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Racial/ethnic disparities in the prevalence and awareness of Hepatitis B virus infection and immunity in the United States

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Abstract

Hepatitis B virus (HBV) infection in the US is the most common among Asians followed by non-Hispanic blacks. However, there have been few studies that describe HBV infection and immunity by racial group. Our study aims to assess racial/ethnic disparities in the prevalence and awareness of HBV infection and immunity using nationally representative data. In the National Health and Nutrition Examination Survey 2011–2014, 14,722 persons had HBV serology testing. We estimated the prevalence of HBV infection, past exposure, and immunity by selected characteristics and calculated adjusted odds ratios using survey-weighted generalized logistic regression. Awareness of infection and vaccination history was also investigated. The overall prevalence of chronic HBV infection, past exposure, and vaccine-induced immunity was 0.34% [95%CI 0.24–0.43], 4.30% [95%CI 3.80–4.81], and 24.4% [95%CI 23.4–25.4], respectively. The

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prevalence of chronic infection was 2.74% [95% CI 1.72–3.76] in Asians, 0.64% [95% CI 0.35–0.92] in non-Hispanic blacks, and 0.15% [95% CI 0.06–0.24] in non-Asian, non-blacks. Only 26.2% of those with chronic infection were aware of their infection. The prevalence of the past exposure was 21.5% [95% CI 19.3–23.7] in Asians, 8.92% [95% CI 7.84–9.99] in non-Hispanic blacks, 2.05% [95% CI 1.49–2.63] in non-Hispanic whites, and 4.47% [95% CI 3.25–5.70] in Hispanics. Prevalence of vaccine-induced immunity by each race was 34.1% [95% CI: 32.0–36.2] in Asians, 25.5% [95% CI: 24.0–27.0] in non-Hispanic blacks, 24.0% [95% CI: 22.6–25.4] in non-Hispanic whites, and 22.2% [95% CI: 21.3–23.3] in Hispanics. There are considerable racial/ethnic disparities in HBV infection, exposure, and immunity. More active and sophisticated healthcare policies on HBV management may be warranted.

Keywords

Hepatitis B virus; racial disparity; awareness; NHANES; epidemiology

Introduction

Hepatitis B virus (HBV) infection remains among the most common causes of acute and chronic liver disease, cirrhosis, and hepatocellular carcinoma in the United States.^{1,2} The number of susceptible persons has decreased as a result of universal infant vaccination, catch-up vaccination in children and adolescents, screening of pregnant women to reduce vertical transmission, exclusion of HBV-infected individuals from blood transfusions, and safer needle practices. Despite these improvements, the number of HBV cases in the United States remains a significant public health problem due to the increasing influx of HBV-infected immigrants from endemic countries.³ A recent study suggests that 3.9% of the U.S population have been exposed to HBV, 0.3% have chronic HBV infection, and 25.1% have HBV vaccine-induced immunity.⁴ It is estimated that over 70% of new U.S cases are imported chronic hepatitis B cases.⁵ HBV infection is associated with a roughly 15% to 25% chance of death from cirrhosis or hepatocellular carcinoma (HCC) if left undiagnosed or without proper medical management.⁶ However, most people with HBV infection remain unscreened and the vaccination rate in high-risk persons is suboptimal.⁷ Thus, it is an important public health issue to estimate the true burden of the disease and screen high-risk persons for both primary and secondary prevention.

The Centers for Diseases and Control Prevention (CDC) estimate that in 2013, non-Hispanic Asians, who are 5% of the nation's population, account for 50% of all chronic HBV infections in the United States.⁸ Additionally, the prevalence of HBV infection in non-Hispanic blacks is around two to three fold greater than the general population.⁴ However, there are few epidemiological studies that have described the prevalence of HBV infection and immunity by racial group, especially including non-Hispanic Asians. From the 2011–2012 cycle, the National Health Nutrition Examination Survey (NHANES), one of the most comprehensive national health surveys, began to include non-Hispanic Asian race information; they were oversampled to increase the number of Asian NHANES participants from <2% to upward of 13%.⁴ Moreover, information about the awareness of HBV infection was included for the first time in the 2013–2014 cycle.⁹ Thus, the aim of our study was to

assess racial/ethnic disparities in the prevalence of HBV infection, previous exposure, and immunity to identify high-risk populations and estimate the awareness rate, using nationally representative data.

Methods

Data Collection

NHANES is a series of cross-sectional, population-based surveys conducted every two years by the National Center for Health Statistics of the Centers for Disease Control and Prevention.¹⁰ It collects nationally representative data on the health and nutritional status of the non-institutionalized, civilian population of the United States in 2-year cycles. This survey is conducted using a complex, stratified, and multi-stage probability sampling design and obtains information using standardized household interviews, physical examinations, and testing of biologic samples. In the NHANES 2011–2014 survey, 16,733 persons age 6 years and over were sampled, of whom 14,722 (88%) were tested for the presence of serum antibody to hepatitis B core antigen (anti-HBc), serum antibody to hepatitis B surface antigen (HBsAb), and serum hepatitis B surface antigen (HBsAg). Among those 14,722 participants, there were two and five participants with missing data on HBsAb and HBsAg, respectively. Because of the relatively small number of HBV-infected persons, data from two consecutive 2-year periods (2011 to 2014) were combined. Persons with or without available HBV serologic testing did not substantially differ with respect to risk factors for HBV infection (age, sex, and race). We excluded participants under six years of age since anti-HBc and HBsAg were not ascertained in that age group. The NHANES study was approved by the National Center for Health Statistics (NCHS) Research Ethics Review Board and all participants provided written informed consent.

Laboratory data

Collected blood specimens were processed, stored, and shipped to the Division of Viral Hepatitis, National Center for Infectious Diseases (Atlanta, Georgia). Enzyme-linked immunoassays were used to measure HBsAg, HBsAb, and anti-HBc (VITROS Immunodiagnostic Products by Ortho-Clinical Diagnostics, Raritan, NJ).¹¹ For each assay, participants were considered negative if the test was non-reactive and no further testing was performed. All reactive tests underwent repeat testing to confirm reactivity. Results were expressed qualitatively as positive or negative for anti-HBc, HBsAb, and HBsAg. For HBsAb testing, a positive result has a quantitative interpretation of greater than 10 IU/L.¹² As previous studies defined^{4,13}, chronic HBV infection (and uncommonly, acute infection) was defined by the presence of positive serum HbsAg, and past exposure by the presence of positive serum anti-HBc. HBV immunity from vaccination was determined when participants were positive for serum HbsAb and negative for serum anti-HBc.

Study variables

NHANES characteristics included in the analysis were the following: race/ethnicity (non-Hispanic whites, non-Hispanic blacks, Hispanics, non-Hispanic Asians), age group (6–19, 20–39, 40–64, 65 years), sex (male, female), education (below high school, high school, above high school), smoking status (current, former, never), heavy alcohol use¹⁴ (>2 drink

per day in men and >1 drink per day in women) (yes or no), marital status (never married, married/with a partner, separated/widowed/divorced), birthplace (United States, foreign), veteran status (yes or no), duration of stay in the US more than 10 years (yes or no), poverty index (1.3, 1.3–1.85, 1.85), insurance status (yes or no), insurance type (private, Medicare, Medicaid), history of blood transfusion (yes or no), history of illicit drug use (cocaine, heroin, amphetamine) (yes or no), IV drug use (yes or no), number of sex partners (0–1, 2–19, 20), HIV status, HSV status, HCV RNA status, diabetes (yes or no), awareness of liver disease and HBV infection, and HBV vaccination history (3 doses, 1–2 doses, no dose, don't know). The cut-offs for poverty index, calculated by dividing family income by the poverty guidelines, specific to family size, appropriate year and state, were made according to the commonly used percentages of the poverty guidelines by federal programs in determining eligibility.¹⁵ The awareness of HBV infection and liver disease was based on the medical questions HEQ010: “Ever told you have Hepatitis B?” and MCQ160L: “Ever told you had any liver condition?”, respectively. HEQ010 question was available only in the 2013–2014 survey. Self-reported vaccination history was obtained from the immunization question, IMQ020: “Have you ever received the 3-dose series of the hepatitis B vaccine?”

Statistical analysis

Data were analyzed using R software version 3.2.2, using the ‘survey’ package.¹⁶ We used appropriate analytic methodology and published weights for all analyses.¹⁷ Appropriate weights were calculated for the 4-year period by halving the 2-year weights provided for NHANES 2011–2014. Data were age-adjusted using the direct standardization method according to NHANES analytic guidelines.¹⁸ To describe the prevalence pattern of chronic HBV infection, past exposure, and immunity within each racial-ethnic group, we estimated the prevalence by categories of study variables and calculated the adjusted odds ratios using survey-weighted generalized logistic regression. ANOVA (F-test) was performed to estimate racial disparity in the prevalence of HBV infection and immunity. Since Asians or non-Hispanic blacks comprised the majority of those with chronic infection, we combined non-Hispanic whites and Hispanics as ‘non-Asians, non-blacks’ for the chronic infection comparison. In each model, past exposure to HBV, chronic HBV infection, or vaccine-induced immunity served as the dependent variable. Each multivariate logistic regression model included primary independent variables of interest (age, sex, birthplace, insurance status, and poverty index) that were known to be associated with HBV infection and available for all age groups. P-value <0.05 was considered significant.

Results

Chronic HBV infection (HBsAg+)

Out of 14,717 persons in the NHANES 2011–2014 survey, there were 81 persons with chronic HBV infection, corresponding to a weighted prevalence of 0.34% [95% CI 0.24–0.43] or 0.86 million people in the United States (Table 1, Supplemental Table 1). Overall, low household income, history of blood transfusions, IV drug use, Medicare insurance plans, HIV infection, and HSV infection were associated with chronic HBV infection. The prevalence in Asians, non-Hispanic blacks, and non-Asian, non-black race groups was 2.74% [95% CI 1.72–3.76, n=47/1,740], 0.64% [95% CI 0.35–0.92, n=21/3,524], and 0.15%

[95% CI 0.06–0.24, n=13/9,453], respectively (p-value <0.01) (Figure 1, Table 2). In Asians, a significantly lower prevalence of the infection was observed in those with an education level above high school, a high household income (poverty index <1.85), and insurance plans, while persons with HSV and HCV infection had higher prevalence. In non-Hispanic blacks, those who were born in a foreign country and had lived in the United States for less than 10 years had higher prevalence (odds ratio: 5.43 [95%CI 1.37–21.5]). In non-Asians, non-blacks, HBV infection was associated with Medicare plans, history of blood transfusion, IV drug use, and HIV infection. There was no association between diabetes and chronic HBV infection despite prior evidence that people with diabetes have a higher rate of HBV infection.¹⁹

Past exposure to HBV infection (anti-HBc+)

Among 14,722 persons, the overall prevalence of past exposure to HBV was 4.30% [95%CI 3.80–4.81, n=905/14,722], corresponding to 10.8 million people in the United States (Table 1, Supplemental Table 1). The prevalence among each race/ethnicity was 21.5% [95%CI 19.3–23.7, n=341/1,740] in Asians, 2.05% [95%CI 1.49–2.63, n=121/5,279] in non-Hispanic whites, 8.92% [95%CI 7.84–9.99, n=296/3,527] in non-Hispanic blacks, and 4.47% [95%CI 3.25–5.70, n=123/3,624] in Hispanics (p-value <0.01) (Figure 1, Table 3). Overall, higher prevalence was seen with increased age, male sex, foreign birthplace, lower household income, Medicare and Medicaid insurance plans, history of blood transfusion, illicit drug use (cocaine, heroin, or amphetamine), IV drug use, HIV, HSV and HCV RNA positive status. Persons married or with a partner had lower adjusted odds of being exposed to HBV infection compared to those who were never married. In the racial comparison, all races showed increased prevalence with increased age, low household income and HSV/HCV RNA positive status. Except in Hispanics, there was an increased prevalence associated with IV drug use. Only non-Hispanic whites and non-Hispanic blacks showed increased prevalence with illicit drug use. Decreased prevalence with higher education level was observed in Asians and non-Hispanic blacks, but only Asians had decreased prevalence with insured status. Higher prevalence with foreign birthplace was only observed in Asians and non-Hispanic blacks. For non-Hispanic whites and Hispanics, decreased prevalence was observed in those who were married or with a partner, or were negative for blood transfusion history or HIV status. Hispanics with Medicare insurance plans had higher prevalence compared to those with private plans. Both Non-Hispanic blacks and Hispanics showed higher prevalence with Medicaid plans while Asians with Medicaid plans had lower odds of past exposure than Asians with private plans.

HBV vaccine-induced immunity (HBsAb+, anti-HBc-)

Out of the 14,720 persons, the overall prevalence of vaccine-induced immunity was 24.4% [95% CI 23.4–25.4], corresponding to 61.4 million people in the United States (Table 1, Supplemental Table 1). Overall, vaccine-induced immunity was higher in people aged 20 to 39, women, veterans, and those who never married. Individuals with an education level above high school, high household income, an insurance plan (especially private insurance), and a length of stay of less than ten years in the U.S. had higher rates of immunity. Moreover, non-smokers and those with no history of illicit or IV drug use, or HSV infection were more likely to have HBV immunity. Prevalence of vaccine-induced immunity by race/

ethnicity was 34.1% [95%CI: 32.0–36.2] in Asians, 24.0% [95%CI: 22.6–25.4] in non-Hispanic whites, 25.5% [95%CI: 24.0–27.0] in non-Hispanic blacks, and 22.2% [95%CI: 21.3–23.3] in Hispanics (Figure 1, Table 4). All races except Hispanics showed the highest prevalence in the age group 20–39 (49.3% [95% CI: 45.1–53.4] in Asians, 48.1% [95%CI: 45.1–51.1] in non-Hispanic Whites, 43.8% [95%CI: 40.0–47.6] in non-Hispanic Blacks). In Hispanics, the prevalence was the highest in age group 6–19 (39.2% [95% CI: 36.6–41.9]). In all races, higher immunity rates were observed in women and veterans. Non-Asians with higher education level and without illicit drug use had a higher prevalence of immunity. Non-Hispanics who never smoked had a higher immunity rate compared to current smokers. In non-Hispanic blacks, those born in a foreign country had a higher immunity rate. Increasing immunity rates by higher household income were observed only in non-Hispanic whites and blacks. The immunity rate varied by insurance type only in non-Hispanic whites, with significantly higher rates among those with private insurance compared to Medicare and Medicaid. Non-Hispanic blacks and Hispanics with HSV infection had a significantly lower vaccine-induced immunity rate.

Awareness of HBV infection, past exposure, and immunity

The awareness of HBV infection and past exposure was 26.2% [95%CI 0.62–51.7] and 12.4% [95%CI 8.38–16.4], respectively (Table 5). The awareness rate of chronic infection was the highest in Asians (33.6%), followed by non-Asian, non-blacks (29.9%). None of the non-Hispanic blacks with chronic infection were aware of their infection. Furthermore, the awareness of HBV past exposure was the highest in non-Hispanic whites (21.1%), followed by Asians (10.0%), Hispanics (7.90%) and non-Hispanic blacks (3.06%). The awareness of their liver diseases among those with chronic infection was similarly low. Approximately 0.73 million Americans without past HBV exposure (0.29% of the general population) erroneously reported to have HBV infection. In addition, 44.6% of the participants reported having been vaccinated against HBV (≥ 3 doses): Asians (46.5%), non-Hispanic whites (45.1%), non-Hispanic blacks (46.4%), and Hispanics (40.1%). Of these individuals, only 40.0% had detectable protective HBsAb level (>10 IU/L), and 0.2% were found to be chronically infected with HBV. Additionally, 23.9% of those who did not know about their immunization history (10.4% of all participants) had detectable protective antibody titers.

Discussion

Implementation of universal infant vaccinations and catch-up vaccinations in children and high-risk individuals has dramatically decreased the number of people susceptible to HBV infection. However, chronic hepatitis B infection remains one of the major liver diseases that lead to cirrhosis and HCC.²⁰ Our study suggests that the prevalence of hepatitis B infection, past exposure, and immunity pattern varies among racial groups. The overall prevalence of chronic HBV infection in 2011–2014 was 0.34%, or roughly 0.86 million Americans. Asians had the highest prevalence of chronic infection (2.74%, n=47/1,740), followed by non-Hispanic blacks (0.64%, n=21/3,524). Notably, only 26.2% of chronically infected people were aware of their infection, with the highest rate of awareness in Asians (33.6%). None of the non-Hispanic blacks with chronic infection reported awareness of their infection although this should be interpreted with caution due to the small sample size. In Asians, a

high education level, high household income, and coverage under a health insurance plan were associated with a lower prevalence of chronic infection while those with HSV and HCV infection had a higher prevalence. Non-Hispanic blacks who were born in a foreign country and had lived in the United States for less than 10 years had a higher prevalence. In addition, the overall prevalence of past exposure to HBV was 4.30%, or 10.8 million people in the United States. Only 12.4% of those with past exposure were aware of their exposure with the highest awareness in non-Hispanic whites (21.1%) and the lowest in non-Hispanic blacks (3.06%). The rate of vaccine-induced immunity was 24.4% or 61.4 million Americans, with the highest rates seen in Asians (34.1%).

To our knowledge, this is the most comprehensive study to describe racial/ethnic disparities and awareness in HBV infection, past exposure, and immunity, including Asians, using nationally representative data. Prior studies based on NHANES data were focused on the overall prevalence and trends of HBV infection, past exposure, and immunity from 1998 to late 2000s, rather than racial disparities.^{4,13} According to the CDC guidelines for routine HBV testing, all individuals born in regions with a high and intermediate endemicity of HBV (≥ 2% prevalence) should be tested for HBsAg reactivity, regardless of vaccination status, as well as American-born individuals who were not vaccinated and whose parents were from an area of high HBV endemicity.²¹ The United States Preventive Services Task Force also recommends screening for HBV in all high risk individuals (injection drug users, hemodialysis patients, people on or needing immunosuppressive therapy, men who have sex with men, people with elevated ALT/AST without a known cause, and HIV-positive persons) as well as in all pregnant women and blood-product donors.²² We believe that our findings could provide new information to stratify high-risk populations by racial group. For example, non-Hispanic blacks who were born in a foreign country and have lived in the United States for less than 10 years have significantly higher odds of being chronically infected (odds ratio 5.43 [95% CI: 1.37–21.5]). As previously reported²³, most Asians with chronic infection were foreign-born (94.0%); however, the odds ratio was not statistically significant after adjusting for age, sex, and insurance status although this could be due to a small sample size. Asians with an education level above high school, insurance plans and high household incomes had a lower prevalence of infection, suggesting that access to healthcare and socioeconomic factors may be as important as birthplace in Asian Americans. Only in the non-Asian, non-black group was chronic HBV infection associated with history of blood transfusion, IV drug use, or HIV infection status.

In NHANES 2011–2014, the overall vaccine-induced immunity rate was 24.4% and the rate was less than 50% even among children. Among the 44.6% of all participants reported as having been vaccinated against HBV (≥ 3 doses), 60.0% lacked detectable levels of protective antibodies, and 0.2% were found to be chronically infected, implying that relying on self-reported vaccination history may not provide a true representation of immunity rates. While the absence of these antibodies does not necessarily indicate a loss of immunity, HBsAb has been shown to correlate with HBV immunity and is the easiest way to identify existing protection.¹³ According to the CDC, reported vaccine coverage in 2014 was 91.4% in adolescents²⁴ and 24.5% in adults (age ≥ 19 years)²⁵. It is plausible that the lower than expected vaccine-induced immunity rates in those born in the era of universal infant vaccination could be in part due to declining levels of HsAb over time.²⁶ However, it has

been suggested that immune memory remains intact for more than 30 years following immunization, and the CDC does not recommend routine serologic testing to assess immune status or booster doses in vaccinated individuals.^{27,28} Still, it is worrisome that the immunity rate in high risk individuals, such as foreign-born Asians and non-Hispanic blacks, who were born before the era of universal vaccination remains suboptimal.

Moreover, it is concerning that self-awareness among individuals with HBV infection was low: less than 30% among those chronically infected and less than 15% among those with past exposure. Even among Asians with chronic HBV infection, the awareness rate was less than 40%. Those chronically infected that remain unaware of their condition are at risk for disease progression and acquisition of further complications.⁶ Current American Association for the Study of Liver Diseases (AASLD) guidelines suggest that those at risk of HCC, including Asian men with hepatitis B aged 50, Asian women with hepatitis B aged 40, African/North American blacks with hepatitis B aged 20, should be routinely screened by ultrasonography every 6–12 months for progression to cirrhosis and development of HCC.^{29,30} Based on our findings, there are ~0.1 million Asians and ~0.2 million non-Hispanic blacks with chronic hepatitis B infection who are not receiving HCC screening due to lack of knowledge of their infection and the importance of surveillance in the United States.³¹ Most individuals with chronic HBV infection are asymptomatic until irreversible liver disease has occurred, making screening and vaccination for preventative management pivotal. Furthermore, even those with past exposure but no active infection can reactivate their virus when they become immunocompromised, such as undergoing chemotherapy or other immunosuppressant treatments.³²

The strengths of our study include that NHANES has begun to over-sample the Asian population, which provides a unique opportunity to estimate the robust prevalence of hepatitis B infection, past exposure and immunity for each racial/ethnic group with comprehensive demographic, biochemical lab values, and chronic disease information. Furthermore, NHANES 2013–2014 included, for the first time, a medical question about HBV infection, allowing us to investigate HBV infection awareness specifically. Limitations include that the number of individuals with chronic infection was small (n=81) due to only four-year survey period. Thus, caution is needed when interpreting results for a handful of categories of selected variables that contain very few cases (although the authors are not aware of any larger nationally representative cohort of patients with HBV infection in the US, including Asian race information). Moreover, NHANES does not include homeless or incarcerated persons who are at high risk of HBV infection with approximately 44,000 infected persons in United States jails and prisons.³³

In conclusion, our findings suggest that the pattern of chronic HBV infection, past exposure, and immunity varies significantly by racial/ethnic groups. Furthermore, awareness of the disease is still very low leading to a concern of late diagnosis with serious complications. The vaccine-induced immunity rate was still suboptimal despite the universal vaccination program. More active and sophisticated healthcare policies regarding screening for HBV infection, vaccination, monitoring for immunity, targeted community outreach and education, and infection management may be warranted.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Prevalence of HBV chronic infection, past exposure, and immunity

Table 1

Prevalence of chronic Hepatitis B infection, past exposure, and vaccine-induced immunity in the total population

	Prevalence of chronic infection (81/14717)		Prevalence of past exposure (905/14722)		Prevalence of vaccine-induced immunity (3782/14720)	
	0.34% [95% CI: 0.24–0.43]	aOR ^a [95% CI]	4.30% [95% CI: 3.80–4.81]	aOR ^a [95% CI]	24.4% [95% CI: 23.4–25.4]	aOR ^a [95% CI]
Age, years						
6–19	0.13% [0.00–0.31]	REF	0.23% [0.00–0.43]	REF	32.0% [29.3–34.7]	REF
20–39	0.27% [0.12–0.42]	1.51 [0.31–7.25]	1.9% [1.42–2.41]	7.80 [2.98–20.4]	45.7% [43.5–47.9]	1.88 [1.59–2.22]
40–64	0.41% [0.25–0.56]	2.15 [0.42–11.1]	7.00% [5.88–8.11]	33.3 [13.9–79.8]	12.9% [11.7–14.2]	0.31 [0.26–0.38]
65	0.59% [0.18–1.00]	3.41 [0.60–19.4]	8.22% [7.10–9.35]	39.4 [15.6–99.1]	5.85% [4.67–7.04]	0.13 [0.10–0.17]
Sex						
Male	0.33% [0.17–0.49]	REF	4.92% [4.18–5.65]	REF	22.1% [20.7–23.4]	REF
Female	0.34% [0.21–0.48]	1.02 [0.53–1.98]	3.72% [3.23–4.20]	0.69 [0.57–0.84]	26.6% [25.5–27.8]	1.33 [1.21–1.46]
Education^b						
Below high school	0.52% [0.25–0.78]	REF	8.90% [7.40–10.4]	REF	11.9% [10.1–13.8]	REF
High school	0.50% [0.26–0.74]	1.23 [0.57–2.66]	6.18% [5.01–7.34]	1.06 [0.81–1.38]	16.5% [14.2–18.7]	1.12 [0.91–1.38]
Above high school	0.34% [0.19–0.49]	0.82 [0.39–1.70]	4.53% [3.80–5.26]	0.92 [0.69–1.22]	26.5% [25.2–27.9]	1.85 [1.53–2.24]
Smoking^c						
Current	0.23% [0.07–0.39]	REF	5.84% [4.58–7.10]	REF	20.8% [18.5–23.0]	REF
Former	0.50% [0.16–0.84]	2.00 [0.69–5.79]	6.32% [5.17–7.47]	0.92 [0.68–1.25]	15.5% [13.1–17.8]	1.11 [0.86–1.45]
Never	0.46% [0.26–0.66]	1.30 [0.63–2.71]	5.05% [4.39–5.70]	0.75 [0.56–1.01]	25.6% [24.4–26.9]	1.33 [1.09–1.61]
Heavy alcohol use^c						
Yes	0.21% [0.13–0.30]	REF	3.65% [2.91–4.39]	REF	29.2% [27.2–31.3]	REF
No	0.36% [0.15–0.56]	1.41 [0.57–3.48]	5.18% [4.12–6.25]	1.07 [0.78–1.46]	20.4% [18.4–22.4]	0.95 [0.80–1.12]
Birthplace						
United States	0.18% [0.10–0.26]	REF	2.74% [2.31–3.17]	REF	24.8% [23.7–25.8]	REF
Foreign	1.17% [0.68–1.66]	3.46 [0.78–15.3]	12.7% [11.3–14.2]	2.69 [2.02–3.59]	22.6% [20.7–24.4]	1.03 [0.87–1.23]
Veteran						
Yes	0.35% [0.01–0.70]	REF	6.57% [4.88–8.26]	REF	16.5% [13.5–19.4]	REF
No	0.42% [0.29–0.55]	0.76 [0.21–2.73]	5.15% [4.53–5.76]	0.74 [0.55–1.00]	23.3% [22.3–24.4]	0.59 [0.43–0.80]

	Prevalence of chronic infection (81/14717)		Prevalence of past exposure (905/14722)		Prevalence of vaccine-induced immunity (3782/14720)	
	0.34% [95% CI: 0.24–0.43]	aOR ^d [95% CI]	4.30% [95% CI: 3.80–4.81]	aOR ^d [95% CI]	24.4% [95% CI: 23.4–25.4]	aOR ^d [95% CI]
Length of stay in the US >10 years^d						
Yes	1.20% [0.55–1.85]	REF	13.9% [12.2–15.5]	REF	18.3% [16.5–20.1]	REF
No	1.14% [0.30–1.97]	0.77 [0.20–2.94]	10.1% [7.37–12.9]	0.99 [0.68–1.44]	38.5% [34.3–42.7]	1.45 [1.07–1.97]
Marriage status^b						
Never married	0.29% [0.10–0.48]	REF	4.68% [3.69–5.67]	REF	40.9% [37.9–43.9]	REF
Married/with a partner	0.37% [0.21–0.53]	1.26 [0.56–2.79]	5.10% [4.45–5.76]	0.71 [0.51–0.98]	19.7% [18.3–21.1]	0.64 [0.56–0.73]
Separated/widowed/divorced	0.58% [0.30–0.85]	1.82 [0.60–5.54]	8.15% [6.80–9.50]	0.98 [0.73–1.31]	11.0% [9.05–12.9]	0.53 [0.42–0.68]
Poverty index						
1.3	0.40% [0.26–0.55]	REF	6.06% [5.01–7.11]	REF	24.9% [23.2–26.6]	REF
1.3–1.85	0.69% [0.12–1.26]	1.67 [0.57–4.95]	4.70% [3.68–5.71]	0.70 [0.54–0.92]	23.7% [21.7–25.8]	1.02 [0.85–1.22]
1.85	0.20% [0.08–0.32]	0.51 [0.26–0.98]	3.08% [2.47–3.68]	0.46 [0.35–0.60]	24.6% [23.2–25.9]	1.17 [1.04–1.31]
Insurance						
Uninsured	0.46% [0.17–0.75]	REF	5.46% [4.10–6.83]	REF	24.0% [21.1–26.9]	REF
Insured	0.31% [0.21–0.42]	0.72 [0.38–1.37]	4.08% [3.55–4.62]	1.05 [0.78–1.41]	24.5% [23.4–25.5]	1.32 [1.11–1.57]
Private	0.22% [0.11–0.33]	REF	2.91% [2.42–3.40]	REF	28.1% [26.7–29.6]	REF
Medicare	0.86% [0.28–1.44]	10.71 [3.02–37.97]	7.46% [5.89–9.03]	1.54 [1.01–2.35]	6.6% [5.34–7.96]	0.76 [0.58–1.00]
Medicaid	0.16% [0.07–0.24]	0.67 [0.27–1.70]	5.25% [3.99–6.51]	1.52 [1.11–2.09]	25.4% [23.3–27.4]	0.84 [0.73–0.97]
Blood transfusion						
No	0.28% [0.18–0.38]	REF	3.85% [3.41–4.29]	REF	25.5% [24.4–26.6]	REF
Yes	0.89% [0.17–1.60]	3.47 [1.54–7.78]	8.85% [6.66–11.1]	1.81 [1.43–2.29]	13.3% [10.9–15.8]	0.95 [0.72–1.25]
Illicit drug use (cocaine, heroin, amphetamine)^c						
No	0.39% [0.25–0.53]	REF	4.18% [3.67–4.69]	REF	27.3% [25.9–28.7]	REF
Yes	0.33% [0.04–0.71]	1.38 [0.36–5.27]	6.60% [4.93–8.27]	2.09 [1.57–2.77]	18.7% [16.4–21.1]	0.71 [0.59–0.85]
IV drug use^c						
No	0.35% [0.25–0.45]	REF	4.27% [3.68–4.85]	REF	25.4% [24.3–26.6]	REF
Yes	1.69% [–0.93–4.30]	8.55 [1.49–48.9]	20.5% [15.6–25.5]	7.87 [4.90–12.6]	14.2% [7.45–21.0]	0.56 [0.32–0.98]
Number of sex partner^c						

	Prevalence of chronic infection (81/14717)		Prevalence of past exposure (905/14722)		Prevalence of vaccine-induced immunity (3782/14720)	
	0.34% [95% CI: 0.24–0.43]	aOR ^d [95% CI]	4.30% [95% CI: 3.80–4.81]	aOR ^c [95% CI]	24.4% [95% CI: 23.4–25.4]	aOR ^a [95% CI]
0–1	0.39% [0.16–0.62]	REF	4.96% [3.70–6.23]	REF	28.3% [25.6–31.1]	REF
2–19	0.40% [0.26–0.54]	1.63 [0.90–2.95]	3.93% [3.19–4.67]	0.93 [0.66–1.32]	25.9% [24.6–27.1]	1.08 [0.91–1.28]
20	0.26% [0.00–0.52]	1.14 [0.27–4.85]	6.73% [4.96–8.50]	1.51 [0.93–2.45]	19.1% [16.1–22.2]	0.88 [0.63–1.24]
HIV^c						
Negative	0.35% [0.22–0.49]	REF	3.93% [3.33–4.52]	REF	29.5% [28.2–30.8]	REF
Positive	3.28% [–2.87–9.43]	11.9 [1.23–116]	31.3% [10.4–52.2]	7.53 [2.40–23.7]	24.4% [3.03–45.8]	1.41 [0.31–6.36]
HSV 1 or 2^e						
Negative	0.03% [0.00–0.07]	REF	0.44% [0.16–0.71]	REF	38.9% [36.0–41.8]	1.28 [1.08–1.53]
Positive	0.53% [0.25–0.80]	18.2 [2.86–116]	3.21% [2.56–3.85]	4.25 [1.89–9.57]	30.8% [28.5–33.1]	0.78 [0.65–0.93]
HCV						
Negative	0.33% [0.23–0.43]	REF	4.07% [3.59–4.54]	REF	24.5% [23.5–25.5]	REF
Positive	1.25% [–0.55–3.06]	3.35 [0.88–12.7]	33.0% [23.0–43.0]	6.88 [4.13–11.5]	8.01% [3.26–12.8]	0.64 [0.33–1.24]
Diabetes						
Yes	0.34% [0.13–0.54]	REF	8.05% [6.54–9.55]	REF	9.45% [8.02–10.9]	REF
No	0.34% [0.23–0.44]	1.94 [0.91–4.12]	3.85% [3.37–4.32]	1.17 [0.94–1.46]	26.2% [25.1–27.3]	1.42 [1.13–1.78]

Numerator is the number with chronic infection, past exposure, and vaccine-induced immunity; denominator is the number in the total population

^a Adjusted Odds Ratio: adjusted by age, sex, race, insurance status, birthplace, poverty index

^b Only includes those with age 20

^c Only includes those with age 18

^d Only includes those with a foreign birthplace

^e Only includes those with age between 14 and 49

Table 2

Prevalence of Chronic Hepatitis B infection by racial/ethnic group

	Asians (47/1740)		Non-Hispanic Blacks (21/3524)		Non-Asians, non-blacks (13/9453)	
	2.74% [95% CI: 1.72–3.76]	aOR ^a [95% CI]	0.64% [95% CI: 0.35–0.92]	aOR ^a [95% CI]	0.15% [95% CI: 0.06–0.24]	aOR ^a [95% CI]
Age, years						
6–19	0.86% [0.42–1.31]	REF	0.00% ^f [0.00–0.00]	NA ^f	0.11% [–0.09–0.28]	REF
20–39	2.73% [0.77–4.69]	1.76 [0.55–5.63]	0.86% [0.11–1.62]	REF	0.04% [0.04–0.24]	0.34 [0.03–3.81]
40–64	3.33% [1.83–4.82]	1.82 [0.55–6.07]	0.73% [0.17–1.30]	0.79 [0.26–2.39]	0.19% [0.11–0.40]	1.49 [0.13–16.8]
65	4.14% [1.48–6.79]	2.78 [0.89–8.65]	1.10% [0.44–1.75]	1.12 [0.39–3.21]	0.31% [0.00–0.80]	2.28 [0.13–40.5]
Sex						
Male	2.59% [1.18–4.00]	REF	0.82% [0.33–1.31]	REF	0.14% [0.00–0.27]	REF
Female	2.87% [1.48–4.25]	1.16 [0.56–2.42]	0.48% [0.19–0.77]	0.60 [0.27–1.34]	0.17% [0.02–0.31]	1.22 [0.29–5.08]
Education^b						
Below high school	8.36% [3.74–13.0]	REF	0.80% [–0.23–1.83]	REF	0.04% [–0.04–0.11]	REF
High school	3.36% [0.66–6.05]	0.40 [0.15–1.07]	1.85% [0.68–3.02]	2.40 [0.55–10.44]	0.14% [0.00–0.28]	4.64 [0.42–51.72]
Above high school	2.20% [1.12–3.29]	0.34 [0.14–0.83]	0.36% [0.13–0.58]	0.40 [0.09–1.83]	0.21% [0.05–0.36]	7.70 [0.98–60.4]
Birthplace						
United States	0.62% [–0.24–1.48]	REF	0.53% [0.28–0.78]	REF	0.12% [0.04–0.21]	REF
Foreign	3.50% [2.14–4.87]	4.03 [0.68–23.9]	1.76% [0.29–3.23]	2.71 [0.99–7.44]	0.35% [–0.09–0.78]	2.99 [0.42–21.1]
Length of stay in the US >10 years^c						
Yes	3.72% [1.84–5.60]	REF	0.80% [–0.40–2.00]	REF	0.47% [–0.11–1.05]	REF
No	2.62% [0.89–4.34]	0.64 [0.23–1.83]	5.44% [0.34–10.5]	5.43 [1.37–21.5]	0.00% ^f [0.00–0.00]	NA ^f
Poverty index						
1.3	3.96% [2.04–5.88]	REF	0.78% [0.34–1.21]	REF	0.13% [0.00–0.26]	REF
1.3–1.85	4.83% [1.50–8.16]	1.21 [0.52–2.82]	0.66% [–0.09–1.42]	0.69 [0.22–2.10]	0.45% [–0.17–1.07]	3.74 [0.42–33.1]
1.85	1.19% [0.48–1.89]	0.38 [0.17–0.84]	0.49% [0.18–0.80]	0.47 [0.20–1.12]	0.11% [–0.01–0.24]	0.93 [0.15–5.82]
Insurance						
Uninsured	6.20% [1.43–11.0]	REF	0.66% [0.03–1.29]	REF	0.16% [0.05–0.27]	REF
Insured	2.12% [1.42–2.83]	0.35 [0.16–0.79]	0.63% [0.35–0.91]	1.32 [0.58–3.03]	0.09% [–0.06–0.24]	1.85 [0.34–10.0]

	Asians (47/1740)		Non-Hispanic Blacks (21/3524)		Non-Asians, non-blacks (13/9453)	
	2.74% [95% CI: 1.72–3.76]	aOR ^a [95% CI]	0.64% [95% CI: 0.35–0.92]	aOR ^a [95% CI]	0.15% [95% CI: 0.06–0.24]	aOR ^a [95% CI]
Private	1.85% [1.08–2.61]	REF	0.87% [0.34–1.41]	REF	0.06% [–0.04–0.16]	REF
Medicare	3.59% [1.05–6.14]	1.94 [0.54–7.04]	1.17% [0.35–1.99]	0.86 [0.19–3.80]	0.69% [0.05–1.33]	68.2 [19.9–234]
Medicaid	2.73% [1.46–4.02]	1.48 [0.67–3.28]	0.22% [–0.09–0.52]	0.40 [0.08–1.95]	0.00% [0.00–0.00]	0.00 [0.00–0.00]
Blood transfusion						
No	2.65% [1.52–3.78]	REF	0.56% [0.26–0.86]	REF	0.10% [0.01–0.18]	REF
Yes	4.55% [–1.86–11.0]	1.36 [0.28–6.58]	1.34% [0.09–2.58]	2.30 [0.76–6.95]	0.70% [–0.06–1.49]	6.26 [1.68–23.3]
IV drug use^d						
No	3.30% [1.73–4.86]	REF	0.82% [0.37–1.27]	REF	0.13% [0.06–0.21]	REF
Yes	13.3% [–12.6–39.2]	7.77 [0.65–92.7]	0.00% ^f [0.00–0.00]	NA ^f	1.78% [–1.12–4.68]	18.8 [2.81–125]
HIV^d						
Negative	3.27% [1.99–4.55]	REF	0.68% [0.23–1.14]	REF	0.13% [0.01–0.26]	REF
Positive	0.00% ^f [0.00–0.00]	NA ^f	0.00% ^f [0.00–0.00]	NA ^f	6.16% [–5.99–18.3]	52.6 [4.06–681]
HSV 1 or 2^e						
Negative	0.16% [–0.15–0.48]	REF	0.00% ^f [0.00–0.00]	REF	0.02% [–0.02–0.06]	REF
Positive	4.60% [2.67–6.52]	28.6 [3.21–255]	1.09% [0.32–1.86]	NA ^f	0.15% [–0.08–0.39]	11.2 [0.45–276]
HCV						
Negative	2.61% [1.62–3.59]	REF	0.62% [0.34–0.90]	REF	0.15% [0.06–0.24]	REF
Positive	62.2% [–3.53–128]	20.3 [1.28–321]	1.57% [–1.36–4.49]	2.00 [0.30–13.4]	0.00% ^f [0.00–0.00]	NA ^f

Numerator is the number with chronic infection; denominator is the number in each race/ethnicity

^a Adjusted Odds Ratio: adjusted by age, sex, insurance status, birthplace, and poverty index

^b Only includes those with age 20

^c Only includes those with a foreign birthplace

^d Only includes those with age 18

^e Only includes those with age between 14 and 49

^f There was no case in the cell

Table 3

Prevalence of past exposure to HBV by racial/ethnic group

	Asians (341/1740)		Non-Hispanic blacks (296/3527)		Non-Hispanic whites (121/5279)		Hispanics (123/3624)	
	21.5% [95% CI: 19.3–23.7]	aOR ^a [95% CI]	8.92% [95% CI: 7.84–9.99]	aOR ^a [95% CI]	2.05% [95% CI: 1.49–2.63]	aOR ^a [95% CI]	4.47% [95% CI: 3.25–5.70]	aOR ^a [95% CI]
Age, years								
6–19	1.29% [0.47–2.11]	REF	0.13% [–0.06–0.32]	REF	0.18% [–0.11–0.48]	REF	0.22% [–0.03–0.47]	REF
20–39	9.50% [7.02–12.0]	5.27 [1.67–16.6]	5.69% [3.68–7.69]	43.2 [11.1–168.7]	0.78% [0.27–1.29]	4.06 [0.64–25.7]	0.84% [0.30–1.39]	3.20 [1.07–9.59]
40–64	31.6% [27.9–35.3]	19.9 [6.87–57.8]	14.0% [12.0–16.0]	120.2 [28.6–505.9]	3.65% [2.38–4.92]	21.1 [4.67–95.4]	7.55% [4.88–10.2]	39.4 [12.5–124.6]
65	46.8% [38.6–54.9]	38.6 [11.7–127.6]	16.7% [13.3–20.0]	148.6 [33.7–655.6]	3.26% [2.40–4.49]	19.3 [4.01–93.2]	10.1% [7.41–12.9]	47.8 [14.8–153.7]
Sex								
Male	24.2% [21.2–27.2]	REF	10.3% [8.61–11.9]	REF	2.54% [1.68–3.41]	REF	5.27% [3.78–6.77]	REF
Female	19.1% [16.9–21.3]	0.68 [0.55–0.84]	7.76% [6.54–8.98]	0.72 [0.56–0.92]	1.59% [1.00–2.17]	0.63 [0.39–1.03]	3.69% [2.35–5.02]	0.63 [0.44–0.92]
Education^b								
Below high school	49.9% [39.0–53.0]	REF	16.3% [13.4–19.2]	REF	3.94% [2.00–5.87]	REF	6.82% [4.76–8.89]	REF
High school	39.1% [26.1–40.2]	1.07 [0.66–1.73]	12.7% [9.82–15.6]	0.89 [0.65–1.21]	2.45% [1.24–3.66]	0.75 [0.41–1.37]	6.62% [4.00–9.26]	1.50 [0.92–2.50]
Above high school	20.5% [15.1–19.7]	0.56 [0.40–0.78]	9.60% [8.01–11.2]	0.72 [0.52–0.99]	2.54% [1.72–3.35]	0.94 [0.51–1.74]	4.37% [2.55–6.19]	1.23 [0.82–1.84]
Birthplace								
United States	1.62% [0.45–2.79]	REF	7.26% [6.25–8.28]	REF	1.98% [1.46–2.50]	REF	2.38% [1.58–3.20]	REF
Foreign	28.7% [25.9–31.5]	14.7 [7.23–29.8]	26.4% [21.8–31.1]	3.71 [2.60–5.30]	4.28% [0.40–8.16]	2.16 [0.82–5.71]	6.44% [4.68–8.20]	1.35 [0.91–2.02]
Length of stay in the US >10years^c								
Yes	32.5 [29.4–35.7]	REF	26.1 [21.3–30.9]	REF	4.17 [0.13–8.22]	REF	7.36 [5.16–9.55]	REF
No	19.0 [14.5–23.5]	0.89 [0.59–1.33]	30.4 [20.1–40.7]	2.51 [1.32–4.77]	4.63 [–1.20–10.5]	1.56 [0.27–8.92]	3.71 [1.51–5.92]	0.97 [0.48–1.95]
Marriage status^b								
Never married	11.4% [6.65–16.1]	REF	8.00% [6.03–10.0]	REF	3.05% [1.58–4.51]	REF	4.58% [2.44–6.72]	REF
Married/with a partner	30.6% [27.2–34.0]	1.20 [0.68–2.13]	12.6% [10.4–14.9]	1.08 [0.66–1.76]	2.15% [1.46–2.83]	0.46 [0.26–0.81]	5.00% [3.52–6.48]	0.47 [0.26–0.83]
Separated/widowed/divorced	34.7% [28.8–40.6]	1.04 [0.47–2.30]	15.1% [12.1–18.1]	1.21 [0.75–1.95]	4.12% [2.91–5.33]	0.70 [0.43–1.15]	9.63% [5.83–13.4]	0.79 [0.47–1.33]
Poverty Index								
1.3	26.5% [20.9–32.1]	REF	9.29% [7.14–11.4]	REF	2.86% [1.69–4.03]	REF	5.83% [4.03–7.63]	REF
1.3–1.85	20.8% [13.7–27.8]	0.69 [0.42–1.12]	11.0% [8.34–13.6]	0.92 [0.66–1.29]	2.30% [1.00–3.59]	0.68 [0.33–1.39]	4.34% [1.93–6.74]	0.71 [0.37–1.34]

	Asians (341/1740)		Non-Hispanic blacks (296/3527)		Non-Hispanic whites (121/5279)		Hispanics (123/3624)	
	21.5% [95% CI: 19.3–23.7]	aOR ^c [95% CI]	8.92% [95% CI: 7.84–9.99]	aOR ^c [95% CI]	2.05% [95% CI: 1.49–2.63]	aOR ^c [95% CI]	4.47% [95% CI: 3.25–5.70]	aOR ^c [95% CI]
1.85	17.8% [15.1–20.5]	0.70 [0.49–0.99]	7.41% [5.89–8.93]	0.54 [0.36–0.79]	1.69% [1.05–2.33]	0.44 [0.25–0.75]	2.53% [0.83–4.23]	0.33 [0.15–0.72]
Insurance								
Uninsured	29.6% [23.7–35.5]	REF	10.6% [7.18–14.0]	REF	2.74% [0.85–4.64]	REF	3.80% [2.36–5.25]	REF
Insured	20.1% [17.6–22.6]	0.64 [0.44–0.92]	8.53% [7.55–9.51]	1.02 [0.67–1.57]	1.97% [1.40–2.55]	0.94 [0.47–1.89]	4.80% [3.31–6.29]	1.39 [0.89–2.19]
Private	15.7% [12.9–18.4]	REF	7.36% [5.94–8.78]	REF	1.44% [0.87–2.01]	REF	3.05% [1.47–4.62]	REF
Medicare	44.3% [36.7–51.8]	1.08 [0.42–2.77]	13.0% [9.68–16.4]	0.96 [0.57–1.62]	3.60% [2.18–5.02]	2.05 [0.88–4.77]	11.3% [7.54–15.1]	2.11 [1.11–4.01]
Medicaid	18.6% [11.9–25.2]	0.48 [0.24–0.96]	8.73% [6.99–10.47]	2.18 [1.36–3.51]	2.23% [0.72–3.73]	1.83 [0.86–3.89]	4.83% [1.74–7.93]	1.72 [1.00–2.98]
Blood transfusion								
No	21.2% [19.2–23.2]	REF	8.28% [7.22–9.34]	REF	1.69% [1.12–2.26]	REF	3.74% [2.70–4.78]	REF
Yes	27.2% [16.0–38.4]	0.92 [0.50–1.70]	14.5% [10.6–18.5]	1.21 [0.85–1.72]	5.61% [3.01–8.22]	2.22 [1.19–4.13]	12.8% [7.38–18.3]	2.12 [1.26–3.55]
Illicit drug use (cocaine, heroin, amphetamine)^d								
No	23.6% [20.5–26.7]	REF	8.67% [7.36–9.99]	REF	1.66% [1.07–2.25]	REF	4.71% [3.11–6.31]	REF
Yes	8.58% [0.87–16.3]	0.57 [0.20–1.60]	20.7% [15.6–25.7]	2.48 [1.70–3.62]	4.79% [2.67–6.90]	2.61 [1.62–4.22]	6.50% [2.97–10.0]	1.47 [0.70–3.09]
IV drug use^d								
No	22.6% [19.6–25.6]	REF	9.66% [8.41–10.9]	REF	1.93% [1.24–2.61]	REF	4.76% [3.27–6.25]	REF
Yes	41.2% [–8.00–90.4]	11.9 [2.62–53.7]	51.8% [35.3–68.3]	9.09 [4.22–19.6]	16.2% [10.1–22.4]	8.57 [4.28–17.2]	19.6% [–2.53–41.7]	3.35 [0.71–15.8]
HIV^d								
Negative	19.4% [16.7–22.1]	REF	8.23% [6.75–9.72]	REF	1.97% [1.24–2.70]	REF	3.69% [2.38–5.01]	REF
Positive	0.00% ^f [0.00–0.00]	NA ^f	14.1% [–1.15–29.3]	1.85 [0.57–5.99]	39.1% [–1.90–80.1]	14.0 [1.57–124]	78.2% [39.7–116.7]	58.6 [4.07–842]
HSV1 or 2^e								
Negative	3.16% [1.57–4.75]	REF	0.62% [0.04–1.20]	REF	0.26% [0.00–0.54]	REF	0.00% ^f [0.00–0.00]	REF
Positive	15.1% [12.1–18.2]	3.47 [2.04–5.92]	7.80% [6.00–9.61]	5.82 [2.39–14.2]	1.38% [0.57–2.20]	4.72 [1.01–22.1]	1.78% [1.17–2.40]	NA ^f
HCV RNA								
Negative	21.3% [19.2–23.4]	REF	8.27% [7.23–9.31]	REF	1.92% [1.38–2.46]	REF	4.14% [3.02–5.27]	REF
Positive	100% ^g [100–100]	NA ^g	41.8% [30.6–53.0]	5.17 [3.07–8.69]	25.1% [10.2–40.1]	7.98 [3.41–18.7]	40.0% [18.0–62.0]	8.25 [3.02–22.5]

Numerator is the number with past exposure; denominator is the number in each race/ethnicity

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- ^a Adjusted Odds Ratio: adjusted by age, sex, insurance status, birthplace, and poverty index
- ^b Only includes those with age 20
- ^c Only includes those with a foreign birthplace
- ^d Only includes those with age 18
- ^e Only includes those with age between 14 and 49
- ^f There was no case in the cell
- ^g There were only two persons in the cell

Table 4

Prevalence of vaccine-induced immunity (HBsAb⁺, anti-HBc⁻) by racial/ethnic group

	Asians (609/1739)		Non-Hispanic blacks (947/3527)		Non-Hispanic whites (1122/5279)		Hispanics (922/3624)	
	34.1% [95% CI: 32.0–36.2]	aOR ^a [95% CI]	25.5% [95% CI: 24.0–27.0]	aOR ^a [95% CI]	24.0% [95% CI: 22.6–25.4]	aOR ^a [95% CI]	22.2% [95% CI: 21.3–23.3]	aOR ^a [95% CI]
Age, years								
6–19	44.9% [41.0–48.9]	REF	38.4% [34.9–41.8]	REF	27.7% [23.9–31.5]	REF	39.2% [36.6–41.9]	REF
20–39	49.3% [45.1–53.4]	1.13 [0.92–1.41]	43.8% [40.0–47.6]	1.30 [1.08–1.58]	48.1% [45.1–51.1]	2.52 [2.02–3.14]	36.3% [32.0–40.6]	0.95 [0.68–1.33]
40–64	25.1% [20.8–29.3]	0.36 [0.27–0.47]	11.7% [10.0–13.4]	0.20 [0.16–0.26]	13.5% [11.9–15.2]	0.40 [0.31–0.52]	8.42% [6.71–10.1]	0.15 [0.11–0.22]
65	15.3% [11.1–19.5]	0.21 [0.13–0.32]	7.44% [5.31–9.56]	0.13 [0.10–0.17]	5.26% [3.57–6.95]	0.14 [0.09–0.21]	4.58% [1.97–7.19]	0.07 [0.04–0.14]
Sex								
Male	31.2% [28.2–34.3]	REF	22.5% [20.0–25.1]	REF	21.9% [19.9–23.9]	REF	20.1% [18.8–21.4]	REF
Female	36.7% [34.1–39.3]	1.32 [1.10–1.57]	28.0% [26.5–29.6]	1.39 [1.16–1.67]	26.0% [24.5–27.5]	1.31 [1.14–1.50]	24.5% [22.5–26.4]	1.33 [1.14–1.55]
Education^b								
Below high school	21.9% [15.1–28.6]	REF	10.5% [7.19–13.8]	REF	12.9% [8.34–17.5]	REF	10.3% [8.86–11.7]	REF
High school	25.0% [20.8–29.3]	0.77 [0.50–1.18]	18.2% [15.5–21.0]	1.70 [1.19–2.42]	16.0% [12.7–19.4]	1.15 [0.76–1.73]	14.2% [10.3–18.1]	0.92 [0.59–1.42]
Above high school	34.0% [31.3–36.7]	1.08 [0.66–1.79]	27.1% [24.5–29.7]	2.46 [1.61–3.74]	26.2% [24.6–27.8]	1.94 [1.32–2.83]	25.8% [22.7–29.0]	1.88 [1.30–2.73]
Smoking^c								
Current	23.9% [14.6–33.3]	REF	16.2% [12.6–19.9]	REF	22.5% [19.9–25.2]	REF	16.5% [11.3–21.7]	REF
Former	21.6% [15.6–27.5]	1.34 [0.65–2.78]	13.4% [10.3–16.5]	1.34 [0.89–2.02]	16.5% [13.4–19.6]	1.11 [0.79–1.54]	11.5% [8.99–14.0]	0.95 [0.60–1.49]
Never	34.4% [31.9–36.9]	1.68 [1.00–2.83]	25.9% [23.8–28.1]	1.57 [1.12–2.21]	26.3% [24.6–27.9]	1.32 [1.04–1.68]	19.7% [18.2–21.1]	1.08 [0.76–1.54]
Birthplace								
United States	39.2% [34.3–44.2]	REF	25.6% [24.0–27.2]	REF	23.8% [22.4–25.2]	REF	28.9% [26.3–31.5]	REF
Foreign	32.3% [29.3–35.3]	1.28 [0.94–1.75]	24.5% [20.1–28.8]	1.32 [1.02–1.70]	29.3% [20.9–37.8]	1.32 [0.82–2.12]	16.2% [14.6–17.9]	0.94 [0.69–1.29]
Veteran								
Yes	34.5% [17.1–51.8]	REF	19.9% [15.0–24.7]	REF	16.3% [12.5–20.2]	REF	14.9% [9.05–20.7]	REF
No	32.2% [29.9–34.5]	0.38 [0.15–0.95]	22.8% [21.3–24.3]	0.43 [0.28–0.64]	23.9% [22.4–25.4]	0.59 [0.39–0.89]	18.5% [17.2–19.9]	0.56 [0.35–0.90]
Marriage status^b								
Never married	50.0% [44.6–55.5]	REF	35.2% [32.0–38.5]	REF	42.6% [38.3–46.9]	REF	38.7% [32.6–44.7]	REF
Married/with a partner	27.0% [24.3–29.7]	0.65 [0.49–0.86]	16.9% [14.1–19.7]	0.68 [0.49–0.93]	20.9% [19.1–22.8]	0.68 [0.57–0.81]	13.5% [12.1–15.0]	0.46 [0.34–0.62]

	Asians (609/1739)		Non-Hispanic blacks (947/3527)		Non-Hispanic whites (1122/5279)		Hispanics (922/3624)	
	34.1% [95% CI: 32.0–36.2]	aOR ^a [95% CI]	25.5% [95% CI: 24.0–27.0]	aOR ^a [95% CI]	24.0% [95% CI: 22.6–25.4]	aOR ^a [95% CI]	22.2% [95% CI: 21.3–23.3]	aOR ^a [95% CI]
Separated/widowed/divorced	24.0% [17.2–30.8]	0.75 [0.47–1.21]	11.1% [8.65–13.6]	0.64 [0.43–0.96]	10.8% [8.02–13.7]	0.52 [0.35–0.76]	9.41% [6.52–12.3]	0.45 [0.27–0.75]
Poverty Index								
1.3	35.1% [30.8–39.4]	REF	26.9% [25.1–28.7]	REF	24.3% [20.9–27.8]	REF	23.1% [21.3–25.0]	REF
1.3–1.85	33.5% [25.1–42.0]	0.91 [0.57–1.46]	24.4% [18.8–30.0]	1.03 [0.75–1.42]	22.6% [18.8–26.5]	1.06 [0.78–1.42]	22.3% [18.5–26.2]	0.93[0.67–1.06]
1.85	34.0% [31.2–36.8]	0.91 [0.69–1.20]	24.3% [21.1–27.4]	1.22 [1.02–1.46]	24.3% [22.8–25.9]	1.25 [1.04–1.49]	21.9% [19.1–24.8]	1.10[0.86–1.39]
Insurance								
Uninsured	32.6% [26.8–38.3]	REF	26.4% [23.1–29.7]	REF	23.4% [17.6–29.1]	REF	22.2% [20.0–24.4]	REF
Insured	34.4% [32.0–36.8]	1.22[0.89–1.67]	25.3% [23.5–27.1]	1.20[0.97–1.49]	24.1% [22.7–25.4]	1.39 [1.02–1.91]	22.3% [21.0–23.6]	1.18 [0.94–1.48]
Private	37.1% [34.5–39.6]	REF	27.4% [24.3–30.4]	REF	28.2% [26.5–29.8]	REF	23.4% [21.3–25.6]	REF
Medicare	16.9% [11.6–22.3]	1.30 [0.60–2.81]	9.41% [7.07–11.8]	1.10 [0.73–1.67]	5.99% [4.39–7.59]	0.67 [0.47–0.97]	5.17% [2.77–7.57]	0.85 [0.42–1.74]
Medicaid	39.3% [28.6–50.0]	1.23 [0.76–1.99]	28.7% [25.6–31.8]	0.80 [0.63–1.01]	21.6% [17.1–26.1]	0.64 [0.46–0.90]	25.3% [22.7–28.0]	1.07 [0.84–1.38]
Illicit drug (cocaine, heroin, amphetamine)^c								
No	35.0% [32.2–37.8]	REF	27.8% [25.9–29.7]	REF	27.3% [25.6–29.1]	REF	20.4% [18.5–22.3]	REF
Yes	27.2% [15.0–39.4]	0.62[0.33–1.15]	9.22% [6.55–11.9]	0.55[0.37–0.81]	19.9% [16.9–22.9]	0.72[0.57–0.90]	17.1% [12.5–21.7]	0.69[0.49–0.96]
IV drug use^c								
No	34.6% [31.8–37.4]	REF	25.3% [23.8–26.9]	REF	26.2% [24.5–27.8]	REF	20.1% [18.3–21.8]	REF
Yes	0.0% ^e [0.00–0.00]	NA ^e	9.96% [–1.14–21.1]	0.75[0.19–2.90]	15.7% [7.77–23.6]	0.60[0.33–1.07]	12.2% [–2.85–27.2]	0.34[0.05–2.60]
HSV1 or 2^d								
Negative	44.8% [38.3–48.3]	REF	41.6% [36.8–46.3]	REF	30.4% [28.6–32.3]	REF	40.9% [35.2–44.5]	REF
Positive	40.5% [33.7–42.9]	0.93[0.67–1.29]	32.5% [27.8–33.8]	0.76[0.60–0.95]	30.3% [–15.2–75.7]	2.80[0.22–34.8]	25.9% [21.2–26.5]	0.69[0.54–0.89]

Numerator is the number with past exposure; denominator is the number in each race/ethnicity

^aAdjusted Odds ratio: adjusted by age, sex, birthplace, insurance status, and poverty index

^bOnly for those with age 20

^cOnly for those with age 18

^dOnly for those with age between 14 and 49

^eThere was no case in the particular cell

Table 5

Awareness of HBV infection, liver disease and immunity

	Asian	Non-Hispanic blacks	Non-Asians, non-blacks		Total
			Non-Hispanic Whites	Hispanics	
HBV awareness among people with chronic infection (%)^a	33.6% [7.82–59.4]	0.00% ^c [0.00–0.00]	29.9% [–20.9–80.8]		26.2% [0.62–51.7]
Liver disease awareness among people with chronic infection (%)	18.8% [11.7–25.9]	0.00% ^c [0.00–0.00]	7.22% [–6.26–20.7]		10.3% [4.8–15.7]
HBV awareness among those with past exposure (%)^a	10.0% [2.08–18.0]	3.06% [–0.84–6.95]	21.1% [12.9–29.3]	7.90% [0.65–15.2]	12.4% [8.38–16.4]
Erroneous awareness of HBV infection among people without HBV infection (%)	0.53% [–0.18–1.24]	0.14% [–0.05–0.32]	0.27% [0.06–0.47]	0.49% [0.13–0.86]	0.29% [0.13–0.45]
Proportion of self reported vaccination history (%)					
3 doses	46.5% [43.3–49.7]	46.4% [43.7–49.0]	45.1% [43.6–46.7]	40.1% [37.4–42.8]	44.6% [43.4–45.9]
1–2 doses	2.86% [1.71–4.01]	1.74% [1.25–2.22]	2.43% [1.87–2.99]	1.79% [1.36–2.23]	2.25% [1.88–2.62]
No dose	38.3% [35.8–40.9]	42.8% [39.9–45.8]	43.3% [41.5–45.0]	42.2% [39.6–44.8]	42.7% [41.4–44.0]
Don't know	12.3% [10.2–14.5]	9.05% [7.85–10.2]	9.20% [8.15–10.2]	15.9% [14.6–17.2]	10.4% [9.78–11.0]
Vaccine-induced immunity rate^b by self-reported vaccination history (%)					
3 doses	46.5% [44.0–49.0]	40.5% [38.0–43.0]	39.4% [36.7–42.1]	36.8% [34.9–38.7]	40.0% [38.3–41.8]
1–2 doses	38.2% [26.2–50.3]	27.0% [18.5–35.5]	35.6% [20.8–50.4]	28.9% [16.5–41.3]	29.5% [23.8–35.1]
No dose	20.1% [16.6–23.6]	7.11% [5.62–8.59]	11.3% [9.91–12.7]	9.57% [7.74–11.4]	8.59% [7.54–9.65]
Don't know	33.0% [26.6–39.5]	24.7% [21.6–27.8]	22.4% [16.5–28.4]	20.4% [17.0–23.8]	23.9% [22.1–25.8]

^a Only available in NHANES 2013–2014^b Serum HbsAb level 10 IU/L^c There was no case in the cell