

Hepatitis B Virus Knowledge, Attitude and Vaccination Status in Dental Students of Khyber Pakhtunkhwa (KPK), Pakistan

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ABSTRACT

Background: Dental students are at a high risk of being infected by the hepatitis B virus (HBV) because of the risk of exposure to blood and body fluids during their clinical training.

Objective: To evaluate knowledge, attitude, practice regarding HBV and vaccination status among dental students in Khyber Pakhtunkhwa, Pakistan.

Methods: A cross-sectional survey was carried out between October 2024 and March 2025 among BDS students from the seven dental institutions affiliated with Khyber Medical University in Khyber Pakhtunkhwa, Pakistan, using a validated questionnaire (n=179; response rate 51.1%). Knowledge was rated out of 5; satisfactory knowledge was considered as $\geq 3/5$ accurate. Attitude was measured using a single item, and practice was measured as self-reported completion of three doses of HBV vaccination. SPSS version 27 was used for data analysis.

Results: Satisfactory knowledge was found in 67.6%, positive attitude in 77.1%, and satisfactory practice was seen in 44.1%. The most critical gaps were the knowledge of recapping safe needles (32.4%) and all major routes of transmission (20.1%). Nearly all respondents (92.2) were willing to receive the vaccine. Odds of satisfactory knowledge were significantly higher in Female students (aOR=2.41, 95% CI: 1.22-4.76, p=0.011) and pre-clinical students (aOR=2.18, 95% CI: 1.05-4.52, p=0.036). No significant associations were found for positive attitude and practice status.

Conclusion: Dental students exhibited moderate knowledge and positive attitudes but low vaccination coverage. It is suggested to implement mandatory HBV vaccination with immunity verification and enhanced practical training on infection control at the institutional level.

Keywords: Dental students, hepatitis B, vaccination, knowledge, attitude, infection control.

INTRODUCTION

Hepatitis B virus (HBV) infection is one of the significant challenges to global human health, with around 254 million individuals being infected with it chronically and 1.1 million deaths attributed to its related complications, including cirrhosis and hepatocellular carcinoma [1, 2]. During clinical training, dental students and other health sciences trainees are at elevated risk of acquiring blood-borne viruses, including Hepatitis B, primarily due to inexperience. Unlike practiced clinicians, students more frequently fail to consistently follow universal precautionary protocols when performing invasive procedures or coming into contact with high-risk bodily fluids [3, 4]. Needle-stick injuries are one of the main routes of transmission, and the estimated number of healthcare personnel infected by HBV annually is 66,000 throughout the world [5]. WHO and CDC strongly recommend pre-exposure vaccination for all at-risk groups, including dental students, with the three-dose course (0, 1, and 6 months) [6, 7].

HBV prevalence remains elevated in some areas of Pakistan, such as Khyber Pakhtunkhwa (KPK), where occupational exposures are aggravated by fluctuations in access to vaccination programmes and infection control training [8-10]. Previous studies among Pakistani dental students and practitioners have reported moderate-to-high knowledge and favorable attitudes but inconsistent vaccination coverage (ranging from 14.8% to 84.9%) [8, 11-13]. However, most of these studies were limited to single institutions, focused on final-year students, or lacked multivariate adjustment for confounders such as gender and academic level. Moreover, few have comprehensively examined KAP across all academic years in a multi-institutional setting in KPK, where regional prevalence and training infrastructure may differ from those in other provinces.

This study addresses a critical research gap by assessing HBV knowledge, attitude, and vaccination status among dental students from all seven Khyber Medical University-affiliated dental colleges in KPK, using a validated questionnaire and multivariate analysis to control for potential confounders. The objective was to assess knowledge, attitudes, practices regarding and vaccination status among dental students in Pakistan's Khyber Pakhtunkhwa province.

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MATERIALS AND METHODS

A cross-sectional survey was conducted among BDS students from the seven dental institutions affiliated with Khyber Medical University in Khyber Pakhtunkhwa, Pakistan, from October 2024 to March 2025. Ethical permission was granted by the Institutional Review Board at Bacha Khan Medical College, Mardan (Ref. No. 677), and the entire study followed the ethical guidelines of the Declaration of Helsinki [14]. The IRB approval letter was shared with the participating institutions, and verbal waivers were confirmed, as a separate full IRB review was not required for this non-invasive, questionnaire-based study.

Eligible participants were BDS students aged 18 years or older enrolled in either pre-clinical (1st and 2nd year) or clinical (3rd and final year) phases. Students not enrolled in the BDS programme, those previously diagnosed with HBV infection, those seeking exam-related materials, and those unwilling to participate were excluded.

The sample size was calculated using the WHO sample size calculator at a 95% confidence level, a 6.91% margin of error, and an estimated proportion of 50%. The estimated eligible population of ≈1,600 students, yielding a required sample of 179. Participants were approached by collecting their cell phone numbers from institutional WhatsApp groups. A total of 250 students were invited. Of the 250 invited students, 179 participated and completed the survey, yielding a response rate of 71.6%. The survey was voluntary, with two reminders sent over two weeks; no incentives were provided for participation.

Data were collected using a structured, validated questionnaire adapted from previously published studies [15] and administered through Google Forms. The questionnaire consisted of a mandatory informed consent section, demographic questions (gender, age, academic year, institution), five multiple-choice knowledge items, one attitude item, and two practice items concerning vaccination status and willingness to vaccinate. The instrument was assessed for content and face validity by three experts in dentistry and public health and pilot-tested on 20 students, yielding a Cronbach's α of 0.80 for the knowledge scale.

Knowledge was scored out of 5 (1 point per correct answer). Satisfactory knowledge was defined as $\geq 60\%$ correct ($\geq 3/5$ correct answers), based on adapted Bloom's taxonomy cutoffs commonly applied in KAP studies [15-17]. Attitude was measured with a single dichotomous item ("I am interested in learning more about HBV prevention and infection control"), a frequently used approach in concise KAP surveys to reduce respondent burden. Practice was assessed primarily through self-reported completion of the full three-dose HBV vaccination series, which is the most critical evidence-based preventive measure recommended by the WHO and CDC for healthcare

students at occupational risk [7, 9, 18]. This served as the primary proxy for preventive behavior, although it did not encompass broader infection control practices such as PPE use or post-exposure management.

Statistical analysis was conducted using IBM SPSS version 27. Descriptive results were reported in the form of frequencies, percentages, and mean values \pm standard deviation. The Chi-square or Fisher's exact test was employed to evaluate the association between demographic factors and the study outcomes. Adjusted odds ratios were obtained through multivariable logistic regression to account for possible confounders, including gender and academic year/level. P-value < 0.05 was considered statistically significant.

RESULTS

Summary of Demographic

A total of 179 dental students participated in the survey, with a mean age of 22.93 ± 0.46 years. The majority were male (58.7%) and in clinical years (63.1%), with 36.9% in pre-clinical years. Only 44.1% of participants reported full HBV vaccination, while 55.9% were unvaccinated or incompletely vaccinated.

Summary of Knowledge Status

Overall, 67.6% of participants demonstrated satisfactory knowledge ($\geq 3/5$ correct answers on the knowledge items), while 32.4% had inadequate knowledge. Female students had significantly higher satisfaction with knowledge (78.4%) than males (59.0%; $p=0.011$). Similarly, pre-clinical students showed higher satisfactory knowledge (80.3%, $n=53$) than clinical students (80.3% *versus* 61.1%, $p=0.012$) (Table 1).

Detailed responses to individual knowledge items are presented in Table 2. Critical gaps were evident: only 32.4% knew the correct needle recapping protocol (single-handed scoop technique or avoidance of recapping), and only 20.1% correctly identified all major HBV transmission routes. A notable misconception was observed: 21.2% incorrectly identified the oral-to-fecal route as a transmission pathway. Clinical students showed a non-significant trend toward better knowledge of safe needle recapping (37.2% *vs.* 24.2%, $p=0.106$). No other significant differences were found between pre-clinical and clinical students. By gender, a higher proportion of male students were aware of the five types of viral hepatitis (95.2% *vs.* 86.5%, $p=0.071$), but no

Table 1: Overall knowledge and stratified knowledge Status based on gender and academic level ($n=179$).

Variable	Category	Satisfactory Knowledge n n(%)	Unsatisfactory Knowledge n n(%)	p-value
Overall		121 (67.6)	58 (32.4)	-
Gender	Male	62 (59.0)	43 (41.0)	*0.011
	Female	58 (78.4)	16 (21.6)	
Academic Level	Pre-clinical	53 (80.3)	13 (19.7)	*0.012
	Clinical	69 (61.1)	44 (38.9)	

*Significant at $p < 0.05$

Table 2: Summary of correct knowledge responses by academic level and gender (n=179).

Knowledge Items	Overall n(%)	Academic level			Gender		
		Pre-clinical n(%)	Clinical n(%)	p-value	Male n(%)	Female n(%)	p-value
Aware of five types of viral hepatitis?	164 (91.6)	62 (93.9)	102(90.26)	0.392	100 (95.2)	64(86.5)	0.071
Recognizes dental office as a source of HBV transmission?	152 (84.9)	58 (87.9)	94 (83.2)	0.392	89 (84.8)	63 (85.1)	0.724
Recognizes HBV as a life-threatening disease?	151 (84.4)	57 (86.4)	94 (83.2)	0.571	87 (82.9)	64 (86.5)	0.500
Knows correct needle recapping protocol? (single-handed scoop or avoid recapping)	58 (32.4)	16 (24.2)	42 (37.2)	0.106	34 (32.4)	24 (32.4)	0.991
Identified all major HBV transmission routes correctly?	36(20.1)	13 (19.7)	23 (20.3)	0.926	22 (21.0)	14 (18.9)	0.737

Table 3: Overall attitude and stratified attitude status based on gender and academic level (n=179).

Variable	Category	Positive Attitude n(%)	Negative Attitude n(%)	p-value
Overall	-	138 (77.1)	41 (22.9)	-
Gender	Male	84 (80.0)	21 (20.0)	0.357
	Female	54 (73.0)	20 (27.0)	
Academic Level	Pre-clinical	48 (72.7)	18 (27.3)	0.306
	Clinical	91 (80.5)	22 (19.5)	

Table 4: Overall practice and stratified practice status based on gender and academic (n=179).

Variable	Category	Satisfactory Practice n(%)	Unsatisfactory Practice n(%)	p-value
Overall	-	79 (44.1)	100 (55.9)	-
Gender	Male	48 (45.7)	57 (54.3)	0.723
	Female	31 (41.9)	43 (58.1)	
Academic Level	Pre-clinical	26 (39.4)	40 (60.6)	0.412
	Clinical	53 (46.9)	60 (53.1)	

other significant differences emerged between males and females.

Summary of Attitude Status

77.1% of participants expressed a positive attitude toward HBV prevention and infection control. No statistically significant differences were found between males and females (80.0% versus 73.0%, p=0.357) and between pre-clinical and clinical levels (72.7% versus 80.5%, p=0.306) (Table 3). Notably, 92.2% of students indicated their willingness to receive the HBV vaccine if they were not already fully vaccinated.

Practice (Vaccination Status)

Full completion of the three-dose HBV vaccination series was reported by 44.1% of participants. Vaccination rates were higher among clinical students than pre-clinical students, but this difference was not statistically significant (46.9% versus 39.4%, p=0.412). No significant difference was seen between males and females (45.7% versus 41.9%, p=0.723) (Table 4).

Multivariable Analysis

To account for potential confounding, multivariate logistic regression was conducted, adjusting for gender and academic level. For satisfactory knowledge, female gender remained significantly associated (aOR=2.41,

95% CI 1.22–4.76, p=0.011), as did pre-clinical academic level (aOR=2.18, 95% CI 1.05–4.52, p=0.036). No significant adjusted associations were found for positive attitude (gender, p=0.312; academic level, p=0.245) and practice status (gender, p=0.598; academic level, p=0.341).

DISCUSSION

Students in medical sciences, such as dental, are highly exposed to blood-borne infections, such as the Hepatitis B virus, during the clinical training stage due to negligence, compared with experienced health care workers, and do not observe universal precautionary measures when carrying out invasive procedures and handling high-risk fluids. In this study of 179 dental students across all seven KMU-affiliated colleges in Khyber Pakhtunkhwa, satisfactory knowledge was observed in 67.6%, positive attitude in 77.1%, and full vaccination in only 44.1%. These findings indicate moderate overall knowledge, attitude, and practice (KAP) regarding HBV, with notable gaps despite generally favorable perceptions. Multivariate logistic regression confirmed that female gender (aOR=2.41, 95% CI 1.22–4.76, p=0.011) and pre-clinical academic level (aOR=2.18, 95% CI 1.05–4.52, p=0.036) were independently associated with satisfactory knowledge, while no significant adjusted associations emerged for attitude or vaccination status.

Knowledge levels were higher among females and pre-clinical students, consistent with some prior Pakistani studies, which found that female students demonstrated better awareness of HBV transmission and prevention [10]. However, this contrasts with findings from Ethiopia, where no gender differences were observed [19]. The higher knowledge among pre-clinical students may reflect recent exposure to foundational microbiology and infection control curricula, which often diminish in intensity during the clinical years due to a focus on practical training. Critical gaps persisted: only 32.4% knew the single-handed scoop technique (or avoidance of recapping) for safe needle handling, and just 20.1% correctly identified all major transmission routes. These deficiencies are concerning, given that improper needle handling is a leading cause of NSIs among dental interns (up to 23.8% incidence) [20]. Clinical students showed better understanding of safe recapping protocols (37.2% vs. 24.2%, p<0.05), likely due to greater procedural

exposure, though overall knowledge did not differ significantly between groups.

Attitude was generally positive, with 92.2% of students expressing willingness to receive the vaccine and 77.2% interested in further education on HBV prevention. This aligns with the Andhra Pradesh and Syria study, in which most dental students viewed HBV as life-threatening and recognized their role in preventing transmission [15, 21]. The high willingness to vaccinate suggests that attitudinal barriers are low, yet actual uptake remains suboptimal.

Vaccination coverage (44.1%) was lower than in several Pakistani studies [9-11]. Practice was assessed primarily *via* self-reported full completion of the three-dose series, a key evidence-based preventive measure recommended by WHO and CDC for healthcare students and personnel at occupational risk [6, 7]. This serves as a core proxy for preventive behavior in high-risk settings. However, it does not encompass broader infection control practices (*e.g.*, consistent PPE use, safe disposal, post-exposure protocols). The low coverage despite moderate knowledge and strong willingness highlights systemic barriers, such as a lack of mandatory institutional vaccination programs, cost, access, or awareness of post-vaccination serologic testing [22]. Vaccination remains the most effective primary prevention strategy, providing near-100% protection and is superior to reliance on innate immunity or post-exposure measures alone [15].

Among the key limitations of this study is its cross-sectional nature, which prevents the establishment of cause-and-effect relationships or definitive causal conclusions. Vaccination status was self-reported without verification *via* records or anti-HBs antibody titers, introducing potential recall and social desirability bias. The focus on vaccination as the primary practice measure may overestimate overall adherence to infection control, as broader behaviors (*e.g.*, PPE compliance, post-exposure management) were not assessed. The 71.6% response rate may introduce selection bias, although anonymity and reminders were used to mitigate this. Non-probability sampling and reliance on quantitative measures limit generalizability. Future studies should incorporate longitudinal designs, serological confirmation of immunity, and comprehensive infection control assessments.

Despite these limitations, this study provides valuable insights into HBV KAP among KPK dental students and highlights the need for targeted interventions. Institutions should implement mandatory pre-clinical HBV vaccination with immunity verification (anti-HBs testing) as a prerequisite for clinical rotations, alongside enhanced infection control training emphasizing safe needle techniques and universal precautions. Ongoing education and awareness campaigns could bridge

knowledge gaps and translate positive attitudes into higher vaccination coverage, ultimately protecting future dental professionals and reducing HBV transmission in healthcare settings.

CONCLUSION

This multi-institutional study of dental students in Khyber Pakhtunkhwa found moderate levels of satisfactory knowledge and positive attitudes, with female students and pre-clinical students demonstrating significantly higher knowledge even after adjustment for confounders. However, only 44.1% reported full HBV vaccination. These results highlight important gaps in knowledge of safe needle handling and transmission routes, as well as suboptimal vaccination coverage in this high-risk group. Institutional strategies to improve vaccination uptake and reinforce practical infection-control skills appear warranted, while recognizing the limitations of self-reported data and the use of vaccination status as the primary practice indicator.

LIST OF ABBREVIATIONS

NSI	Needle Stick Injury
WHO	World Health Organization
CDC	Centers for Disease Control and Prevention
KAP	Knowledge, Attitude, and Practice
HBV	Hepatitis B Virus
DHCWs	Dental Health Workers
HBsAb	Hepatitis B Surface Antibody

ETHICS APPROVAL

This study was conducted after ethical approval from the IRB of Bacha Khan Medical College, Mardan, Pakistan (Reference No. 677) and adhered to the ethical principles outlined in the Helsinki Declaration.

CONSENT FOR PUBLICATION

Informed consent was taken from all participants.

AVAILABILITY OF DATA

Not applicable.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORS' CONTRIBUTION

Conceptualization: MUS

Material collection and data acquisition: MUS, IU, SK, US, WHM, MA

Statistical analysis and interpretation: MA, MUS

Manuscript writing: MUS, IU, SK, US, WHM, MA

Final review and approval: MUS, IU, SK, US, WHM, MA

GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this work, the authors used Grammarly sparingly to obtain language suggestions and to perform minor proofreading in some parts of the manuscript. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

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