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Trends in Prevalence of Protective Levels of Hepatitis B Surface Antibody Among Adults Aged 18–49 Years With Risk Factors for Hepatitis B Virus Infection—United States, 2003–2014

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Abstract

Background.—Hepatitis B virus (HBV) infection can be prevented through vaccination. However, previous data show that only about 24%–45% of US adults at high risk of HBV infection are protected. Our aims were to assess prevalence and trends in protective levels of hepatitis B surface antibody (anti-HBs) from 2003 to 2014 and explore factors associated with protection among adults at high risk.

Methods.—Data were taken from the 2003–2014 National Health and Nutrition Examination surveys. Our sample included adults aged 18–49 years who were tested for HBV and reported at least 1 of the following infection risks: history of sexually transmitted disease, sex with men (for men), infection with human immunodeficiency virus, and injection drug use. We calculated the prevalence of anti-HBs (≥10 mIU/mL), indicative of immunity from vaccination, among respondents for three 4-year time intervals (2003–2006, 2007–2010, and 2011–2014) and applied the Cochran-Mantel-Haenszel test to assess trends. Using multivariable logistic regression, we examined factors associated with positive anti-HBs serology.

Results.—The prevalence of positive anti-HBs serology was 23.4%. Prevalence increased from 2003–2006 (16.3%) to 2007–2010 (27.3%), but no change occurred from 2007–2010 (27.3%) to 2011–2014 (28.1%). Among factors predicting positive anti-HBs serology were young age and higher education.

Conclusions.—By 2014, less than one-third of adults aged 18–49 years at risk of infection exhibited protective antibodies ≥10 mIU/mL. Because these adults account for a majority of

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unprotected adults, targeted intervention strategies are essential to achieve the hepatitis B elimination goal.

Keywords

hepatitis B; hepatitis B virus (HBV) infection; hepatitis B vaccination; National Health and Nutrition Examination Survey; United States

Hepatitis B virus (HBV) infection is an important public health problem. Worldwide, chronic HBV infection affects approximately 350 million persons [1, 2], and in the United States, 850 000 persons are estimated to be chronically infected [3]. HBV is transmitted by exposure to infectious blood or body fluids, and chronic infection with HBV can lead to serious, life-threatening liver disease [4, 5]. Hepatitis B is preventable through vaccination. An effective vaccine has been available in the United States for 35 years [6]. Since licensure of the vaccine, vaccination has been recommended for persons with a history of sexually transmitted disease (STD), men who have sex with men (MSM), persons living with human immunodeficiency virus (HIV) infection, heterosexuals with multiple sex partners, and injection drug users [4, 5]. However, estimates from previous studies conducted in different years over an 11-year period (1999–2009) found that only about 24%–45% of US adults with 1 or more of these risks for HBV infection had been vaccinated [7–11].

In 1991, the Advisory Committee on Immunization Practices (ACIP) recommended a national strategy for eliminating HBV transmission comprised of 4 elements: vaccinating infants at birth, routinely screening pregnant women for HBV infection and providing immunoprophylaxis to infants born to HBV-infected mothers, vaccinating previously unimmunized children and adolescents, and vaccinating adults at high risk of infection [12]. In 1995 and 1999, the ACIP further recommended routine vaccination for previously unvaccinated adolescents (aged 11–12 years) [13] and unvaccinated children aged <19 years, respectively [14]. However, while the consequences of chronic HBV infection can be life-threatening, adults who acquire acute infection in adulthood are substantially less likely than children to progress to chronic infection. Still, adults at high risk are more likely to be chronically infected than adults not at high risk. As a result, in 2006, ACIP expanded hepatitis B vaccination recommendations to increase vaccination in settings frequented by large numbers of unvaccinated adults at high risk of HBV infection [4]. These settings included STD clinics, HIV testing and treatment facilities, drug abuse treatment and prevention settings, facilities that provide care to persons who inject drugs, healthcare settings that serve MSM, correctional facilities, and other care settings that direct services to persons at risk for HBV infection.

From 1990 to 2016, the incidence of acute hepatitis B in the United States decreased significantly among persons aged ≤ 20 years [15]. In 2016, hepatitis B vaccination among US children aged 19–35 months and 13–17 years was 90.5% and 91.4%, respectively [16, 17]. In addition, recent studies have shown reductions in perinatal transmission by testing pregnant women for HBV and administering prophylaxis to infants born to infected women [18, 19]. Nonetheless, challenges in reducing the incidence of HBV infection among key populations remain. From 2014 to 2015, new cases of HBV infection increased by more than

20% nationally, primarily among MSM and persons who inject drugs [15]. A study that examined hepatitis B vaccination among patients receiving medical care for HIV infection in the United States found that less than 10% of the patients had been vaccinated [20]. Furthermore, many US adults infected with HBV are unaware of their infection [3, 21] and can unknowingly infect others. In 2017, both the National Academies of Science, Engineering, and Medicine and the National Viral Hepatitis Action Plan published strategies for reducing HBV infection [22, 23]. Implementing these strategies will require sustained improvements in hepatitis B vaccination among unprotected adults at risk of HBV infection.

To determine whether progress has been made among US adults at high risk of infection, we analyzed recently available national data. The study aims were 3-fold: to assess the prevalence of having protective levels of HBV antibody, to assess trends in prevalence from 2003 to 2014, and to examine factors associated with having protective levels of HBV antibody among adults at high risk of HBV infection.

METHODS

Sample

Data for the years 2003–2014 were obtained from the National Health and Nutrition Examination Survey (NHANES), an annual survey conducted by the Centers for Disease Control and Prevention (CDC) [24]. The survey, which uses a multistage, stratified sampling design, combines data from interviews and physical examinations to capture the health and nutritional status of the US noninstitutionalized civilian population aged ≥2 years; approximately 5000 persons participate each year. More detailed information regarding NHANES survey design, including institutional review board approval, is available to the public [24]. For this study, data analysis was restricted to adults aged 18–49 years at high risk of HBV infection. Adults were classified as high risk if they self-reported 1 or more of the following: an STD during the previous 12 months (eg, herpes, chlamydia, gonorrhea, and genital warts), sex with another man (among male respondents), infection with HIV, and past or current injection drug use. All other adults were excluded from the analysis. The 18–49 year age range was selected because NHANES collects data related to sexual behavior, drug use, and HIV status only for adults in this age group.

Study Variables

Laboratory Data—Serum specimens were collected for all NHANES participants who provided documented consent for HBV testing. The following serological markers were used to assess immunity to HBV infection: hepatitis B surface antibody (anti-HBs; 10 mIU/mL or greater), indicative of immunity from vaccination or resolved prior HBV infection; hepatitis B surface antigen (HBsAg), indicative of acute or chronic HBV infection; and hepatitis B core antibody (anti-HBc), indicative of previous or ongoing infection with HBV. In our study, only participants who tested positive for anti-HBs, negative for anti-HBc, and negative for HBsAg (ie, immunity from vaccination) were considered protected. Serum specimens obtained from 2003 to 2006 were tested with a quantitative solid phase enzyme-linked immunoassay using the Abbott AUSAB EIA (Abbott Laboratories, North Chicago, IL). Serum specimens obtained from 2007 to 2014 were tested

with quantitative chemiluminescence immunoassay using the VITROS ECi Immunodiagnostic System (Ortho-Clinical Diagnostics, Inc., Rochester, NY).

Cofactors—Selected sociodemographic and healthcare-related variables were examined. These included age group (18–29, 30–39, 40–49 years), sex (male, female), race/ethnicity (based on respondents' self-assessment and categorized as non-Hispanic white, non-Hispanic black, Mexican American, other Hispanic, or other race), education level (greater than high school or high school or less), marital status (married, widowed/divorced/separated, or never married), poverty level (<1.0 below the national poverty level, 1.0–4.9 at the national poverty level, ≥5.0 above the national poverty level), health insurance (yes or no), had a place for routine healthcare (yes or no), number of physician visits during the previous 12 months (0, 1–3, 4–9, ≥10 visits), and self-reported receipt of hepatitis A vaccination (yes or no).

Statistical Analyses—All analyses were conducted with weighted data. We first calculated the prevalence of protective levels of anti-HBs from 2003 to 2014 for all participants and by sociodemographic and healthcare-related characteristics. To evaluate associations within each characteristic, we computed prevalence ratios with 95% confidence intervals (CIs). Next, we calculated the prevalence for three 4-year time intervals (2003–2006, 2007–2010, and 2011–2014) and applied the Cochran-Mantel-Haenszel test to assess trends over the 3 intervals for all respondents and by sociodemographic and healthcare-related characteristics. Finally, to explore factors associated with prevalence of protective levels of anti-HBs, we calculated adjusted odds ratios (AORs) and 95% CIs using multivariable logistic regression with backward elimination. All variables were initially included in the model in which the least statistically significant variable was removed after each run, until only variables with a significance level of ≤0.10 remained. The final model was then examined using the Hosmer-Lemeshow χ^2 goodness-of-fit test. If this measure was >0.05, the model was considered a good fit. For all other statistical tests, a P value of ≤.05 was considered significant. All analyses were performed with SAS version 7.11 (SAS Institute Inc., Cary, NC) and SAS-Callable SUDAAN version 11.0 (Research Triangle Institute, Cary, NC), the latter to account for the multistage clustered sampling design.

RESULTS

Sociodemographic and Healthcare-related Characteristics

The weighted sample size for adults aged 18–49 years who participated in the NHANES from 2003 to 2014 was 19 604 (Table 1). Of the total, 2127 (10.8%) were considered adults at high risk of HBV infection. The majority of the sample was non-Hispanic white (62.0%), aged 30–49 (75.9%) years, never married and/or widowed/divorced/separated (59.0%), had greater than a high school education (61.7%), lived at or above the federal poverty level (80.7%), and had health insurance (74.9%) compared with their counterparts.

Prevalence and Trends by Select Characteristics

Overall, from 2003 to 2014, the prevalence of protective levels of anti-HBs among adults at high risk aged 18–49 years was 23.4% (95% CI, 21.2–25.7; Table 2). This was significantly

lower than the prevalence among adult participants of the same age during the same time period who were not at high risk (25.9%; 95% CI, 25.0–26.9; $P = .03$; data not shown). Significant differences within subgroups in overall hepatitis B protection prevalence from 2003 to 2014 were observed as well (Table 2). Prevalence was significantly higher among females compared with males (prevalence ratio [PR], 1.44; 95% CI, 1.21–1.71) and among adults aged 18–29 years compared with adults aged 30–39 years (PR, 3.22; 95% CI, 2.41–4.30) and those aged 40–49 years (PR, 1.54; 95% CI, 1.14–2.09). Adults educated beyond high school were more likely to be protected than those with a high school education or less (PR, 1.60; 95% CI, 1.27–2.01). Additionally, adults who were never married were more likely to be protected than those who were married. Last, adults who had health insurance (PR, 1.51; 95% CI, 1.21–1.90) and those who reported receiving hepatitis A vaccination (PR, 1.67; 95% CI, 1.67–2.53) were more likely than their counterparts to be protected from HBV infection. Notably, the prevalence of protective levels of anti-HBs across all population subgroups from 2003 to 2014 was relatively low, ranging from 13.6% to 43.8%.

The prevalence of protective levels of anti-HBs among participating adults increased significantly over time from 16.3% (2003–2006) to 28.1% (2011–2014), reflecting a 72% increase (Table 3, Figure 1). However, no significant changes in prevalence were observed from 2007–2010 (27.3%) to 2011–2014 (28.1%). Similar trends (ie, increases in prevalence from 2003–2006 to 2011–2014 and no changes from 2007–2010 to 2011–2014) were found for males and females, adults aged 18–29 years, non-Hispanic whites and other Hispanics, those who were never married, and those who lived at or below the federal poverty level. Overall increases from 2003 to 2014 in hepatitis B protection prevalence also were found among high-risk adults who had a routine place for healthcare, ≥1–3 physician visits during the previous 12 months, and previous vaccination for hepatitis A, again with no significant changes from 2007–2010 to 2011–2014.

Predictors of Protective Levels of Hepatitis B Surface Antibody

Findings from our multivariable analyses revealed several significant results (Table 4) and confirmed a number of our bivariate findings. Younger adults aged 18–29 (AOR, 4.62; 95% CI, 3.08–6.92) and 30–39 years (AOR, 1.76; 95% CI, 1.21–2.55) were more likely to have protective levels of anti-HBs compared with adults aged 40–49 years. Females (AOR, 1.53; 95% CI, 1.12–2.10) had higher odds than males of being protected. Compared with non-Hispanic whites, non-Hispanic blacks (AOR, 0.60; 95% CI, 0.43–0.84) were less likely to have protective levels of anti-HBs. Adults with greater than a high school education (AOR, 1.91; 95% CI, 1.38–2.65) had increased odds of being protected from hepatitis B compared with those with a high school education or less. Finally, adults with health insurance (AOR, 1.76; 95% CI, 1.23–2.52) compared with those without health insurance and those who reported having received hepatitis A vaccine (AOR, 2.30; 95% CI, 1.66–3.19) compared with those who did not were more likely to be protected from hepatitis B.

DISCUSSION

Our findings reveal that from 2003 to 2014, the prevalence of protective levels of anti-HBs increased among adults at high risk of HBV infection; however, no increases in prevalence

were observed in the most recent years of this time period, from 2007–2010 to 2011–2014. Lu et al reported similar increases in hepatitis B vaccination among adults at high risk from 2004 to 2009 using data from the National Health Interview Survey [11]. These findings suggest that ACIP recommendations have had some impact among adults at high risk since 2003; however, our findings show virtually no change in hepatitis B protection prevalence since 2010. The reasons for this are not evident from our study, but we can speculate on factors that might have contributed to this finding. Adults at high risk of HBV infection are generally hard-to-reach populations for intervention, and programs to increase hepatitis B vaccination coverage in the United States often must compete with programmatic interventions for other infectious diseases.

Previous research has shown that certain factors (eg, lack of access to care, absence of health insurance, and mistrust of the healthcare system) are barriers to receipt of hepatitis B vaccine [25–33]. Several studies have shown that persons at increased risk of HBV infection who are younger, married, of higher socioeconomic status, have recent contact with a doctor, and have familiarity with other vaccinations (eg, influenza, hepatitis A) are important facilitators for hepatitis B vaccination [7–11]. Such factors need to be considered in developing intervention strategies.

Many of these facilitating factors were confirmed by our findings. The prevalence of protective levels of anti-HBs was positively associated with younger age (<30 years). Protection from hepatitis B among those aged <30 years was not unexpected since many adults, including those at increased risk for HBV infection, who were in their 20s when surveyed likely benefited from the 1995 and 1999 ACIP recommendations that called for routine vaccination of unvaccinated adolescents aged <19 years [13, 14]. We note, however, that anti-HBs vaccination titers can wane over time, resulting in a lower proportion of older adults with anti-HBs ≥10 mIU/mL but who may remain immune from infection [34, 35]. Thus, while our trend data show a significant increase in immunity over time only among the 18–29 age group, some respondents in the older age groups are likely immune. We also found that females were more likely than males to be protected from hepatitis B, which is consistent with other studies [7–11]. However, non-Hispanic black adults were less likely than non-Hispanic white adults to be protected. The prevalence of chronic HBV infection among non-Hispanic black adults is 2–3 times higher than it is among the general population [3], highlighting the importance of targeted intervention for this population.

Finally and again supported by prior research, we found that a higher education level, having health insurance, receiving hepatitis A vaccination, and more physician visits were all associated with protection from hepatitis B [7–11]. These findings most likely reflect a heightened awareness and familiarity with hepatitis, vaccines, and the healthcare system, plus the resources to obtain vaccination.

Guidelines from the US Preventive Services Task Force and the American Association for the Study of Liver Diseases recommend hepatitis B screening, vaccination, and linkage to care for specific populations, including adults at risk for HBV infection [36, 37]. Because we found that only 28% of adults at high risk of HBV infection had evidence of protection during 2011–2014 but were able to confirm the importance of several facilitating factors for

being protected, these factors can serve as a driving force to improve hepatitis B vaccination coverage. Targeted educational campaigns can be developed and implemented to boost awareness, knowledge, and perceived susceptibility of HBV infection among adults at high risk of infection. Dedicated vaccination programs can be established for high-risk adults with particular focus on those at even greater risk within this population, such as the uninsured. For example, from 2007 to 2010, the CDC launched a national vaccination program called the Adult Hepatitis B Vaccination Initiative. This initiative provided hepatitis B vaccine to selected healthcare settings that served US adults at risk for HBV infection at no cost. More than 1200 venues in 48 states, 3 cities, and 4 territories participated in the initiative; and 1 080 425 doses of vaccine were administered (unpublished data). This effort likely influenced the increase we observed from 2003–2006 to 2007–2010 as well as our finding of no change in prevalence of protection from 2007–2010 to 2011–2014. Another study of high-risk adults conducted in the Netherlands found that a majority (58%) of people who used drugs and participated in a targeted vaccination program completed a series of 3 hepatitis B vaccinations [38].

Our study is subject to unavoidable limitations. First, we used serological data to document hepatitis B vaccination status, and because anti-HBs vaccination titers can wane over time, our estimates might be underestimated by some unknown factor [34, 35]. Another limitation is the exclusion of institutionalized populations and persons not living in households (eg, incarcerated or homeless adults). Also, 2 laboratory assays were used to confirm HBV infection during our time period under study; consequently, the estimates might have been affected by this change in assays. However, previous research has shown a 94% correlation in the performance of the anti-HBs test results between the 2 assays [39], thus any effect from this change in assays is likely nominal. An additional limitation of our data is that NHANES includes a series of questions related to drug use and sexual behaviors that might lead to socially desirable response bias [40]. Finally, NHANES uses a cross-sectional study design; therefore, test–retest reliability and causal inferences cannot be made [24].

Although these limitations might have influenced our point estimates, we have confidence in our trends. Moreover, to our knowledge, this is the first study to assess trends in protection from hepatitis B among adults at high risk using serological data. However, despite an effective vaccine to prevent HBV infection and an increase in the prevalence of protective levels of anti-HBs among our respondents since 2003, still less than one-third of US adults at high risk exhibited anti-HBs ≥10 mIU/mL, indicative of protection against HBV infection, by 2014. Intervention strategies at the national, state, and local levels are needed to improve hepatitis B vaccination coverage among this population in order to achieve the national goal of hepatitis B elimination.

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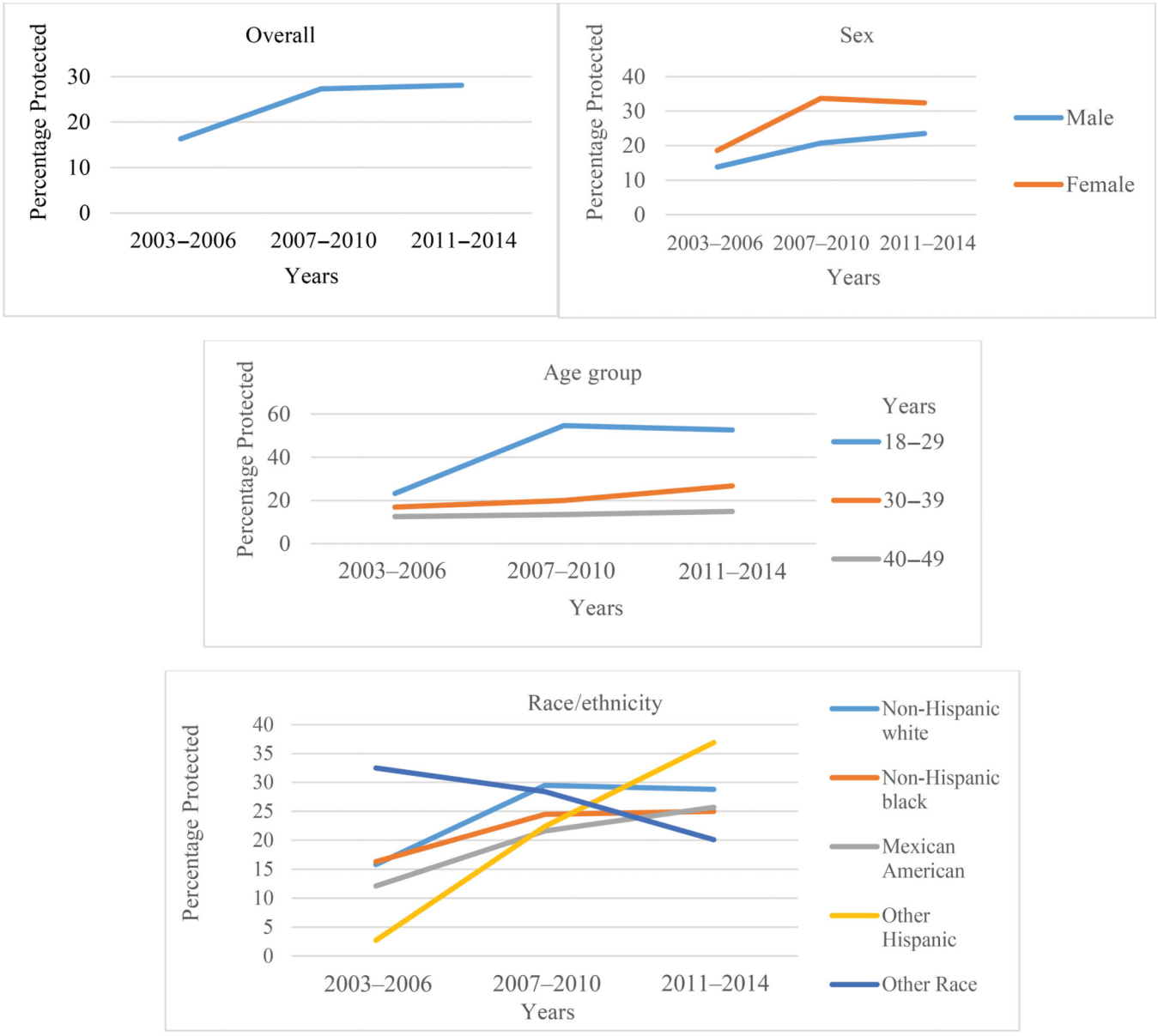

Figure 1.

Trends in prevalence of having protective levels of hepatitis B virus (HBV) antibody among adults aged 18–49 years at high risk of HBV infection overall and by sex, age group, and race/ethnicity, United States, 2003–2014.

Table 1.

Sociodemographic and Healthcare-related Characteristics of Participants to the National Health and Nutrition Examination Survey Aged 18–49 Years at High Risk of Hepatitis B Virus Infection, by Time Interval, United States, 2003–2014

	Time Interval							
	2003–2006		2007–2010		2011–2014		Overall (2003–2014)	
Characteristic	Sample Size	% (95% CI)	Sample Size	% (95% CI)	Sample Size	% (95% CI)	Sample Size	% (95% CI)
Total	6459	…	6652	…	6493	…	19 604	…
Adults at high risk	788	12.2	653	9.8	686	10.6	2127	10.8
Sex								
Male	355	47.8 (43.6–52.1)	317	49.4 (44.7–54.2)	317	48.6 (43.6–53.7)	989	48.5 (45.8–51.3)
Female	433	52.2 (47.9–56.4)	336	50.6 (45.8–55.3)	369	51.4 (46.3–56.4)	1138	51.5 (48.7–54.2)
Age group, y								
18–29	260	20.4 (17.2–24.1)	200	28.8 (24.2–33.9)	176	24.7 (19.8–30.3)	636	24.2 (21.7–26.9)
30–39	251	37.3 (33.4–41.4)	196	28.9 (25.0–33.2)	227	33.1 (29.4–37.0)	674	33.6 (31.3–35.9)
40–49	277	42.3 (38.1–46.6)	257	42.2 (37.3–47.3)	283	42.2 (37.8–46.8)	817	42.3 (39.6–44.9)
Race/ethnicity								
Non-Hispanic white	307	62.3 (56.7–67.7)	241	57.6 (51.1–63.9)	295	65.0 (58.6–70.9)	843	62.0 (58.4–65.4)
Non-Hispanic black	297	18.9 (14.7–24.1)	213	22.1 (17.6–27.4)	201	15.8 (11.6–21.3)	711	18.7 (16.1–21.7)
Mexican American	108	6.3 (4.6–8.5)	87	7.3 (4.9–10.6)	60	7.0 (5.1–9.4)	255	6.8 (5.6–8.2)
Other Hispanic	32	4.6 (3.1–6.9)	80	7.2 (5.1–10.1)	65	6.9 (4.5–10.4)	177	6.1 (4.8–7.7)
Other race	44	7.8 (5.7–10.7)	32	5.8 (3.6–9.0)	65	5.3 (4.1–6.9)	141	6.4 (5.2–7.8)
Education level								
High school or less	300	36.8 (32.1–41.7)	299	43.7 (36.9–50.7)	258	35.8 (30.8–41.2)	857	38.3 (35.2–41.5)
Greater than high school	389	63.2 (58.3–67.9)	295	56.3 (49.3–63.1)	404	64.2 (58.8–69.2)	1088	61.7 (58.5–64.8)
Marital status								
Married	284	42.8 (37.3–48.5)	201	38.3 (33.7–43.2)	245	40.9 (34.9–47.2)	730	41.0 (37.7–44.3)
Widowed/divorced/separated	117	17.8 (14.0–22.4)	110	16.8 (12.8–21.6)	94	14.3 (11.0–18.2)	321	16.3 (14.1–18.8)
Never married	386	39.4 (33.1–46.1)	282	44.9 (39.2–50.8)	324	44.8 (38.7–51.1)	992	42.7 (39.1–46.5)
Federal poverty level[a]								
<1.0	197	17.0 (13.9–20.6)	183	21.3 (17.6–25.4)	185	20.5 (16.7–24.9)	565	19.3 (17.3–21.6)

	Time Interval							
	2003–2006		2007–2010		2011–2014		Overall (2003–2014)	
Characteristic	Sample Size	% (95% CI)	Sample Size	% (95% CI)	Sample Size	% (95% CI)	Sample Size	% (95% CI)
1.0–4.99	436	57.3 (51.4–63.1)	337	55.5 (49.3–61.6)	352	57.5 (51.1–63.7)	1125	56.9 (53.3–60.4)
≥5.0	133	25.6 (21.6–30.1)	85	23.2 (17.6–30.0)	98	22.1 (16.6–28.7)	316	23.8 (20.8–27.0)
Health insurance								
Yes	575	78.2 (74.0–81.9)	421	68.5 (61.9–74.4)	482	76.4 (71.8–80.4)	1478	74.9 (72.1–77.5)
No	206	21.8 (18.1–26.0)	230	31.5 (25.6–38.1)	203	23.6 (19.6–28.2)	639	25.1 (22.5–27.9)
Place of routine healthcare								
Yes	640	82.6 (78.7–85.9)	495	75.6 (70.8–79.9)	546	83.4 (79.2–86.9)	1681	80.9 (78.6–83.1)
No	143	17.4 (14.1–21.3)	156	24.4 (20.1–29.2)	131	16.6 (13.1–20.8)	430	19.1 (16.9–21.4)
Physician visits (number of times) during the previous 12 months								
0	107	11.5 (9.0–14.6)	128	19.0 (15.9–22.5)	124	15.1 (12.8–17.8)	359	14.8 (13.2–16.5)
1–3	387	50.8 (46.9–54.6)	308	44.9 (41.4–48.5)	321	46.8 (42.4–51.2)	1016	47.8 (45.5–50.2)
4–9	163	21.3 (18.4–24.4)	141	23.2 (19.8–26.9)	158	24.2 (20.6–28.3)	462	22.8 (20.9–24.9)
≥10	131	16.5 (13.3–20.2)	76	12.9 (10.0–16.6)	83	13.8 (11.1–17.0)	290	14.6 (12.8–16.6)
Received hepatitis A vaccination								
Yes	161	20.9 (17.2–25.3)	194	31.4 (26.9–36.2)	257	43.6 (38.5–48.9)	612	31.4 (28.7–34.2)
No	538	79.1 (74.7–82.8)	365	68.6 (63.8–73.1)	319	56.4 (51.1–61.5)	1222	68.6 (65.8–71.3)

Adults were classified at high risk of hepatitis B virus infection if they reported at least 1 of the following: a sexually transmitted disease during the previous 12 months (eg, herpes, chlamydia, gonorrhea, and genital warts), sex with another man (among male respondents), infection with human immunodeficiency virus, and past or current injection drug use.

Abbreviation: CI, confidence interval.

[a] <1.0 = below poverty level, 1.0–4.99 = at poverty level, >5.0 = above poverty level.

Table 2.

Prevalence and Prevalence Ratios of Having Protective Levels of Hepatitis B Virus (HBV) Antibody Among Adults Aged 18–49 Years at High Risk of HBV Infection by Sociodemographic and Healthcare-related Characteristic, United States, 2003–2014

Characteristic	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	Prevalence Ratio[a] (95% CI)	*P* Value[b]
Overall	508/2127	23.4 (21.2–25.7)	…	…
Sex				
Male	180/989	19.1 (16.5–21.9)	Ref	…
Female	328/1138	27.4 (24.3–30.8)	1.44 (1.21–1.71)	<.0001
Age group, y				
18–29	287/636	43.8 (37.9–49.9)	3.22 (2.41–4.30)	<.0001
30–39	121/674	21.0 (17.0–25.6)	1.54 (1.14–2.09)	.0063
40–49	100/817	13.6 (10.7–17.1)	Ref	…
Race/ethnicity				
Non-Hispanic white	198/843	24.0 (20.9–27.3)	Ref	…
Non-Hispanic black	173/711	21.5 (18.6–24.8)	0.90 (.74–1.08)	.247
Mexican American	54/255	19.7 (15.2–25.2)	0.82 (.61–1.11)	.1776
Other Hispanic	45/177	22.4 (16.5–29.6)	0.93 (.67–1.29)	.668
Other race	38/141	27.9 (18.7–39.4)	1.16 (.79–1.72)	.474
Education level				
High school or less	131/857	16.2 (13.1–19.9)	Ref	…
Greater than high school	280/1088	25.9 (23.1–29.0)	1.60 (1.27–2.01)	<.0001
Marital status				
Married	132/730	19.3 (15.6–23.7)	Ref	…
Widowed/divorced/separated	47/321	15.7 (10.5–22.6)	0.81 (.52–1.25)	.319
Never married	276/992	27.9 (24.5–31.5)	1.44 (1.11–1.87)	.0038
Federal poverty level[c]				
<1.0	138/565	22.2 (18.4–26.5)	Ref	…
1.0–4.99	259/1125	23.0 (20.1–26.1)	1.03 (.83–1.29)	.766
≥5.0	82/316	26.2 (21.4–31.7)	1.18 (.91–1.53)	.213
Health insurance				
Yes	396/1478	25.6 (22.9–28.5)	1.51 (1.21–1.90)	.0002

Characteristic	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	Prevalence Ratio[a] (95% CI)	*P* Value[b]
No	110/639	16.9 (13.9–20.5)	Ref	…
Place of routine health care				
Yes	414/1681	23.5 (21.0–26.2)	1.10 (.85–1.43)	.443
No	86/430	21.3 (16.9–26.4)	Ref	…
Physician visits (number of times) during the previous 12 months				
0	61/359	19.3 (14.1–25.8)	Ref	…
1–3	253/1016	22.6 (19.1–26.5)	1.17 (.81–1.68)	.380
4–9	122/462	26.6 (21.5–32.4)	1.38 (.94–2.02)	.0861
≥10	72/290	25.2 (19.0–32.5)	1.31 (.87–1.95)	.1891
Received hepatitis A vaccination				
Yes	224/612	37.4 (32.7–42.3)	2.05 (1.67–2.53)	<.0001
No	219/1222	18.2 (15.6–21.2)	Ref	…

Adults were classified at high risk of hepatitis B virus infection if they reported at least 1 of the following: a sexually transmitted disease during the previous 12 months (eg, herpes, chlamydia, gonorrhea, and genital warts), sex with another man (among male respondents), infection with human immunodeficiency virus, and past or current injection drug use.

Abbreviation: CI, confidence interval.

[a] Crude prevalence ratio.

[b] Significant if $P \leq .05$.

[c] <1.0 = below poverty level, 1.0–4.99 = at poverty level, ≥5.0 = above poverty level.

Table 3.

Trends in Prevalence of Having Protective Levels of Hepatitis B Virus (HBV) Antibody Among Adults Aged 18–49 Years at High Risk of HBV Infection by Sociodemographic and Healthcare-related Characteristics and by Time Interval, United States, 2003–2014

	Time Interval						
	2003–2006		2007–2010		2011–2014		
Characteristic	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	*P* Value for Trend[a]
Overall	148/788	16.3 (13.4–19.7)	171/653	27.3 (23.3–31.6)	189/686	28.1 (24.2–32.3)	<.0001
Sex							
Male	52/355	13.8 (10.5–17.9)	56/317	20.7 (15.9–26.5)	72/317	23.5 (18.9–28.8)	.0026
Female	96/433	18.6 (14.4–23.8)	115/336	33.7 (27.2–40.8)	117/369	32.4 (27.2–38.1)	.0002
Age Group							
18–29	82/260	23.2 (16.5–31.6)	112/200	54.6 (45.3–63.6)	93/176	52.6 (42.6–62.4)	.0002
30–39	36/251	16.9 (11.1–24.9)	31/196	20.0 (13.5–28.6)	54/227	26.7 (20.0–34.6)	.0644
40–49	30/277	12.5 (8.7–17.8)	28/257	13.5 (8.5–20.8)	42/283	14.9 (9.7–22.1)	.55
Race/Ethnicity							
Non-Hispanic white	49/307	15.8 (12.3–20.0)	65/241	29.5 (23.5–36.4)	84/295	28.8 (23.3–35.0)	.0005
Non-Hispanic black	67/297	16.3 (12.6–21.0)	55/213	24.5 (18.4–31.7)	51/201	25.0 (20.1–30.7)	.0116
Mexican American	16/108	12.1 (6.2–22.1)	23/87	21.6 (15.1–29.9)	15/60	25.7 (16.9–37.1)	.0362
Other Hispanic	2/32	*b*	20/80	22.4 (15.1–31.9)	23/65	36.9 (26.4–48.8)	.0001
Other race	14/44	*c*	8/32	*c*	16/65	20.1 (11.4–32.8)	.29
Education level							
High school or less	33/300	10.7 (7.6–14.9)	43/299	15.4 (10.5–21.9)	55/258	23.3 (16.5–31.7)	.0045
Greater than high school	71/389	18.8 (15.1–23.2)	84/295	30.7 (26.7–35.1)	125/404	30.5 (24.7–36.9)	.0016
Marital status							
Married	42/284	14.9 (10.7–20.4)	37/201	21.1 (15.0–28.9)	53/245	23.2 (15.6–33.1)	.1031
Widowed/divorced/ separated	19/117	18.2 (9.6–32.0)	14/110	12.2 (6.5–21.8)	14/94	15.1 (7.9–27.1)	.64
Never married	87/386	17.2 (12.5–23.1)	76/282	31.0 (24.6–38.2)	113/324	36.1 (30.7–41.9)	<.0001

Characteristic	Time Interval						*P* Value for Trend[a]
	2003–2006		2007–2010		2011–2014		
	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	Unweighted Number Protected/Sample Size	Weighted Prevalence (95% CI)	
Federal poverty level[d]							
<1.0	43/197	15.2 (9.7–22.9)	50/183	24.5 (17.4–33.2)	45/185	27.1 (21.2–33.9)	.0128
1.0–4.99	79/436	16.7 (13.1–21.1)	80/337	24.7 (19.8–30.4)	100/352	28.8 (22.9–35.6)	.0016
≥5.0	23/133	17.5 (11.6–25.6)	33/85	40.9 (30.1–52.7)	26/98	25.6 (17.9–35.1)	.0899
Health insurance							
Yes	120/575	18.2 (14.7–22.3)	134/421	32.5 (27.5–37.9)	142/482	29.0 (24.1–34.5)	.0012
No	28/206	10.6 (6.8–16.2)	36/230	15.8 (10.6–23.0)	46/203	24.5 (18.8–31.2)	.0008
Place of routine healthcare							
Yes	118/640	16.0 (12.8–19.8)	140/495	28.7 (23.4–34.5)	156/546	27.9 (23.6–32.8)	<.0001
No	29/143	17.2 (11.6–24.8)	30/156	22.9 (14.4–34.6)	27/131	24.0 (18.4–30.8)	.1417
Physician visits (number of times) during the previous 12 months							
0	17/107	14.6 (8.0–25.4)	23/128	19.7 (10.5–33.9)	21/124	22.7 (14.9–33.1)	.21
1–3	68/387	15.0 (10.3–21.4)	82/308	28.1 (21.9–35.3)	103/321	27.3 (21.3–34.4)	.0049
4–9	30/163	13.3 (8.2–20.9)	47/141	34.4 (26.1–43.8)	45/158	33.5 (23.8–44.7)	.0031
≥10	33/131	25.4 (16.7–36.8)	19/76	22.3 (12.6–36.4)	20/83	27.0 (16.2–41.4)	.88
Received hepatitis A vaccination							
Yes	50/161	25.9 (19.5–33.5)	80/194	42.3 (35.3–49.6)	94/257	41.0 (33.0–49.5)	.0185
No	85/538	15.2 (12.0–19.1)	69/365	20.3 (15.4–26.2)	65/319	21.1 (15.6–27.9)	.0859

Adults were classified at high risk of hepatitis B virus infection if they reported at least 1 of the following: a sexually transmitted disease during the previous 12 months (eg, herpes, chlamydia, gonorrhea, and genital warts), sex with another man (among male respondents), infection with human immunodeficiency virus, and past or current injection drug use.

Abbreviation: CI, confidence interval.

[a] Cochran-Mantel-Haenszel test for trend; significant if $P \leq .05$.

[b] Number positive is <5, thus prevalence estimate is not reported.

[c] Absolute CI width ≥30, thus prevalence estimates are not reported.

[d] <1.0 = below poverty level, 1.0–4.99 = at poverty level, ≥5.0 = above poverty level.

Table 4.

Multivariate Logistic Regression Estimates of Characteristics Predicting the Likelihood of Having Protective Levels of Hepatitis B Virus (HBV) Antibody Among Adults Aged 18–49 Years at High Risk of HBV Infection, United States, 2003–2014

Characteristic	Adjusted Odds Ratio (95% Confidence Interval)	*P* Value[a]
Year		
2003–2006	Ref	…
2007–2010	1.60 (1.09–2.34)	.017
2011–2014	1.67 (1.14–2.45)	.009
Sex		
Male	Ref	…
Female	1.53 (1.12–2.10)	.008
Age group, y		
18–29	4.62 (3.08–6.92)	<.001
30–39	1.76 (1.21–2.55)	.003
40–49	Ref	…
Race/ethnicity		
Non-Hispanic white	Ref	…
Non-Hispanic black	0.60 (.43–.84)	.003
Mexican American	0.85 (.52–1.38)	.51
Other Hispanic	0.63 (.39–1.02)	.062
Other race	1.36 (.67–2.75)	.39
Education level		
High school or less	Ref	…
Greater than high school	1.91 (1.38–2.65)	<.001
Health insurance		
Yes	1.76 (1.23–2.52)	.002
No	Ref	…
Received hepatitis A vaccination		
Yes	2.30 (1.66–3.19)	<.001
No	Ref	…

Model adjusted for year, sex, age group, race/ethnicity, education level, health insurance, and hepatitis A vaccination status. Hosmer-Lemeshow χ^2 goodness-of-fit test, $P = .052$; Hosmer-Lemeshow Satterthwaite adjusted F test, $P = .155$. Adults were classified at high risk of hepatitis B virus infection if they reported at least 1 of the following: a sexually transmitted disease during the previous 12 months (eg, herpes, chlamydia, gonorrhea, and genital warts), sex with another man (among male respondents), infection with human immunodeficiency virus, and past or current injection drug use.

[a]Significant if $P \leq .05$.