

Diagnostic Associations and Risk Factors of Hepatitis B Infection among Participants with a History of Dental Surgery: A Cross Sectional Study

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ABSTRACT

Hepatitis B remains a significant global health concern and dental surgery is considered a potential risk factor for its transmission. This study aimed to assess the prevalence of hepatitis B and its diagnostic associations among participants with a history of dental surgery. HBsAg immuno-chromatic test, qPCR, blood count, LFTs, RFTs, blood sugar, serum electrolytes, and lipid profile were evaluated. Questionnaire was used to collect information on risk factors. The prevalence of HBsAg was 2.9% and HBV DNA was detected among 0.45% of the total participants. A significant association of increasing age ($p = 0.0043$, $R^2 = 0.5948$) and the number of dental surgeries ($p < 0.0001$) was found with HBsAg prevalence. Appendicitis, blood transfusion, tuberculosis history, cut from the barber/beautician, hospitalization history, and employment status were significant risk factors at $p < 0.0001$. Various diagnostic parameters, such as elevated WBCs, platelets, ALT levels, total bilirubin, low urea, creatinine, cholesterol, serum sodium, and calcium levels were also positively associated ($p < 0.0001$) with HBsAg. Blood group AB+ had the highest HBsAg (6.38%) prevalence. Our findings emphasize the multifactorial nature of hepatitis B transmission and underscore the importance of thorough screening and risk assessment, particularly in individuals with a history of dental surgery. Implementing preventive measures and raising awareness about potential risk factors are important for mitigating the impact of hepatitis B on global health.

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AR and SAK has equal contributions as the first authors and both contributed to the study design, sample collection, experimentation, results analysis, and manuscript writing. NF, ZA and HA contributed in results analysis, validation, and manuscript writing. All authors have read and approved the final version of the manuscript.

Key words

Dental surgery a risk factor, Diagnostics of hepatitis B, HBsAg, HBV, Prevalence of hepatitis B, Risk factors of hepatitis B

INTRODUCTION

Hepatitis B infection poses a significant worldwide health concern, affecting approximately 296 million individuals globally (Hsu *et al.*, 2023). Efforts have been made at an international level to combat this public health

threat and aim for its complete eradication by the year 2030 (McNaughton *et al.*, 2020). The global burden of hepatitis B virus (HBV) infection is staggering, with an estimated 290 million cases. Sadly, a significant portion of these cases remain undiagnosed and untreated, exacerbating the public health challenge posed by this virus (O'Hara *et al.*, 2017). Hepatitis B is transmitted through blood and sexual fluids, with various risk factors such as direct contact with infected blood, mother to baby transmission, contaminated medical/dental equipment, unprotected sex, and intravenous drug use with contaminated syringes. Practices like body piercing and sharing sharp instruments can also facilitate transmission. Certain high-risk groups include healthcare providers, sexually active individuals with multiple partners, men who have sex with men, and individuals born or adopted from regions where hepatitis B is prevalent. Additionally, cancer patients, kidney dialysis

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patients, inmates, pregnant women, and those in close contact with infected individuals are also vulnerable to the infection (Hepatitis B Foundation, 2023).

Substantial evidence indicates that a history of dental treatments or procedures is a significant risk factor for HBV infection in developing countries. Multiple studies conducted in regions such as Palestine, Bahrain, Iran, Kashmir (India), Iraq, and Azad Kashmir (Pakistan) have consistently identified dental procedures as a risk factor for HBV transmission (Kazmi *et al.*, 2022; Hussein and Daniel, 2017; Naqshbandi *et al.*, 2016; Nazzal and Sobuh, 2014; Janahi, 2014; Sali and Bashtar, 2005). In Pakistan, the increased prevalence of hepatitis can be attributed to various risk factors, including sexual contact, dental surgery, other surgeries, household contact, and transfusions (Shafiq *et al.*, 2015). Specifically, within the Pakistani male community, injections, other surgeries, and dental treatments are frequently reported as key risk factors for the spread of hepatitis B (Qureshi *et al.*, 2009).

Hepatitis B blood tests are essential for infection management. Anti-HBc IgM and Anti-HBc IgG distinguish between acute and chronic infections, with IgM indicating acute infection and IgG indicating chronic HB. HBsAg positivity indicates high infectivity. HBV DNA Quantification assesses viral load for treatment evaluation. Liver-related tests, such as ALT, AST, AFP, and ferritin, monitor inflammation, potential damage, and screen for cancer, providing a comprehensive liver health assessment (Hepatitis B Foundation, 2023).

In a meta-analysis, Jing *et al.* (2020) found an 8% lower HB infection risk in blood group “B” individuals compared to non-B groups, observed consistently across diverse settings. Conversely, blood group “O” showed a 12% higher risk in areas with higher prevalence rates and sensitivity analysis confirmed stability in risk estimates for blood group “B.” In Nigeria, Oladeinde *et al.* (2022) reported an association (OR = 20.174; $P > 0.05$) between “B-” status and HBV infection when combining ABO and Rh blood group systems.

In Pakistan, HBV affects individuals across different ages and genders. Khan *et al.* (2011) found that males are more exposed to identified risk factors compared to females. The younger age group showed a higher infection rate than both children and older adults. Key risk factors included syringe reuse, barber-related practices, dental procedures, and a history of injections.

Building on Kazmi *et al.* (2022) findings that 37.5% (2630 out of 7015) of participants had undergone dental surgery, our research, diagnostic associations and risk factors of hepatitis B infection among participants with a history of dental surgery: A cross-sectional study, focuses on this subset. We investigate the prevalence and diagnostic

associations of hepatitis B, emphasizing dental surgery as a risk factor. By focusing on this group, we aim to clarify the connections between dental procedures and hepatitis B prevalence within the university population. This study builds on Kazmi *et al.* (2022) and aims to provide insights into risk factors for hepatitis B transmission related to dental surgeries.

MATERIALS AND METHODS

Population description

This prospective cross-sectional study was conducted across various campuses of the University of Azad Jammu and Kashmir (AJ & K). The study population consisted of individuals affiliated with the university, including students, faculty, and staff members, who met the inclusion criteria. Participants were required to be 18 years of age or older and to have undergone at least one dental surgical procedure. Participants were recruited through on-campus outreach efforts, including informational sessions, announcements shared through student groups, and visits to academic departments. Individuals who agreed to participate were first informed about the study’s purpose and procedures. Those who provided written consent were then enrolled and interviewed about their dental surgery history.

The required sample size was calculated using the Raosoft online calculator in April 2020, based on the 2017 census data for the Muzaffarabad district (population: 149,913). With a confidence level of 95% and a 5% margin of error, the minimum recommended sample size was 384. However, 2,630 participants (72% males [$n = 1,894$] and 28% females [$n = 736$]) were ultimately included. This larger sample size approximately 6.85 times greater than the minimum requirement was achieved due to the high level of voluntary participation and was retained to improve the precision of subgroup analyses, reduce sampling error, and increase the statistical power and generalizability of the findings within the university population.

Screening for hepatitis B prevalence

The screening for hepatitis B followed the methodology of Kazmi *et al.* (2022). Approximately 5 milliliters of blood were collected from each participant. After centrifugation, the serum was separated and stored at -20°C until further analysis. All serum samples were tested for hepatitis B surface antigen (HBsAg) using immuno-chromatographic test (ICT) devices as per the manufacturer’s instructions (Bio-line Diagnostics LLPH-1478, DSIDC, Narela Ind. Area, Delhi/110-040, India). For individuals testing positive for HBsAg, HBV DNA was extracted from their serum using the remolded DNAzol

method. The extracted DNA was used to amplify the HBV surface gene using PCR. Due to the low concentration of DNA in the serum, a two-round PCR amplification approach was adopted. The following primers were utilized in the first round of PCR:

Forward: 5'-CATCCTGCTGCTATGCCTCATCT-3'

Reverse: 5'-CGAACCACTGAACAAATGGCACT-3'

Primers used in the 2nd round of nested PCR were following:

Forward: 5'-GGTATGTTGCCCCGTTTGTCTCT-3'

Reverse: 5'-GGCACTAGTAACTGAGCCA-3'

Various diagnostic tests of the participants

A range of diagnostic tests was used to investigate their correlation with hepatitis B infection and to assess the general health status of the participants. Total bilirubin, alanine transaminase (ALT), alkaline phosphatase (ALP), serum urea, blood sugar, creatinine, electrolytes, cholesterol, and triglycerides (TG) were evaluated according to the manufacturer's instructions (CHEMELEX, S.A., Pol. Ind. Can Castells, C/ Industria 113, Nau J, 08420 Canovelles-Barcelona, Spain) using the Microlab-300 semi-automatic clinical chemistry analyzer of the Merck company, USA. Similarly, blood count (WBCs, Hb level, RBCs, and platelets) was processed through using the reagents (i.e. diluting fluid, surfactant buffer, etc. CAT No. HC4; Lot No. 211201) of ERMA Incorporated Company (Kiuri Yoshi-kawashi Saitama 342-0045, Tokyo, Japan) under manufacturer instructions of Hematology-analyser model PCE-210 of the same ERMA Inc. Moreover, for the detection of blood groups of the participants the anti-sera (A, B, and D) of the "Atlas Medical" from Ludwig-E/R-3, 15827 B. Mahlow Germany were used and the results were interpreted manually.

Risk factor assessment

Before sampling, participants were interviewed to obtain consent and inquire about their dental surgery history and age as inclusion criteria. Risk factors were assessed using a structured questionnaire designed specifically for this study. The questionnaire was developed by the research team, with input from medical professionals to ensure its validity and relevance to the study's objectives. It consisted of both closed- and open-ended questions covering various risk factors, including dental surgery history, age, blood transfusion history, tuberculosis, cuts from barbers or beauticians, and hospitalization, etc. The questionnaires were administered face-to-face by trained research assistants, who explained the purpose of the study and ensured that participants understood each question. Data collection took place on the university campuses and other designated locations where participants were accessible.

The interviews were conducted in a confidential manner, with participants personal information kept secure. Multiple statistical tests were performed to analyze the relationship between HBsAg positivity (the dependent variable) and the risk factors. The Chi-square test was used to examine the association between the number of dental surgeries (a risk factor) and HBsAg positivity, with a significance level of $p < 0.05$ and a 95% confidence interval (CI). Linear regression was applied to assess how various risk factors, such as age, history of blood transfusion, tuberculosis, cuts from barbers or beauticians, and hospitalization, relate to HBsAg positivity. The results were further confirmed using logistic regression ($p = 0.05$; 95% CI).

Statistical analysis

Statistical analyses were conducted using Microsoft Excel 2013 (Microsoft Corp., Redmond, WA, USA) and GraphPad Prism, Version 7 (GraphPad Software Inc., San Diego, CA, USA). All statistical tests were two-sided, and a P value of < 0.05 was considered statistically significant. CIs were reported at the 95% level, where applicable. To assess the association between the number of surgeries and HBsAg prevalence, a Chi-square test (two-sided) was performed. The relationship between age and HBsAg prevalence was analyzed using linear regression, with the LINEST function in Microsoft Excel used to calculate the regression equation and associated P value ($P < .05$). To explore the associations between HBsAg status and various risk factors, both linear regression and logistic regression models were applied. The logistic regression estimated the odds ratios (ORs) for each variable in relation to HBsAg positivity, with significance tested at $P = 0.05$ and 95% CIs.

For categorical diagnostic variables, associations with HBsAg prevalence were assessed using the Chi-square test with Yates' continuity correction where appropriate, or Fisher's exact test when cell counts were low. The association between sex and HBsAg prevalence was evaluated using a combination of Fisher's exact test, Koopman asymptotic score test, Baptista-Pike method, and Wilson-Brown continuity-corrected confidence interval, each performed at the 95% CI level. The methodology followed the principles recommended in the SAMPL (Statistical Analyses and Methods in the Published Literature) guidelines reported by [Lang and Altman \(2013\)](#) to ensure transparent and accurate reporting of statistical results.

RESULTS

Total prevalence of hepatitis B with respect to gender and age

In [Table I](#), we examined the prevalence of HBsAg among 2630 participants with a history of dental surgery.

Table I. Overall HBsAg and HBV prevalence among participants.

Sex based analysis					
Sex	Participants count	HBsAg + (N=2630)	HBsAg - (N=2630)	HBV DNA ⁺ (N=76)	HBV DNA ⁻ (N=76)
Male	1894 (72%)	57 (3.0%)	1837 (97.0%)	10 (17.5%)	47 (82.5%)
Female	736 (28%)	19 (2.6%)	717 (97.4%)	02 (10.5%)	17 (83.0%)
Total	2630	76 (2.9%)	2554 (97.1%)	12 (15.8%)	64 (84.2%)
Age based analysis					
Age clusters	Participants count	Mean age with 95% SD CI $\pm$ SE		HBsAg ⁺ participants	HBV DNA ⁺ participants
19-28	2163	21.89 $\pm$ 0.04557	2.119	40	4
29-38	249	32.88 $\pm$ 0.1776	2.802	8	1
39-48	128	43.28 $\pm$ 0.2683	3.035	11	3
49-60	90	53.33 $\pm$ 0.3568	3.385	17	4
Total	2630	25.05 $\pm$ 0.1546	7.929	76	12

SD, standard deviation, SE, Standard error.

Table II. Association b/w number of surgeries and HBsAg prevalence.

Group of participants	Count of dental surgeries performed and number of participants					Chi-square (two tailed) with p<0.05 and 95% CI
	1 Time	2 Times	3 Times	4 Times	5 Times	
HBsAg +	11	23	28	9	5	$\chi^2 = 78787.68$; df = 4; p < 0.0001
HBsAg -	2454	92	1	6	0	

Overall, 2.9% (n=76) tested positive for HBsAg, with 15.8% (n=12) positive for HBV DNA. Males had a higher prevalence (3.0%, n=57) than females (2.6%, n=19), but no significant correlation with sex was found (p=0.6061). Table 1 also details age-specific prevalence. For the 19-28 age group, 1.85% (n=40) were HBsAg positive. In the 29-38 group, prevalence was 3.21% (n=8), while for 39-48 and 49-60 groups, it rose to 8.59% (n=11) and 18.89% (n=17), respectively. Across all age groups, the overall HBsAg prevalence was 2.9%, and HBV DNA was found among 0.46% of the total participants. The mean age across all participants was 25.05 (95% CI $\pm$ 0.1546). Statistical analysis revealed a significant association between age and hepatitis B prevalence (p=0.0043).

Linear regression indicated an increase of 0.0081 units in hepatitis B prevalence with each unit increase in age ($R^2=59.48\%$). [Supplementary Figure 1](#) visually represents this relationship, supporting a robust association between age and hepatitis B prevalence.

Association of number of dental surgeries with hepatitis B prevalence

[Table II](#) presents the Chi-square test results examining the association between the number of dental surgeries and HBsAg prevalence among participants (Chi-square=78,787.68; df= 4; P < 0.001). The analysis revealed a statistically significant association between the number

of dental surgeries and HBsAg positivity. Specifically, a greater number of surgeries was associated with an increased likelihood of HBsAg positivity, suggesting that the number of dental procedures may be a relevant risk factor for HBV infection in dental practice.

Predictors of hepatitis B among the participants

[Table III](#) presents the results of the linear and logistic regression analyses used to predict HBsAg prevalence based on various risk factors. The logistic regression analysis estimated the odds of HBsAg positivity for each variable. Instances labeled as “Not converged” likely indicate issues such as sparse data or multicollinearity. Significant predictors of HBsAg positivity (P < 0.001) included spinal surgery, appendicitis, blood transfusion, tuberculosis history, cuts from barbers or beauticians, history of hospitalization, and employment status. These associations were further supported by Z-values ranging from 2.49 to 16.51. The performance of the logistic regression model in predicting HBsAg status was evaluated using a receiver operating characteristic (ROC) curve, as shown in [Figure 1](#). In contrast, variables such as asthma, gastric ulcer, history of anemia, hypertension, kidney transplant, diabetes, hepatitis A, hypocalcemia, allergies, typhoid, and vision abnormalities did not show statistically significant associations with HBsAg prevalence (P > 0.05).

Table III. Linear and logistic regression test for the risk variables regarding hepatitis B.

Variables	Partic- ipants count	HBsAg +	Simple linear regression (95% CI; p<0.05)		Logistic regression (95% CI and p<0.05)		
			Goodness of Fit (r ²)	P-value	Z-Value	SE	P- value
Asthma	6	0	0.00006804	0.6724	Not converged		
Gastric ulcer	5	0	0.00005668	0.6996	Not converged		
Anaemia history	4	0	0.00004533	0.7300	Not converged		
Spinal surgery	2	1	0.006019	< 0.0001	2.486	0.2257	0.0129
Hypertension	2	0	0.00002265	0.8073	Not converged		
Kidney transplant	1	0	0.00001132	0.8631	Not converged		
Appendicitis	27	12	0.06383	< 0.0001	8.486	0.06270	<0.0001
Diabetes history	2	0	0.00002265	0.8073	Not converged		
Blood transfusion	56	43	0.4233	< 0.0001	15.31	0.03371	<0.0001
Needle prick in any clinic	11	1	0.0005755	0.2187	1.157	0.09170	0.2471
Tuberculosis history	27	15	0.08861	< 0.0001	9.327	0.06115	<0.0001
Cut from the barber or beautician	16	7	0.03642	< 0.0001	6.473	0.08147	<0.0001
Jaundice	205	76	0.3520	< 0.0001	Not converged		
Hospitalization history	83	67	0.6819	< 0.0001	16.51	0.02639	<0.0001
Hepatitis A	477	76	0.1347	< 0.0001	Not converged		
Hypocalcaemia	173	76	0.4226	< 0.0001	Not converged		
Any allergy	265	76	0.2656	< 0.0001	Not converged		
Typhoid	438	76	0.1489	< 0.0001	Not converged		
Vision abnormalities	55	76	0.7178	< 0.0001	Not converged		
Employment	468	33	0.01336	< 0.0001	5.556	0.01513	<0.0001

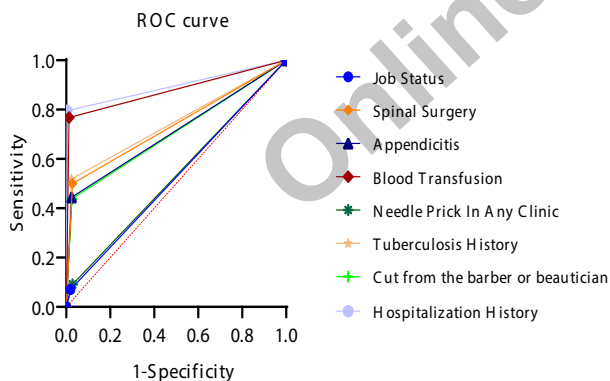


Fig. 1. The ROC curve was employed to assess the logistic regression model's performance. This curve demonstrates the trade-off b/w sensitivity (true positive rate) and specificity (1- false positive rate) as the discrimination threshold varies.

Diagnostic associations of hepatitis B

In Table IV, we used the Chi-square test with Yates correction to examine the association between various diagnostic parameters and hepatitis B prevalence among

adult participants. The analysis was conducted at a 95% confidence interval (CI) with a significance level of $P < 0.05$. However, due to limited variability, the analysis did not yield applicable results for Hb level, RBCs, ALP, TG, and random blood sugar levels. In contrast, elevated WBC count, platelet count, ALT, and total bilirubin levels were significantly associated with HBsAg-positive status ($P < 0.001$). Conversely, low levels of urea, creatinine, cholesterol, serum sodium, and serum calcium were also significantly associated with hepatitis B prevalence ($P < 0.001$). Additionally, no significant associations were observed for serum potassium ($P = 0.84$) and serum chloride ($P = 0.89$).

Prevalence of hepatitis B regarding ABO blood groups

Table V presents the distribution of blood groups among the 2,630 participants and their corresponding HBsAg prevalence. The highest prevalence of HBsAg was observed in blood group AB+ with 6.4% positivity. However, blood groups AB- and O- had no observed cases of HBsAg positivity, suggesting a potentially lower risk of hepatitis B infection in individuals with these blood types.

Table IV. Various diagnostic parameters assessed in the study and their association with hepatitis B.

Test contents	Average range in adults	Correlation with hepatitis B prevalence at 95% CI and P<0.05						
		HBsAg positive (N=76) participants			HBsAg negative (N=2554) participants			Chi-square test with Yates correlation
		Normal	High	Low	Normal	High	Low	P-value
Hb level	12 to 18 g/dl	76	0	0	2554	0	0	N/A
WBCs count	4,500 to 11,000 WBCs/ μ L	21	55	0	2541	13	0	<0.0001
RBCs count	4.2 to 6.1 million cells/ μ L	76	0	0	2554	0	0	N/A
Platelets count	150,000 to 450,000 platelets/ μ L	40	21	15	2547	07	0	<0.0001
ALT level	4 to 36 IU/L	64	12	0	2549	05	0	<0.0001
Total bilirubin level	0.1 to 1.2 mg/dL	70	06	0	2554	0	0	<0.0001
ALP level	44 to 147 IU/L	76	0	0	2554	0	0	N/A
Urea level	5 to 20 mg/dl	72	0	4	2554	0	0	<0.0001
Creatinine level	0.6 to 1.3 mg/dL	74	0	2	2554	0	0	<0.0001
Cholesterol level	Less than 200 mg/dL	69	0	7	2553	0	1	<0.0001
TG level	Below 150 mg/ dL	76	0	0	2554	0	0	N/A
Serum Sodium level	136 to 145 mmol/ L	73	0	3	2554	0	0	<0.0001
Serum Calcium level	8.6 to 10.3 mg/dL	67	0	9	2530	0	24	<0.0001
Serum Potassium level	3.5 to 5.2 mmol/L	76	0	0	2541	0	13	0.8365
Serum Chloride level	96 to 106 mmol/L	76	0	0	2533	21	0	0.8889
Blood sugar (Random)	Up to 6.9 mmol/L	76	0	0	2554	0	0	N/A

HBsAg, Hepatitis B surface antigen; Hb, Haemoglobin; WBCs, White blood cells; ALT, Alanine transaminase; RBCs, Red blood cells; ALP, Alkaline phosphatase; TG, Triglycerides. P-values less than 0.05 indicate a significant correlation with hepatitis B prevalence. Not Applicable (N/A) indicates that the test is not applicable for comparison in this context. Correlations were evaluated at a 95% confidence interval (CI).

Table V. Prevalence of HBsAg among various blood groups.

Group type	No. of participants	HBsAg +	HBsAg -
A ⁺	421	18 (4.3%)	403 (95.7%)
A ⁻	344	06 (1.7%)	338 (98.3%)
B ⁺	702	15 (2.1%)	687 (97.8%)
B ⁻	113	02 (1.8%)	111 (98.2%)
AB ⁺	47	03 (6.4%)	44 (93.6%)
AB ⁻	19	0 (0%)	19 (100%)
O ⁺	963	31 (3.2%)	932 (96.8%)
O ⁻	21	0 (0%)	21 (100%)

DISCUSSION

Previous studies have primarily focused on hepatitis B among healthcare staff in dental settings, with limited research on its prevalence and risk factors in dental surgery patients. For example, screenings of dental professionals revealed HBsAg positivity rates of 10% in 1991 and 2% in 2012, particularly among periodontists with a history

of needle-stick injuries. Dentists, who are at high risk for hepatitis, often lack sufficient knowledge about factors affecting hepatitis B vaccination adherence. Highlighting their role in proactive prevention is important for improving the public health ([Dahiya et al., 2015](#); [Narasimhan et al., 2015](#)). Patient assessments should include recent hepatitis information, as individuals can be infectious for up to four months after contraction. Identifying high-risk groups and deferring dental treatment for contagious patients are essential steps. Maintaining high standards of clinical hygiene, including the use of disposable needles and sterilized instruments, is vital ([Woods, 1984](#)).

Our study contributes to this field by identifying key factors associated with HBsAg positivity among individuals with a history of dental surgery. Specifically, it highlights the significance of age, the number of dental surgeries, and other risk variables in relation to HBsAg positivity. These findings offer valuable insights for improving preventive measures and managing the disease among at-risk populations.

Comparing our findings with those from different regions, [Massaquoi et al. \(2018\)](#) reported an 8.7% HBsAg positivity rate among healthcare workers in Sierra Leone.

In Rwanda, [Umutesi et al. \(2021\)](#) found HBV positivity rates of 4.3% among prisoners and 4.0% among other high-risk individuals. [Bhate et al. \(2015\)](#) reported a point prevalence of 0.92% in India. These variations may be attributed to differences in population characteristics, geography, and healthcare practices. However, in our study, increase in age ($R^2=59.48\%$) and number of times dental surgery performed ($\chi^2=78787.68$), were significantly associated with HBsAg positivity ($p < 0.0001$), indicating higher susceptibility in specific age groups and individuals with a history of dental procedures. Additionally, we identified several other significant risk factors for hepatitis B, including spinal surgery ($p=0.0129$), appendicitis ($p < 0.0001$), blood transfusion ($p < 0.0001$), tuberculosis history ($p < 0.0001$), cuts from barbers or beauticians, hospitalization history ($p < 0.0001$), and occupation ($p < 0.0001$).

In our study, HBsAg positivity was significantly correlated with elevated levels of WBCs, platelets, ALT, and total bilirubin, and with decreased levels of urea, creatinine, cholesterol, serum sodium, and calcium ($p < 0.0001$). This suggests that HBsAg positivity has broad implications for various organ systems and metabolic processes. [Zhang et al. \(2023\)](#) reported a 28-day mortality rate of 40.90% in patients with hepatitis B-related acute-on-chronic liver failure, noting that non-survivors had lower lymphocyte-to-white blood cell ratio (LWR) levels. They suggest that LWR could be a potential prognostic biomarker for assessing disease severity and outcomes ($p < 0.05$). Additionally, [Puri et al. \(2017\)](#) found a high prevalence of abnormal liver function tests (LFTs) at baseline in HIV-infected patients, with HBV infection being a major contributor to these abnormalities ($p < 0.05$).

The assessment of electrolyte disturbance in chronic liver disease patients in the Kumaon region revealed a substantial prevalence of hyponatremia, hypokalemia, and hypocalcemia. Interestingly, these electrolyte disturbances did not show significant variations based on disease severity or complications. However, the association of sodium and potassium levels with outcomes suggests their potential impact on disease progression and prognosis ($p < 0.05$) ([Sing et al., 2022](#)). However, our study found that low levels of serum sodium and serum calcium were significantly associated with hepatitis B prevalence ($p < 0.0001$), aligning with observations from [Sing et al. \(2022\)](#), which suggested an impact of sodium levels on disease progression. Conversely, serum potassium and serum chloride levels in our study showed no significant association with hepatitis B prevalence ($p = 0.8365$ and $p = 0.8889$, respectively), differing from the findings of [Sing et al. \(2022\)](#) that highlighted the relevance of electrolyte disturbances. Moreover, a cross-sectional study in Western

India found lower levels of serum cholesterol, HDL, total cholesterol (TC), and LDL in hepatitis B patients compared to negative controls ($p < 0.05$) ([Meena et al., 2022](#)). Our study also found low cholesterol levels significantly associated with hepatitis B prevalence ($p < 0.0001$), supporting the notion of lipid metabolism alterations in chronic hepatitis B patients. However, for ALP and TG level, our analysis did not yield significant results due to limited variability.

In our study, the analysis of Hb level, RBCs, ALP, TG level, and random blood sugar did not yield significant results due to limited variability. [Khalili et al. \(2015\)](#) reported higher prevalence of hyperglycemia among HBV-infected North American adults, which was linked to liver damage. Similarly, [Suzuki et al. \(2022\)](#) documented a case of hemolytic anemia following acute HBV infection, which resolved with normalized hemoglobin levels within three months. Serum ALP levels have been identified as a potential marker for significant fibrosis ($S \geq 2$) in treatment-naïve HBeAg-negative chronic hepatitis B (CHB) patients ([Hu et al., 2019](#)), providing a non-invasive alternative to liver biopsies. The Hepatitis B Foundation (2023) highlights the importance of blood tests, including liver function tests (LFTs), lipid profiles, complete blood counts (CBC), ferritin levels, and serum electrolytes, in monitoring liver inflammation and damage from hepatitis B. Therefore, a knowledgeable healthcare provider is essential for accurate diagnosis and appropriate management.

[Jing et al. \(2020\)](#) reported an 8% lower risk of HBV infection in individuals with blood group “B,” a finding consistently observed across different populations and settings. In contrast, blood group “O” was associated with a 12% higher risk of HBV infection in regions with high prevalence rates. [Oladeinde et al. \(2022\)](#) found an association between blood group “B-” and HBV infection, although the result was not statistically significant ($OR = 20.174$; $p > 0.05$). Our study supports these findings, revealing varying HBsAg positivity rates among blood groups: A+ had a 4.3% positivity rate, B+ had a 2.1% positivity rate, and AB+ had the highest rate at 6.4%, while blood group O- tested negative. These results highlight the influence of blood group types on HBV infection risk. Combined with evidence from previous studies, our findings underscore the multifaceted impact of hepatitis B on various physiological parameters and its potential association with disease severity and outcomes.

CONCLUSIONS

This prospective cross sectional study highlights the prevalence of hepatitis B infection among individuals

with a history of dental surgery. Increasing age and the number of dental surgeries were found to be significant risk factors ($p < 0.0001$) for HBsAg prevalence. Moreover, various diagnostic parameters, such as elevated WBCs, platelets, ALT levels, total bilirubin, low urea, creatinine, cholesterol, serum sodium, and calcium levels were also positively associated with HBsAg ($p < 0.0001$). Blood group AB+ had the highest HBsAg (6.38%) prevalence. Our findings emphasize the multifactorial nature of hepatitis B transmission and underscore the importance of thorough screening and risk assessment, particularly in individuals with a history of dental surgery. Implementing preventive measures and raising awareness about potential risk factors are important for mitigating the impact of hepatitis B on global health.

DECLARATIONS

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IRB statement

The research received approval from the Board of Advanced Studies and Research (BASR) under approval letter number F-BASR/(41st M)/16-40/1669-71/2018. The BASR is responsible for approving research topics and addressing ethical considerations at the University of Azad Jammu and Kashmir, Muzaffarabad.

Ethical approval

The study received ethical approval from the Board of Advanced Studies and Research (BASR) at the University of Azad Jammu and Kashmir, Muzaffarabad, under approval letter No. F-BASR/(41st M)/16-40/1669-71/2018. This board holds the authority to approve research topics and oversee ethical compliance within the university.

Consent to participate

Prior to participation, each individual was provided with detailed information about the study's objectives, procedures, potential risks, and benefits. After ensuring that they fully understood this information, a written informed consent form was signed and collected from each participant. This process ensured voluntary participation and compliance with ethical research standards.

Availability of data and material

The basic data file is under the consideration of another project for optimising machine learning models to predict the hepatitis B infection. The basic data other than diagnostic parameters is available and will be provided to the journal on a suitable demand.

Supplementary material

There is supplementary material associated with this article. Access the material online at: <https://dx.doi.org/10.17582/journal.pjz/20240615125220>

Generative AI and AI assisted technology statement

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

Conflicts of interest

The authors declare that the research was carried out without any affiliations or financial ties that could be interpreted as a potential conflict of interest.

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Supplementary Material

Diagnostic Associations and Risk Factors of Hepatitis B Infection among Participants with a History of Dental Surgery: A Cross Sectional Study

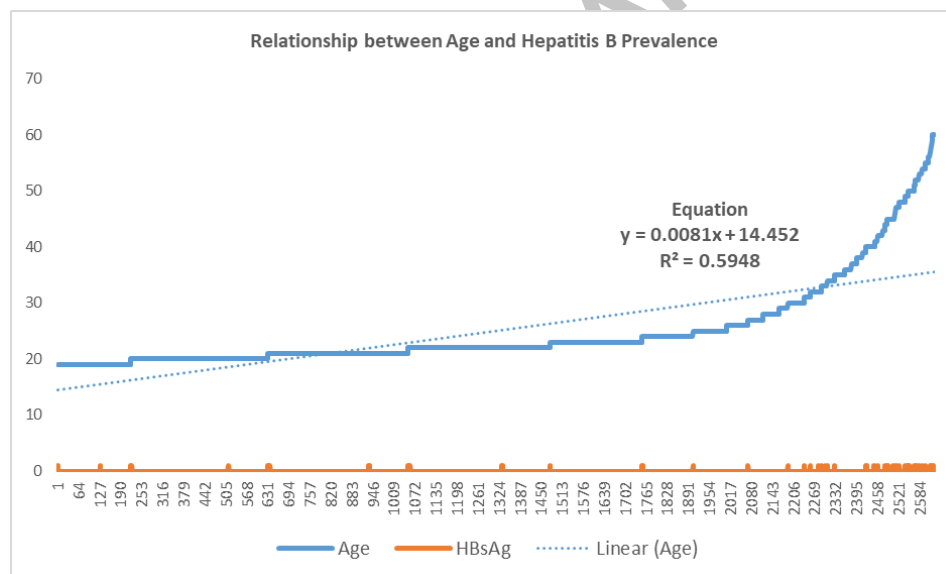
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Supplementary Fig. 1. This figure shows the relationship between Age and Hepatitis B Prevalence. Utilizing the LINEST function in Microsoft Excel, the p-value was found to be 0.0043.

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