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Prevalence and factors associated with hepatitis B susceptibility among men who sex with men on HIV pre-exposure prophylaxis in Northeastern Brazil: a cross-sectional study

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Abstract

Background This study aimed to determine the prevalence and factors associated with susceptibility to hepatitis B virus (HBV) among cisgender men who have sex with men (MSM) on HIV pre-exposure prophylaxis (PrEP) in Northeastern Brazil.

Methods This was a cross-sectional, analytical study conducted between September 2021 and June 2023. Participants underwent structured interviews to collect sociodemographic and clinical information, including hepatitis B vaccination history, HIV PrEP use and sexual health history. Blood samples were collected for hepatitis B serologic testing: HBV surface antigen (HBsAg), HBV surface antibody (anti-HBs), total and IgM HBV core antibody (anti-HBc). HBV susceptibility was defined as nonreactive results for all these serological markers.

Results A total of 287 participants were enrolled into the study. The median age of the individuals was 31 years (interquartile range: 27; 36). HBV susceptibility was found in 58 out 286 individuals (20.3%; 95% CI: 15.9–25.2). Seventy-six percent of the participants reported completing the three-dose hepatitis B vaccine schedule. Susceptibility was significantly associated with a monthly income ≤ 5 minimum wages (PR: 2.02; 95% CI: 1.01–4.05), lack of complete hepatitis B vaccination schedule (PR: 4.52; 95% CI: 2.89–7.06), initiation of HIV PrEP (PR: 2.18; 95% CI: 1.21–3.94), duration of six months of HIV PrEP (PR: 2.16; 95% CI: 1.19–3.91), absence of tattoos (PR: 1.55; 95% CI: 1.00–2.40) and no history of sexually transmitted infections (PR: 1.65; 95% CI: 1.07–2.54).

Conclusion Our findings highlight the significant burden of HBV susceptibility among MSM on HIV PrEP in Northeastern Brazil. Socioeconomic factors, vaccination status, PrEP use and sexual health behaviors play critical roles in determining susceptibility to HBV. Integrating hepatitis B screening and vaccination into PrEP services is critical for

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identifying and addressing HBV susceptibility among MSM. Interventions aimed at increasing vaccination coverage and promoting safer sexual practices are essential for mitigating the burden of HBV infection in this population.

Keywords Hepatitis B, Vaccines, Pre-exposure prophylaxis, Men who have sex with men

Background

In Brazil, hepatitis B is a significant cause of morbidity and mortality from liver disease, particularly among key populations such as men who have sex with men (MSM), where sexual contact is the primary mode of transmission [1–3]. While most adults with acute hepatitis B virus (HBV) infection recover fully, up to 5% progress to chronic infection [4]. About 20% of new cases of hepatitis B in United States of America (USA) occur among MSM [5]. According to data from the Pan American Health Organization, the prevalence of chronic HBV infection in MSM communities is ten times higher than in general population [6]. The greatest burden of disease arises from complications of chronic infection, such as cirrhosis, liver failure and hepatocellular carcinoma [7].

In turn, hepatitis B is a vaccine-preventable sexually transmitted infection (STI). The Brazilian Immunization Program (PNI) is recognized worldwide for its successful experiences in eliminating and controlling vaccine-preventable diseases [8]. PNI has recommended universal HBV vaccination of children from birth since 1998. From 2000 onwards, PNI has included MSM in the recommendation of HBV immunization. And in 2016 the Brazilian Ministry of Health expanded the vaccine offer to the entire population regardless of age and/or vulnerability conditions [9, 10]. However, these recommendations have not been widely implemented. Vaccination coverage rates have declined over the past seven years, being worsened by the Coronavirus Disease 2019 (COVID-19) pandemic [11, 12].

Vaccination rates against hepatitis B among MSM have been below 90% for achieving HBV elimination across the world [6]. Coverage among MSM was as low as 50.7% in Scotland, 19.4–74.4% in Brazil, 53.6% in USA, and varied from 12.8 to 62.2% in Europe [13–17]. Insufficient vaccine coverage among MSM is partly explained by vaccine hesitancy, which is associated with issues such as older age, low education, poor financial status, reluctance to disclose sexual orientation to healthcare provider, misinformation and lack of confidence in vaccines [18, 19].

Pre-exposure prophylaxis (PrEP) has emerged as an important strategy to combat the human immunodeficiency virus (HIV) infection, a pivotal health issue for MSM. As part of a national public health policy since 2018, PrEP currently serves approximately 70,000 Brazilian citizens, with around 80% being MSM [20]. In Brazil, HIV PrEP has been demonstrated to be highly effective, potentially increasing life expectancy and reducing HIV transmission by one-third over five years among MSM

[21–23]. Within the framework of combination HIV prevention, PrEP services provide a unique opportunity for integrating care and prevention of other health issues disproportionately affecting more MSM, such as HBV infection [24].

The greater vulnerability of MSM to hepatitis B involves several issues such as unsafe sexual practices (e.g., condomless anal intercourse and multiple sexual partners), low access to health services, context of violence and low social integration [3]. The use of HIV PrEP is increasing among MSM and has been associated with behavioral shifts toward more risky sexual practices (e.g., condomless anal sex, unprotected sex with HIV-unknown partners and increased number of sexual partners) and greater frequency of sexually transmitted infections (STI), including hepatitis B [25, 26].

This vulnerability is further influenced by regional disparities in a country with continental dimensions like Brazil. The Northeastern region faces poor socio-economic indicators, such as high illiteracy and income inequality rates and poor basic sanitation, and faces problems of prejudice and discrimination against vulnerable populations in healthcare settings [27, 28]. These determinants of health related to social, economic, cultural, ethnic/racial and behavioral factors can directly influence risk factors and exposure to STI as well as the ability to respond and deliver quality services with adequate coverage for key populations. [27]

MSM could be considered a potential target group for catch-up vaccination against HBV during PrEP follow-up. According to the Brazilian Guidelines for Pre-Exposure Prophylaxis for Risk of HIV Infection, individuals on HIV PrEP should undergo evaluation for HBV susceptibility/immunity by testing for HBV-specific antigens and antibodies [29]. Understanding HBV immune status is crucial for clinical decision-making regarding preventive education and vaccination for susceptible individuals as well as for the appropriate management of persons on HIV PrEP with chronic HBV infection.

Given the limited literature on HBV immune status among MSM on HIV PrEP in Northeastern Brazil, identifying the correlates of HBV susceptibility in this population is essential for designing effective public health interventions to increase the vaccination coverage. Investment in prevention remains paramount for HBV elimination. Therefore, this study aims to determine the prevalence of HBV-susceptible individuals and the factors associated with susceptibility.

Methods

Study design and participants

This cross-sectional study was conducted at the Institute of Tropical Medicine of Rio Grande do Norte (IMT-RN) in Northeastern Brazil. The IMT-RN is a specialized unit of the Federal University of Rio Grande do Norte (UFRN), focusing on infectious diseases and serving as the primary public HIV PrEP service in the state [20]. The study was approved by the Institutional Review Board at UFRN under the protocol number – CAAE:31650520.0.2005.5292. All study participants provided signed and dated informed consent forms upon study entry, adhering to the principles outlined in the Declaration of Helsinki.

Eligible participants were cisgender MSM aged at least 18 years, either starting or already using HIV PrEP on the day of the interview. Cisgender MSM were defined as males whose current gender identity is the same as the sex they were assigned at birth and engage in sexual relationships with other males. The term “MSM” was used clinically to refer to sexual behavior alone, regardless of self-described sexual orientation. People with HIV infection, as defined by diagnostic criteria established by the Brazilian Ministry of Health, [30] were excluded.

The study population was recruited between September 30, 2021 and June 19, 2023 by convenience sampling as participants attended scheduled PrEP visits at the IMT-RN. The sample size was calculated using the website OpenEpi (<https://www.openepi.com/SampleSize/SSPropor.htm>), based on the prevalence of 74.4% for positive antibody to hepatitis B surface antigen (Anti-HBs) among MSM, [15] confidence limits of $\pm 6\%$, 5% of α -error and 20% of β -error, aiming to include at least 204 individuals.

Data collection and laboratorial procedures

Face-to-face interviews using a structured standardized questionnaire were carried out to collect sociodemographic characteristics (e.g., age, self-declared race/skin color, marital status, sexual orientation, education, income and health insurance) and clinical information: hepatitis B vaccination status, self-reported sexual behaviors (e.g., condomless anal sex, sexual role during anal intercourse, frequency of condom use, condomless sex with HIV-infected partner, number and gender of partners, steady partner, exchange of sex for money and goods, sex worker, oral sex, sexualized drug use, attendance at gay saunas, sharing of insertive sex toys, participation in fisting, fingering, rimming and group sex), other behaviors (e.g., binge drinking, substance use, use of erectile dysfunction drugs, use of geosocial dating apps, duration of PrEP use, sharing of sharp personal items and instruments, tattooing) and medical history of STIs.

Condomless anal sex was defined as penile-anal intercourse without condom. Oral sex referred to penile-oral intercourse. Sexualized drug use meant intentional drug use before or during sex to facilitate, enhance, prolong and sustain sexual activity. Sharing insertive sex toys was defined as using sex toys that are inserted into the anus. Fisting involved inserting a fist into the rectum. Fingering and rimming referred to using a finger and tongue to provide stimulation to the anus, respectively. Group sex was defined as engaging in sex with more than one individual simultaneously.

Hepatitis B vaccination status was based on the self-reported completion of three-dose hepatitis B vaccine schedule. Binge drinking was defined as consuming ≥ 5 drinks of alcohol within two hours. Substance use included use of marijuana, cocaine, poppers, solvents and/or club drugs (such as amphetamines, hallucinogens, lysergic acid diethylamide [LSD], ketamine, gamma-hydroxybutyric acid [GHB], ecstasy, bath salts). Use of erectile dysfunction drugs involved taking any drug belonging to the phosphodiesterase inhibitors class (e.g., sildenafil). The study also recorded the use of the geosocial dating apps such as Grindr®, Hornet®, Scruff®, Tinder®, Badoo® and Growlr®. Medical history of STIs included syphilis, anogenital warts, genital herpes, chancroid, hepatitis B, chlamydia, gonorrhea, non-gonococcal and non-chlamydial urethritis, mpox and proctitis.

After interviews, blood samples were collected for STIs screening (HIV, syphilis, hepatitis B and C) using rapid immunochromatographic tests, as recommended by the Brazilian Ministry of Health [29]. The presence of hepatitis B surface antigen (HBsAg) was determined by a commercial rapid immunochromatographic assay kit (Bioclin® HBsAg, Brazil) [31]. Serum samples were tested for Anti-HBs, IgM and total antibodies to hepatitis B core antigen (IgM and total anti-HBc) using a commercial chemiluminescent immunoassay kit (Diasorin LIAISON® total and IgM Anti-HBc and Anti-HBs, Italy) at the Central Public Health Laboratory of Rio Grande do Norte (LACEN/RN) [32]. Tests were carried out in accordance with the manufacturer's instructions. Sample collection, transport and storage followed the standard procedures from LACEN/RN, as well as the validation process and quality control of laboratory tests.

HBV status was categorized based on the serological markers as follows: (1) susceptible (negative HBsAg, negative total and IgM Anti-HBc, and negative Anti-HBs); (2) immune from prior vaccination (negative HBsAg, negative total and IgM Anti-HBc, and positive Anti-HBs); (3) immune from resolved infection (negative HBsAg, positive total Anti-HBc, negative IgM Anti-HBc, and positive Anti-HBs); (4) acute infection (positive HBsAg, positive total and IgM Anti-HBc, and negative Anti-HBs); and (5) chronic infection (positive HBsAg,

positive total Anti-HBc, negative IgM Anti-HBc, and negative Anti-HBs) [33].

Statistical analysis

Descriptive analysis presented continuous variables as median±interquartile range (IQR) and categorical variables as absolute and relative values. Continuous variables were converted into categorical variables as appropriate for analysis purposes. The prevalence of HBV susceptibility was calculated with 95% confidence interval (95% CI). HBV susceptibility was the dependent variable, and the sociodemographic characteristics and clinical information were the independent variables.

Missing data occurred in only three independent variables due to non-response, representing at most 1% of the data, and were therefore excluded from the analysis. Bivariate analyses were performed using Pearson

chi-square or Fisher's exact tests for categorical variables as appropriate. The linear-by-linear association chi-square test was used for ordinal variables. Patients with acute or chronic HBV infection were also excluded from bivariate analysis. Prevalence Ratio (PR) and their respective 95% CIs were calculated for these associations.

Independent variables with p-value<0.20 in bivariate analysis were considered for multivariate Poisson regression analysis with robust variance. To retain the variables in multivariate analysis, multicollinearity tests were performed. Multicollinearity was measured by crossing the independent variables, and those with p-values<0.001 were considered collinear. From this, the variables presenting the best correlation with the theoretical model were chosen. The objective of the robust Poisson regression model was to assess the individual effect of each independent variable remaining in the model on HBV susceptibility, calculating the adjusted PR and respective 95% CI. All reported values are two-tailed, with a p-value<0.05 considered statistically significant. Data were analyzed using SPSS package (IBM Corp. Released 2011. IBM® SPSS® Statistics for Windows®, Version 20.0. Armonk, NY: IBM Corp.).

Results

Sociodemographic characteristics and hepatitis B virus status of study population

Between September 2021 and June 2023, 315 individuals were potentially eligible and invited to participate in the study. A total 287 out 315 (91.1%) individuals agreed to participate in the study and all participants underwent the interviews and provided blood samples for STIs screening and hepatitis B serologic testing. The median age of the study participants was 31 years (IQR: 27; 36). Most MSM on HIV PrEP were non-white (54.7%), single/divorced (82.6%) and identified as gay/homosexual (78.7%). Additionally, the majority had a high schooling (87.8%) and reported a low/moderate income (78.8%). Most subjects were immune to HBV (79.4%), with vaccination being the primary means (88.2%) of acquiring the immunity against HBV infection in this population, as shown in Table 1. HBV susceptibility was observed in 58 individuals (20.3%; 95% CI 15.9–25.2) of the study population.

Hepatitis B vaccination status, sexual characteristics, other behaviors and medical history of sexually transmitted infections

Seventy-six percent of participants reported having completed the three-dose hepatitis B vaccine schedule. Among those born after the universal infant vaccination recommendation, eighty-two percent reported full hepatitis B vaccination, while only 75% of those born before this did so (shown in the supplementary material).

Table 1 Sociodemographic characteristics and HBV status of MSM on HIV PrEP in Northeastern Brazil

Variable	Total	
	N=287	%
Age (years)		
18–24	30	10.5
25–29	90	31.4
30–39	122	42.5
40–49	36	12.5
≥ 50	9	3.1
Race/Skin color		
White	130	45.3
Black	40	13.9
Brown	114	39.7
Indigenous	3	1.1
Marital status		
Single/ Divorced	237	82.6
Civil Union/ Married	50	17.4
Sexual Orientation		
Gay/ homosexual	226	78.7
Bisexual	61	21.3
Length of schooling (years)		
≤ 11	35	12.2
> 11	252	87.8
Monthly Income (minimum wages)[†]		
< 2.0	82	28.5
2.0–5.0	144	50.2
> 5.0	61	21.3
Health insurance		
No	138	48.1
Yes	149	51.9
HBV status		
Susceptible	58	20.3
Immune from prior vaccination	201	70.0
Immune from resolved infection	27	9.4
Chronic HBV infection	1	0.3

[†] One minimum wage represented approximately R\$ 1,204.00 (US\$ 247.64 USD).

Commonly reported sexual behaviors included oral sex (95.5%), rimming (92.7%), condomless anal intercourse (83.9%), group sex (73.5%), fingering (59.9%), multiple sexual partners (59.0%) and infrequent condom use (54.1%). Approximately two-thirds of subjects reported binge drinking and the use of geosocial dating apps. Sixty-four percent of MSM on HIV PrEP reported having experienced at least one STI in their lifetime. Table 2 provides more details about sexual and non-sexual behaviors of study population.

Sociodemographic and clinical factors associated with hepatitis B virus susceptibility

In bivariate analysis (Table 3), HBV susceptibility was associated with birth after universal infant vaccination recommendation (PR: 1.76; 95% CI: 1.08–2.87; $p=0.030$), low monthly income (PR: 2.35; 95% CI: 1.06–5.21; $p=0.022$), lack of full hepatitis B vaccination (PR: 4.63; 95% CI: 2.97–7.23; $p<0.001$), starting HIV PrEP (PR: 2.55; 95% CI: 1.30–5.01; $p=0.007$), six months of HIV PrEP (PR: 2.62; 95% CI: 1.32–5.22; $p=0.007$), no lifetime history of any STI (PR: 2.04; 95% CI: 1.29–3.22; $p=0.002$) and not attending gay sauna for sexual encounters (PR: 1.67; 95% CI: 0.99–2.81; $p=0.049$).

Multivariate analysis (Table 4) revealed that significant factors included: a monthly income ≤ 5 minimum wages (PR: 2.02; 95% CI: 1.01–4.05; $p=0.047$); lack of complete hepatitis B vaccine schedule (PR: 4.52; 95% CI: 2.89–7.06; $p<0.001$); initiation of HIV PrEP (PR: 2.18; 95% CI: 1.21–3.94; $p=0.010$); duration of six months of HIV PrEP (PR: 2.16; 95% CI: 1.19–3.91; $p=0.011$), absence of tattoos (PR: 1.55; 95% CI: 1.00–2.40; $p=0.049$) and no lifetime history of STIs (PR: 1.65; 95% CI: 1.07–2.54; $p=0.024$).

Discussion

In this cross-sectional study, we investigated the prevalence and factors associated with HBV susceptibility among MSM receiving HIV PrEP in a state capital of Northeastern Brazil. The sociodemographic characteristics of the study population closely mirrored the overall profile of MSM on HIV PrEP in Brazil [20]. We found that one-fifth of MSM were susceptible to HBV, a proportion lower than that reported in studies conducted in Campinas, São Paulo State, in 2004 ($>50.0\%$) [2], and in Goiânia, Goiás State, in 2014 (44.3%) [3], but similar to findings from a multicenter survey study in 12 Brazilian state capitals in 2016 (25.6%) [15].

Low vaccination coverage rates may explain why HBV susceptibility among the MSM community has remained at the same level in recent years. This phenomenon seems to result from a combination of factors, including the weakening of the Brazilian Unified Health System, irregular supply of hepatitis B vaccines to federative units, growth of anti-vaccine movements, vaccine

hesitancy and, more recently, fear of contagion through visiting health facilities and adherence to recommendations for social distancing and mobility restrictions during the COVID-19 Pandemic [12, 16, 18, 34].

Despite universal infant hepatitis B vaccination since 1998, we observed that a high proportion of MSM born thereafter exhibited a serological profile of susceptibility to HBV. This reinforces the role of PrEP services as an opportune setting for catch-up vaccination of these individuals, encompassing those who have not yet vaccinated, those whose anti-HBs levels declined or disappeared over time, and those who were initially non-responders.

Our study revealed an association between low/moderate income and HBV susceptibility, but within the threshold of statistical significance, suggesting the potential influence of socioeconomic-related inequalities on healthcare services access and utilization. Individuals with lower socioeconomic status face greater difficulty accessing preventive and curative services, including vaccination against hepatitis B [35, 36]. Furthermore, although education level did not emerge as a significant correlate of HBV susceptibility, low/moderate income was associated with low schooling (shown in the supplementary material). Education level influences knowledge about HBV, perception of vulnerability and severity of infection and the pursuit of protective measures among MSM [14, 36].

A notable finding was the observed decrease in HBV susceptibility with longer duration of PrEP use, consistent with a previous study [37]. Despite the association between PrEP use and increased STI diagnosis, tenofovir-based PrEP showed a potential prophylactic effect against HBV infection in a real-world setting [25, 38]. In this study, we did not observe an increase in the prevalence of resolved HBV infection as length of HIV PrEP use increased (shown in the supplementary material). Therefore, the progressive reduction in HBV susceptibility is likely due to vaccination against hepatitis B during PrEP follow. This trend was expected, as hepatitis B serologic testing is part of routine initial care for people initiating PrEP, with HBV-susceptible individuals being referred for immunization. This highlights the potential of PrEP services to integrate viral hepatitis care and increase vaccination coverage among vulnerable populations.

The absence of tattoos was associated with HBV susceptibility, but also at the threshold of statistical significance. Having a tattoo is classically a risk factor for HBV infection because HBV can be transmitted by tattoo instruments and/or pigments when they are contaminated with blood and bodily fluids and used on more than one person without appropriate sterilization [39]. So, the absence of tattoos could indicate less exposure to HBV and, by consequence, susceptibility. However, in this study, we did not observe an association between

Table 2 Description of vaccination and sexual health history among MSM on HIV PrEP in Northeastern Brazil

Variable	Total	
	N = 287	%
Complete hepatitis B vaccine schedule		
No	68	23.7
Yes	219	76.3
Unprotected anal intercourse in the past 3 months[†]		
No	43	16.1
Yes	224	83.9
Sexual role during anal intercourse in the past 3 months[†]		
Protected anal intercourse (<i>Activo, Pasivo or Moderno</i>)	43	16.1
Only receptive (<i>Pasivo</i>)	40	15.0
Receptive and insertive (<i>Versatile or Moderno</i>)	102	38.2
Only insertive (<i>Activo</i>)	82	30.7
Frequency of condom use during intercourse in the past 3 months[‡]		
Never once	64	23.9
Less than half of the time	47	17.5
Half of the time	34	12.7
More than half of the time	80	29.9
Everytime	43	16.0
Number of sexual partners in the past 3 months[‡]		
≤ 2	110	41.0
3–5	75	28.0
> 5	83	31.0
Gender of sexual partners in the past 3 months[‡]		
Only cisgender men	244	91.0
Cis and transgender men and women and nonbinary people	24	9.0
Steady partner		
No	132	46.0
Yes	155	54.0
Unprotected sex with HIV-infected partner in the past 6 months[§]		
No	52	21.0
Yes	76	30.6
Unsure	120	48.4
Exchange sex for money, housing, drugs and/or goods (ever)		
No	249	86.8
Yes	38	13.2
Sex worker		
No	280	97.6
Yes	7	2.4
Oral sex in the past 3 months		
No	13	4.5
Yes	274	95.5
Sexual role during oral sex in the past 3 months[¶]		
Only receptive	26	9.5
Only insertive	21	7.7
Receptive and insertive	227	82.8
Sexualized drug use (ever)[¶]		
No	201	70.8
Yes	83	29.2
Group sex (ever)[¶]		
No	75	26.5
Yes	208	73.5
Attendance at gay sauna for sexual encounters (ever)		
No	175	61.0

Table 2 (continued)

Variable	Total	
	N= 287	%
Yes	112	39.0
Sharing insertive sex toys with partners during intercourse (ever)		
No	223	77.7
Yes	64	22.3
Fisting (ever)		
No	230	80.1
Yes	57	19.9
Anal fingering (ever)		
No	115	40.1
Yes	172	59.9
Rimming (ever)		
No	21	7.3
Yes	266	92.7
Binge drinking in the past 3 months		
No	104	36.2
Yes	183	63.8
Substance use in the past 3 months		
No	182	63.4
Yes	105	36.6
Erectile dysfunction drugs use in the past 3 months		
No	261	90.9
Yes	26	9.1
Use of geosocial dating app in the past 3 months		
No	94	32.8
Yes	193	67.2
Length of HIV PrEP use		
Starting HIV PrEP	102	35.6
6 months of HIV PrEP	85	29.6
≥ 12 months of HIV PrEP	100	34.8
Sharing of sharp personal items and instruments (ever)		
No	190	66.2
Yes	97	33.8
Tattooing[‡]		
No	140	49.3
Yes	144	50.7
Any lifetime sexually transmitted infection		
No	103	35.9
Yes	184	64.1

[‡] Total number of participants: 267; ^{*} Total number of participants: 268; [§] Total number of participants: 248; [¶] Total number of participants: 274; [‡] Total number of participants: 284; [£] Total number of participants: 283

having tattoos and a history of prior HBV infection (shown in the supplementary material). Another explanation is based on the fact that people who plan to get tattoos are more likely to obtain information about their risks and complications, which include hepatitis B, and, therefore, seek vaccine protection [40].

Lack of a complete hepatitis B vaccination was a significant correlate of HBV susceptibility in this study. However, evidence of this association is conflicting in the literature [41–43]. Completing the three-dose series of the HBV vaccine results in seroprotection (defined as

anti-HBs level ≥ 10 mIU/mL) in 90–95% of the immunocompetent adult population [44]. Despite this, in the present study, we observed some discrepancy between self-reported hepatitis B vaccination and hepatitis B immune status among some participants (shown in the supplementary material). This discrepancy may be attributed to a combination of factors, including the reliability of vaccination status information based on self-report (rather than verification of vaccination records), prior history of resolved HBV infection, the variability in

Table 3 Bivariate analysis of factors associated with HBV susceptibility among MSM in Northeastern Brazil

Variable	HBV status		Crude PR (95% CI)	p-value *	Cramer's V
	Susceptible N (%)	Immune N (%)			
Age (years)					
< 30	25 (20.8)	95 (79.2)	1.05 (0.66–1.67)	0.843	0.012
Born after universal infant vaccination recommendation (1998)					
Yes	16 (31.4%)	35 (68.6)	1.76 (1.08–2.87)	0.030	0.129
Race/ Skin color					
White	24 (18.6)	105 (81.4)	0.87 (0.54–1.39)	0.555	0.035
Marital status					
Single/ Divorced	46 (19.4)	191 (80.6)	0.79 (0.46–1.38)	0.421	0.048
Sexual orientation					
Gay/homosexual	45 (20.0)	180 (80.0)	0.94 (0.54–1.62)	0.821	0.013
Length of schooling (years)					
≤ 11	6 (17.6)	28 (82.4)	0.86 (0.40–1.84)	0.684	0.024
Monthly income (national minimum wage)†					
≤ 5	52 (23.1)	173 (76.9)	2.35 (1.06–5.21)	0.022	0.135
Health insurance					
No	29 (21.0)	109 (79.0)	1.07 (0.68–1.70)	0.765	0.018
Complete hepatitis B vaccine schedule					
No	34 (50.7)	33 (49.3)	4.63 (2.97–7.23)	< 0.001	0.419
Binge drinking in the past 3 months					
No	17 (16.3)	87 (83.7)	0.73 (0.44–1.21)	0.211	0.074
Substance use in the past 3 months					
No	33 (18.1)	149 (81.9)	0.75 (0.48–1.20)	0.232	0.071
Erectile dysfunction drug use in the past 3 months					
No	54 (20.8)	206 (79.2)	1.35 (0.53–3.43)	0.515	0.038
Geosocial dating app use in the past 3 months					
Yes	39 (20.2)	154 (79.8)	0.99 (0.61–1.61)	0.965	0.003
Length of HIV PrEP use					
Starting HIV PrEP	26 (25.5)	76 (74.5)	2.55 (1.30–5.01)	0.007	0.188
6 months of HIV PrEP	22 (26.2)	62 (73.8)	2.62 (1.32–5.22)		
≥ 12 months of HIV PrEP	10 (10.0)	90 (90.0)	1.00		
Sharing of sharp personal items and instruments (ever)					
No	37 (19.5)	153 (80.5)	0.89 (0.55–1.43)	0.633	0.028
Tattooing					
No	33 (23.6)	107 (76.4)	1.40 (0.88–2.25)	0.155	0.085
Any lifetime STI					
No	31 (30.1)	72 (69.9)	2.04 (1.29–3.22)	0.002	0.183
Unprotected anal intercourse in the past 3 months					
No	8 (18.6)	35 (81.4)	0.85 (0.43–1.66)	0.622	0.030
Sexual role during anal intercourse in the past 3 months					
Protected anal intercourse (Activo, Pasivo or Moderno)	8 (18.6)	35 (81.4)	1.00	0.909	0.045
Only receptive (Pasivo)	18 (22.0)	64 (78.0)	1.18 (0.56–2.49)		
Receptive and insertive (Versatile or Moderno)	10 (25.0)	30 (75.0)	1.34 (0.59–3.06)		
Only insertive (Activo)	21 (20.8)	80 (79.2)	1.12 (0.54–2.32)		
Frequency of condom use during intercourse in the past 3 months					
Never once	13 (20.6)	50 (79.4)	1.00	0.669	0.055
Less than half – half of the time	20 (24.7)	61 (75.3)	1.27 (0.75–2.14)		
More than half – everytime	24 (19.5)	99 (80.5)	1.06 (0.58–1.93)		
Number of sexual partners in the past 3 months					
≤ 2	24 (22.0)	85 (78.0)	0.87 (0.52–1.45)	0.354	0.088
3–5	12 (16.0)	63 (84.0)	0.63 (0.33–1.20)		

Table 3 (continued)

Variable	HBV status		Crude PR (95% CI)	p-value *	Cramer's V
	Susceptible N (%)	Immune N (%)			
>5	21 (25.3)	62 (74.7)	1.00		
Gender of sexual partners in the past 3 months					
Only cisgender men	53 (21.8)	190 (78.2)	1.31 (0.52–3.30)	0.557	0.036
Steady sexual partner					
No	23 (17.4)	109 (82.6)	0.77 (0.48–1.23)	0.266	0.066
Unprotected sex with HIV-infected partner in the past 6 months					
No	14 (27.5)	37 (72.5)	1.23 (0.67–2.26)	0.563	0.068
Unsure	24 (20.0)	96 (80.0)	0.89 (0.52–1.55)		
Yes	17 (22.4)	59 (77.6)	1.00		
Exchange sex for money, housing, drugs and/or goods (ever)					
No	51 (20.6)	197 (79.4)	1.12 (0.55–2.28)	0.760	0.018
Sex worker					
No	57 (20.4)	222 (79.6)	1.43 (0.23–8.91)	1.000 **	0.024
Sexualized drug use (ever)					
No	40 (19.9)	161 (80.1)	0.96 (0.58–1.59)	0.874	0.009
Group sex (ever)					
No	17 (22.7)	58 (77.3)	1.17 (0.71–1.94)	0.537	0.037
Attendance at gay sauna (ever)					
No	42 (24.0)	133 (76.0)	1.67 (0.99–2.81)	0.049	0.116
Sharing insertive sex toys with partners during intercourse (ever)					
No	46 (20.6)	177 (79.4)	1.08 (0.61–1.92)	0.783	0.016
Fisting (ever)					
No	46 (20.0)	184 (80.0)	0.93 (0.53–1.64)	0.812	0.014
Anal fingering (ever)					
No	24 (21.1)	90 (78.9)	1.07 (0.67–1.70)	0.791	0.016
Rimming (ever)					
No	2 (9.5)	19 (90.5)	0.45 (0.12–1.72)	0.267	0.075

* Pearson's chi – square test for all variables, except for variable “sex worker”; † One minimum wage represented approximately R\$ 1,204.00 (US\$ 247.64 USD); ** Fisher's exact test

Table 4 Multivariate analysis of factors associated with HBV susceptibility among MSM in Northeastern Brazil

Variable	Crude PR (95% CI)	Adjusted PR †	95% CI	p-value
Monthly income (national minimum wage) ‡				
≤5	2.35 (1.06–5.21)	2.02	(1.01–4.05)	0.047
Complete hepatitis B vaccine schedule				
No	4.63 (2.97–7.23)	4.52	(2.89–7.06)	< 0.001
Length of HIV PrEP use				
Starting HIV PrEP	2.55 (1.30–5.01)	2.18	(1.21–3.94)	0.010
6 months of HIV PrEP	2.62 (1.32–5.22)	2.16	(1.19–3.91)	0.011
≥ 12 months of HIV PrEP	1.00	1.00	-	
Tattooing				
No	1.40 (0.88–2.25)	1.55	(1.00–2.40)	0.049
Any lifetime STI				
No	2.04 (1.29–3.22)	1.65	(1.07–2.54)	0.024

† Model adjusted for the variables: monthly income, complete hepatitis B vaccine schedule, length of HIV PrEP use, tattooing and any lifetime STI.

vaccine response among individuals and the waning of Anti-Hbs levels over time [43, 45].

MSM who did not have a previous history of STIs in their lifetime were proportionally more susceptible to HBV than those who did. Sexually transmitted pathogens

and HBV share some overlapping risk behaviors and transmission routes. Thus, no history of STI suggests a lower risk of exposure of HBV through sexual contact [46]. Furthermore, according to the Brazilian STI Treatment Guidelines, persons with STI should be tested for

hepatitis B, preferentially by rapid immunochromatographic tests, and, once identified as HbsAg negative, should be vaccinated [46, 47].

This study has some limitations. For instance, the lack of association between sexual practices and HBV immune status may be attributed to the focus on sexual behaviors reported over the previous three months. Life-long sexual behaviors might offer a more comprehensive assessment of HBV exposure/susceptibility. Besides this, the use of sensitive questions about sexual practices may have led to information bias due to underreporting of stigmatized behaviors.

Another limitation of this study is the self-reported hepatitis B vaccination status by the participants. This is subject to recall bias, since we could not verify this information through vaccination records or electronic medical records. In addition, the three-dose schedule of the hepatitis B vaccine is more difficult to remember than other single-dose vaccines. This bias may affect the accuracy of results, underestimating the association between the full hepatitis B vaccine series and HBV immunity/susceptibility status. Convenience sampling, drawn from individuals attending scheduled PrEP visits, has a recruitment bias, limiting the generalizability of the study findings to the entire MSM population in Brazil.

Despite these limitations, the study findings have important implications for public health practice. PrEP use is increasing among MSM, given its effectiveness in preventing HIV, and is known to change the sexual and non-sexual behaviors of its users. Although the sample may not be representative of the MSM community at large, this study contributed to outlining the prevalence of HBV susceptibility and its respective correlates in the subgroup of MSM on HIV PrEP. Integration of hepatitis B screening and vaccination into PrEP services is critical for identifying and addressing HBV susceptibility among MSM. Targeted interventions aimed at increasing vaccination coverage and reducing transmission risk should be prioritized to mitigate the burden of HBV in this population.

In conclusion, our study addresses a gap in the scientific literature regarding the prevalence of HBV susceptibility among MSM on HIV PrEP in Brazil. Approximately one-fifth of study participants were susceptible to HBV, with susceptibility associated with low/moderate monthly income, short-term PrEP use, lack of full hepatitis B vaccination, absence of tattoos and no lifetime history of STIs. Understanding the sociodemographic and clinical correlates of HBV susceptibility in key populations is crucial for formulating public health interventions aimed at HBV elimination. HIV PrEP services offer an optimal setting to identify MSM susceptible to HBV and promote vaccination, thus contributing to increased vaccination coverage rates.

Abbreviations

MSM	Men Who Sex With Men
HBV	Hepatitis B Virus
USA	United States of America
STI	Sexually Transmitted Infection
PNI	Brazilian Immunization Program
COVID-19	Coronavirus Disease 2019
PrEP	Pre-Exposure Prophylaxis
HIV	Human Immunodeficiency Virus
IMT-RN	Institute of Tropical Medicine of Rio Grande do Norte
UFRN	Federal University of Rio Grande do Norte
Anti-Hbs	Antibody to Hepatitis B Surface Antigen
LSD	Lysergic Acid Diethylamide
GHB	Gamma-Hydroxybutyric Acid
HbsAg	Hepatitis B Surface Antigen
Anti-Hbc	Antibody to Hepatitis B Core Antigen
LACEN/RN	Central Public Health Laboratory of Rio Grande do Norte
IQR	Interquartile Range
95% CI	95% Confidence Interval
PR	Prevalence Ratio
SESAP/RN	Public Health Secretariat of the State of Rio Grande do Norte

Supplementary Information

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Supplementary Material 1

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Author contributions

HTV and KCL contributed to the conception and methodology of the study, data collection, analysis and interpretation and writing of the article and successive reviews. CHSF, FLNP, MGMM, JGFCS and MBB contributed to the data collection, data interpretation and writing of the article. All authors read and approved the final manuscript.

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Data availability

The datasets generated and/or analysed during the current study are available in Figshare repository at DOI:10.6084/m9.figshare.24750288.

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board at UFRN under the protocol number - CAAE:31650520.0.2005.5292. All study participants provided signed and dated informed consent forms at study entry, adhering to the principles outlined in the Declaration of Helsinki.

Consent for publication

Not applicable.

Competing interests

The authors have no competing interests as defined by BMC, or other interests that might be perceived to influence the results and/or discussion reported in this paper.

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