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Original Article

Hepatitis-B Surface Antibody Titers in Vaccinated Dental Students at Semnan University of Medical Sciences

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Abstract

Background: Hepatitis B virus (HBV) infection continues to represent a significant global public health challenge, and in the absence of a definitive cure, prevention through vaccination remains essential. The assessment of post-vaccination antibody titers among clinical dental students, together with the evaluation of their association with potential contributing factors, may yield important insights. Such assessments facilitate the determination of the optimal timing for antibody titer measurement, the evaluation of vaccine-induced immunity, and the identification of the need for booster doses. The present study was undertaken to evaluate anti-HBs antibody titers in vaccinated dental students at Semnan University of Medical Sciences.

Methods: This cross-sectional study was conducted among 64 clinical dental students at the School of Dentistry, Semnan University of Medical Sciences. Following the acquisition of informed consent, anti-HBs antibody testing was performed for all participants. Statistical analyses were conducted using chi-square tests and regression models in SPSS software (version 23.0). A p-value of less than 0.05 was considered statistically significant.

Results: Of the 64 participants, 49 students (76.6%) had anti-HBs titers above 100 mIU/mL, while 15 students (23.4%) had titers between 10 and 100 mIU/mL. A statistically significant association was observed between antibody titers and age ($P = 0.026$). However, no statistically significant associations were observed between antibody titers and gender, body mass index (BMI), smoking status, or years since vaccination ($P > 0.05$).

Conclusion: The findings indicate that anti-HBs antibody titers decrease with age, suggesting a decline in vaccine-induced immunity over time. This highlights the importance of periodic assessment of antibody titers among vaccinated dental students, who remain at high occupational risk for exposure to HBV.

Key Words: Age Factors; Antibody Formation; Hepatitis B virus; Immunogenicity, Vaccine; Students, Dental; Vaccination

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Introduction

Viral hepatitis refers to inflammation of the liver caused by hepatotropic viruses. The five primary causative agents—hepatitis A virus (HAV), hepatitis B virus (HBV), hepatitis C virus (HCV), hepatitis D virus (HDV), and hepatitis E virus (HEV)—all present with similar clinical symptoms (1). HAV and HEV are typically transmitted via the fecal-oral route, whereas HBV, HCV, and HDV are primarily spread through percutaneous and mucosal exposure to infected blood and body fluids, including via injection drug use, needle stick injuries, and sexual contact (1, 2).

Chronic viral hepatitis is a leading cause of liver disease and the fifth most common cause of death worldwide (3). The global prevalence of HBV

infection is less than 1%; however, in Iran, approximately 3% of the population is chronically infected (4-6). HBV is transmitted through contact with infectious blood or body fluids (such as saliva, tears, urine, and semen), including via sexual contact, needlestick injuries, and exposure to non-intact skin. The virus can also survive in the environment for at least seven days (7-9). The risk of HBV transmission from an infected source following a needlestick injury ranges from 37% to 62% (10).

HBV infection becomes chronic in 5% to 10% of infected individuals. A substantial proportion of patients with chronic HBV (15% to 40%) progress to cirrhosis, liver failure, or hepatocellular carcinoma, making chronic hepatitis B one of the ten leading causes of death worldwide (11, 12). As there is no definitive cure for HBV infection, prevention remains paramount. Strict adherence to infection control and sterilization protocols is essential to prevent disease transmission (11, 12).

Vaccination with the recombinant HBV vaccine is the most effective preventive measure. Three doses of the vaccine can induce protective antibodies in 85% to 90% of healthy individuals (2, 11). However, several factors influence vaccine immunogenicity, including the site and frequency of vaccination, genetic predisposition, gender, age, body mass index (BMI), smoking, and alcohol consumption (8, 11). Vaccine-induced immunity is not universal, and some individuals fail to mount an adequate immune response (anti-HBs titers <10 mIU/mL), leaving them susceptible to infection—a particular concern for those in high-risk occupations. Therefore, it is essential to assess post-vaccination immunity and identify non-responders, especially among healthcare workers (8, 11).

Reported HBV vaccination coverage among dental healthcare workers varies widely, ranging from 26% to 96.6% globally and from 74.8% to 94.9% in Iran (13). On average, 70% of dentists have received at least one dose of the HBV vaccine. Among Iranian dentists, the seroconversion rate (anti-HBs titers >10 mIU/mL) following one to three vaccine doses ranges from 89.2% to 94.4% (13). Numerous studies worldwide have investigated HBV vaccination and antibody titers, underscoring the global importance of this issue (13-31). Since protective immunity following primary HBV vaccination wanes over time, booster doses are recommended, particularly for individuals with anti-HBs titers below 10 mIU/mL who remain at high risk of occupational exposure (20).

The present study aimed to measure anti-HBs antibody titers and to investigate their association with age, gender, BMI, time elapsed since the last vaccination, and smoking status among vaccinated dental students at Semnan University of Medical Sciences during the 2010-2011 academic year. Assessing anti-HBs titers and their relationship with these potential contributing factors may provide valuable insights. Such evaluation facilitates the determination of the optimal timing for titer measurement, elucidate vaccine efficacy under varying conditions, and establish the need for booster doses-a critical consideration for this high-risk population.

Methods and Materials

Study Design and Setting

This cross-sectional study was conducted at the School of Dentistry, Semnan University of Medical Sciences, after obtaining ethical approval from the Research Ethics Committee of the Vice Chancellor for Research (Approval No: IR.SEMUMS.REC.1399.103).

Study Population

All clinical dental students (third- to sixth-year) who had received all three doses of the HBV vaccine and had commenced their clinical training were eligible for inclusion. A total of 64 students met the inclusion criteria and were enrolled in the study.

Data Collection

After providing written informed consent, all participants who had received the complete three-dose series of the Recombivax HB vaccine and had no history of hepatitis underwent anti-HBs antibody testing. Blood samples were collected and analyzed to determine anti-HBs titers.

Based on their antibody levels, participants were classified into three categories:

Negative: anti-HBs titer < 10 mIU/mL

Moderate: anti-HBs titer between 10 and 100 mIU/mL

Good: anti-HBs titer > 100 mIU/mL (13)

Demographic and clinical data, including age, gender, body mass index (BMI), time elapsed since the last vaccination, and smoking status, were also recorded for each participant.

Statistical Analysis

Data were analyzed using SPSS for Windows (Version 23.0, IBM Corp., Armonk, NY, USA). The Chi-square test was used to assess the association between antibody titer categories and categorical variables such as gender and academic year. Fisher's exact test was employed to evaluate the associations between antibody titer and BMI, time since last vaccination, and smoking status. A *P*-value of less than 0.05 was considered statistically significant.

Results

Anti-HBs titers were measured in 64 clinical dental students at the School of Dentistry, Semnan University of Medical Sciences. Of these, 49 students (76.6%) had titers above 100 mIU/mL, indicating adequate seroprotection, while 15 students (23.4%) had titers between 10 and 100 mIU/mL, indicating moderate immunity.

Gender

Antibody titers above 100 mIU/mL were observed in 72.2% of female students and 82.1% of male students. This difference was not statistically significant ($P = 0.353$, Table 1).

Age

Among students aged 21 to 25 years, 80.7% had antibody titers above 100 mIU/mL, compared to 42.9% of students aged 26 to 30 years. The association between age and antibody titer was statistically significant ($P = 0.026$, Table 1).

Time Since Vaccination

Of the students who had received their last vaccine dose less than two years prior, 77.4% had titers above 100 mIU/mL, compared to 50% of those vaccinated more than two years ago. No significant association was found between antibody titers and time since the last vaccine dose ($P = 0.417$, Table 1).

Smoking Status

Among students who smoked fewer than five cigarettes per day, 78% (n = 46) had antibody titers above 100 mIU/mL, compared to 60% (n = 3) of those who smoked five or more cigarettes daily. This difference was not statistically significant ($P = 0.583$, Table 1).

Body Mass Index (BMI)

Antibody titers above 100 mIU/mL were observed in 75.5% of students with a normal BMI (<25 kg/m^2) and in 81.8% of students who were overweight (BMI ≥25 kg/m^2). No significant association was found between BMI and antibody titers (P=1.000, Table 1).

Discussion

Dental students, like other healthcare workers, are at significant risk of exposure to infectious agents during their clinical training. Effective vaccination, particularly against hepatitis B virus (HBV), plays a fundamental role in protecting their health (23). This study investigated anti-HBs antibody titers among clinical dental students at Semnan University of Medical Sciences.

Of the 64 participants, 49 (76.6%) had titers above 100 mIU/mL, indicating adequate seroprotection, whereas 15 (23.4%) had titers between 10 and 100 mIU/mL, reflecting moderate immunity. The associations between antibody titer and gender, age, time since vaccination, smoking status, and BMI were also evaluated.

In the present study, 72.2% of females and 82.1% of males had antibody titers above 100 mIU/mL, however this difference was not statistically significant. This finding is consistent with several previous studies (9, 18, 26, 32). In contrast, other studies have reported a significant association between gender and antibody response. For instance, Qarzi et al. (8) and Habibi and Motavaslian (11) found higher titers in females, whereas Usman et al. (28) reported higher titers in males. A significant gender-based difference was also reported by Kaviani and Kia (33), Duran et al. (31), and Khattak et al. (15). These discrepancies may be attributed to differences in study populations, methodologies, and vaccine types used.

Age was significantly associated with antibody titer in our study, with 80.7% of students aged 21–25 years having titers above 100 mIU/mL compared to 42.9% of those aged 26–30 years. This inverse relationship between age and antibody levels aligns with the findings of Mehdipour et al. (9). However, several other studies found no significant association between age and antibody titer, contrasting with our results (11, 15, 26, 33).

Antibody titers above 100 mIU/mL were observed in 77.4% of students vaccinated within the previous two years, compared to 50% of those vaccinated more than two years ago. Although this difference

Table 1. Frequency distribution of anti-HBs titers in dental students of Semnan University based on their demographics

Demographics	Number	Percentage	Antibody titer				P-value
			Moderate (10-100) mIU/mL		Good (> 100) mIU/mL		
			Number	Percentage	Number	Percentage	
Gender							
Female	36	56/2	10	27/8	26	72/2	0/353*
Male	28	43/8	5	17/9	23	82/1	
Age (yrs)							
25-21	57	89	11	19/3	46	80/7	0/026*
30-26	7	11	4	57/1	3	42/9	
Time passed since vaccination (yrs)							
≤ 2	62	96/8	14	22/6	48	77/4	0/417**
> 2	2	3/2	1	50	1	50	
Number of cigarettes smoked daily							
4-0	59	92/1	13	22	46	78	0/583**
10-5	5	7/9	2	40	3	60	
BMI							
< 25	53	82/8	13	24/5	40	75/5	1/00**
≥ 25	11	17/2	2	23/4	9	76/6	

***Chi-square test; **Fisher's exact test**

was not statistically significant, numerous studies have reported a significant decline in antibody titers over time following vaccination (8, 11, 33, 34).

The lack of significance in our study may be due to the relatively short interval since vaccination in our cohort, as all participants had been vaccinated within the preceding one to two years.

No significant association was found between smoking status and antibody titers. Antibody levels above 100 mIU/mL were observed in 78% of light smokers (<5 cigarettes/day) and 60% of heavier smokers (≥5 cigarettes/day). This finding is consistent with previous research (9, 11, 33).

Similarly, no significant association was observed between BMI and antibody titers. Adequate seroprotection was found in 75.5% of students with a normal BMI and in 81.8% of overweight students. This result aligns with several studies (8, 26, 33) but contrasts with the findings of Habibi and Motavaslian (11), who reported a significant inverse relationship between BMI and antibody response.

These findings have important implications for dental education and occupational health policy. Given the high risk of HBV exposure in clinical settings, we recommend:

- Mandatory verification of hepatitis B immunity for all dental students prior to clinical training.
- Integration of routine immunity monitoring into the dental curriculum.
- Implementation of timely booster dose strategies for students with waning immunity.

This study is limited by its cross-sectional design and relatively small sample size. Larger, longitudinal studies with diverse populations are needed to define optimal monitoring intervals and confirm these findings. Future research should also explore the impact of booster doses on long-term immunity in this high-risk group.

Conclusion

The present study demonstrated that anti-HBs antibody titers decreased with age, indicating declining vaccine-induced immunogenicity over time. This finding underscored the importance of routine antibody titer assessment in vaccinated dental students, who remained at high occupational risk for hepatitis B virus (HBV) exposure. Furthermore, students whose antibody titers fell below the protective threshold should be identified for close

monitoring and should receive booster doses as clinically indicated to ensure sustained immunity and occupational safety.

Declarations

Ethics Approval and Consent to Participate

This cross-sectional study was conducted at the School of Dentistry, Semnan University of Medical Sciences. Ethical approval was obtained from the Research Ethics Committee of the Vice Chancellor for Research (Approval No: IR.SEMUMS.REC.1399.103). Written informed consent was obtained from all participants prior to enrollment in the study.

Availability of Data and Materials

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

Competing Interests

The authors declare that they have no competing interests, financial or non-financial, that could have influenced the design of the study, data collection, analysis, interpretation of the results, or the writing of the manuscript.

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Authors' Contributions

AA (Almas Abednejad) contributed to data collection, data entry, and preparation of the initial manuscript draft. AH (Azam Hosseini) contributed to the study conception and design, and supervised the clinical aspects of the research. ZA (Zahra Amiri) contributed to methodological guidance and interpretation of clinical findings. RG (Raheb Ghorbani) contributed to the study design, statistical analysis, and data interpretation. SS (Shabnam Sohanian) contributed to the overall study supervision, conceptualization, critical revision of the manuscript, and served as the corresponding author. All authors read and approved the final manuscript.

Declaration of Generative Artificial Intelligence (AI) Utilization

During the preparation of this manuscript, generative artificial intelligence tools were used solely to assist with language refinement, including grammar, punctuation, and stylistic improvements. No AI tools were used for the generation of scientific content, data analysis, interpretation of results, or drawing of conclusions. All intellectual content, data interpretation, and final manuscript approval were performed by the authors, who take full responsibility for the integrity and accuracy of the work.

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