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Correlates of hepatitis B among patients with mental illness in Brazil

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ABSTRACT

Objective: To assess correlates of hepatitis B among adults with mental illness under care in Brazil.
Method: Cross-sectional national multicenter study of 2206 patients with mental illnesses randomly selected from 26 public mental health services. Sociodemographic and behavioral data were obtained from face-to-face interviews and psychiatric diagnoses from medical charts. Serology testing was conducted, and prevalence rate ratios were estimated by log-binomial regression.
Results: The weighted prevalence rates of current hepatitis B virus (HBV) infection (HBsAg+) and previous HBV exposure (anti-HBc+) were 2.0% [95% confidence interval (CI): 1.5%–2.7%] and 17.1% (95% CI: 16.0%–19.0%), respectively. Correlates of HBsAg+ included male gender, younger age (18–29 years), unstable place of residence, intellectual disability, main psychiatric diagnosis of dementia, presence of other medical comorbitidy, use of alcohol/drugs during sex, more than one sexual partner and use of cocaine. Correlates of anti-HBc+ included male gender, older age (≥30 years), black skin color, lower education, unstable place of residence, currently hospitalized, intellectual disability, history of any sexually transmitted disease or syphilis, poor HIV knowledge, history of imprisonment and sexual violence.
Conclusions: Hepatitis B is an important comorbidity among psychiatric patients in Brazil. Screening for HBV, effective prevention and intervention strategies, including universal HBV immunization, should be routine practices in these mental health services.

1. Introduction

Hepatitis B virus (HBV) infection is a major cause of morbidity and mortality worldwide and a serious public health problem. The World Health Organization currently estimates that 2 billion people have been infected with HBV, with more than 240 million living with lifelong chronic infection [1]. Hepatitis B is often neglected because of its largely asymptomatic course with long-term complications such as cirrhosis of the liver and liver cancer. Approximately one third of all cases of cirrhosis and half of all cases of hepatocellular carcinoma can be attributed to chronic hepatitis B (CHB) [2]. An estimated 600,000 people worldwide die every year due to the acute or chronic consequences of hepatitis B [1]. A vaccine against hepatitis B has been available since 1982. It is 95% effective in preventing infection and its chronic consequences, and it was the first vaccine against a major human cancer [1]. In Brazil, it has been available for universal immunization at birth since 1992 in selected regions (e.g., Amazon State) and nationwide since 1998.

HBV can be transmitted vertically from infected mothers to their offspring, horizontally (e.g., child-to-child transmission within a household), sexually or parenterally (e.g., via injecting drug use or unsafe injections, sharps injury or contaminated blood products) [3]. HBV and HIV share common modes of transmission, especially injecting drug use and unprotected sex [4].

Prevalence rates of CHB are associated with differences in the age of acquisition of the virus. In areas of high endemicity, that is, seroprevalence of hepatitis B surface antigen (HBsAg) greater than or equal to 8.0%, as in China, Indonesia, Africa and Western Amazon Region, lifetime risk of HBV infection is 60% and most infections are acquired perinatally or in early infancy via child-to-child transmission. Early infection in life is associated with the highest risk for development of chronic infection — children do not mount an effective immune response to infection, particularly if their mothers are positive for hepatitis B *e* antigen. In areas of low prevalence, that is,

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seroprevalence less than 2.0%, as in the United States and Western Europe, lifetime risk of HBV infection is less than 20% and most infections occur via percutaneous or sexual transmission in adults, particularly among health care workers, injecting drug users and men who have sex with men. Transmission of HBV among adults is more often associated with symptomatic acute HBV and an effective immune response, resulting in clearance of the virus — only 2% to 5% of adult HBV infections develop into CHB [2,5].

Brazil is considered a country of intermediate seroprevalence, that is, HBsAg between 2.0% and 7.0% [2]. However, the Western Amazon basin, including Brazil and Peru, is a highly endemic area, with observed HBsAg seroprevalence rates greater than 10.0% [6]. A recent Brazilian population-based survey carried out in the urban population between 2005 and 2009 estimated that 11.6% of the population ages between 20 and 69 years had prior exposure to HBV, defined as reactive hepatitis B core antibody (anti-HBc positive) and 0.6% had current HBV infection (HBsAg positive) [7].

Reports indicate that patients with mental illnesses have a high prevalence of HBV infection [4,8–16]. A systematic review of the published literature showed that the prevalence of HBV infection (prior exposure or current infection) among patients with chronic mental illnesses varied from 3.2% to 66.0% [17]. This high HBV prevalence could be partially explained by the fact that people with mental illness appear to have increased rates of sexually transmitted diseases (STDs) and are more likely to engage in high-risk behaviors such as injection drug use, multiple sexual partners and high-risk partners, unprotected sex, same-sex sexual activity, exchange of sex for money or drugs and sex while using psychoactive substances [18–21].

Although several studies have been conducted on hepatitis B among psychiatric patients, few studies were carried out among this population in low- and middle-income countries, especially with a large and representative sample of patients. We have previously reported point seroprevalence rates of previous exposure to HBV (reactive anti-HBc) and current HBV infection (reactive HBsAg) of 14.7% and 1.64%, respectively, in a national representative sample of psychiatric patients in Brazil [16]. These rates were significantly higher compared to the general Brazilian population, with an estimated prevalence of 7.4% for anti-HBc (previous exposure) and 0.37% for HBsAg (current infection) [7], and other specific Brazilian populations, such as pregnant women (HBsAg=0.3%) [22] and blood donors (anti-HBc-total=4.6%; HBsAg=0.35%) [23]. Furthermore, there are also limited data on the assessment of factors associated with HBV infection, especially with a large representative sample of patients with mental illness on a national scale.

The aim of this study was to move beyond simply documenting these high rates of HBV infection to ascertain the association of sociodemographic, clinical and behavioral factors with HBV infection (previous exposure to HBV or current HBV infection) among Brazilian adults under public hospital or outpatient care for mental illness.

2. Methods

This analysis is part of a larger cross-sectional national multicenter study in 11 public psychiatric hospitals and 15 public mental health outpatient clinics (psychosocial care center [CAPS]) in Brazil, designed to assess risk behavior and the seroprevalence of HIV and others STDs, including HBV infection, among patients with mental illness (PESSOAS Project), between June and September 2006, as described in detail elsewhere [16,24].

A two-stage probability sampling was used proportionally to the type of care (hospital or outpatient care center [CAPS]) and the distribution of reported AIDS cases according to the five Brazilian Regions, yielding a total of 2475 participants. In the first stage, mental health services were randomly selected proportionally to the number of beds in the hospital stratum or number of registered patients in the CAPS stratum in each region. The second sampling stage was carried out by selecting patients using simple random probability process at each site. Eligibility criteria included adult (18 years or older) psychiatric patients receiving care either at hospitals or adult CAPS. Only patients who were considered capable of providing written informed consent and who understood the aims of the study were included in the study. This assessment was based on a preliminary evaluation adapted from the Mini-Mental Status Examination (MMSE), and it was applied by trained mental health professionals (brief-MMSE) [25]. Public mental health outpatient clinics that exclusively treated substance use disorders (CAPS-Ad) as primary diagnoses were also excluded in order to avoid overestimating prevalence rates. For this paper, a cross-sectional analysis was conducted to examine correlates of HBV infection, and only patients with both interview data and serology results for HBV infection were included in this analysis ($n=2206$). Protocol, questionnaires and procedures were tested in a pilot study and have been previously described [24]. A semistructured person-to-person interview was conducted to obtain sociodemographic, clinical and behavioral data. A survey was developed to ascertain organizational attributes of treatment settings. All interviews were carried out by experienced mental health care professionals. The study was approved by the Research Ethics Committee from the Federal University of Minas Gerais (UFMG/ETIC 125/03) and the Brazilian National Review Board (CONEP 592/2006).

2.1. Exposure and event measurements

The event of interest, infection of hepatitis B, was assessed in two ways: previous exposure to HBV infection, represented as reactive total anti-HBc and current HBV infection, represented as reactive HBsAg. Blood samples for serology were collected using standard procedures, including pretest counseling, and processed and checked for quality control [16]. Blood testing for HBV was conducted using standard markers for hepatitis B: HBsAg (ELISA, BioMerieux) and total (IgG + IgM) anti-HBc (ELISA, BioMerieux). Results were returned to patients in each participating site by research staff members. Patients who were positive were referred for medical care and follow-up.

Potential explanatory characteristics investigated included the following: (1) sociodemographic information (e.g., gender, age, skin color, marital status, schooling, family income, place of residence, history of homelessness or imprisonment), (2) clinical and psychiatric conditions (e.g., type of center of recruitment, previous psychiatric hospitalization, main psychiatric diagnoses, any degree of intellectual disability, history of transfusion, history of any STD, previous HIV testing and any medical comorbidity), and (3) behavioral variables (history of injection drug use, alcohol or tobacco use, age of first sexual intercourse, number of lifetime sexual partners, lifetime unsafe sex, alcohol/drug use during sexual intercourse, money/drug exchange for sex, physical and sexual violence, self-perceived HIV risk and HIV/AIDS knowledge). HIV/AIDS knowledge was assessed based on a mean score of 10 questions rated on a 0 to 10 scale. Self-perception of HIV risk was how the participants assessed their risk of becoming HIV infected (low, did not know or high). Psychiatric diagnoses were ascertained by psychiatrists and were obtained from medical charts. When more than one psychiatric diagnosis were present, these were recorded hierarchically according to clinical severity as follows: (1) schizophrenia and other psychotic disorders, (2) bipolar disorder, (3) depression with psychotic symptoms (DSP), (4) depression, (5) anxiety, (6) substance use disorder, and (7) others, according to the *International Classification of Diseases, 10th Revision*. For this analysis, categories (1), (2) and (3) were grouped together as severe mental illness (SMI), and the remaining diagnoses were categorized as non-SMI. Dementia was considered a separate category. Current place of residence was defined as unstable (living in shelters, hostels, streets, rooms) and stable (living in houses or

apartments), and unsafe sex was defined as not always using condoms. Reliability of the interview was considered adequate for most variables as previously published [24].

2.2. Statistical analysis

A descriptive analysis was carried out, and Pearson chi-square test was performed for the analysis of categorical data. The prevalence of previous exposure to HBV infection and current HBV infection were estimated by dividing the number of participants who were, respectively, positive for anti-HBc or HBsAg markers, by the total number of participants. The magnitude of the associations between putative risk factors and each HBV infection marker was given by the weighted prevalence ratio (PR_w) with 95% confidence intervals (CIs) using log-binomial regression for both univariate and multivariate analyses. Estimates were proportionally weighted by the sample size of each site relative to its total population, that is, number of beds or number of registered patients, considering the potential within-cluster correlation. The level of significance was .05. All variables with *P*-values equal to or less than .20 obtained in the univariate analysis were used to start multivariate modeling. A backward deletion strategy was applied, and those variables with *P*-values equal to or less than .05 remained in the final regression model. All analyses were carried out using SAS.

3. Results

Of the 3255 patients recruited during the study, 2475 were interviewed and, for this analysis, 2206 had both interview data and HBV serology available. No statistical differences were observed between participants and nonparticipants with regard to age, sex and type of care. Among the 2206 participants, 45 (2%; 95% CI: 1.5%–2.7%) and 378 (17.1%; 95% CI: 16.0%– 19.0%) tested positive for HBsAg and anti-HBc, respectively.

Descriptive data can be seen in Table 1. The majority of participants were female (52.0%), were older than 30 years (81.8%), were single (66.5%), had less than 5 years of schooling (50.3%), had low monthly family income (<US$ 210) (53.7%), and lived in a stable place of residence (87.8%). Eighteen percent had a history of homelessness, and most participants were recruited from outpatient centers (CAPS) (64.4%). History of psychiatric hospitalization was reported by 58.0%, and 31.2% had some degree of intellectual disability symptoms. SMI accounted for most psychiatric diagnoses (56.5%), followed by non-SMI (36.5%) and dementia (7.0%). Other medical comorbidity was reported by 45.2% of individuals.

Previous STDs were reported by 24.0% of participants. Despite a high percentage of high-risk behavior among this population, including age of first sexual intercourse less than 18 years (57.3%), use of alcohol and drugs during sex (27.3%), more than one sexual partner in lifetime (65.5%) and unsafe sex (80.8%), more than 73.0% had never tested for HIV infection before. Also, 45.2% had poor HIV knowledge, and only 17.9% perceived themselves in a high-risk situation for HIV acquisition. Although 24.7% of this population reported the use of any illicit drug, including cannabis use (21.4%) and inhaled cocaine use (10.4%), the proportion of lifetime injection drug use was low (2.9%). Moreover, tobacco and alcohol use were reported by 71.3% and 64.0%, respectively. History of imprisonment was reported by 25.3%, and physical violence and sexual violence were described by 58.0% and 20.0%, respectively.

3.1. Univariate analysis

Univariate analyses for both HBV markers can be seen in Table 2. For most variables, statistical significance and direction of the prevalence rate ratio were similar for both markers. Among socio-demographics, male gender, black skin color, single marital status, unstable place of residence, history of homelessness, study recruitment in hospital, symptoms of intellectual disability, main diagnosis of dementia, history of syphilis, poor HIV/AIDS knowledge, low/don't know self-perceived risk of HIV, history of imprisonment, cocaine use in lifetime, alcohol use in lifetime and report of physical violence were statistically associated with both serologic markers for hepatitis B: HBsAg (current HBV infection) and anti-HBc (previous exposure to HBV infection).

In addition, less than 5 years of schooling, low family income, previous psychiatric hospitalization, history of any STD, younger age of first sexual intercourse (<18 years), money/drugs exchange for sex, tobacco use in lifetime, unsafe sex and report of sexual violence were also statistically associated with previous exposure to HBV (positive anti-HBc) in this population. We should note an opposite direction of the association for the variable age: younger age (18–29 years) was associated with a positive HBsAg, while older age (more than 30 years) was associated with a positive anti-HBc.

3.2. Multivariate analysis

The following variables showed a statistically independent association with a positive HBsAg: male gender, younger age (18–29 years), unstable place of residence, symptoms of intellectual disability, main psychiatric diagnosis of dementia, presence of other medical comorbidity, use of alcohol/drugs during sex, more than one sexual partner and use of cocaine in lifetime. On the other hand, male gender, older age (≥30 years), black skin color, less than 5 years of schooling, unstable place of residence, study recruitment in hospital, symptoms of intellectual disability, history of any STD, history of syphilis, poor HIV knowledge, history of imprisonment and the report of sexual violence were found to be independently associated with a positive anti-HBc (Table 3).

4. Discussion

The present study is the first known national representative study to assess potential factors associated with HBV infection among adults under public hospital or outpatient care for mental illness in Brazil. We were able to demonstrate that while HBV infection occurs at an elevated rate among people with mental illness, HBV infection is not uniformly distributed in this population but rather is linked to specific sociodemographic characteristics, comorbidities and risk behaviors.

As in our previous study, we found that psychiatric patients had much higher rates of exposure to HBV than the general Brazilian population, with 17.1% of the psychiatric patients in this survey having been previously exposed to HBV infection (represented as reactive anti-HBc) compared with 7.4% of the general Brazilian population (11.6% when stratified for age between 20 and 69 years) [7]. Current HBV infection (reactive HBsAg) at time of the survey was found in 2.0% of psychiatric patients compared with 0.37% (0.6% between 20 and 69 years old) in the general Brazilian population [7]. Our frequencies were similar to those found among psychiatric populations in Taiwan [26], the United States [4], and India [19], corroborating studies indicating that patients with mental illness have a higher risk for hepatitis B infection [4,10,14,15,17].

Considering that HBsAg is a marker of current infection, that it is present in acute HBV infection, and that acute hepatitis B resolves spontaneously in more than 90% of adults, we hypothesize that some patients with reactive HBsAg could be in the acute phase of the infection and might subsequently clear the infection. We cannot comment on this further due to the cross-sectional nature of our study and the lack of testing for the IgM anti-HBc marker to confirm acute hepatitis B infection.

With regard to sociodemographic characteristics, age showed a distinct pattern between the two markers in our study: younger age (18–29 years) was associated with current infection (HBsAg), while

Table 1
Descriptive analysis of selected variables, PESSOAS Project 2006–2007 (n=2206)

Characteristics	n (%)
Gender	
Male	1059 (48.0)
Female	1147 (52.0)
Age (y)	
18–29	402 (18.2)
≥30	1804 (81.8)
Skin color	
Black	358 (16.2)
Nonblack	1848 (83.8)
Marital status	
Single	1467 (66.5)
Married/in union	739 (33.5)
Schooling (y)	
≥5	1097 (49.7)
<5	1109 (50.3)
Family income	
≥US$ 210.0	969 (46.3)
<US$ 210.0	1124 (53.7)
Place of residence	
Unstable	269 (12.2)
Stable	1937 (87.8)
History of homelessness	
No	1810 (82.0)
Yes	396 (18.0)
Type of center of recruitment	
CAPS	1421 (64.4)
Psychiatric hospital	785 (35.6)
Previous psychiatric hospitalization	
No	922 (42.0)
Yes	1276 (58.0)
Intellectual disability (any degree)	
No	1509 (68.8)
Yes	685 (31.2)
Main psychiatric diagnosis	
Substance use disorder, anxiety, depression, others	805 (36.5)
Psychosis/Bipolar disorder/DSP	1246 (56.5)
Dementia	155 (7.0)
Medical comorbidity	
No	1199 (54.8)
Yes	990 (45.2)
History of any STD	
No	1655 (76.0)
Yes	521 (24.0)
History of syphilis	
No	2068 (96.6)
Yes	72 (3.4)
Previous HIV testing	
No	1608 (73.0)
Yes	598 (27.0)
Age of first sexual sex (y)[a]	
≥18	794 (42.7)
<18	1063 (57.3)
Alcohol/drug use during sex	
No	1592 (72.7)
Yes	599 (27.3)
Money/Drugs exchange for sex	
No	1615 (73.6)
Yes	578 (26.4)
Number of sexual partners	
More than one	1362 (65.5)
Only one or none	719 (34.6)
HIV knowledge	
Good	1198 (54.8)
Low/Did not know	987 (45.2)
Self-perceived risk of HIV	
Low/Did not know	1810 (82.1)
High	396 (17.9)
History of imprisonment	
No	1647 (74.7)
Yes	559 (25.3)
Any illicit drug use (ever)	
No	1661 (75.3)
Yes	545 (24.7)
Cannabis use (ever)	
No	1729 (78.5)
Yes	472 (21.4)
Inhaled cocaine use (ever)	
No	1970 (89.6)
Yes	230 (10.4)
Injection drug use (ever)	
No	2130 (97.1)
Yes	64 (2.9)
Tobacco use (ever)	
No	629 (28.7)
Yes	1566 (71.3)
Alcohol use (ever)	
No	794 (36.0)
Yes	1412 (64.0)
Physical violence	
No	925 (42.0)
Yes	1276 (58.0)
Sexual violence	
No	1757 (80.0)
Yes	442 (20.0)
Lifetime unsafe sex	
No	417 (19.2)
Yes	1758 (80.8)
HBsAg	
Negative	2161 (98.0)
Positive	45 (2.0)
Total anti-HBc	
Negative	1828 (82.9)
Positive	378 (17.1)

[a] Among those sexually active ever.

older age (30 years or older) was associated with previous exposure to HBV infection (anti-HBc). A possible explanation for this finding is that age is a marker for longer exposure and thus a higher probability of acquiring HBV infection. Additionally, universal immunization beginning at birth and other successful hepatitis B vaccination strategies of the Brazilian Ministry of Health since 1992 have resulted in a dramatic reduction of vertical HBV transmission. However, in this century, it is estimated that 25% of the population younger than 20 years in Brazil has not been vaccinated against HBV [27].

Sexual and household transmission of HBV remains a concern among unvaccinated adolescents and adults. HBV is efficiently transmitted sexually, and sexual contacts of chronically infected persons have been shown to have a higher seroprevalence of HBV infection than control populations, as have nonsexual household contacts of infected persons. People with acute hepatitis B are more likely to report multiple heterosexual partners than controls, and the seroprevalence of HBV infection correlates with greater numbers of recent and lifetime heterosexual partners [2]. Men who have sex with men have persistently higher HBV seroprevalence rates than the general population [2].

Sexual transmission of HBV is certainly of concern among psychiatric populations where patterns of unsafe sexual behaviors have been repeatedly documented. In this study, the majority of our participants had more than one lifetime sexual partner, had a history of unsafe sex with low self-perceived risk of HIV infection and had not been tested for HIV. Our analyses indicated that hepatitis B was consistently associated with sexual risk behaviors such as alcohol/drug use during sex and more than one sexual partner for current HBV infection (reactive HBsAg), while a history of any STD or syphilis was associated with previous exposure to HBV (reactive anti-HBc). Moreover, sexual violence was significantly associated with previous exposure to HBV infection. Such associations of hepatitis B and sexual risks are consistent with prior research among persons with mental illness [4,28,29]. A history of cocaine use was also a predictor of HBV infection (current infection — HBsAg) in our study, and this association is corroborated by other authors [4,10,29].

With regard to gender, our results are consistent with other studies conducted among persons with mental illness [14,19,30] in finding higher rates among men of both current infection (HBsAg)

Table 2
Univariate analysis of HBsAg and total anti-HBc seroprevalence, PESSOAS Project 2006–2007 (n=2206)

Characteristics	N[a]	HBsAg				Total anti-HBc			
		n (%)[b]	(Wt%)[c]	PRR (95% CI)[d]	χ^2 (P-value)	n (%)[2]	(Wt%)[c]	PRR (95% CI)[d]	χ^2 (P-value)
Gender									
Female	1147	13 (1.13)	(1.51)	1.00		148 (12.90)	(15.39)	1.00	
Male	1059	32 (3.02)	(4.66)	3.09 (2.23–4.25)	46.80**	230 (21.72)	(32.00)	2.08 (1.89–2.29)	222.70**
Age (y)									
≥30	1804	34 (1.88)	(2.80)	1.00		348 (19.29)	(26.51)	2.27 (1.91–2.70)	
18–29	402	11 (2.74)	(5.18)	1.85 (1.32–2.44)	15.80**	30 (7.46)	(11.67)	1.00	86.10**
Skin color									
Others	1848	33 (1.79)	(2.83)	1.00		298 (16.13)	(22.27)	1.00	
Black	358	12 (3.35)	(5.07)	1.79 (1.32–2.44)	13.80**	80 (22.35)	(34.36)	1.54 (1.40–1.70)	74.20**
Marital status									
Married/in union	739	12 (1.62)	(1.67)	1.00		109 (14.81)	(20.15)	1.00	
Single	1467	33 (2.25)	(3.75)	2.25 (1.53–3.30)	17.10**	269 (18.30)	(25.66)	1.27 (1.15–1.41)	20.70**
Schooling (y)									
≥5	1097	22 (2.01)	(2.71)	1.00		140 (12.76)	(18.65)	1.00	
<5	1109	23 (2.07)	(3.54)	1.30 (0.98–1.72)	3.50	238 (21.46)	(28.49)	1.53 (1.39–1.68)	81.30**
Family income									
≥US$ 210	969	17 (1.75)	(2.36)	1.00		119 (12.34)	(15.89)	1.00	
<US$ 210	1124	24 (2.14)	(3.21)	1.36 (0.99–1.87)	3.63	231 (20.52)	(28.15)	1.77 (1.59–1.97)	107.80**
Place of residence									
Stable	1937	29 (1.50)	(1.68)	1.00		284 (14.66)	(17.03)	1.00	
Unstable	269	16 (5.95)	(6.37)	3.78 (2.86–5.00)	87.60**	94 (34.94)	(39.62)	2.33 (2.14–2.53)	388.20 **
History of homelessness									
No	1810	28 (1.55)	(2.35)	1.00		283 (15.61)	(22.46)	1.00	
Yes	396	17 (4.29)	(6.21)	2.64 (2.02–3.46)	49.70**	95 (24.17)	(30.58)	1.36 (1.24–1.50)	40.60**
Type of center of recruitment									
Outpatient (CAPS)	1421	24 (1.69)	(1.60)	1.00		197 (13.92)	(13.94)	1.00	
Hospital	785	21 (2.68)	(4.38)	2.73 (1.97–3.78)	36.50**	181 (22.88)	(31.92)	2.29 (2.07–2.54)	247.70**
Previous psychiatric hospitalization									
No	922	16 (1.74)	(2.84)	1.00		120 (13.04)	(21.45)	1.00	
Yes	1276	29 (2.27)	(3.44)	1.21 (0.92–1.61)	1.83	256 (20.03)	(26.19)	1.22 (1.12–1.34)	18.60**
Intellectual disability (any degree)									
No	1509	25 (1.66)	(2.03)	1.00		200 (13.24)	(18.42)	1.00	
Yes	685	19 (2.77)	(4.64)	2.28 (1.73–3.02)	33.50**	176 (25.77)	(33.01)	1.79 (1.64–1.95)	176.60**
Main psychiatric diagnosis									
SUD, anxiety, depression, others	805	11 (1.37)	(2.54)	1.00		125 (15.63)	(20.89)	1.00	
Psychosis/Bipolar disorder/DSP	1246	28 (2.25)	(2.70)	1.27 (0.88–1.82)	1.70	216 (17.27)	(24.41)	1.16 (1.05–1.29)	7.80**
Dementia	155	6 (3.87)	(7.18)	3.43 (2.30–5.14)	36.20 **	37 (23.87)	(31.11)	1.42 (1.23–1.64)	22.60**
Medical comorbidity									
No	1199	19 (1.58)	(2.51)	1.00		209 (17.4)	(24.8)	1.00	
Yes	990	26 (2.63)	(4.14)	1.64 (1.25–2.16)	12.70 **	164 (16.6)	(22.9)	0.92 (0.83–1.02)	2.32
History of any STD									
No	1655	34 (2.05)	(3.26)	1.00		259 (15.67)	(22.69)	1.00	
Yes	521	10 (1.92)	(3.01)	0.93 (0.66–1.30)	0.21	112 (21.37)	(28.32)	1.25 (1.33–1.38)	19.30**
History of syphilis									
No	2068	40 (1.93)	(3.03)	1.00		336 (16.24)	(23.05)	1.00	
Yes	72	3 (4.17)	(7.13)	2.36 (1.36–4.07)	9.40 **	21 (29.17)	(40.93)	1.78 (1.48–2.13)	38.00**
Previous HIV testing									
No	1608	29 (1.80)	(3.18)	1.00		271 (16.81)	(23.84)	1.00	
Yes	598	16 (2.68)	(3.15)	0.99 (0.73–1.35)	0.00	107 (18.01)	(25.01)	1.05 (0.95–1.16)	0.90
Age of first sexual intercourse (y)[e]									
≥18	794	15 (1.89)	(2.55)	1.00		114 (14.34)	(18.32)	1.00	
<18	1063	20 (1.88)	(2.31)	0.91 (0.64–1.29)	0.30	178 (16.86)	(22.96)	1.25 (1.12–1.40)	15.80**
Alcohol/Drug use during sex									
No	1592	27 (1.70)	(2.39)	1.00		261 (16.42)	(23.48)	1.00	
Yes	599	18 (3.01)	(5.67)	2.37 (1.81–3.10)	39.80**	113 (18.80)	(24.57)	1.05 (0.95–1.16)	0.80
Money/Drugs exchange for sex									
No	1615	31 (1.92)	(3.10)	1.00		264 (16.36)	(22.82)	1.00	
Yes	578	14 (2.42)	(3.46)	1.12 (0.83–1.49)	0.55	113 (19.52)	(27.16)	1.19 (1.09–1.30)	13.70**
Number of sexual partners									
Only one or none	719	10 (1.39)	(1.98)	1.00		116 (16.13)	(24.16)	1.00	
More than one	1362	30 (2.20)	(3.66)	1.85 (1.33–2.59)	13.10**	236 (17.33)	(23.34)	0.97 (0.88–1.06)	0.52
HIV knowledge									
Good	1198	20 (1.67)	(2.61)	1.00		147 (12.33)	(16.29)	1.00	
Low/Did not know	987	25 (2.53)	(3.76)	1.44 (1.09–1.91)	6.60**	223 (22.43)	(29.65)	1.82 (1.65–2.00)	176.60**
Self-perceived risk of HIV									
High	396	7 (1.77)	(1.34)	1.00		71 (17.93)	(21.16)	1.00	
Low/Did not know	1810	38 (2.10)	(3.50)	2.60 (1.50–4.52)	11.60**	307 (16.96)	(24.68)	1.67 (1.03–1.33)	5.50*
History of imprisonment									
No	1647	29 (1.76)	(2.44)	1.00		230 (14.01)	(18.69)	1.00	
Yes	559	16 (2.86)	(5.01)	2.06 (1.57–2.69)	27.80**	148 (26.24)	(37.53)	2.01 (1.85–2.18)	266.40**
Any illicit drug use (ever)									
No	1661	31 (1.87)	(2.85)	1.00		275 (16.57)	(24.17)	1.00	
Yes	545	14 (2.57)	(4.28)	1.50 (1.12–2.01)	7.51**	103 (18.86)	(24.06)	0.99 (0.90–1.10)	0.01

Table 2 (*continued*)

Characteristics	N[a]	HBsAg				Total anti-HBc			
		n (%)[b]	(Wt%)[c]	PRR (95% CI)[d]	χ^2 (*P*-value)	n (%)[2]	(Wt%)[c]	PRR (95% CI)[d]	χ^2 (*P*-value)
Cannabis use (ever)									
No	1729	32 (1.85)	(2.80)	1.00		286 (16.54)	(24.00)	1.00	
Yes	472	13 (2.75)	(4.75)	1.69 (1.26–2.27)	12.50**	90 (19.07)	(24.62)	1.02 (0.92–1.14)	0.22
Cocaine use (ever)									
No	1970	34 (1.73)	(2.67)	1.00		328 (16.64)	(23.72)	1.00	
Yes	230	11 (4.78)	(8.13)	3.04 (2.24–4.14)	50.40**	48 (20.96)	(27.97)	1.18 (1.03–1.35)	5.70*
Injection drug use (ever)									
No	2130	43 (2.02)	(3.05)	1.00		359 (16.85)	(23.84)	1.00	
Yes	64	2 (3.13)	(7.46)	2.44 (1.54–3.89)	14.30**	15 (23.44)	(27.64)	1.16 (0.94–1.43)	1.93
Tobacco use (ever)									
No	629	9 (1.43)	(2.69)	1.00		83 (13.20)	(18.03)	1.00	
Yes	1566	36 (2.30)	(3.35)	1.24 (0.89–1.74)	1.68	293 (18.71)	(26.09)	1.45 (1.29–1.62)	39.40**
Alcohol use (ever)									
No	794	12 (1.51)	(1.39)	1.00		131 (16.56)	(22.66)	1.00	
Yes	1412	33 (2.34)	(4.27)	3.08 (2.14–4.22)	36.90**	247 (17.46)	(25.04)	1.10 (1.00–1.21)	4.70*
Physical violence									
No	925	16 (1.73)	(2.42)	1.00		140 (15.18)	(22.13)	1.00	
Yes	1276	29 (2.27)	(3.75)	1.55 (1.16–2.07)	8.87*	237 (18.54)	(25.75)	1.16 (1.06–1.27)	11.10**
Sexual violence									
No	1757	34 (1.94)	(3.08)	1.00		286 (16.23)	(22.81)	1.00	
Yes	442	11 (2.49)	(3.65)	1.18 (0.86–1.62)	1.11	89 (20.37)	(28.37)	1.24 (1.13–1.37)	18.60**
Lifetime unsafe sex									
No	417	9 (2.16)	(3.25)	1.00		79 (18.76)	(27.68)	1.00	
Yes	1758	35 (1.99)	(3.07)	0.94 (0.68–1.30)	0.13	293 (16.70)	(22.85)	0.82 (0.75–0.91)	14.92**

* *P*<.05.
** *P*<.01.
[a] *N*=total number of participants in each category.
[b] *n* (%)=number and unweighted proportion of positives in each category.
[c] Wt%=weighted proportion of positives in each category.
[d] PRR=prevalence rate ratio (weighted prevalence rate ratio).
[e] Among those sexually active.

and previous exposure to HBV (anti-HBc). This may be linked to several social contextual factors that are more common among men such as homelessness, unstable residence, imprisonment and drug use, each of which was associated with reactive HBsAg and anti-HBc in our study.

The association between HBV infection and indicators of low social class is quite strong. In the general population, socioeconomic factors such as low educational attainment, lower social stratum and crowded urban residence have been reported to predict higher HBV infection prevalence in both developed and developing countries [31]. A similar pattern has been observed among patients with mental illness. Butterfield et al. [28], for example, studying racial differences in hepatitis B (reactive anti-HBc) and associated risk behaviors in American veterans with SMI, found a higher HBV prevalence (odds ratio=1.47) among African Americans (27.6%), a group known to be highly disadvantaged in the United States, as compared to Caucasians (12.3%). A plausible explanation is a potential difference in baseline

Table 3
Final multivariate analysis of HBsAg and total anti-HBc seroprevalence, PESSOAS Project 2006–2007

Characteristics	HBsAg		Total anti-HBc	
	PRR (95% CI)[a]	χ^2 (*P*-value)	PRR (95% CI)[a]	χ^2 (*P*-value)
Gender (male)	2.25 (1.60–3.16)	21.90**	1.77 (1.55–2.01)	78.20**
Age (y)				
≥30	1.0		2.07 (1.70–2.53)	50.40**
18–29	2.23 (1.55–3.20)	19.00**	1.0	
Skin color (black)	–	–	1.52 (1.33–1.73)	38.90**
Schooling (y) (<5)	–	–	1.17 (1.03–1.32)	6.14*
Place of residence (unstable)	3.38 (2.43–4.69)	52.90**	1.35 (1.18–1.54)	20.10**
Type of center (hospital)	–	–	1.24 (1.09–1.42)	22.70**
Intellectual disability (any degree)	2.06 (1.53–2.78)	22.50**	1.45 (1.30–1.62)	42.90**
Main psychiatric diagnosis				
SUD, anxiety, depression, others	1.0	1.27	–	–
Psychosis/Bipolar disorder/DSP	0.81 (0.57–1.66)	5.52*	–	–
Dementia	1.66 (1.09–2.54)			
Medical comorbidity (yes)	1.66 (1.24–2.21)	11.60**	–	–
History of any STD (yes)	–	–	1.24 (1.09–1.42)	10.10**
History of syphilis (yes)	–	–	1.37 (1.06–1.78)	5.63*
Alcohol/drug use during sex (yes)	1.43 (1.01–2.03)	4.06*	–	–
Number of sexual partners (>1)	2.14 (1.42–3.24)	13.10**	–	–
HIV knowledge (low/Did not know)	–	–	1.18 (1.04–1.34)	6.23*
History of imprisonment (*yes*)	–	–	1.34 (1.19–1.51)	22.50**
Inhaled cocaine use (ever) (*yes*)	1.90 (1.29–2.79)	10.60**	–	–
Sexual violence (*yes*)	–	–	1.45 (1.27–1.64)	32.50**

* *P*<.05.
** *P*<.01.
[a] PRR=prevalence rate ratio (weighted prevalence rate ratio).

prevalence rates of HBV within social networks. Our study demonstrated similar findings. For example, psychiatric patients with black skin color and less than 5 years of schooling were significantly more likely to have had past hepatitis B infection.

Unstable residence was correlated with both past and current HBV infection. Although not independently associated with the outcomes in this study, the finding of increased risks of current or past HBV infection with a history of homelessness in the univariate analysis is consistent with previous studies, which have indicated a significant association between homelessness and HBV risk [10,32–34]. High risk for HBV infection in the homeless population is due to multiple factors such as poverty, less social support, a larger number of people who inject drugs, needle sharing, unprotected sex, unwanted sex and survival sex and more frequent history of imprisonment [10,34–36].

History of imprisonment is of particular interest, as this characteristic was independently associated with previous exposure to HBV in our psychiatric patients, confirming studies showing that imprisonment is an important predictor of HBV infection in patients with mental illness [29,37]. Prison conditions increase the risk of transmission of infections, including blood-borne viral infections. This can be attributed to higher risky behaviors during incarceration including sharing needles and razors and unsafe sex.

With respect to psychiatric characteristics, we found that HBV infection was independently associated with any degree of intellectual disability and a dementia diagnosis. Other studies have reported a higher prevalence of HBV infection among people with intellectual disabilities [38–41]. This association may be a result of factors related to intellectual disability itself, institutionalization and specific behaviors. These behaviors include taking objects into the mouth and sharing food, small injuries inflicted by themselves or others, dribbling or spitting, scratching and biting, self-mutilation, unhygienic toilet habits, and bleeding lips and gums caused by antiepileptic medication [40]. More frequent institutionalization is an important factor influencing the risk for and frequency of HBV exposure [40]. Finally, poor HIV knowledge and low perception of HIV risk were associated with HBV, although only the former remained in the final model and with previous exposure only. Because HIV and HBV share common modes of transmission, these variables are potential markers for intervention points, especially in Brazil, where HIV and hepatitis programs are within the same Department at the Ministry of Health.

There are some limitations to the study. First, it is possible that the prevalence of HBV infection in this population with mental illness may be underestimated because the exclusion of CAPS-Ad (which usually have a higher proportion of patients with substance use disorder and/or injecting drug use) and because the heterogeneous distribution of HBV by Brazilian Regions may not follow the AIDS pattern. Second, because this is a cross-sectional study, direct causal effect cannot be established. Finally, we were unable to assess the actual phase of active HBV infection (acute or chronic), because we did not use the anti-HBc-IgM serologic marker.

Nevertheless, the results reported in this national representative study show that hepatitis B is an important comorbidity among persons with mental illness in Brazil, with high prevalence of HBV infection (previous and current infection). This particularly applies to people with mental illness who are male, have black skin color, have low education, suffer from intellectual impairment, have been homeless or in prison, have experienced sexual violence, have engaged in substance use during sex or had multiple sexual partners, or have a history of cocaine use or an STD. Understanding these sociodemographic and behaviorally related independent predictors of HBV infection is important to the design of effective prevention and intervention strategies. These would include systematic and universal hepatitis B immunization of psychiatric patients; HBV serologic screening; health education with preventive interventions that target substance abuse and promote safer sex; reducing the incidence of incarceration, psychiatric hospitalization and other forms of institutionalization; achieving residential stability for people with mental illness; and considering the feasibility of treatment for chronic active HBV infection.

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