

Injection Drug Use and Crack Cocaine Smoking: Independent and Dual Risk Behaviors for HIV Infection

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PURPOSE: Previous studies have examined the practices of injecting drugs or smoking crack cocaine as high-risk, but independent, factors for HIV transmission. To explore the independent and dual risks of injection practices and crack smoking, this study examined HIV seroprevalence rates among distinct drug user groups, based on patterns of daily administration.

METHODS: A sample of 3555 drug users and neighborhood controls in urban Miami, FL and rural Belle Glade and Immokalee, FL were partitioned into four mutually-exclusive groups: 1) injection drug users (IDUs); 2) crack-cocaine smokers; 3) dual users who both smoked crack and injected drugs; and 4) non-drug-user controls.

RESULTS: HIV seroprevalence rates were 45.1% for IDUs, 30.5% for dual users, 20.1% for crack smokers and 7.3% for controls. Multivariate logistic regression analysis found that when compared with controls odds ratios for HIV seropositivity were 9.81 for IDUs, 5.27 for dual users, and 2.24 for crack smokers.

CONCLUSIONS: These findings provide evidence of: 1) behavioral and structural co-factors that influence HIV exposure patterns among drug users; and 2) the substantially higher risk of HIV infection among IDUs compared with other drug users. Intervention strategies must be tailored for the specific drug use subpopulations to optimize efficacy.

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INTRODUCTION

As the HIV/AIDS epidemic enters its third decade in the United States, research has shown that illicit drug users continue to fuel the epidemic due to high risk drug use and sexual practices, accounting for over one quarter of the nation's total AIDS cases (1). In the year 2000, 42,156 new cases of AIDS were reported (1), 28% of which were injection drug user (IDU)-related, due to both high-risk injection and sex practices (2–28). Non-injection drug use (such as crack-cocaine and heroin sniffing) also contributes to the spread of the epidemic through risky sexual behaviors such as trading sex for drugs and/or money or having sex with an HIV-infected drug user (1, 7, 29–37).

Although injection drug use is clearly a high-risk behavior for HIV infection, the epidemiological literature is not

as clear in terms of how or why certain subpopulations within the IDU group such as multi-drug users may contribute to the epidemic. Despite findings reporting that IDUs and crack cocaine smokers share social networks, norms, and risk behaviors (38, 39), few studies have considered the interplay of drug injection and crack smoking for those who engage in both forms of drug use and their subsequent relationship to HIV transmission and seroprevalence (7, 32, 40, 41). In one of the only recent studies that has considered this interaction, a *lower* rate of HIV infection was found in dual users of crack and injection drugs compared with IDUs who did not smoke crack, despite a higher prevalence of self-reported sexual risk behaviors (32). However, this study did not include a non-drug using control group. The authors, as well as others (41), have suggested that crack-smoking injectors may comprise a subgroup with distinctive drug use patterns and unique social network characteristics.

Further investigation is needed to clarify the intersection of drug injection and crack smoking in relation to HIV seropositivity to address the gaps in basic behavioral and social processes that contribute to HIV risk (42). Therefore, the present study compares HIV seroprevalence among four mutually-exclusive drug-user groups: 1) current injectors who did not smoke crack, 2) current crack cocaine smokers who did not inject, 3) dual users who both currently smoked crack and injected drugs, and 4) a baseline comparison group of neighborhood controls who neither smoked crack nor injected drugs.

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METHODS

Data for this analysis were obtained from the University of Miami Community AIDS Research and Evaluation Studies (Miami CARES) conducted between 1988 and 1994 in urban Miami, Florida and two rural communities, Belle Glade and Immokalee, also located in South Florida (43-46). More specifically, Belle Glade is a small, rural, agricultural community located at the southern tip of Lake Okeechobee in Palm Beach County, approximately 50 miles north of Miami. Immokalee is a rural, migrant agricultural community located in Collier County, approximately 150 miles Northwest of Miami. Both Belle Glade and Immokalee have a permanent population of approximately 18,000, and are supplemented by migrant workers who winter in the area, picking vegetables and fruits. Outreach workers recruited participants from street venues, housing projects, public transport, and other public areas not associated with medical care, drug treatment, or the criminal justice system. Eligible participants were at least 18 years of age, had not been in drug treatment for 30 days prior to assessment, and reported current drug use (defined as drug use in the last 30 days). Interviews were conducted by trained interviewers at a free-standing community assessment center in the respective areas. Respondents were encouraged to participate through the use of small monetary incentives and by written assurance of anonymity and confidentiality.

After agreeing to participate and signing a consent statement, study participants were administered a standardized HIV risk assessment instrument and provided with pre-test counseling. Certified phlebotomists collected blood samples for HIV serotesting. HIV seropositivity was defined as a repeatedly reactive ELISA with Protein gel blot confirmation and was performed by local licensed laboratories. Verification of self-reported drug use among both the IDU and non-IDU drug user groups was confirmed by urinalysis with the ONTRAK toxicological screen kits from Roche Diagnostic Laboratories for opiates, cocaine, and marijuana and direct examination for physical track marks. Non-IDUs were also examined for tracks marks to contend with any possible detection bias.

Study participants were members of one of the following mutually-exclusive drug-user groups: 1) current injectors who did not smoke crack, 2) current crack cocaine smokers who did not inject, 3) dual users who both currently smoked crack and injected drugs, and 4) a baseline comparison group of neighborhood controls who neither smoked crack nor injected drugs. Although the baseline comparison group included individuals who neither smoked crack nor injected drugs, in some cases there was alcohol and/or marijuana use reported. The control group was recruited from the same geographic locales, by the identical methods that

were used to recruit their drug user counterparts, and shared similar demographic and social characteristics as a result.

To determine whether drug type was independently related to HIV seropositivity, additional demographic and risk behavior variables traditionally associated with HIV seropositivity (7, 29, 32) were analyzed. Univariate logistic regression analysis was used to evaluate the relationship between each independent variable and HIV seropositivity. Cross-tabulations of risk behaviors by drug use group and stepwise multivariate logistic regression analysis were performed to quantify the association between drug use and HIV seropositivity. Finally, a stepwise comparison of each drug type group vs. the control group was performed to determine what, and how much, risk behaviors were being conducted by each group.

RESULTS

Outreach workers recruited 3555 participants: 2465 from Miami, 254 from Belle Glade, and 836 from Immokalee. Demographic characteristics and respective HIV status are presented in Table 1. Overall, 62.9% of the sample

TABLE 1. Demographic characteristics and HIV seropositivity of study participants (N = 3555)

	N	%	HIV+ (%)
Study site			
Miami	2465	69.4	26.6
Belle Glade	254	7.1	23.6
Immokalee	836	23.5	8.4
Gender			
Male	2235	62.9	19.5
Female	1320	37.1	26.5
Ethnicity*			
African American	2558	72.0	26.5
Hispanic	613	17.3	9.1
Non-Hispanic White	343	9.7	12.5
Age*			
18-24	393	11.1	16.0
25-44	2721	77.0	24.0
45+	422	11.9	16.1
Education*			
< High school	2017	56.8	22.4
> High school	1534	43.2	21.7
Employment*			
Full-time	406	11.4	15.5
Part-time	1102	31.0	18.0
Unemployed	2045	57.6	25.0
Lives alone			
No	2535	71.3	22.2
Yes	1020	28.7	21.8
Children living with you			
No	2980	83.8	21.9
Yes	575	16.2	23.0
Street homeless			
No	3119	87.7	22.1
Yes	436	12.3	21.8

*Does not add up to 3555 due to missing value.

was male, 72% were African American (black), 17.3% Hispanic, and 9.7% white, 77% were between 25 and 44 years of age, 43.2% had a high school education, 57.6% were unemployed, 28.7% lived alone, 16.2% had children that lived with them, and 12.3% were homeless.

In terms of HIV serostatus over one quarter (26.5%) of females were HIV positive, while almost one fifth (19.5%) of the males were HIV positive. Over one quarter of African Americans (26.5%) were HIV positive, while 12.5% of non-Hispanic whites, and 9.1% of Hispanics were HIV positive, respectively. One quarter of those reporting being unemployed were HIV positive, as well as 24% of those between 25 and 44 years of age.

Analysis of HIV risk behaviors (see Table 2) found that overall, 19.7% of the sample had exchanged sex for money, 13.7% had exchanged sex for drugs, 50.8% had more than one sex partner, and 69.8% reported using condoms less than always. Almost one half (48.2%) of the sample reported a history of STDs and 66.1% reported never having been in drug treatment.

In terms of HIV serostatus and specific sexual risks (see Table 2), 33.5% of those who exchanged sex for money, 30% of those who reported exchanging sex for drugs, and 24.9% of those who reported having more than one sex partner were HIV positive. Virtually the same percentage (23.5% and 23.6%, respectively) who reported no IDU sex partners and more than one IDU sex partner were HIV positive. Also, 31.8% of those who said they always used a condom during sex were HIV positive, while 20.9% of those who reported they used a condom less than always were HIV positive. Almost 30% of the sample who had a history of STDs was HIV positive.

Finally, those who reported injecting drug use only had the highest HIV-1 prevalence rate (45.1%), while 30.5% of dual users, and 20.1% of crack smokers were HIV positive. Those who reported neither injecting drugs nor smoking crack had the lowest HIV-1 prevalence rate (7.3%).

Results of both univariate and multivariate logistic regression analyses are presented in Table 3. Univariate analyses indicated that females were 1.49 times more likely (95% CI: 1.27-1.75) to be HIV seropositive compared with their male counterparts. Persons aged 25 to 44 years were 1.64 times more likely (95% CI: 1.25-2.16) to be HIV seropositive than those older than 44 years. Compared with non-Hispanic whites, African Americans were 2.52 times more likely to be seropositive (95% CI: 1.81-3.51) while Hispanics were less likely to be positive [odds ratio (OR) 0.70, 95% CI: 0.46-1.07].

Those who reported alcohol, crack, cocaine, heroin, and speedball use were more likely to be positive compared with their non-using counterparts. Sexual risk factors, including having more than one sex partner, having a history of

TABLE 2. Behavioral risk factors and HIV seropositivity of study participants (N = 3555)

	N	%	HIV+ (%)
Alcohol use in last 30 days			
No	580	16.3	17.9
Yes	2975	83.7	22.9
Marijuana use in the last 30 days			
No	1346	37.9	22.2
Yes	2209	62.1	22.0
Crack use in the last 30 days*			
No	757	21.3	18.6
Yes	2797	78.7	23.0
Cocaine use (injected/non-injected) in the last 30 days*			
No	2016	56.7	19.0
Yes	1538	43.3	26.1
Heroin use (injected/non-injected) in the last 30 days			
No	2880	81.0	18.9
Yes	675	19.0	35.6
Speedball use (injected/non-injected) in the last 30 days			
No	2908	81.8	18.4
Yes	647	18.2	38.5
Frequency of injection drug use in last 30 days			
None	2534	71.3	17.4
1-30 times	480	13.5	26.0
> 30 times	539	15.2	40.6
Exchanged sex for money*			
No	2846	80.3	19.3
Yes	699	19.7	33.5
Exchanged sex for drugs*			
No	3058	86.3	20.8
Yes	487	13.7	30.0
Number of sex partners*			
Did not have sex	565	15.9	18.8
Only one partner	1180	33.3	19.4
> one partner	1802	50.8	24.9
Number of IDU sex partners*			
None	1942	66.5	23.5
One IDU sex partner	520	17.8	20.0
> one IDU sex partner	458	15.7	23.6
Condom use			
Did not have sex	565	15.9	18.8
Always	507	14.3	31.8
Less than always	2483	69.8	20.9
History of STDs			
No	1842	51.8	15.8
Yes	1713	48.2	28.8
Enrolled in drug treatment*			
Never	2333	66.1	18.2
Lifetime	848	24.0	31.4
Recent	350	9.9	26.3
Drug type			
Neither	531	14.9	7.3
Crack smoker (only)	2002	56.3	20.1
Crack/injector	794	22.3	30.5
Injector only	226	6.4	45.1

*Does not add up to 3555 due to missing value.

STDs, and exchanging sex for drugs or money, were all positively associated with HIV seropositivity.

Seropositivity varied by drug use category. Compared with those who reported neither crack smoking nor injection

TABLE 3. Association between drug use and seropositivity

	Univariate		Multivariate final model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Study site				
Miami	1.00		1.00	
Belle Glade	0.86 (0.63, 1.16)	0.31	0.91 (0.65, 1.29)	0.61
Immokalee	0.25 (0.20, 0.33)	0.0001	0.62 (0.46, 0.84)	0.002
Gender				
Male	1.00		1.00	
Female	1.49 (1.27, 1.75)	0.0001	1.43 (1.16, 1.75)	0.001
Ethnicity				
Non-Hispanic				
White	1.00		1.00	
African American	2.52 (1.81, 3.51)	0.0001	2.91 (2.03, 4.15)	0.0001
Hispanic	0.70 (0.46, 1.07)	0.099	1.55 (0.98, 2.45)	0.06
Age				
45+	1.00		1.00	
18-24	0.99 (0.68, 1.45)	0.97	1.47 (0.97, 2.22)	0.066
25-44	1.64 (1.25, 2.16)	0.0001	1.43 (1.01, 1.92)	0.018
Education				
< High School	1.00			
> High School	0.96 (0.82, 1.13)	0.62		
Employment				
Unemployed	1.00		1.00	
Part-time	0.64 (0.53, 0.77)	0.0001	0.70 (0.57, 0.86)	0.001
Full-time	0.54 (0.40, 0.71)	0.0001	0.68 (0.50, 0.94)	0.02
Lives alone				
No	1.00			
Yes	0.97 (0.82, 1.16)	0.77		
Children living with you				
No	1.00			
Yes	1.06 (0.86, 1.31)	0.58		
Street homeless				
No	1.00			
Yes	0.98 (0.77, 1.25)	0.86		
Alcohol use in last 30 days				
No	1.00			
Yes	1.36 (1.08, 1.71)	0.009		
Marijuana use in last 30 days				
No	1.00			
Yes	0.99 (0.84, 1.16)	0.88		
Cocaine use (injected/non-injected) in last 30 days				
No	1.00		1.00	
Yes	1.51 (1.29, 1.77)	0.0001	0.73 (0.58, 0.91)	0.006
Crack use in last 30 days				
No	1.00			
Yes	1.31 (1.07, 1.60)	0.01		
Speedball use (injected/non-injected) in the last 30 days				
No	1.00			
Yes	2.77 (2.30, 3.33)	0.0001		
Frequency of injection drug use in the last 30 days				
None	1.00			
1-30 times	1.67 (1.33, 2.10)	0.0001		
> 30 times	3.25 (2.66, 3.97)	0.0001		
Exchanged sex for money				
No	1.00		1.00	
Yes	2.11 (1.75, 2.53)	0.0001	1.36 (1.09, 1.69)	0.006
Exchanged sex for drugs				
No	1.00			
Yes	1.63 (1.32, 2.01)	0.0001		

(continued)

TABLE 3. Continued

	Univariate		Multivariate final model	
	OR (95% CI)	p-value	OR (95% CI)	p-value
Number of sex partners				
Did not have sex	1.00			
One partner	1.04 (0.81, 1.35)	0.75		
> one partner	1.43 (1.13, 1.82)	0.003		
Number of IDU sex partners				
None	1.00			
One IDU partner	0.81 (0.64, 1.03)	0.09		
> one IDU partner	1.00 (0.79, 1.28)	0.98		
Condom use				
Did not have sex	1.00			
Less than always	1.14 (0.91, 1.44)	0.26		
Always	2.02 (1.52, 2.67)	0.0001		
History of STDs				
No	1.00		1.00	
Yes	2.16 (1.84, 2.54)	0.0001	1.69 (1.41, 2.03)	0.0001
Enrolled in treatment				
Never	1.00			
Lifetime	2.06 (1.72, 2.46)	0.0001		
Recent	1.61 (1.24, 2.08)	0.0001		
Drug type				
Neither	1.00		1.00	
Crack only	3.17 (2.25, 4.47)	0.0001	2.24 (1.54, 3.27)	0.0001
Crack/injectors	5.53 (3.86, 7.92)	0.0001	5.27 (3.40, 8.17)	0.0001
Injectors only	10.38 (6.83, 15.77)	0.0001	9.81 (6.07, 15.9)	0.0001

drug use, those who reported crack smoking only were 3.17 times more likely (95% CI: 2.25-4.47) to be HIV seropositive, those who reported both crack use and injection drug use were 5.53 times more likely (95% CI: 3.86-7.92) to be seropositive, and those who reported injection drug use only were 10.38 times more likely (95% CI: 6.83-15.77) to be seropositive.

Multivariate logistic regression (Table 3) reveals that drug use type remained significantly associated with seropositivity after controlling for demographic and risk behavior variables. Compared with those who were neither crack smokers nor injectors of illicit drugs, those who were crack smokers only were 2.24 times more likely (95% CI: 1.54-3.27) to be HIV seropositive, while those who were both crack smokers and injectors were 5.27 times more likely (95% CI: 3.40-8.17) to be seropositive, and those who were injectors only were 9.81 times more likely (95% CI: 6.07-15.9) to be seropositive.

In terms of specific drug use group and sexual HIV risk behaviors, the majority of all three drug using groups as well as controls tend to have unprotected sex (no condom use). However, when compared with controls, all 3 drug user groups demonstrated significantly higher risk behaviors across all drug and sex practice variables (Table 4). Having unprotected sex was reported by 80.9% of the dual user group, 79.8% of the injectors only group, 65.3% of the

crack smoker only group, and 70.4% of the control group, respectively. However, 65.8% of the injectors-only group reported injecting more than 30 times a month (approximately once a day) and 72.6% reported speedball use.

TABLE 4. Sexual and drug use risk behaviors by drug type (N = 3553)

Risk behaviors	Neither %	Crack smokers only %	Injecting crack smokers %	Injectors only %
Drug use				
Alcohol use	57.4	86.3**	94.5**	84.1**
Marijuana use	42.6	60.3**	82.1**	53.5*
Crack use	0.0	100.0**	100.0**	0.0
Heroin use	0.2	1.6*	62.0**	66.4**
Speedball use	0.4	0.8	58.4**	72.6**
Injects > 30 times	0.0	0.0	49.2**	65.8**
Sexual practices				
Unprotected sex	70.4	65.3**	80.9**	79.8*
STDs	22.6	51.4**	57.1**	47.8**
More than 1 sexual partner	26.7	49.2**	71.3**	49.6**
Sex for money	5.7	22.6**	24.1**	11.5*
Sex for drugs	2.8	14.9**	19.8**	7.5*
HIV+	7.3	20.1**	30.5**	45.1**

Stepwise comparison of each drug type group to control group: *p ≤ 0.05, **p < .0001.

DISCUSSION

This study provides estimates of the associations between HIV infection and specific risk factors for infection among three distinct drug user groups and a non-user control group, and demonstrates a clear pattern of risk persisting even after adjusting for demographic and risk behavior variables. These findings elucidate our understanding of the pivotal role of chronic drug use in the HIV epidemic. In this analysis, IDUs accounted for the largest risk for HIV seropositivity, lending support to reported AIDS cases and recent estimates of HIV seroprevalence in the United States which indicate that the HIV epidemic is now driven by infections occurring among IDUs, their sexual partners, and their children (5). Additionally, this analysis provides further evidence of the differential burden of HIV seropositivity among two specific subgroups of IDUs: women and African-Americans.

An explanation of the very high risk for HIV infection among IDUs may relate to the frequency and duration of exposure (i.e., extremely high injection rates). Epidemiological studies have demonstrated that HIV infection and other bloodborne pathogens are transmitted by multiperson use of needles (10-13). The high injection rates reported by our sample, compounded by the likelihood of using infected works confers the increased risk of HIV infection in this population.

Our findings relevant to crack-cocaine smokers' HIV risks are almost identical to those reported in an earlier multi-site study (29) which found that HIV infection was 2.3 times more likely among crack smokers than among non-smokers. Although we participated in that study, this study is based on a different population but nevertheless found very similar results. Our findings support the literature that reports that the use of crack is associated with a range of behaviors that puts users at risk for HIV transmission, particularly high risk sexual practices such as exchanging sex for money or drugs, and a history of sexually transmitted diseases (29, 30). These findings were even more striking among women: 48.3% of those who reported crack use only and 53.8% of those who were dual users reported exchanging sex for money and/or drugs compared with 29.4% of women who were IDUs and 2% of women who were in the control group ($p < 0.0001$) (data not shown).

Dual users have tended to be less studied than other drug using groups, yet in the present study almost one third (30.5%) were HIV positive. Dual users were more likely to be HIV positive than their crack-smoking only counterparts, but were also less likely to be HIV positive than injectors only (30.5% vs. 45.1%, respectively). This finding is consistent with those from Iguchi and Bux (32) who also reported that a dual user group was less likely to be HIV positive than IDUs only, and with Deren and colleagues (39) who found

HIV rates to be higher among dual users than those who only smoked crack. Although we did not assess drug paraphernalia risks in this study, previous studies have found that dual users were more likely than IDUs only to use unsafe needles and to share injecting paraphernalia including cookers, cottons, and rinse waters, offering a possible explanation as to why their HIV rates are higher than the crack smokers only group, but less than the IDU only group (47-49). Our data support this thesis because the frequency of injections is significantly higher among IDUs compared with the dual users (see Table 3).

However, dual users were more likely than the other drug user groups and the control group to engage in high risk sexual practices including unprotected sex, have more than one sex partner, exchange sex for money and/or drugs, and have a history of STDs (Table 4). These behaviors might not only be the result of neuropsychological processes, but might also be influenced by specific subcultures and structural factors in the drug users' environment. Ethnographic research has demonstrated that drug users participate in subcultures that have well-defined networks, roles, and values (48). For example, many crack smokers, particularly women, engage in "survival sex" that includes unprotected sex with multiple partners for purely economic reasons. The survival sex is associated with more unprotected sex (women are paid more for this), which in turn is associated with an increased risk for STDs (49-52). Additionally, although dual users may inject drugs less frequently, they are more likely than users of other injection drugs to use shooting galleries when they do inject (53). A shooting gallery functions as a structural facilitator for the transmission of HIV: there is the dual risk of increased probability of encountering infected paraphernalia, and increased risk of encountering persons already infected with HIV with whom the drug user shares paraphernalia (42).

Although our findings indicate that IDUs have the highest risk for HIV infection, the proportion of drug users who report injection drug use only is small (6.5% of total sample) compared with approximately 60% who reported crack smoking only. Therefore, in addition to showing the strong risk for HIV infection among IDUs compared with those who smoke crack, it is useful to document the burden of risk to the community among these drug groups.

Although the risk for HIV infection among IDUs is much higher, the community must still look at the burden of risk associated with crack (attributable to the higher prevalence of crack in this population). Nationally, IDUs are estimated to number more than one million, while cocaine users are estimated to number more than 12 million, with the majority being crack smokers (5, 46). Therefore, due to its much higher prevalence, crack smoking presents a greater population risk for HIV transmission than does injection drug use. This highlights the important public health issues of both

multiple risk groups and behaviors, which must be considered in policy decisions and planning of HIV interventions targeting specific high-risk sub-populations.

In interpreting these data, it is important to recognize potential study limitations. First, our sample was not randomly selected, a limitation of most studies of drug users recruited from the community. Second, our data on drug use and sexual behavior are based on the participants' self-reports, although objective validation procedures were used to confirm self-reports of drug use. Interestingly, 70% of the control group reported having unprotected sex, which may lend support to accurate information and absence of social desirability issues. Control subjects were not asked, however, if they were having unprotected sex because they were in a monogamous relationship or to become pregnant, another study limitation. Nevertheless, this is an important issue, due to the close proximity these individuals have to the three drug using groups, both geographically and socially, they are most likely at an increased risk of having unprotected sex with a drug user. And finally, since the data for this analysis were from a cross-sectional study, caution should be taken regarding issues of temporality. One specific temporality issue warranting further investigation is how some individuals may move from one category of drug use to another over time. For example, some individuals who are HIV positive and who identified as crack smokers in the past 30 days, may have in fact previously been an IDU-only, and they were infected through unsafe injection practices unrelated to their current risk behaviors in context to crack smoking. Certainly this area in general deserves more attention, but was beyond the scope of this article. Finally, because of the effects of addiction and the consequential addictive lifestyle, recent drug use is reflective of past behaviors and practices in the absence of successful drug treatment intervention; less than 10% of our study population had been in drug treatment in the last 2 years, none in the last 30 days before the study interview. Also, the average years of illicit drug use of our study population is more than 10 years. Therefore, recent drug use may be reasonably argued to be predictive of long term drug use and other risk behaviors.

CONCLUSIONS

The HIV epidemic is driven by two of the strongest human behavioral mechanisms, sexual practices and drug use (4, 54). Epidemiological analyses have been instrumental in identifying specific HIV high-risk behaviors in drug user populations to inform intervention development and implementation. The present analysis contributes to the literature by further defining risks for HIV infection within sub-groups of the drug using population. This study highlights the substantial HIV risks associated with three distinct

types of drug use and represents a wide variation in seroprevalence rates across distinct groups. Increased efforts to target sizeable risk groups such as injectors and crack smokers who spread HIV through their risk behaviors should be a top priority of our public health goals to stem these epidemics and also to prioritize scarce resources by targeting risk subpopulations efficiently and effectively.

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