A Community-Based Study of Hepatitis B Infection and Immunization Among Young Adults in a High-Drug-Use Neighborhood in New York City

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ABSTRACT *We conducted a community-based study of the prevalence and correlates of hepatitis B virus (HBV) infection and immunization among young adults in a “drug supermarket” neighborhood in New York City. Four hundred eighty-nine young adults ages 18–24 years were recruited from Bushwick, Brooklyn through multistage household probability sampling ($n=332$) and targeted sampling ($n=157$), interviewed, and tested for three hepatitis B markers (HBsAg, anti-HBc, and anti-HBs). Serological evidence of HBV infection was found in 8.0% (6.0% in the household sample and 12.1% in the targeted sample) and of hepatitis B immunization in 19.6% (22.6% in the household sample and 13.4% in the targeted sample). HBV infection was higher among young adults who either used crack or injected drugs and among those who traded sex for money or drugs. Having Medicaid was significantly associated with lower odds of infection in the household sample and higher odds of immunization in the targeted sample. Although adolescent hepatitis B immunization has been a public health priority in the United States since 1995, nearly three-quarters of young adults in this community did not have serological evidence of being either exposed or immunized. Whereas subsequent younger generations benefited from universal childhood hepatitis B immunization, this particular cohort of young adults who live in communities like Bushwick presents a unique group for prevention intervention.*

KEYWORDS *Drug use, Hepatitis B infection, Hepatitis B vaccination, Youth.*

INTRODUCTION

Hepatitis B virus (HBV) infection is a major public health concern in the United States. Approximately 1.25 million Americans are infected.^{1,2} Despite the availability

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The opinions expressed herein are those of the authors and not of USAID or other organizations to which the authors belong.

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of an effective vaccine,³⁻⁵ estimated annual incidence of HBV was still 73,000 new cases in 2003,^{6,7} with the majority of these infections occurring among adolescents, race/ethnic minority groups, and drugs users.¹

Although childhood immunization strategies have been successful, hepatitis B (HB) immunization coverage among adolescents and young adults remains low and varies across socioeconomic groups.^{8,9} Vaccination coverage for high-risk groups such as sexually transmitted disease (STD) clinic patients, drug users, and men who have sex with men are generally low.¹⁰⁻¹² Inadequate vaccination coverage has been attributed to lack of awareness of HBV risk, poor health care access, vaccination cost, and shortage of programs for hepatitis B vaccination.¹³⁻¹⁵ Furthermore, the three-dose vaccine regimen makes compliance difficult. Nevertheless, several intervention strategies have been shown to be successful in improving vaccination coverage among adolescents and high-risk groups.¹⁶⁻¹⁸

Sexual activity and injection drug use are the predominantly reported routes of HBV transmission in the United States.¹⁹ The National Health and Nutrition Examination Survey (NHANES III) data show high HBV prevalence among non-Hispanic blacks, drug users, and those with many sexual partners during their lifetime.² Young adults in communities with high levels of drug use who were born before 1991, before the initiation of universal childhood hepatitis B immunization, are particularly at high risk of HBV infection.

Few population-based studies of HBV prevalence and immunization status have been conducted.^{2,20} Little is known about the prevalence of HBV and the extent of immunization among young adults in communities where a large number of drug users are HBV-infected. We conducted a population-based study of the prevalence and correlates of HBV infection and immunization among young adults aged 18-24 years in a "drug supermarket" neighborhood in New York City where use of both injected and noninjected drugs has been widespread for many years.²¹ Our population was born before the introduction of widespread hepatitis B childhood vaccination in the United States.

METHODS

The data were collected as part of a survey of young adults ages 18-24 years in Bushwick, New York City, between July 1997 and June 2000. Bushwick, a low-income, predominantly Hispanic Brooklyn community with a population of approximately 100,000, has been a major "drug supermarket" for many years. Drug selling and drug use, including injection drug use, are still widespread in this neighborhood, as are HIV and other blood-borne infections.^{21,22}

Study participants were recruited, interviewed, and tested using procedures approved by an Institutional Review Board. Two groups of young adults were sampled from the neighborhood: (1) a population-representative household probability sample of 363 young adults; and (2) a targeted sample of 165 young adults who used heroin, cocaine, or inject drugs.

The household sample was drawn through multistage cluster sampling. The primary sampling units (PSU), all 577 face blocks (both sides of one street between adjacent blocks) in Bushwick, were listed in random order and screened sequentially. Dwelling units within each PSU were screened for young adults ages 18-24 years who had resided there for 14 consecutive days. When a dwelling unit had multiple eligible residents, one person was randomly selected. Among 2,675 dwelling units in 43 PSUs, 2404 (90%) were successfully screened; of these, 499 (21%) had an

age-eligible resident, and among those, 363 (73%) sample persons agreed to participate in the study.

The targeted sample of 165 young adults who used heroin, cocaine, crack, or injected drugs in the last 6 months was drawn through ethnographically based targeted sampling in drug use venues and chain referral by household and targeted-sample participants.^{23,24} Participants were asked to recruit 18- to 24-year-old Bushwick residents whom they knew closely and who used cocaine, heroin, crack, or any injected drugs.

Interviews were conducted by trained bilingual (English and Spanish) interviewers at a project storefront or in respondents' homes. Participants were paid \$20 for the interview and an additional \$10 for giving blood and urine specimens. The interview covered sociodemographics, medical history, sexual behaviors, and drug use. Blood samples were collected with additional written informed consent and HIV/STI pretest counseling. Hepatitis B vaccination was not offered as part of the study. Participants could pick up their test results at a community service agency, receive posttest counseling and, if appropriate, get referrals for sexually transmitted infections (STI) treatment and medical services including hepatitis B vaccination.

Sera were tested for the following hepatitis B markers (Abbott Laboratories, Abbott Park, IL): hepatitis B surface antigen (Auszyme EIA), antibody to hepatitis B core antigen (Corzyme EIA), and antibody to hepatitis B surface antigen (Ausab EIA). The serologic criteria used to classify the HBV infection and immunization statuses of study participants were as follows: those who tested positive for either the surface antigen (HBsAg) or the core antibody (anti-HBc) were classified as having a current or past HBV infection; those who tested positive for the surface antibody (anti-HBs) and negative for both the surface antigen (HBsAg) and the core antibody (anti-HBc) were classified as immunized.

The analysis examines the prevalence of markers of current or past HBV infection, hepatitis B immunization, and their sociodemographic, behavioral, and health care related correlates. Because the targeted sample was not drawn probabilistically and participants reported higher levels of drug use and sexual risk behaviors than the household sample participants,²⁵ results are presented separately. Confidence intervals for estimates from the household sample were calculated using Agresti and Coull's method²⁶; they were not derived for the targeted sample because of its nonprobabilistic nature.

RESULTS

Among the 528 study participants, 489 (92.6%) had valid test results on all three HBV markers. Missing results were either due to refusal of phlebotomy or insufficient sera for testing. There were no significant differences between participants with and without HBV test results by recruitment type, sociodemographics or sexual behaviors. Participants who reported never using any drugs were more likely than others (14.3% vs. 5.4%; $P < .05$) to refuse phlebotomy and, therefore, to have missing HBV test results. Of the analysis sample of 489 young adults, 332 (68%) were from household sample and 157 (32%) from targeted sample. Participants were more or less evenly distributed across the 7-year age range (median=21 years). Most of participants (56%) were male; 80% were Hispanic (mostly of Puerto Rican origin), and 16% were African-American. Only 29% were high school graduates. Median annual household income was \$16,500.

Table 1 shows the distribution of hepatitis B serological markers in the sample. Thirty-nine of 489 participants (8.0%) had serological evidence of past (anti-HBc) or present (HBsAg) infection; these rates were 6.0% (95% CI=3.9%–9.1%) for the

TABLE 1. Distribution of participants based on their serostatus on various hepatitis B markers, young adults 18–24 years, Bushwick, New York, 1997–2000

Category	HBsAg	Anti-HBc	Anti-HBs	Number	Percent
Neither exposed nor immunized	Negative	Negative	Negative	354	72.4
Immunized	Negative	Negative	Positive	96	19.6
Exposed	Negative	Positive	Positive	28	5.7
Exposed	Negative	Positive	Negative	9	1.8
Exposed	Positive	Positive	Negative	1	0.2
Exposed	Positive	Positive	Positive	1	0.2
Total number (%)	2 (0.4)	39 (8.0)	125 (25.5)	489	100

HBsAg, hepatitis B surface antigen; anti-HBc, antibody to hepatitis B core antigen; anti-HBs, antibody to hepatitis B surface antigen.

household sample and 12.0% for the targeted sample. Only two participants had seromarkers of current infection (HBsAg). Ninety-six of 489 (19.6%) were positive for anti-HBs and negative for both HBsAg and anti-HBc, which is indicative of hepatitis B immunization. The prevalence of immunization was 22.6% (95% CI=18.4%–27.4%) in the household sample and 13.4% in the targeted sample. The prevalence of each of the HBV markers in the total sample was as follows: HBsAg 0.4%; anti-HBc 8.0%; anti-HBs 25.5%. Twenty-eight people (5.7%) tested positive for both anti-HBc and anti-HBs. One person tested positive for all three markers, probably because of an active infection at the stage of developing antibodies. Nine people were positive on anti-HBc and negative on both anti-HBs and HBsAg (characteristics of these people are described later in this section).

As summarized in Table 2, prevalence of current or past HBV infection was higher in the targeted sample than the household sample. In the targeted sample, women were more likely than men to be infected (24% vs. 8%). Prevalence did not vary significantly by age or place of birth (mainland United States vs. outside) either in the household sample or targeted sample. Prevalence, in the targeted sample, was higher among those who ever sold sex for money or drugs (22% vs. 8%). Crack users and drug injectors were more likely than others to be infected, although the relationship was not statistically significant in the household sample because of its small number ($n=20$) of drug injectors and crack users. Household sample participants who had Medicaid were less likely to be infected than those who did not have Medicaid (3% vs. 8%).

Prevalence of hepatitis B immunization was higher for the household sample than the targeted sample (Table 3). Immunization rates did not vary significantly by gender, race/ethnicity or foreign birth. Prevalence of immunization decreased significantly with age. Immunization status was negatively related to lifetime use of crack or injection drugs for the overall sample and the targeted sample ($P=.058$). Medicaid coverage was positively and significantly associated with having been immunized for participants in the targeted sample.

The characteristics of nine people who tested positive for anti-HBc and negative for both HBsAg and anti-HBs were examined for explanations for the discordant test results. Seven out of nine were recruited through targeted sampling; five had two or more sex partners; three sold sex for money or drugs; six had used crack or injected drugs; and four tested positive for hepatitis C, two for HSV-2, and one each for HIV, syphilis, and chlamydia. The “high-risk” behavioral and biomarker profile of these people suggests that the discordant results may be more likely due to undetectable levels of anti-HBs or HBsAg than due to possible false positive anti-HBc test results.²⁷

TABLE 2. Correlates of past or current hepatitis B infection among young adults 18–24 years by type of recruitment, Bushwick, New York, 1997–2000

	Total sample			Household sample			Targeted sample		
	n	% infected	P*	n	% infected	P*	n	% infected	P*
Sample size	489			332			157		
Number infected	39	8.0		20	6.0		19	12.1	
Gender									
Male	272	8.5		152	8.6		120	8.3	
Female	217	7.4	.661	180	3.9	.075	37	24.3	.009
Race/ethnicity									
Black	76	1.3		69	1.4		7	0.0	
Hispanic	380	9.2		244	7.4		136	12.5	
Others	33	9.1	.066	19	5.3	.186	14	14.3	.592
Age									
18–19 years	167	5.4		128	5.5		39	5.1	
20–21 years	124	8.1		86	5.8		38	13.2	
22–24 years	198	10.1	.253	118	6.8	.906	80	15.0	.293
Birth place									
Mainland									
United States	340	7.4		225	4.4		115	13.0	
Elsewhere	149	9.4	.442	107	9.4	.079	42	9.5	.559
Number of sexual partners									
0–1	282	6.7		224	5.8		58	10.3	
≥2	207	9.7	.238	108	6.5	.808	99	13.1	.605
Sold sex for money or drugs									
Never	424	6.4		312	5.8		112	8.0	
Ever	65	18.5	.001	20	10.0	.441	45	22.2	.014
Lifetime drug use hierarchy									
No drugs	102	5.9		102	5.9		0	N/A†	
Marijuana	161	5.0		161	5.0		0	N/A†	
Heroin or cocaine	131	6.9		49	8.2		82	6.1	
Crack	59	11.9		14	14.3		45	11.1	
Any injected drugs	36	25.0	.001	6	0.0	.594	30	30.0	.003
Crack use or injected drug use									
Never	394	5.8		312	5.8		82	6.1	
Ever	95	16.8	.001	20	10.0	.441	87	18.7	.016
Had private health insurance									
No	380	8.4		248	6.1		132	12.9	
Yes	104	5.8	.373	80	6.3	.948	24	4.2	.219
Had Medicaid									
No	279	8.6		180	8.3		99	9.1	
Yes	207	6.8	.455	150	3.3	.050	57	15.8	.207

*Chi-square test.
†N/A-Not applicable.

TABLE 3. Correlates of hepatitis B immunization among young adults 18–24 years by type of recruitment, Bushwick, New York, 1997–2000

	Total sample			Household sample			Targeted sample		
	n	% immunized	P*	n	% immunized	P*	n	% immunized	P*
Sample size	489			332			157		
Number infected	96	19.6		75	22.6		21	13.4	
Gender									
Male	272	18.4		152	22.2		120	13.3	
Female	217	21.2	.436	180	22.9	.882	37	13.5	.978
Race/ethnicity									
Black	76	23.7		69	24.6		7	14.3	
Hispanic	380	19.0		244	21.7		136	14.0	
Others	33	18.2	.623	19	26.3	.810	14	7.1	.773
Age									
18–19 years	167	29.9		128	32.0		39	23.1	
20–21 years	124	21.8		86	24.1		38	15.8	
22–24 years	198	9.6	.001	118	11.1	.001	80	7.5	.057
Birth place									
Mainland									
United States	340	20.9		225	24.4		115	13.9	
Elsewhere	149	16.8	.293	107	18.7	.241	42	11.9	.744
Number of sexual partners									
0–1	282	20.9		224	22.8		58	13.8	
≥2	207	17.9	.402	108	22.2	.911	99	13.1	.906
Sold sex for money or drugs									
Never	424	20.8		312	22.8		112	15.2	
Ever	65	12.3	.110	20	20.0	.775	45	8.9	.295
Lifetime drug use hierarchy									
No drugs	102	26.5		102	26.5		0	N/A†	
Marijuana	161	21.7		161	21.7		0	N/A†	
Noninjected									
heroin/cocaine	131	18.3		49	18.4		82	18.3	
Crack	59	10.2		14	21.4		45	6.7	
Any injected drugs	36	11.1	.071	6	16.7	.813	30	10.0	.153
Crack use or injected drug use									
Never	394	21.8		312	22.8		82	18.3	
Ever	95	10.5	.013	20	20.0	.775	87	8.0	.058
Had private health insurance									
No	380	19.0		248	22.2		132	12.9	
Yes	104	23.1	.349	80	25.0	.601	24	16.7	.617
Had Medicaid									
No	279	17.2		180	21.7		99	9.1	
Yes	207	23.2	.101	150	24.0	.615	57	21.1	.035

*Chi-square test.

†N/A-Not applicable.

DISCUSSION

Our estimates of HBV infection and immunization in these unique samples of inner-city youths indicate the limited effectiveness of hepatitis B prevention programs in this community. Prevalence of current or past HBV infection among 18–24 year olds in the Bushwick household sample was 6.0% as compared to national estimates of 3.5% for the same age group in the general US household population (NHANES III prevalence estimates for ages 18–24 years: 1.6% for non-Hispanic whites, 5.3% for non-Hispanic blacks, and 1.2% for Mexican Americans).²⁸ Because the Bushwick sample is predominantly of Puerto Rican origin, it may not be meaningful to compare HBV prevalence in this sample with that of Mexican Americans in NHANES.

As expected, prevalence of HBV infection in the Bushwick targeted sample of hard-drug-users was higher than that of the household sample. Young adults who inject drugs or use crack are particularly at high risk of HBV infection and need special attention for primary and secondary prevention. In the targeted sample of drug users, women were more likely than men to be HBV infected. Sexual risk behaviors and networks of youths in this community have been previously described.^{25,29} High-risk behaviors and networks, particularly among young adults who use drugs, together with a 6% prevalence of HBV infection among non-drug-users in the household sample, suggest a potential for widespread transmission and the need for targeted prevention.

Approximately one fifth of the overall sample of young adults ages 18–24 years have been immunized for hepatitis B. The fact that the immunization levels steadily decline with age indicates that vaccination efforts in recent years have been relatively more successful; still only 29% of 18–21 year olds in the household sample have biomarkers of immunization. Because barely one third of the sample had completed high school and more than one fourth had dropped out of school before age 16, school-based vaccination programs can be effective only if implemented at an early age. Lower immunization rates among crack smokers and drug injectors are worrisome because they are the ones at greatest risk of infection. Sixty percent of targeted sample participants reported that they have been incarcerated, and 40% have been in drug treatment. Still, only 13% of them have been immunized. Prisons, drug treatment centers and syringe exchange programs may be appropriate venues to reach this population for vaccination. Our results suggest that Medicaid coverage may enhance vaccination rates by reducing financial barriers. Provision of adequate public funding for hepatitis B vaccine and its administration may be a potential way to improve immunization rates in low-income communities.

This study has a number of limitations. Results from the nonprobability targeted sample have limited generalizability. Screening errors and nonparticipation may have limited the true probability nature of the household sample, and information on non-participants was insufficient to estimate the extent of such bias. Recruitment information was not adequate to create sample weights, and, therefore, the results are based on unweighted data. The survey did not include a question on completion of a three-dose hepatitis B vaccination series. Some individuals who received vaccination (one or more doses) and became protected with anti-HBs levels above 10 mIU/mL, the minimum protective level, might not have had detectable levels of antibody (anti-HBs) and, therefore, may have been misclassified as not immunized. Given the age group (18–24 years), most hepatitis B vaccinations are likely to have been relatively recent, and, therefore, the observed antibody prevalence may be a reasonable proxy marker of effective vaccination or immunization levels in the population.

In summary, hepatitis B immunization was not widely prevalent among young adults in this community. Close to three quarters of young adults were neither infected nor immunized, and remain susceptible. Whereas subsequent younger generations benefited from universal childhood immunization, this particular cohort of young adults, who did not receive hepatitis B vaccination as part of their childhood vaccination schedule, presents a unique group for prevention intervention. High prevalence of HBV infection among drug injecting and crack-using youth suggests the need for special programs targeting them to prevent acquisition of infection and secondary transmission. Given the high level of sexual risk behaviors among these young adults,^{25,29} intense, targeted vaccination campaigns may be an appropriate strategy of primary prevention, especially in Bushwick and similar neighborhoods where HBV may be endemic among its large number of drug users. The Healthy People 2010 initiative calls for eliminating race/ethnic disparities in immunization rates and incidence of HBV infection. Achieving this goal requires increased funding for hepatitis B vaccination as well as other modalities of hepatitis B prevention for young adults and drug users in inner-city minority communities.

ACKNOWLEDGEMENT

Data collection for this research was supported by the United States National Institute on Drug Abuse (DA10411). TOPS FOR YOU, Brooklyn performed post test counseling and referrals. Richard Curtis, Elsie Rodriguez, Herminio Martinez, Joy Settembrino, Jane Rodriguez-White, and Jane Schmirler assisted in data collection. Jeff Yuenger and Kathy Schmidt processed laboratory data. Geraldine McQuillan gave valuable comments.

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