination or measures that are less dangerous during medical procedures.

Farida has made a personal initiative to make the community in which she lives more aware of the issue of HBV through such activities as informal programs and provision of educative literature. It shows her initiatives are necessary since grass-root movements can be used to counter the disinformation and promote installing protective habits, particularly in low-resource regions.

The real-life stories of Ezatullah, Amina, professional healthcare providers, local leaders of the area of Lashkar Gah, clearly show how HBV severely affects a person and communities. Through these case studies, it is clear that much more needs to be done in relation to the development of public health facilities to improve access to vaccines and treatment and the advent of sensitization programs to address the stigma and early diagnosis. Addressing these issues will not only alleviate the burden on healthcare systems but also improve the quality of life for those affected by HBV in Lashkar Gah.

On the other hand, integrated pharmacological and holistic modalities, endorsed by 50% and 46% of respondents respectively in Lashkar Gah City, highlight the significance of amalgamating antiviral treatment with preventive interventions such as immunization and public health awareness in the comprehensive control of HBV infection.

Previous studies indicate that the incidence of HBV in Afghanistan is higher in areas with limited healthcare access, poor sanitation, and socioeconomic challenges [42]. A population-based investigation conducted in the United States revealed that adults with chronic hepatitis B infection exhibited a 1.9-fold elevation in all-cause mortality risk and a 13.3-fold augmentation in liver-related mortality risk relative to uninfected counterparts [48, 49].

According to Abera et al. (2014) revealed that liver hepatitis resulting from co-infection with Hepatitis B and C is the leading cause of morbidity and mortality in HIV-infected children, with 19.5% testing positive for HBsAg or anti-HCV antibodies, thus highlighting the need for routine screening [50, 51]. Karabaev et al. (2017) observed that post-Soviet Kyrgyzstan has experienced a rise in blood-borne infections, with 78% of donors being male and 22% female. The study documented a decline in the prevalence of HBsAg, anti-HCV, and anti-T. Pallidum from 2012 to 2015, while HIV prevalence increased [52]. Ahmadi Gharaei et al. (2021) highlight considerable global and regional disparities in the co-occurrence of hepatitis B and C among HIV-positive incarcerated individuals, with prevalence rates varying from 12% for HBV-HIV co-infection to 62% for HCV-HIV co-infection. The research advocates for enhanced screening and therapeutic interventions, specifically directed at high-risk cohorts. It underscores the efficacy of community-based needle and syringe exchange programs, which averted 25,000 HIV infections in Australia [53]. Chu et al.

(2023) investigated the genotype-specific influence of HLA variants on HBsAg seroclearance in chronic hepatitis B patients, finding that the Rs1710 G allele was linked to seroclearance in both genotype B and C infections, while the Rs2770 G allele was associated exclusively with genotype B infections [54-56].

A study in Uganda found that hepatitis B and C viruses cause liver damage in HIV-positive individuals, with higher rates among women, the prevalence of HBV is 10% in Uganda, while HCV is not documented. The chronicity of these infections depends on age, sex, and immune-competence. Proper diagnosis is crucial for better management, as HIV prevalence in Uganda is 6% among adults aged 15-49 years and 10% in children under five [57].

Research conducted at the University of Nigeria Teaching Hospital revealed that co-infection with hepatitis B and C viruses occurs more frequently than with hepatitis C alone, with instances of triple viral infection also observed. Vigilant screening for these infections is essential for early detection and comprehensive management of HIV patients, especially in Africa, which remains the most severely affected region [58, 59]. A research investigation in Western Saudi Arabia identified an 8.5% prevalence of coinfections among patients with HIV, HBV, and HCV. However, 20 out of every 1,000 cases had undiagnosed coinfections due to insufficient screening protocols. Such coinfections elevate morbidity and mortality rates, with liver disease resulting from HCV or HBV coinfection being the predominant cause of non-AIDS-related fatalities [59].

Additionally, a 34-year-old Caucasian female presented with severe acute hepatitis, coagulopathy, and ascites attributed to a coinfection of HBV and Epstein-Barr virus (EBV) [60]. This case represents the first documented instance of HBV and EBV coinfection in the medical literature. The concomitant infection of HBV and EBV can precipitate severe acute hepatitis with potential for HBV chronicity. The World Health Organization estimates that 400 million individuals globally are carriers of HBV, and coinfections with other viruses tend to exacerbate clinical severity and progression. The optimal treatment strategy for HBV coinfections remains uncertain, with current guidelines emphasizing the identification and treatment of the predominant virus [60, 61].

A study conducted at Adnan Menderes University Medical Faculty in Turkey revealed that hepatitis B infections frequently present with unconventional serological profiles within the liver. The research identified that a significant number of cases exhibited these atypical serological patterns, and a correlation was found between these profiles in hepatitis B patients [62]. And a study conducted in southern China revealed that 47.4% of anti-HBc-positive blood donors exhibited anti-HBc, indicative of previous HBV exposure [63]. The prevalence of anti-HBc positivity correlated positively with age, with 777 donors also testing positive for anti-HBs. The occurrence of occult hepatitis B infection (OBI) among anti-HBc-positive donors was 2.86%. This study indicates that a minor subset of donors harbors HBV DNA despite HBsAg and NAT screening, underscoring the necessity for more sensitive NAT testing methods [63, 64].

The investigation scrutinized the prevalence of Hepatitis B and C Virus infections among expectant mothers at Borumeda General Hospital in Northeast Ethiopia. Involving 124 participants, the study employed a structured questionnaire to evaluate various factors and sociodemographic attributes. The overall seroprevalence of HBV or HCV infections was determined to be 11.3%. The findings indicate that the prevalence of HBV and HCV infections among pregnant women is notably high, categorizing it within the high endemic bracket of the WHO classification scheme. Consequently, the study advocates for ongoing screening, the provision of hepatitis B vaccinations for women, and the implementation of health education initiatives to enhance awareness regarding these infections [65]. And Plasma levels of HBV DNA and quantitative measurements of HBsAg serve as indicators of infection risk. The advent of the HBV vaccine has significantly diminished the incidence of acute hepatitis B (AHB), with the United States reporting its lowest rates since 1990. High numbers of CHB are common in Southeast Asia, China, sub-Saharan Africa and among Indigenous communities [66]. The number of persons living with CHB worldwide was estimated at 400 million individuals of whom 1.25 million in the United States alone. Serious consequences that are related to the disease are cirrhosis, hepatocellular carcinoma, and liver failure. Although antiviral therapies have been authorized, a limited number of patients are treated [67]. Effective management involves evaluating cirrhosis progression, assessing alcohol consumption and metabolic risk factors, and considering the patient's family medical history [67-69]. Hepatitis B and C viruses present a formidable global health issue, particularly in low- and middle-income nations. Inadequate diagnosis impedes progress towards the 2030 eradication goals. Swift

and precise diagnostic methods are crucial for effective detection and healthcare provision. There is a pressing need for advanced biomarkers and rapid diagnostic technologies [70]. And HBV replicates its genome within the nucleus, utilizing distinctive nuclear import pathways to traverse the cytoplasm and nuclear envelope. Lipofection and paclitaxel treatments demonstrate that capsid translocation is crucial for capsid arrival and genome release [71].

In summation, Stasi, Silvestri, and Voller (2017) note that HBV infection rates are notably elevated in sub-Saharan Africa and East Asia, particularly in correctional facilities. The substantial prevalence in West and Central Africa underscores the imperative for blood screening and vaccination initiatives targeting high-risk demographics [72]. Zheng et al. (2023) elucidate that HBV utilizes the tumor susceptibility gene 101 (TSG101) to facilitate its egress through multiple multivesicular bodies (MVBs). TSG101 recognizes ubiquitinated HBc, thereby enabling the sorting and export of HBV capsids [73]. A study conducted in the Netherlands proposes that implementing universal anti-HBc screening along with HBV nucleic acid amplification testing could potentially eliminate the need for HBV antigen testing, thereby identifying potentially infectious donors with recent infections or occult hepatitis B infection (OBI) [74]. And For instance, research conducted in Nigeria revealed that 17% of blood donors were confirmed to have OBI, with genotype E being predominant. The study advocates for pre-testing blood donors for OBI and/or anti-HBc prior to transfusion to reduce the risk of HBV transmission [75]. At the same time, whether we consider a study conducted in Santiago, Chile, analyzed Hepatitis B and C virus infection rates among individuals living with HIV. The majority of HIV cases were transmitted through sexual contact, with 25.7% of participants having progressed to AIDS and 90.4% receiving antiretroviral therapy (ART). The HBV coinfection rate was comparatively lower than that observed in non-industrialized areas; however, a minimal proportion of patients had received vaccination. The presence of HBV coinfection exacerbates morbidity and mortality in people living with HIV (PLWH) [76]. And the World Health Organization has set a goal to eliminate viral hepatitis worldwide by 2030, emphasizing the importance of understanding the regional prevalence and epidemiology of HBV and HDV coinfection. Advances are being made in developing rapid diagnostic tools for the screening and management of patients with HBV/HDV coinfection. These emerging tools are designed to be more straightforward, accessible, and economical, particularly benefiting low- and middle-income countries. The implementation of such tools could significantly enhance screening efforts, patient monitoring, and the determination of treatment eligibility [77, 78]. And a study conducted in British Columbia revealed that 14.4% of individuals with diagnoses of HBV, HCV, or HIV had co-infections with one or more of these viruses [79]. Among the population, injection drug use was most common among those identified as Not a Visible Minority (22.1%), whereas severe material and social deprivation was notably higher among visible ethnic minorities. The World Health Organization and the United Nations Programme on HIV/AIDS have set a goal to eradicate these epidemics by the year 2030 [79, 80]. And the Global Burden of Disease Study 2019 provided estimates on the worldwide prevalence of HBV, associated mortality, and disability-adjusted life-years (DALYs) attributable to HBV. The study reported a global prevalence of chronic HBV infection at 4.1% for 2019, marking a 31.3% reduction from 1990. HBV-related illnesses accounted for 550,000 deaths globally in 2019. The findings emphasize the need for accelerated efforts to meet the 2030 elimination targets, advocating for the strategic enhancement and expansion of HBV interventions to achieve eradication. The WHO Global Health Sector Strategy on Viral Hepatitis aims to eliminate viral hepatitis as a significant public health threat [81]. And covalently closed circular DNA (cccDNA) serves as a crucial parameter for evaluating antiviral efficacy in CHB. Nonetheless, measuring cccDNA is invasive and necessitates serum biological markers. Recent investigations have shifted focus to viral indicators, host factors, and emerging detection technologies [82]. According to the EASL 2017 Clinical Practice Guidelines, chronic HBV infection is categorized into five distinct phases, with HBV RNA and HBcrAg emerging as innovative markers for both diagnosis and therapeutic monitoring. Proficiency in these markers can enhance predictions of disease progression and evaluate treatment effectiveness in CHB. However, a standardized assay or commercial kit for precise quantification of HBV cccDNA remains unavailable [82, 83]. And the Advisory Committee on Immunization Practices (ACIP) and the Centers for Disease Control and Prevention (CDC) have published a comprehensive report on strategies for the prevention of HBV infection in the United States [84]. This report advocates for the screening of pregnant women for hepatitis B surface antigen, the administration of the Hepatitis B vaccine and

hepatitis B immune globulin, and the immunization of children and adolescents up to 19 years of age. Additionally, it outlines CDC recommendations for postexposure prophylaxis and synthesizes the American Association for the Study of Liver Diseases (AASLD) guidelines on maternal antiviral therapy to mitigate perinatal HBV transmission (Table 4) [84-95].

Table 4 – Comparison of main Transmission Drivers of HBV and critical preventive strategies in Lashkar Gah and other epidemic high-risk areas in the world.

Risk Factor	Details	Key Insights
Lashkar Gah city		
Unsafe Medical Practices	44% of patients in Lashkar Gah visit the Helmand Provincial Infectious Disease Therapy Hospital, highlighting concentration of HBV management facilities.	Proper equipment and accessibility are essential for effective prevention and treatment.
Lack of Vaccination	Vaccination efforts are insufficient, particularly among high-risk groups like pregnant women, children, and adolescents.	Vaccination is critical to achieving WHO's 2030 hepatitis elimination goals.
Cultural Practices	Socioeconomic and cultural factors, including injection drug use, lack of healthcare access, and stigma, contribute to HBV prevalence.	Public health education is needed to address cultural and behavioral barriers.
Coinfections (HBV with HCV, HIV, etc.)	Coinfections increase morbidity and mortality, with undiagnosed cases often resulting from poor screening practices.	Improved diagnostics and regular screening are necessary to manage co-infections effectively
High-risk regions globally		
Blood-borne Transmission	Blood donors in Nigeria show a 17% prevalence of occult hepatitis B infection (OBI), highlighting risks from unscreened blood.	Universal blood screening and nucleic acid amplification testing are crucial to reduce transmission.
Socioeconomic and High-Risk Groups	14.4% of HBV, HCV, and HIV patients in British Columbia had co-infections; injection drug use and socioeconomic factors are major contributors	Customized efforts are needed for individuals belonging to at-risk populations and especially those in regions where resources are scarce.
Transmission through sexual contact	In Chile's capital, HIV is often caught through sexual contact and having both HIV and the HBV often makes the effects of HIV worse on people living with it.	Preventive immunization programs combined with targeted educational outreach addressing sexual transmission pathways are indispensable for diminishing infection rates.
Perinatal Transmission	Screening of pregnant women and immunization of newborns are insufficient, leading to increased risk of vertical HBV transmission.	Postexposure prophylaxis and maternal antiviral therapy can significantly reduce perinatal transmission
Global Burden	HBV-related illnesses caused 550,000 deaths globally in 2019 despite a 31.3% decrease in chronic HBV prevalence since 1990	Meeting the 2030 elimination targets requires expanded interventions and improved healthcare systems.
Advances in Diagnosis	Emerging biomarkers (HBV RNA, HBcrAg) and diagnostic techniques offer potential for better disease management but lack standardization	Investment in advanced diagnostics is needed to enhance HBV monitoring and treatment outcomes.

Challenges and Recommendations for the management of HBV infection in Lashkar Gah City

By addressing these challenges and recommendations through targeted interventions, resource allocation, and international collaboration, Lashkar Gah city can improve its ability to manage and prevent HBV, reduce disease burden, and improve public health outcomes, (Table 5).

Table 5 – Barriers and difficulties in controlling HBV in Lashkar Gah City

Challenge/Barrier	Description	Impact on HBV Control
Inadequate Vaccination Coverage	The study identifies gaps in vaccination efforts, especially among high-risk groups such as children under five. Despite global vaccination recommendations, coverage remains insufficient in Lashkar Gah.	Insufficient vaccination coverage leads to higher infection rates, particularly in younger populations, exacerbating long-term health consequences.
Poor Public Health Awareness	Limited public knowledge and awareness of HBV transmission, prevention, and treatment contribute to ongoing transmission and stigma around the disease.	Poor awareness hinders the adoption of preventive measures like vaccination and timely treatment, prolonging disease burden in the population.
Limited Healthcare Resources	Healthcare infrastructure and resources are limited in Lashkar Gah, affecting the availability of diagnostic tools, treatments, and vaccines.	Limited resources reduce the ability to effectively diagnose and treat HBV, leading to underreporting and undiagnosed cases.
Socio-political Volatility	The issue of political instability and violence in Afghanistan have destabilized healthcare provision and minimized the impact of both the public health initiatives and immunization programs.	Instability makes it difficult to implement coordinated public health strategies, impeding vaccination efforts and necessary health interventions.
Economic Constraints	Economic limitations, both within healthcare systems and at the individual level, impact the affordability and accessibility of HBV-related treatments and preventive services.	Economic barriers prevent widespread access to vaccines, diagnostic tests, and long-term treatment, which is essential to control HBV.
Geographical & Demographic Factors	The study shows higher infection rates in densely populated areas and regions with warmer climates. Certain demographics, such as males and children, are disproportionately affected.	Geographic and demographic factors complicate targeted interventions and resource allocation. Higher prevalence in certain areas demands more focused efforts.
Chronic Nature of HBV	Chronic HBV infection persists in 87% of cases, necessitating long-term treatment and monitoring.	Chronic infections require ongoing healthcare interventions, straining already limited resources and creating a burden on the healthcare system.

Conclusion

This study provides an in-depth analysis of HBV infection in Lashkar Gah City, highlighting significant public health challenges based on laboratory testing, demographic trends, and geographical patterns. Over a span of two years, 3,003 tests were conducted across three private laboratories, with LEMAR contributing approximately 75% of the total testing efforts. The testing methodologies employed demonstrated exceptional reliability, with sensitivities, specificities, and accuracies ranging between 97% and 99%, despite the persistent regional limitations in healthcare resources. Children under five years old were identified as the most affected group, representing 56% of cases, while infection rates showed a notable decline with age, with 41% of cases observed in individuals over 16. HBV infection predominantly affects males (99%), and areas characterized by high population density and hot climates report significantly higher infection rates (96% and 92%, respectively). Chronic HBV infections, which persist in 87% of cases, necessitate long-term healthcare interventions, as the severity of the condition varies from moderate to severe among patients. Because of the lack of resources, Helmand Bost Provincial Hospital and its laboratories have managed to deal with the huge obstacles and that was primarily possible thanks to the international partners, which have assisted in improving their infrastructure and technology, as well as diagnostic possibilities. The processed to combat HBV in Lashkar Gah would effectively demand a collaborated public health plan involving improved schemes of vaccination, mass community information methods, and entry to diagnostic strategy in disadvantaged areas. Moreover, the enhancement of healthcare systems and research on the approach to prevention and treatment will be important in minimizing the overall burden of diseases and enhancing the health outcome in the population. This multifactor solution is important in terms of long run development of HBV management.

Abbreviations and Acronyms

AHB – Acute Hepatitis B
ALT – Alanine Aminotransferase
BMI – Body Mass Index
BUH – Bost University Hospital
CBC – Complete Blood Count
cccDNA – Covalently Closed Circular DNA
CHB – Chronic Hepatitis B
EBV – Epstein – Barr virus
ENT – Ear, Nose, and Throat
HBcAg – Hepatitis B Core Antigen
HBeAg – Hepatitis B Envelope Antigen
HBIG – Hepatitis B Immunoglobulin
HBsAg – Hepatitis B Surface Antigen
HBV – Hepatitis B Virus
HBVr – Hepatitis B Virus Reactivation
HCC – Hepatocellular Carcinoma
HCV – Hepatitis C Virus
HIV – Human Immunodeficiency Virus
HLA – Human Leukocyte Antigen
MVBs – Multivesicular Bodies
NAT – Nucleic Acid Testing
NGOs – Non-Governmental Organizations
OBI – Occult Hepatitis B Infection
SPSS – Statistical Package for the Social Sciences (IBM SPSS Statistics Version 25)
TDF – Tenofovir Disoproxil Fumarate
TSG101 – Tumor Susceptibility Gene 101
WHO – World Health Organization

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Conflict of interest

All authors are aware of the article's content and declare no conflict of interest.

Authors' Contribution

The principal development of the idea of study, data painstaking curation, and formalization of it were primarily developed by Abdul Bari Hejran. He is also the driving force behind the drafting of the initial manuscript as well as high-level supervision during the research procedure. Virendra Kumar Yadav also performed the important task of funding, SPSS software settings and maintenance and verification of the data in a stringent manner. His professionalism greatly contributed to the worth of the manuscript in its review and editing. Parwiz Niazi managed to do a lot of volunteering work by conducting the investigation, formulating the methodological framework, and contributing to resources and software tools necessary. He was prominent in validation, visualization, and intense review and editing of the manuscript.

Data availability statement

The data generated and analyzed during the current study are available from the corresponding author on reasonable request.

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