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ORIGINAL PAPER

# Determinants of Hepatitis B Virus (HBV) Infection Among University Students in Central Bangladesh

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## Abstract

This study aimed to determine the seroprevalence and determinants of hepatitis B virus (HBV) infection among university students in Bangladesh. This cross-sectional study was conducted among 614 students from five universities in central Bangladesh. Data were collected on demographic information, immunization history, medical and blood transfusion history through the face-to-face interview. Blood samples were collected and screened for anti-HBsAg using ELISA, HBsAg Rapid Test-cassette, and immune chromatographic test. The overall seroprevalence of HBV infection was 5.0%, and vaccination coverage was 19.2% among the participants. Students having a history of surgery (OR 11.004, 95% CI 3.211–37.707), blood transfusion (OR 5.651, 95% CI 0.965–33.068), being married (OR 4.776, 95% CI 1.508–15.127), and not being vaccinated (OR 9.825, 95% CI 1.130–85.367) were at higher risk of being infected by HBV. This study showed the endemicity of HBV infection among the Bangladeshi population. Marriage, surgical or blood transfusion history, not being vaccinated were the determinants of HBV infection within the study population. Public health initiatives for preventing HBV infection at the university levels should be envisaged.

**Keywords** Hepatitis B virus · Infection · Risk factors · Students · Bangladesh

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## Introduction

Hepatitis B virus (HBV) infection is one of the most common and severe infectious diseases responsible for significant morbidity and mortality [1]. Worldwide, around 257 million people have been chronically infected with HBV, and 887,000 deaths have resulted from HBV infection, including cirrhosis and hepatocellular carcinoma in 2015 [2]. Almost half of all cases of hepatocellular carcinoma and one-third of all cases of cirrhosis are accountable for HBV infections [3, 4]. A high prevalence (HBV infection affects more than 8.0% of the population) of chronic HBV infection has been found in the Asia Pacific and sub-Saharan African regions of the world [5]. HBV seroprevalence is classified as intermediate (2–7%) in North Africa and the Middle East, Eastern and Southern Europe, Latin America, and South Asia [5]. In South-West Asia, the Russian Federation, Eastern, and Southern Europe, most of central and South America, the seroprevalence of chronic HBV was > 2 to < 8%. The seroprevalence of chronic HBV infection was low (< 2% of the population HBsAg-positive) in Northern and Western Europe, Australia, New Zealand, and North America [6]. Almost three-quarters of HBV infection was found in Asia, the Middle East, and Africa [7]. HBV infection has been identified as an emerging future health problem in many developing countries in Asia [8–11]. Substantial morbidity and mortality occur due to severe infection and chronic sequelae, including chronic hepatitis, liver cirrhosis, liver cancer, and hepatocellular carcinoma [12, 13]. Among the 1.34 million deaths caused by viral hepatitis, most of the deaths were due to chronic liver cirrhosis (720,000 deaths) and hepatocellular carcinoma (47,000 deaths) in 2015 [14].

In the Indian sub-continent, the chronic HBV infection carriage rate ranged within 2–5%, which is recognized as intermediate endemicity of HBV infection [15, 16]. The HBsAg prevalence of Bangladesh is within the range of 2–7%, which was reported by previous studies among the different selective populations of this country [17]. In developed countries, HBV infection is mostly infected people through injecting the drug, sexual activity, or occupational exposure. Other reasons for infections can be included in developing countries, such as household contact, vertical transmission via hemodialysis, transmission from a surgeon [18], and the receipt of blood or bloody fluids or organs [19]. The sustainable development goals (SDGs) have been set to target 3.3.4 to combat HBV incidence per 100,000 populations [20]. Younger people are at more risk of being infected by HBV [21]. However, most previous studies were conducted among selected populations such as drug addicts, blood donors, hospitalized patients, and commercial sex workers [22–26]. In Bangladesh, there is a scarcity of information about HBV infection among young individuals. This study aimed at assessing the seroprevalence of HBV infection and determinants among university students in Central Bangladesh.

## Methods

### Study Design and Population

This study was planned as a descriptive cross-sectional study among students from five Bangladeshi universities (Jahangirnagar University, Daffodil International University, City University, Manarat International University, and Eastern University, Dhaka). Pre-advertising was done using a poster, brochure, and university Facebook page/group after receiving approval from each university. At each university's medical center, a data and sample collection area was developed. From 10 a.m. to 3 p.m., one research assistant (data collector) and one nurse were stationed in each corner to collect data and blood samples. The information was gathered between July and November 2018. Students who expressed an interest were freely questioned, and a blood sample was taken. The sample was taken to the Thalassemia Hospital and Institute's laboratory and analyzed daily. The report was sent to the pupils at no cost to them.

### Sample Size and Data Collection

A total of 1030 students from five universities expressed an interest in participating in this study. 424 male and 207 female students approved blood testing. Of them, 15 were not included in the study because they were unwell, and two were pregnant. In the end, 416 students were removed, and 614 students were enrolled in the study out of 1030. A structured questionnaire was utilized to capture their sociodemographic information using a face-to-face interview technique.

### Blood Sample Collection and Lab Test

A nurse took blood samples from the middle cubital vein after taking adequate aseptic precautions and storing them in an EDTA tube on the spot. The blood samples were subsequently delivered to the Thalassemia Hospital and Institute's laboratory. To avoid errors and biases, the samples were labeled differently. To reduce inaccuracies, data about the responders were assigned the same credential number as their blood samples. The test tubes containing blood samples were centrifuged at 3000 rotations per minute for 8–10 min at room temperature, and blood plasma was extracted. Plasma samples were tested for the presence of HBsAg using a commercial test kit (chromatographic immunoassay), the HBsAg Rapid Test-cassette

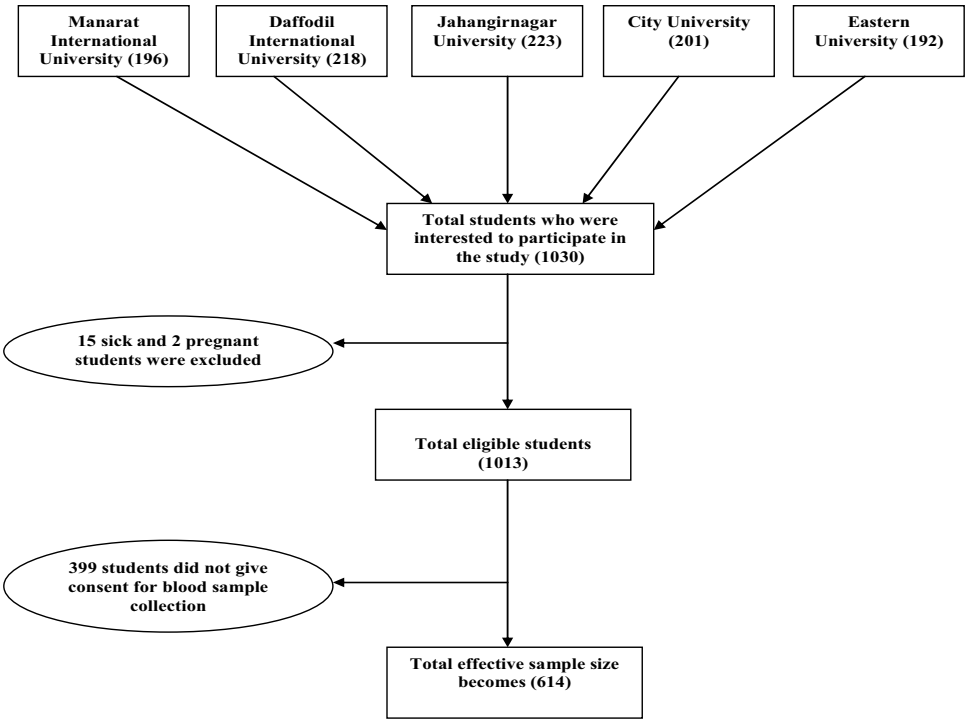


**Fig. 1** Selection of study sample

(CTK, bioscience, Inc. USA). The test was repeated once if any of the test 1 results were positive. A medical technologist performed the test, which a physician later validated. The ELISA test was used to confirm positive instances (Fig. 1).

## Data Analysis

The data were analyzed using Stata version 14.2 SE (Stata Corp 2015; Statistical Software: Release 14. College Station, TX: Stata Corp LP). The age of the students was changed from a continuous to a categorical variable. Using descriptive statistics, the frequency and proportion of socio-demographic and background variables, HBV infection, immunization status, and clinical exposure of university students were investigated. The correlation between HBV infection and demographic factors was investigated using chi-square tests. Multiple logistic regressions were used to examine the relationships between marital status and HBV infection, with marital status as an explanatory variable and HBV infection status as an outcome variable. To find the determinants of HBV infection, researchers used multiple logistic regressions with odds ratios (OR). We used HBV infection as an outcome variable in numerous logistic regressions, age, level of study, gender, marital status, division, history of surgery, HBV vaccination status, and history of blood transfusion as explanatory variables. Multiple logistic regression models were used to control the influence of all confounders when they were connected with the key exposure variable and the result of interest in this article. A covariate was considered a confounder if it was significantly related to the exposure variable and the result of interest in the binary logistic regression.

# Results

## Socio-Demographic, Infection and Vaccination Status of the Students

A total of 614 students were tested for HBV infection, with 92.7% of those tested being under the age of 25. 79.8% of the study participants were undergraduate students, the majority (66.9%) were men, and 93.5% of the respondents were single. Only 19.2% of the 614 students tested positive for HBsAg, and only 31 (5.0%) were HBV vaccinated. Only 2.0% of all responders had ever received a blood transfusion, and only 3.9 percent had ever had surgery (Table 1).

## Seroprevalence of Hepatitis B Infection by Demographic Characteristics

The prevalence of HBV infection was substantially greater among respondents aged 25 years or less ($P = 0.008$), and there was also a significant link between HBV infection and level of study ($P < 0.05$); however, undergraduates reported a higher proportion of HBV infection. Gender was not shown to be significantly linked ($P = 0.096$) with HBV infection in this study, while male students had a greater frequency of HBV infection (6.1%) than female

**Table 1** Socio-demographic, infection and vaccination status of the students (N = 614)

| Variables | Frequency | Percentage |
|---|---|---|
| Age (years) | | |
| ≤25 | 569 | 92.7 |
| >25 | 45 | 7.3 |
| Level of study | | |
| Undergraduate | 490 | 79.8 |
| Graduate | 124 | 20.2 |
| Gender | | |
| Male | 411 | 66.9 |
| Female | 203 | 33.1 |
| Marital status | | |
| Married | 40 | 6.5 |
| Unmarried | 574 | 93.5 |
| Hepatitis B virus infection | | |
| Yes | 31 | 5.0 |
| No | 583 | 95.0 |
| Hepatitis B virus vaccination status | | |
| Yes | 118 | 19.2 |
| No | 496 | 80.8 |
| History of blood transfusion | | |
| Yes | 12 | 2.0 |
| No | 602 | 98.0 |
| History of surgery | | |
| Yes | 24 | 3.9 |
| No | 590 | 96.1 |

**Table 2** Distribution of hepatitis infection by demographic characteristics (N = 614)

| Characteristics | N | Hepatitis | | P value |
|---|---|---|---|---|
| | | N | % | |
| Age (years) | | | | |
| ≤25 | 569 | 25 | 4.4 | 0.008 |
| >25 | 45 | 6 | 13.3 | |
| Level of study | | | | |
| Undergraduate | 490 | 20 | 4.1 | 0.030 |
| Graduate | 124 | 11 | 8.9 | |
| Gender | | | | |
| Male | 411 | 25 | 6.1 | 0.096 |
| Female | 203 | 6 | 3.0 | |
| Marital status | | | | |
| Married | 40 | 9 | 22.5 | 0.000 |
| Unmarried | 574 | 22 | 3.8 | |
| History of surgery | | | | |
| Yes | 24 | 9 | 37.5 | 0.000 |
| No | 590 | 22 | 3.7 | |
| Hepatitis B virus vaccination status | | | | |
| Yes | 118 | 1 | 0.8 | 0.020 |
| No | 496 | 30 | 6.0 | |
| History of blood transfusion | | | | |
| Yes | 12 | 6 | 50.0 | 0.000 |
| No | 602 | 25 | 4.2 | |

students (3%), (P = 0.010). The prevalence of married students (22.5%) was higher than that of unmarried students (3.8%) (P = 0.001). Respondents who had previously undergone surgery had a higher prevalence (37.5%) than those who had not (3.7%) (P = 0.001). The frequency of HBV infection was higher among students (50.0%) who had previously received blood transfusions than among others (4.2%) (P = 0.001) (Table 2).

## Determinants for HBV Infection Among University Students

A binomial logistic regression analysis was done to identify the determinants of HBV infection. HBV infection status was the dependent variable, while age, education level, gender, marital status, surgery history, hepatitis vaccine status, and blood transfusion history were the independent variables. The risk of HBV infection was greater (OR 1.293, 95% CI 0.335–4.990) among students aged 25 and under. There was no significant relationship between the students' ages and the risk of HBV infection. The level of study of the participants did not affect the likelihood of having HBV infection (OR 1.691, 95% CI 0.594–4.816). Married students had a greater risk of HBV infection (OR 4.776, 95% CI 1.508–15.127) than unmarried students. HBV infection was 11 times more likely among students who had previously undergone surgery (OR 11.004, 95% CI 3.211–37.707) than students who had never undergone surgery. Students who were not immunized (OR 9.825, 95% CI 1.130–85.367) had an almost ninefold higher chance of contracting HBV than those who were. HBV infection was linked to a history of blood transfusion (OR 5.651, 95% CI 0.965–33.068), with individuals who had blood transfusions being more than 5 times more likely to contract the virus (Table 3).

## Discussion

To the best of our knowledge, this is the first study to investigate the seroprevalence of HBV infection, vaccination status, and HBV infection determinants among university students in Bangladesh. In this study, the seroprevalence of HBV infection was around 5.0%, which is similar to 4.3% in a similar survey conducted in Bangladesh [27]. The findings

**Table 3** Determinants for HBV infection among university students (N = 614)

| Factors | Crude OR | CI (95%) | | P value | Adjusted OR | CI (95%) | | P value |
|---|---|---|---|---|---|---|---|---|
| | | Lower | Upper | | | Lower | Upper | |
| Age (years) | | | | | | | | |
| ≤ 25 | Ref | | | | | | | |
| > 25 | 3.347 | 1.296 | 8.642 | 0.013 | 1.293 | 0.335 | 4.990 | 0.709 |
| Level of study | | | | | | | | |
| Undergraduate | Ref | | | | | | | |
| Graduate | 2.287 | 1.065 | 4.910 | 0.034 | 1.691 | 0.594 | 4.816 | 0.325 |
| Marital status | | | | | | | | |
| Married | 7.284 | 3.095 | 17.141 | 0.000 | 4.776 | 1.508 | 15.127 | 0.008 |
| Unmarried | Ref | | | | | | | |
| History of surgery | | | | | | | | |
| Yes | 15.490 | 6.113 | 39.249 | 0.000 | 11.004 | 3.211 | 37.707 | 0.000 |
| No | | | | | | | | |
| HBV vaccination status | | | | | | | | |
| Yes | Ref | | | | | | | |
| No | 7.532 | 1.016 | 55.802 | 0.04 | 9.825 | 1.130 | 85.367 | 0.038 |
| History of blood transfusion | | | | | | | | |
| Yes | 23.08 | 6.949 | 76.653 | 0.000 | 5.651 | 0.965 | 33.068 | 0.055 |
| No | Ref | | | | | | | |

of our investigation are validated by Ashraf et al., [28], who found a 6.5% prevalence rate of HBsAg. The prevalence of HBsAg in our study is within 2–7%, which has been documented in earlier studies among Bangladesh's various selective populations [17]. In 2017, the Directorate General of Health Services (DGHS) of Bangladesh's Ministry of Health and Family Welfare recorded 546 cases of HBV infection per 100,000 people [29]. Marital status was one of the most critical determinants for HBsAg positive among university students.Married students were more likely than unmarried pupils to test positive for HBsAg.

HBV infection can be spread through sexual activity, and unsafe sexual practices can lead to HBsAg infection [30–34]. One probable explanation is that married people are more likely to become infected with HBsAg through sexual activity. Pathogen transmission from the hospital environment to the population, particularly HBV infection, is a significant source of pathogen transmission from the hospital environment to the community, especially in developing countries like Bangladesh. The majority of HBV infection transmissions happen during invasive or obstetric procedures [35]. This study indicated that persons with any surgical history were at risk for HBV infection, consistent with prior findings. During surgery, HBV infection can be spread in three ways: from the surgeon to the patient, from contaminated surgical tools to the patient, and from an HBsAg positive patient to another in the same hospital room [36–38]. To prevent all healthcare-related transmissions of HBV infection, a comprehensive approach is required, which includes ensuring hygiene and cleanliness for health workers, hospital rooms and medical equipment to prevent nosocomial infections, administering HBV vaccination to health workers, and taking measures to reduce blood exposure [39–41]. Another key risk factor for HBV infection, according to this study, is a history of blood transfusion. Recent research has proven that blood transfusion is one of the critical risk factors exacerbated by blood donors' occult HBV infection (OBI) [16, 42]. The previous investigation found that the seroprevalence of HBsAg was high among commercial blood donors (18–29%) in Bangladesh [22, 43]. This higher prevalence occurs partly due to previous contamination of blood transfusion.

The presence of HBV immunization was a significant factor in HBsAg infection. Immunization against HBV can prevent mild to chronic infection, as well as complications such as cirrhosis and hepatocellular cancer [35]. The introduction of HBV vaccination resulted in a considerable decrease in HBV seroprevalence and HBV-related illnesses [35, 44, 45]. The government of Bangladesh began including the HBV vaccine in the expanded program of immunization (EPI) in 2003 to meet the World Health Organization's objective of eradicating HBV infection by 2030 [46, 47]. The immunization coverage program, however, is just for infants. It is highly anticipated that a program for HBV infection vaccination coverage among young adults will be implemented [48]. Unlike other studies, ours found gender and location to be unimportant [42, 49].

There were a few flaws in this study as well. For starters, due to a lack of time and funds, only ELISA tests were used

to detect positive instances of HBV infection using the ICT method. Second, because medical records were not used to verify vaccination status for HBV infection, self-reported vaccination status could be underreported due to recollection bias. Finally, the researchers were unable to determine the precise path of HBV infection transmission among university students. Fourth, we could not determine whether the risk factors and behaviors were adopted after or before the entrance to the institution. Finally, we included the key risk factors for HBV infection; nevertheless, other factors may have been overlooked in our analysis.

## Conclusion

In this study, university students in Bangladesh had a high seroprevalence of HBV infection. HBV infection was more likely in married students, had a surgical history, had a history of blood transfusion, and had not been vaccinated. To prevent HBV infection among married students, sexual education and awareness should be widely disseminated. To prevent HBV infection resulting from a blood transfusion or surgery, healthcare facilities should maintain good cleanliness and sanitary procedures. Young people should be included in the vaccination program. To prevent HBV infection among university students in Bangladesh, public health activities are required.

## Declarations

**Ethical Approval** The Bangladesh Institute of Allergy and Clinical Immunology's ethical review committee approved the study (IACIB). Each participant signed a written informed consent form. They were informed about the study's nature and goal and the fact that their information would be kept private. In addition, all volunteers received free laboratory tests, interviews, and results from notification. Each participant's test results were sealed, encased, and personally delivered. As a thank you for taking part in the study, each participant received a modest gift.

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