Published in final edited form as:

Subst Use Misuse. 2014 June ; 49(7): 783–792. doi:10.3109/10826084.2014.880176.

A Perfect Storm: Crack Cocaine, HSV-2, and HIV Among Non-Injecting Drug Users in New York City

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Abstract

Prevalence of human immunodeficiency virus (HIV) infection has reached 16% among non-injecting drug users (NIDU) in New York City, an unusually high prevalence for a predominantly heterosexual population that does not inject drugs. Using a long-term study (1983–2011, >7,000 subjects) among persons entering the Beth Israel drug-treatment programs in New York City, we identified factors that contributed to this high prevalence: a preexisting HIV epidemic among injectors, a crack cocaine epidemic, mixing between injectors and crack users, policy responses not centered on public health, and herpes-simplex virus 2 facilitating HIV transmission. Implications for avoiding high prevalence among NIDU in other areas are discussed.

Keywords

Keywords HSV-2; HIV; non-injecting drug users; crack cocaine

INTRODUCTION

Psychoactive drug use can increase unsafe sexual behavior and the risk of sexual transmission of human immunodeficiency virus (HIV) through several causal pathways: (i) impaired decision making while under the influence of drugs; (ii) perceived increased sexual pleasure (from some drugs) leading to increased sexual activity; and (iii) through exchanging of sex for drugs or money to purchase drugs (Decker et al., 2012; Gu et al., 2008). Because of the greater efficiency of transmission through shared injecting equipment than through heterosexual intercourse (Mayer & Pizer, 2009; Normand, Vlahov, & Moses, 1995), HIV prevalence has historically been much higher among injecting drug users compared with non-injecting drug users (NIDU) in the United States (CDC, 2012). In

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Declaration of Interest

The author reports no conflicts of interest. The author alone is responsible for the content and writing of the article.

several studies, however, there has been a convergence of HIV prevalence among injecting drug users and NIDUs in locations including Baltimore (Sherman, 2003) and New York City (Des Jarlais, Arasteh, et al., 2007). Improved prevention for persons who inject drugs has played a major role in reducing HIV incidence and, over time, prevalence among injectors, but the factors behind the increase in HIV prevalence among NIDUs have not been fully explained.

In this report, we present a history of the increase in HIV prevalence among NIDUs in New York City, with a focus on the doubling of HIV prevalence among NIDUs from 1990–1995 to 2005–2011. The increase was a result of multiple concurrent factors, a “perfect storm” of many things going wrong and almost nothing going right. We pay particular attention to the high background prevalence of herpes simplex virus type II (HSV-2) among NIDUs. HSV-2 infection increases both susceptibility to HIV infection (Corey, Wald, Celum, & Quinn, 2004; Venkatesh et al., 2011) and transmissibility of HIV from persons co-infected with HSV-2 and HIV (Celum et al., 2008; Ghebremichael, Habtzgi, & Paintsil, 2012; Schacker, 2001; Thurman & Doncel, 2012). The relationship between HSV-2 and sexual transmission of HIV has been studied extensively in Africa (Auvert et al., 2001; Freeman & Glynn, 2004), but there has been relatively little attention given to this relationship in the United States (Des Jarlais et al., 2011; Des Jarlais et al., 2013; Hook et al., 1992).

METHODS

In this paper, we describe the history of the HIV epidemic among NIDUs (primarily crack cocaine users) in New York City over the last 25 years. We, therefore, draw upon multiple data sources, including previously published data, to tell this history. Most of the data reported here were collected from drug users entering the Beth Israel Medical Center drug detoxification and methadone maintenance programs in New York City. The methods for this “Risk Factors” study have been previously described in detail (Des Jarlais et al., 2009; Des Jarlais et al., 1989), therefore, only a summary is presented here. The Beth Israel Medical Center detoxification program serves New York City as a whole, with approximately half of its patients living in Manhattan, one quarter in Brooklyn, one fifth in the Bronx, and the remainder (i.e., 5%) living elsewhere. The methadone maintenance program primarily serves Manhattan, Brooklyn, and Queens. Patients enter both programs voluntarily. There have been no changes in the requirements for entry into the programs over the time periods for the data presented here.

Persons entering the detoxification program are assigned to different wards depending upon the availability of beds. In the detoxification program, research staff visited the general admission wards of the program in a preset order and examined all intake records of a specific ward to construct lists of patients admitted within the prior 3 days. All of the patients on the list for the specific ward were then asked to participate in the study. Among patients approached by our interviewers, willingness to participate has been more than 95%. After all the patients admitted to a specific ward in the 3-day period had been asked to participate and interviews had been conducted among those who agreed to participate, the interviewers moved to the next ward in the preset order. Because there was no relationship between the assignment of patients to wards and the order that the staff rotated through the

wards, these procedures should produce an unbiased sample of persons entering the detoxification program.

In the methadone program, subjects were recruited and they participated in the study during the intake process for methadone treatment. Subjects were asked to participate simply in the order in which they came for intake processing each day. Willingness to participate in the study was also high in the methadone program, with more than 95% of those asked agreeing to participate in the study.

Informed consent was obtained, and a structured questionnaire covering sociodemographic characteristics, drug use, sexual risk behavior, and use of HIV-prevention services was administered by a trained interviewer. Most questions about HIV risk behavior referred to the 6 months prior to the interview.

Both persons who injected drugs and persons who used injectable drugs (heroin, cocaine, and/or amphetamines) through non-injecting routes of administration, participated in the study. The NIDUs were persons who reported current use of heroin, cocaine, or methamphetamine without ever having injected an illicit drug. Reports of never injecting were checked with program admissions data, and arms were inspected for partial verification of never injecting. Due to a change in the specific aims of the study, however, we did not recruit NIDUs between 2000 and 2004. In this report, results are reported separately for injectors and for NIDUs.

After completing the interview, the subject was seen by an HIV counselor for pre-test counseling and serum collection. HIV testing was conducted at the New York City Department of Health Laboratory using a commercial, enzyme-linked, immunosorbent assays (EIA) test with Western blot confirmation (BioRad Genetic Systems HIV-1-2+0 EIA and HIV-1 Western Blot, BioRad Laboratories, Hercules, CA). Serum samples for 1976 to 1981 had been collected as part of a liver disease study, frozen, and stored at -70°C and then thawed and tested for HIV as part of the Risk Factors study (Des Jarlais et al., 1989).

Subjects were permitted to participate in the study multiple times, although only once per year. All data from subjects who participated in different years were used in the analyses, as those subjects were members of the population of interest in the different years. There were, however, relatively few repeat subjects; typically less than 3% of subjects in a given year had participated in the study earlier. We re-ran the analyses using only one randomly selected interview from subjects with multiple interviews, and there was no change in the patterns or statistical significance of the results. The design of the study is a series of annual cross-sectional surveys of the population of persons who used injectable drugs and received treatment at the Beth Israel Medical Center drug-detoxification and methadone programs from 1990 through 2011.

HSV-2 testing was conducted for all subjects in the study beginning in 2005 to ensure that we have both HIV and HSV-2 data for all subjects after that date. HSV-2 testing was performed by BioReference Laboratories using the Focus HerpeSelect 1 and 2 ELISA. We used an optical density value of 1.1 or greater for classifying a subject as HSV-2 seropositive.

To estimate HSV-2 prevalence among NIDUs recruited between 1995 and 1999, we selected a stratified sample of 200 NIDUs who participated in the study during those years. Serum samples from these NIDUs were thawed and tested for HSV-1 and HSV-2 by Bio-Reference Laboratories as described earlier. We stratified the sample of NIDUs according to gender and HIV serostatus, such that 100 NIDU were selected for each gender, with 80 HIV seronegative men, 80 HIV seronegative women, 20 HIV seropositive men, and 20 HIV seropositive women. Sampling was random within these strata.

Chi-square tests for differences in proportions were the primary statistical test used, with a two-tailed $P < 0.05$ as the significance level. We used Stata 12 statistical software (STATA Corp, 2012) for statistical analyses.

The study was approved by the Beth Israel Medical Center Institutional Review Board and the National Development and Research Institutes Institutional Review Board.

Results 1: The HIV Epidemic Among Persons Who Inject Drugs in New York City

Figure 1 shows HIV prevalence among our subjects from 1976 onwards. The data are from patients in the Beth Israel Medical Center drug treatment programs (Des Jarlais, Arasteh, & Friedman, 2011). Serum samples for 1976 to 1981 had been collected as part of a liver disease study, frozen, and stored at -70°C and then thawed and tested for HIV (Des Jarlais et al., 1989). From the late 1970s through the mid-1990s, HIV prevalence was quite high among drug injectors in the city; therefore, there were large numbers of HIV-positive injectors capable of transmitting the virus to both injecting and sexual partners.

Results 2: The Crack Cocaine Epidemic in New York City

Similar to what happened in many other large US cities, New York City experienced an epidemic of crack cocaine use during the 1980s and early 1990s (Golub & Johnson, 1999). The epidemic in New York City included the frequent exchange of sex for drugs (Golub & Johnson, 1999).

Results 3: Crack Cocaine Use Among Persons Who Inject Drugs in New York City

Smoking crack cocaine was not confined to NIDUs; indeed, many persons who injected heroin and/or cocaine also reported smoking crack. Table 1 shows self-reported crack smoking (for the 6 months prior to the interview) for *persons who injected drugs* entering the Beth Israel Medical Center drug treatment programs and participating in the Risk Factors study (as the subjects were recruited from among persons entering the drug-treatment programs, the 6 months prior to the interview would primarily reflect time *not* during substance-use treatment). There are several factors of interest: crack smoking was particularly high during the early 1990s, when HIV prevalence was high among injectors (see Figure 1); crack use was also high among African American subjects, who had the highest HIV prevalence; and crack use was higher among females (who would be more likely to exchange sex for crack or money to purchase crack and are more susceptible to HIV infection) than among males. Finally, crack use was higher among HIV seropositives than among HIV seronegatives.

All of these factors would promote sexual transmission from HIV-seropositive drug injectors to HIV-seronegative NIDUs through crack-related sexual activities. Modest numbers (10%) of our NIDU subjects did report sexual relationships with persons who injected drugs. These would not include sex for crack exchanges, which were usually semi-anonymous (Inciardi, 1995; Sharpe, 2005).

Results 4: Initial Policy Responses to the HIV Epidemic and the Crack Cocaine Epidemic

The transmission of HIV through sharing of drug-injection equipment did lead to public consideration of syringe-exchange programs in New York City (Des Jarlais & Hopkins, 1985), but the crack epidemic was associated with a considerable increase in violent crime (Inciardi, 1995; Sharpe, 2005). Although most of the violent crime was related to the distribution of crack cocaine rather than to the effects of the drug on the behavior of users, much of the general community reaction was against anything that could be seen as “encouraging” drug use. The reaction in the African American community against syringe exchange was particularly vehement (Anderson, 1990). Large-scale public funding for syringe exchange was, thus, delayed until the mid-1990s (Heller & Paone, 2011).

The crack cocaine epidemic did not provoke a public health-oriented response. Rather, it intensified the existing “War on Drugs” policy toward illicit drug use. This resulted in the large-scale incarceration of crack cocaine and other drug users. Policing and sentencing practices (penalties for possession of crack cocaine were much more severe than penalties for powder cocaine) led to arrest and incarceration rates that were particularly high among young African American men in New York City and elsewhere in the United States (Alexander, 2012). As Adimora and colleagues have noted (Adimora & Schoenbach, 2002, 2005; Adimora, Schoenbach, & Doherty, 2006), high incarceration rates among young African American men affected the structure of sexual networks by reducing the number of male sexual partners. The resulting low male-to-female sex ratios may reduce women’s power to negotiate condom use and maintain mutually monogamous relationships due to a fear of losing a partner to other available women (Adimora et al., 2006; Carey, Senn, Seward, & Vanable, 2010; Hodder et al., 2010; Nunn et al., 2011). Low male-to-female sex ratios are also thought to promote multiple overlapping (“concurrent”) partnerships (Adimora & Schoenbach, 2005; Pouget, Kershaw, Niccolai, Ickovics, & Blankenship, 2010), which are associated with increasing the size of sexually transmitted infections and HIV epidemics and the speed at which they are spread (Doherty, Shiboski, Ellen, Adimora, & Padian, 2006; Ghani, Swinton, & Garnett, 1997). Partners left behind may initiate new relationships to replace the emotional, sexual, and financial support that their incarcerated partner provided. These dynamics may be particularly pronounced for drug-using women, as they are more likely than women in the general population to forge romantic and sexual relationships with drug-using men—a population who were particularly at increased risk of arrest and incarceration during the “War on Drugs” era.

Results 5: HSV-2 as an Amplifier of HIV Transmission Among NIDU

Table 2 shows HIV Prevalence among our NIDU subjects in 1995 to 1999 and 2005 to 2011. HIV prevalence increased from 8% to 16% among the subjects as a whole over the two time periods. There were statistically significant increases in HIV prevalence in almost

all demographic and drug-use subgroups over the two time periods. There were differences in HIV prevalence among the subgroups, particularly in 2005 to 2011, but the size of the increases in HIV prevalence—approximate doubling—was quite consistent across the subgroups. Increases occurred among both males and females, among all racial/ethnic groups, among younger and older subjects, and among persons reporting use of different drugs (crack cocaine, powder cocaine, and heroin). The consistency of the increases across the various subgroups indicates that the overall increase in HIV prevalence (from 8% to 16%) was not due simply to changes in the demographic composition of the 1995–1999 and 2005 to 2011 samples.

Table 3 shows HSV-2 prevalence by HIV serostatus for the two time periods by sex and by race/ethnicity. HSV-2 prevalence was high among HIV seronegatives and very high among HIV seropositives in both time periods. Among all subjects, HSV-2 was significantly associated with HIV in both time periods, odds ratio (OR) = 3.6, 95% confidence interval (CI) 1.5–8.5 for 1995–1999 and OR = 3.4, 95% CI 2.5–4.7 for 2005–2011. The odds ratios were statistically significant among all subgroups where we had sufficient numbers of subjects for meaningful statistical testing.

As noted in the introduction, HSV-2 infection biologically increases susceptibility to HIV and increases transmissibility of HIV from persons infected with both viruses. Assessing the total contribution of HSV-2 to the increase in HIV over the two time periods is beyond the scope of this paper, but it is worthwhile to simply consider how HSV-2 infection increased susceptibility to HIV among the HIV seronegatives in 1995 to 1999. Based on meta-analysis of the available studies, Freeman and colleagues (Freeman et al., 2006) estimated that HSV-2 infection increases susceptibility to HIV by a relative risk of 2.5. That is, if persons engaged in the same levels of risk behavior, those who were infected with HSV-2 would be 2.5 times as likely to become infected with HIV as those who were not infected with HSV-2. Thus, almost half (49%, weighted sum of 39% among males and 75% among females) of the 1995 to 1999 HIV seronegative NIDUs who were infected with HSV-2 would have been 2.5 times as likely to become infected with HIV than they would have if they had not been infected with HSV-2. The very high rate of HSV-2 infection among the HIV seropositives in 2005 to 2011 is consistent with this increased risk for acquiring HIV infection among persons infected with HSV-2 (Table 4).

It is possible that other sexually transmitted diseases might have contributed to increased transmission of HIV among NIDUs in the city. Syphilis is the other genital ulcerative disease that is strongly associated with HIV transmission (Boily et al., 2009), but would not appear to have been a factor among these NIDUs. Syphilis testing is conducted as part of the entrance medical examination for persons entering Beth Israel Medical Center drug treatment programs, and the rate of positive tests for syphilis has been less than 1% (unpublished data), much lower than the rates of 50% to 60% for HSV-2.

Results 6: The Passing of the Storm?

There is now some evidence that the “perfect storm” of the background HIV epidemic among persons who inject drugs (PWID), the crack cocaine epidemic, use of crack cocaine by HIV-seropositive PWID and HSV-2 as a facilitator of HIV transmission, may have

passed its peak. HIV prevalence among NIDUs stabilized in our 2005 to 2011 sample, with no trend toward either increasing or decreasing prevalence during these 7 years. As discussed further, this stabilization may be the result of various historical changes (there are fewer new users of crack cocaine [Golub & Johnson, 1999] and various HIV-prevention interventions have been implemented in the city).

DISCUSSION

By 2005 to 2011, HIV prevalence among never-injecting drug users entering the Beth Israel Medical Center drug-treatment programs had increased to 16%. This is an extremely high prevalence for a US subpopulation that does not inject drugs and is predominantly heterosexual (only ~5% of subjects reported male-with-male sexual behavior). Our data are from a single medical center in the city, but the drug-treatment programs of this center serve the city as a whole, and the data are consistent with HIV prevalence among NIDU recruited from community settings in New York City in 2004 (Des Jarlais, Hagan, McKnight et al., 2007) and with the HIV prevalence among “high risk heterosexuals” in the 2006–2007 National HIV Behavioral Survey (NHBS) conducted in New York City. The NHBS study recruited subjects from high-risk neighborhoods in New York City, and found an overall HIV prevalence of 8.6% (Hagan et al., 2010) and a strong relationship between HSV-2 seroprevalence and HIV seroprevalence (AOR = 3.5) (Hagan et al., 2010). The data presented here are also consistent with the recent study showing unexpectedly high HIV incidence among women in six US cities (Hodder et al., 2012), including New York City.

We have used the metaphor of a perfect storm—with multiple contributing factors—to describe the rise of HIV prevalence among NIDUs in New York City. Several of the contributing factors would appear to have been *necessary conditions* for the relatively high HIV prevalence that developed among NIDUs in the city. The initial HIV epidemic among persons who inject drugs in the city, and the crack cocaine epidemic, including the use of crack by many HIV-seropositive injectors, would all appear to have been necessary conditions.

As noted earlier, the initial policy responses to the HIV epidemic among drug users in New York City were not based in an HIV-prevention/harm reduction perspective but, rather, a “War on Drugs” perspective. It is interesting to speculate on whether different policy responses to the HIV epidemic among persons who inject drugs and to the crack cocaine epidemic might have reduced HIV transmission among NIDU in New York City. Syringe exchange was first considered in the mid-1980s in the city, but not implemented on a large scale until the mid-1990s. The large-scale implementation of syringe exchange programs in New York City was associated with an 80% reduction in HIV incidence among persons who injected drugs in the city (Des Jarlais et al., 2005). If large-scale syringe exchange had been implemented a decade earlier in the city, it is likely that the numbers of highly infectious acute HIV infections among injectors would have been reduced, and that transmission from injectors who also smoked crack cocaine to non-injecting crack users would also have been reduced. Given that approximately half of the drug injectors in the city were HIV seropositive when the crack epidemic occurred, however, substantial HIV transmission from injectors who used crack to non-injectors who used crack would still have been likely.

Highly effective antiretroviral treatment (HAART) for HIV infection was developed in the mid- to late-1990s. Drug users lagged behind other groups in receiving antiretroviral treatment (ART) in New York City, but there are now a substantial percentage of HIV-seropositive drug users on ART. In our 2005 to 2011 NIDU sample, 77% of the subjects were receiving ART in the 6-month period prior to the time they entered the Beth Israel Medical Center drug-treatment programs. Receiving ART not only contributes to the health of these drug users, but may also reduce their infectivity and the potential for HIV transmission to sexual partners (Des Jarlais et al., 2005). In 2011, the New York City Department of Health and Mental Hygiene announced a policy of offering ART to all HIV-seropositives regardless of CD4 cell count to ensure that the percentage of HIV-seropositive drug users receiving ART would increase.

In 2007, the New York City Department of Health and Mental Hygiene initiated a large-scale condom social marketing program, with more than 30 million, free, branded, NYC condoms distributed per year (Burke et al., 2009; New York City Department of Health and Mental Hygiene, 2007). The NYC condoms have distinctive packaging and were publicized in the media and with bus and subway ads. Both injecting and NIDUs were target populations for this program, and implementation of the program was associated with reductions in sexual risk behavior among HIV-seropositive drug users in the city (Des Jarlais et al., in press). In hindsight, it clearly would have been desirable if this program had been implemented in the mid-1980s.

LIMITATIONS

In this paper, we have attempted to provide a history of the “perfect storm” of HIV infection among NIDUs in New York City. We believe that this epidemic is probably the largest HIV epidemic among heterosexuals in the United States, and probably among heterosexuals in all high-income countries. We were fortunate in having a long-term study of HIV among drug users in New York City and HSV-2 data in our reconstruction of this perfect storm. However, there are several important limitations that should be noted.

First, the research design is of serial cross-sectional surveys. We, therefore, cannot be certain of when subjects acquired HSV-2 and/or acquired HIV, and we had to use a literature-based estimate of the relative risks for increased susceptibility to HIV infection due to existing HSV-2 (Des Jarlais et al., 2005). However, the high prevalence of HSV-2 among both HIV-seronegative and HIV-seropositive subjects indicates that HSV-2 is likely to have been a major factor in HIV transmission among NIDUs in the city.

Second, we had to rely upon self-reports for identifying persons who never injected drugs and for the data on sexual risk behavior. Subjects were recruited into the study prior to the survey questions on route of drug administration, to ensure that there was no external motivation to falsely report injecting or non-injecting drug use. In addition, we did check the admissions records for consistency with the interviews and examined the subjects’ arms for signs of injecting.

Third, the data reported here are from a single set of drug-treatment programs. These programs are, however, quite large and serve the city as a whole. Previous comparisons of

data from the Beth Israel Medical Center drug treatment programs with data from other sites in New York City show great consistencies (Des Jarlais et al., 2000; Des Jarlais et al., 1998). Moreover, we did not collect data from NIDUs between 2000 and 2005, but it would seem very unlikely that HIV or HSV-2 either spiked or dropped during these 6 years.

Although these limitations need to be considered, it would seem highly unlikely that they would have created the patterns we observed in the data: the HIV epidemic among persons who inject drugs, the crack epidemic, crack use among persons who inject drugs, and the associations between HSV-2 and HIV. Rather, we believe that the patterns were observed despite the limitations.

CONCLUSIONS

New York City has experienced what is probably the largest HIV epidemic among predominantly heterosexual NIDUs. There were many contributing factors, and the HIV epidemic among persons who inject drugs, the crack cocaine epidemic, and crack use among HIV-seropositive injectors would all appear to have been necessary factors. The prevalence of HSV-2 indicates that the majority of the NIDUs were at a substantially increased susceptibility to HIV infection. A more public health-oriented policy response would almost certainly have led to lesser HIV transmission among NIDUs, but it is not possible to estimate this reduction.

Although it is premature to make predictions about the future course of HIV transmission among NIDUs in the city, it appears that the decline in the crack epidemic and the implementation of multiple evidence-based interventions has at least stabilized HIV prevalence among NIDUs.

In retrospect, there is nothing mysterious about the emergence of high HIV seroprevalence among NIDUs in New York City. Given the multiple contributing factors, substantial transmission of HIV among NIDUs would seem to have been inevitable. There are currently many areas in the world with high prevalence of HIV epidemics among persons who inject drugs (Mathers et al., 2008) and increasing use of non-injected drugs such as smoked cocaine and amphetamine-type stimulants (UNODC, 2012). Close monitoring of these situations is needed, including assessing the extent to which the non-injecting drug use is associated with high rates of unsafe sexual behavior and the prevalence of sexually transmitted diseases that would facilitate HIV transmission. If there is a potential for large-scale transmission of HIV among NIDUs then large-scale condom-distribution programs and treatment-as-prevention for HIV-infected NIDUs should be implemented as rapidly as possible.

Acknowledgments

This study was financially supported by the National Institutes of Health (NIH) through the NIH Grant no. 5 R01 DA 03574.

GLOSSARY

Perfect Storm	an event where a rare combination of circumstances drastically aggravates a bad situation. In this case, a combination of epidemics with HIV, crack cocaine, use of crack cocaine by HIV-positive persons, and HSV-2 as a facilitator of HIV transmission among non-injecting drug users
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FIGURE 1.
Historical reconstruction of HIV prevalence among persons who inject drugs in New York City, 1976–2012.

TABLE 1

Crack cocaine use among persons who inject drugs, New York City, 1990–2011

	Crack cocaine use	
	No <i>n</i> (%)	Yes <i>n</i> (%)
Time-period*		
1990–1994	624 (51)	599 (49)
1995–1999	1201 (64)	688 (36)
2000–2004	1814 (71)	734 (29)
2005–2011	918 (60)	611 (40)
Gender*		
Male	3848 (67)	1928 (33)
Female	707 (50)	699 (50)
Race/ethnicity*		
White	1216 (63)	708 (37)
African American	763 (48)	828 (52)
Hispanic	2475 (70)	1044 (30)
HIV serostatus*		
HIV–	724 (61)	464 (39)
HIV+	93 (50)	93 (50)

* Significant difference by Chi-square test ($P < 0.05$).

TABLE 2

HIV seroprevalence among NIDUs, New York City, 1995–1999 and 2005–2011

	1995–1999		2005–2011	
	<i>n</i>	HIV+ <i>n</i> (%)	<i>n</i>	HIV+ <i>n</i> (%)
Total	792 (100)	64 (8)	1870 (100)	300 (16) [#]
Sex				
Male	580 (73)	41 (7)	1447 (77)	209 (14) [#]
Female	212 (27)	23 (11)	423 (23) [#]	91 (22) ^{*#}
Race/ethnicity				
White	65 (8)	1 (2)	103 (6)	6 (6)
African American	312 (39)	32 (10)	1290 (69)	226 (18) ^{*#}
Hispanic	415 (52)	31 (7)	477 (26)	68 (14) [#]
Age				
<35	375 (47)	23 (6)	235 (13)	33 (14) [#]
35	417 (53)	41 (10)	1600 (87)	259 (16) [#]
Drug use past 6 months				
Crack cocaine	367 (46)	42 (11)	1376 (74)	261 (19) [#]
Cocaine	368 (47)	30 (8)	760 (41)	91 (12)
Heroin	681 (86)	47 (7)	702 (38)	71 (10) [#]

[#] Significant difference by Chi-square test (comparing same row across time periods).^{*} Significant difference by Chi-square test (largest subgroup compared with all others within time period).

TABLE 3

HSV-2 seroprevalence by HIV seroprevalence, sex, and race/ethnicity among NIDUs, New York City, 1995–1999 and 2005–2011

	Total Sample** <i>n</i> +/ <i>Total N</i> (%)	White <i>n</i> +/ <i>N</i> (%)	African American <i>n</i> +/ <i>N</i> (%)	Hispanic <i>n</i> +/ <i>N</i> (%)
1995–1999				
HIV-negative males*	30/79 (39)	0/1 (0)	21/33 (64)	9/45 (20)
HIV-negative females*	58/77 (75)	2/8 (25)	27/34 (79)	29/35 (83)
HIV-positive males	14/20 (70)	0	9/10 (90)	5/10 (50)
HIV-positive females	19/20 (95)	1/1 (100)	10/11 (90)	8/8 (100)
2005–2011				
HIV-negative males*	608/1238 (49)	21/72 (29)	476/845 (56)	111/321 (35)
HIV-negative females*	276/332 (83)	13/25 (52)	189/219 (86)	74/88 (84)
HIV-positive males	156/209 (75)	4/5 (80)	119/154 (77)	33/50 (66)
HIV-positive females	89/91 (98)	1/1 (100)	71/72 (99)	17/18 (94)

* Significant difference for race/ethnicity by Chi-square test.

** Females had significantly higher HSV-2 prevalence than males in all HIV serostatus and time period comparisons except among HIV seropositives in 1995–1999 where $P = 0.09$.

TABLE 4

Odds ratios for the associations of HSV-2 with HIV among demographic subgroups of NIDUs, New York City, 1995–1999 and 2005–2011

	1995–1999 OR (95% CI)	2005–2011 OR (95% CI)
Total	3.6 (1.5–8.5)	3.4 (2.5–4.7)
Males	3.8 (1.3–11.0)	3.0 (2.2–4.2)
Females	6.2 (0.8–49.6)	9.0 (2.2–37.8)
Non-Hispanic Whites*		9.3 (1.0–82.5)
African Americans*		3.2 (2.2–4.7)
Hispanics*		3.6 (2.0–6.3)

* Numbers of HIV seropositives in 1995–1999 were too few for meaningful estimation of odds ratios.