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# Substance Use and High-Risk Sex Among People with HIV: A Comparison Across Exposure Groups

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Substance use is associated with increased risk for HIV transmission by HIV-positive people to uninfected partners through sexual contact. The largest risk groups for infection, men who have sex with men (MSM) and injecting drug users (IDUs), have high rates of substance use, but little is known about their substance use post-HIV diagnosis. We compared the prevalence of substance use between these two groups and a third group, heterosexual men and women, and tested for differential association between substance use and sexual behaviors across exposure groups in a national sample of patients in treatment for HIV. Substance use was most prevalent among MSM. Substance use and current dependence were associated with being sexually active among MSM but not IDUs; marijuana, alcohol, and hard drug use were most strongly associated with being sexually active among MSM. Whereas substance use predicted high-risk sex, there were few differences among exposure groups in these associations.

**KEY WORDS:** HIV-seropositive; exposure group; risk behaviors; condom use; sexual behavior; substance abuse.

A growing body of work focuses on the intersection of substance use and sexual behavior as they affect the risk of HIV infection. Research has shown that alcohol and drug use are strongly related to high-risk sexual behaviors such as inconsistent condom use and having multiple sex partners (Chesney *et al.*, 1998; Leigh and Stall, 1993; Ostrow *et al.*, 1993; Seage *et al.* 1992; Siegel *et al.*, 1989; Stall *et al.*, 1986). This is true among men who have sex with men (MSM) (Chesney *et al.*, 1998; Stall *et al.*, 1986; Woody *et al.*, 1999), arrestees in Los Angeles (Longshore and Anglin 1995; Longshore *et al.*, 1993), African-American women (Wingood and DiClemente, 1998), and high school students (Shrier *et al.*, 1996). This finding has been obtained for a range of measures, including any use, quantity of use, dependence, use at most recent sex, use over a 6-month period, and use during sex. Thus, links between substance use and sexual behaviors are

well established among those at high risk for HIV infection.

The literature has less to say about the association between substance use and unprotected sex among HIV-infected people. Previous research on the relationship between substance use and risky sex behaviors has examined this relationship primarily among people who are HIV-negative or whose serostatus is unknown (Kalichman and Fisher, 1998). Yet, HIV transmission necessarily involves unprotected contact between an HIV-infected person and an uninfected partner. Given the relative sizes of the HIV-positive and HIV-negative populations in the United States, prevention interventions would be most cost-effectively targeted at those already infected with HIV. However, it is unclear whether substance use poses the same problems for persons with HIV as it does for those at risk. Most research on behavioral change among HIV-infected populations shows that a majority of persons reduce risky sexual and injecting drug practices (see Heckman *et al.* [1998] for a summary of this research). Those in treatment for HIV also tend to adopt healthier lifestyles more generally

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(Collins *et al.*, in press). Nonetheless, by definition, those who become infected with HIV remain at risk for infecting uninfected partners through sexual and drug use practices, and diagnosis appears to attenuate, rather than eliminate, the at-risk status (Heckman *et al.*, 1998).

A handful of studies has explored the relationship between substance use and unprotected sex among HIV-infected populations. Of these, about half have found relationships between substance use of one or more types and failure to use condoms (Kalichman *et al.*, 1997; Kline and Van Landingham, 1994; Kwiatkowski and Booth, 1998; Purcell *et al.*, 2001) whereas the other half have failed to do so (Heckman *et al.*, 1998; Ostrow *et al.*, 1999; Stacy *et al.*, 1999; Wulfert *et al.*, 1999). Most of these studies have been general studies of risk in the seropositive population rather than on substance use as a risk factor, have used small convenience samples, or have focused on only one HIV exposure group.

The HIV-infected adult population mainly consists of three distinct exposure groups: Men who have sex with men (MSM), injecting drug users (IDUs), and persons exposed through heterosexual intercourse. There is reason to believe from prior research that not only are these three exposure groups demographically distinct, but they also differ in their sexual behavior and substance use. HIV-positive MSM are more likely to be White than are IDUs and heterosexual exposure groups and they are more educated than the general population (Black *et al.*, 2000). Among those whose HIV status is negative or unknown, MSM may be more likely to be heavy drinkers (Stall and Wiley, 1988) and to use certain substances (e.g., inhalants) specifically for their ability to enhance sexual experiences (Stall and Purcell, 2000). HIV-positive IDUs are generally male (about 70%), African American or Hispanic, and, compared with MSM, have higher rates of unemployment and any previous arrests (Booth *et al.*, 1991, 1998; Ferrando *et al.* 1996; Wiebel *et al.*, 1996). Because of their IDU status, this group may have greater and more enduring problems with drug and alcohol dependence. They may also be less concerned with health status and less likely to comply with health guidelines (Des Jarlais *et al.*, 1985; Marmor *et al.*, 1984), including those regarding safer sex. Persons exposed through heterosexual intercourse are primarily low income, minority women, many of whom have IDU partners or have sex in exchange for money or drugs (Centers For Disease Control and Prevention, 1998; Edlin *et al.*, 1994). Among these women, control over sexual safety may be held

primarily by their partners, rendering these women's own substance use less relevant to the issue of safety (Gomez and Martin, 1996).

The objective of this paper is to analyze and compare the prevalence and strength of association between substance use and sexual risk across exposure groups in a national data set to inform policy and programs. There are a number of reasons we might expect such a relationship between substance use and sexual behaviors to vary across subgroups (George and Stoner, 2000; George *et al.*, 2000; Leigh and Stacy, 1993; Ostrow *et al.*, 1990; Stall *et al.*, 1986), including disinhibiting effects of drugs (and its special case, alcohol myopia), an "aphrodisiac" effect of drugs on sexual behaviors, personality traits such as unconventional drug use and sexual behaviors that jointly determine drug use and sexual behaviors, the social milieu in which drug use and risky sexual encounters occur, and outcome expectancy effect.

As we have noted, the few studies that focus on HIV-positive populations use small convenience samples restricted to a single exposure group. None of the existing studies compares two or more exposure groups within a single sample and with identical measures. In this paper, we examine differences across the three major HIV exposure groups (MSM, IDUs, and persons infected with HIV through heterosexual intercourse) on each of three epidemiological parameters: (1) *prevalence of substance use*, (2) *strength of the association between substance use and sexual activity*, and (3) *the association between substance use and unprotected sex with partners of unknown or negative HIV status (among those who are sexually active)*. In these analyses, we make use of a large nationally representative sample of people undergoing medical treatment for their HIV infection, thereby achieving greater generalizability and more reliable tests for group differences than has been possible in previous studies.

## METHODS

### Study Design

Respondents were participants in the HIV Cost and Services Utilization Study (HCSUS), a national probability sample of 2,864 persons at least 18 years old with known HIV infection who made at least one visit to a nonmilitary, nonprison medical provider other than an emergency department in the contiguous United States during the first 2 months of 1996.

Full details of the HCSUS design are available elsewhere (Frankel *et al.* 1999; Shapiro *et al.* 1999a).

The risk and prevention (R&P) sample used for this paper consisted of 1,421 HCSUS participants. Eligible members for the R&P sample were those HCSUS respondents who were interviewed in English at HCSUS baseline, whose gender was unambiguous based on HCSUS data, and who participated in the second follow-up HCSUS interview, conducted from August 1997 through January 1998 ( $n = 2, 205$ ). We drew 1,794 individuals from this group, sampling randomly after stratifying by primary HCSUS sampling unit, type of health care provider, age, ethnicity, and self-described sexual orientation. Eligible White gay men aged 40 year and older were sampled with probability 1/3, eligible White gay men aged 39 years and younger were sampled with probability 4/9, and all other groups were sampled with a probability 1. Interviews were conducted from September through December 1998. The completion rate was 79%, and the response rate after allowing for known mortality was 84%.

The R&P sample was weighted to represent a population of 197,063 HIV-positive adults receiving medical care in the 48 contiguous states of the United States in 1996 and surviving until 1998. The analytic weights take into account differential selection probabilities, nonresponse, multiplicity, and attrition (Duan *et al.*, 1999). Men who identified as gay, bisexual, or heterosexual and all women were included in the analysis reported in this paper. Men who specified "other" or did not report their sexual orientation were excluded ( $n = 24$ ). Tables show proportions weighted to represent the population as well as unweighted sample sizes.

## Measures

Measures for these analyses come from the HCSUS baseline and second follow-up interviews and from the R&P interview.

### *Exposure Group*

The baseline interview asked about sexual and drug use behaviors before diagnosis. From these, we constructed three exposure groups: IDU, MSM, and heterosexual contact. Since it is rarely possible to know with certainty how a respondent was exposed, a respondent who fit in more than one category

was assigned to the first of these categories as listed here.

### *Demographic and Health Items*

The demographic items were also collected as part of the baseline interview; health was measured at R&P. Respondent *age* was measured continuously in years, by calculating the difference between birth date and the baseline interview date. Respondents classified their race/ethnicity as non-Hispanic White, non-Hispanic African American, Hispanic or Latino, Indian or Alaska Native, Asian or Pacific Islander, or "other." The last three groups were collapsed in analyses because of small sample sizes. Education was measured with four categories: did not complete high school, high school degree, some college, bachelor's degree or higher. Household income (1995) was measured as an ordinal variable in dollars (0–4,999/5,000–9,999/10,000–24,999/25,000 or more). Region of the country refers to location of baseline interview (West/Midwest/South/Northeast). Participants reported their latest CD4 cell counts as part of the R&P interview. Past work supports the validity of self-report methods as a way of collecting CD4 data (Cunningham *et al.*, 1997). A measure assessing mental health and substance abuse treatment was based on R&P questions about visits to a mental health provider on an individual or family basis for emotional or personal problems in the past 6 months and participation during the last 6 months in a 12-step program for substance abuse or sex.

### *Substance Use Items*

Indicators of substance use were derived from items at follow-up 2. Items about quantity and frequency of alcohol consumption in the past 4 weeks were used to classify drinking patterns as no drinking, 1–5 drinks in past month, 6–29 drinks in past month, and 30 or more drinks in past month. Participants were asked which of a list of illicit drugs they had used in the past 12 months including: marijuana, sedatives, amphetamines, analgesics, cocaine, inhalants, LSD or other hallucinogens, and heroin. We constructed two drug use variables: any marijuana use in the year before follow-up 2 and any hard drug use in that same year. Marijuana use is considered apart from hard drug use because marijuana is often used for medicinal purposes, whereas hard drug use is considered recreational.

### *Lifetime Drug Dependence*

This was measured with a slightly modified version of the CIDI screener for drug dependence (Kessler and Mroczek, 1993). During the interview at follow-up 1, participants were asked which of a list of illicit drugs they used in their lifetime. Participants who reported any use were asked two additional questions to detect dependence symptoms: ever needing to use more in order to get the same effect and ever experiencing emotional or psychological problems because of drug use.

### *Sexual Risk Behavior*

The measures of sexual behavior were collected as part of the R&P interview. Portions of the interview in which sexual behavior was measured were self-administered by respondents, using computer-assisted self-interview (CASI) techniques to reduce biases attributable to socially desirable reporting (Turner *et al.*, 1998). For each of up to five of the most recent sex partners in the past 6 months, respondents reported frequency of protected and unprotected anal insertive, anal receptive, and vaginal sex. Capping the experiences at the five most recent sex partners would truncate the experiences of some of the risk groups. However, on average, this does not appear to be an issue in our sample. Overall, the median number of partners in the past 3 months was 1 for all three exposure groups; among the sexually active, the median number of partners was 2 for MSM and 1 each for the IDU and heterosexual exposure groups. Data concerning partners' HIV status were also collected. These were used to derive a measure of high-risk sex, defined as any incident of unprotected anal or vaginal intercourse with a partner of negative or unknown HIV status. A measure of any sexual behavior was also created indicating any oral, anal, or vaginal intercourse in the past 6 months.

Three sets of items in the R&P interview were used to measure substance use in conjunction with sex. Adapted from the National Health and Social Life Survey (NHSLS) Laumann *et al.*, 1992, one asks about alcohol use "before or during" usual sex with each of the most recent partners in the last 6 months (up to five partners) and a second set of items about use of other drugs in this situation. A follow-up set asks those who used illicit substances in this way to indicate all drugs they took with a given partner. These same sets of items were asked separately about each

recent partner's substance use during sex for up to five partners. From these we derived respondent used alcohol with sex, respondent used marijuana with sex, respondent used hard drugs with sex, a partner used alcohol with sex, a partner used marijuana with sex, and a partner used hard drugs with sex.

### **Statistical Analyses**

Analyses used imputation for key demographic variables pulled from the HCSUS baseline to deal with item-level missing data (Kalton, 1983).

Descriptive statistics were calculated to describe the demographics, health, sexual behaviors, and substance use patterns of the three exposure groups. Chi-square analysis was used to assess group differences in the prevalence of substance use. To assess the association between substance use and whether the respondents were sexually active in the past year, we estimated a series of logistic regressions within each exposure group, predicting the likelihood of being sexually active using each substance use predictor variable individually. All coefficients were converted into odds ratios. To assess group differences in the strength of the association between substance use and sexual activity in the past year, we pooled the three exposure groups and reestimated each of the simple logistic regressions, but included an interaction between exposure group and each substance use predictor variable. Finally, we limited the sample to those who were recently sexually active and we tested the association of high-risk sexual activity and substance use using logistic regression models within each exposure group and then pooling the three exposure groups to test for the interaction between exposure group and each predictor variable.

Because gender may confound the analysis of differences among exposure groups (since MSM by definition are male and most people exposed through heterosexual contact are women), we conducted simultaneous analyses of differences in substance use patterns across exposure group and of group differences in the strength of the association between exposure group and substance use by gender separately. The results in general were the same for men, but in some cases differed for women. We note these differences below.

### **RESULTS**

In the total weighted sample of 1,278 respondents with known exposure group status, 44% were

men exposed to HIV through sex with other men, 28% were exposed through injection drug use, and 28% were exposed through heterosexual sex. Three fourths of the total sample were males, about half were White, 35% were Black, and 14% were Hispanic. The level of education was about equally distributed across the four education groups. Consistent with what would be expected from a sample of people undergoing treatment for HIV for at least 2 years, a small percentage (5%) reported latest CD4 counts of >500; nearly one fourth reported a CD4 count <50. One third of the sample received mental health or substance abuse treatment during the 6 months prior to the R&P interview.

The demographic and health characteristics of the three exposure groups are presented in Table I. Gay men tend to be White (68.6%), be more educated, have higher income, and reside in the western U.S. IDUs are generally male, older, and White or Black, have low income, live in the Northeast, and are likely to have received mental health or substance abuse treatment. Heterosexuals are mostly women, younger, Black, have 12 years or less education, low income, live in the southern United States, and are less likely than gay men or IDUs to have experienced CD4 counts below 200/mm<sup>3</sup>. Levels of sexual activity in the last 6 months and, among those sexually active, the prevalence of high-risk sex are roughly equivalent

**Table I.** Demographic, Health, and Sexual Risk Characteristics by HIV Exposure Group (Weighted Percentages)

Characteristic	Gay/bisexual men	Injecting drug users	Heterosexuals
Gender***			
Male	100.0	73.1	35.8
Female	0.0	26.9	64.2
Age*** (years)			
20–34	37.2	20.2	47.5
35–39	25.8	23.0	22.7
40–44	16.8	28.5	15.4
≥ 45	20.2	28.3	14.5
Race/ethnicity***			
White	68.6	42.4	23.0
Black	15.8	38.3	61.0
Hispanic	11.1	16.7	14.5
Other	4.5	2.6	1.5
Education*** (years)			
<12	9.6	35.1	41.9
12	24.6	32.8	30.5
13–15	31.4	23.2	22.7
≥ 16	34.4	9.0	4.9
Annual income*** (#)			
0–5K	11.2	25.8	25.5
5–10K	19.4	34.3	29.9
10–25K	24.8	23.5	30.4
≥ 25K	44.6	16.3	14.3
Region***			
Northeast	11.8	42.6	33.0
Midwest	13.2	4.7	10.1
South	34.7	28.2	49.2
West	40.3	24.5	7.7
Lowest reported CD4*			
>500	4.2	5.1	6.8
200–499	36.0	35.3	44.7
50–199	33.8	37.9	28.8
0–49	26.0	21.7	19.7
Any mental health/drug therapy***	29.0	45.4	27.5
Any sex in past 6 months	71.5	65.4	69.3
If yes, any high-risk sex	2	19.9	23.9
Sample (unweighted n)	562	362	354

\*Chi-square test;  $p \leq .05$ .

\*\*\*Chi-square test;  $p \leq .001$ , for differences across exposure groups.

**Table II.** Weighted Percentage of Persons Using Substances by HIV Exposure Group

Risk factor <sup>a</sup>	Gay/bisexual men	Injecting drug users	Heterosexuals
Alcohol consumption*** (drinks per month)			
0	32.0 <sup>b,c</sup>	56.5	54.1
1–5	25.8 <sup>b</sup>	12.8	19.6
6–29	29.2 <sup>b,c</sup>	20.2	14.5
30+	13.0	10.5	11.8
Marijuana use***	36.7 <sup>c</sup>	30.4 <sup>c</sup>	15.1
Hard drug use***	28.2 <sup>c</sup>	29.2 <sup>c</sup>	10.6
Drug dependence history***			
Never	71.1 <sup>b</sup>	31.2	72.0 <sup>b</sup>
Previous	21.8 <sup>b</sup>	52.0	22.2 <sup>b</sup>
Current	7.1 <sup>b</sup>	16.8 <sup>c</sup>	5.8
Among those who had sex in past 6 months			
R used alcohol with sex**	53.1 <sup>c</sup>	40.2	35.2
R used marijuana with sex***	29.1 <sup>b,c</sup>	19.5 <sup>c</sup>	9.6
R used hard drugs with sex***	22.9 <sup>c</sup>	18.9 <sup>c</sup>	7.3
P used alcohol with sex***	62.3 <sup>c</sup>	51.6	42.0
P used marijuana with sex***	30.3 <sup>c</sup>	19.6	8.9
P used hard drugs with sex***	29.0 <sup>c</sup>	24.1 <sup>c</sup>	5.5
Full sample (unweighted <i>n</i> )	562	362	354
Sample who had sex in past 6 months (unweighted <i>n</i> )	392	227	246

<sup>a</sup>R, Respondent; P, one or more of the respondent's sex partners.

<sup>b</sup>Significantly different from IDUs at  $p \leq .05$ .

<sup>c</sup>Significantly different from heterosexuals at  $p \leq .05$ .

\*\*Chi-square test;  $p \leq .01$ .

\*\*\* Chi-square test;  $p \leq .001$ , for differences across exposure groups.

for the three groups: about two thirds of the sample reported being sexually active, and about one fourth of these persons reported high-risk sex.

Three distinct patterns of substance use in general and in conjunction with sex emerge in Table II. MSM are heavier drinkers than IDUs and heterosexuals. With the exception of heavy daily drinking (30+ drinks in the assessed month), gay men are significantly more likely to consume alcohol than IDUs and persons exposed through heterosexual sex and to have used alcohol with sex than people exposed to HIV through heterosexual sex. IDUs, not surprisingly, reported the highest level of drug dependence history: About half were previously dependent and one sixth are currently dependent. Although they reported higher levels of current drug dependency, overall IDUs closely resemble gay men in the percentage using hard drugs in the past year as well as their use of hard drugs during sex. When we replicate these results for men and women separately, the patterns reported here generally hold.

The heterosexual exposure group is distinct in its low level of drug use, including marijuana use, compared with MSM and IDUs. The rates of the respondents' and their partners' substance use during sex differ across the three exposure groups on every mea-

sure. Most notably, use of hard drugs or marijuana during sex is relatively rare among heterosexuals and their partners.

In the sample as a whole, we found that marijuana use, hard drug use, and moderate alcohol consumption (6–29 drinks per month), as well as previous and current drug dependence, were each positively related to being sexually active in the past 6 months. Table III presents the odds ratios by exposure group, derived from the bivariate logistic regressions predicting sexual activity in the past 6 months from each substance use indicator. Among MSM, moderate alcohol consumption (6–29 drinks per month) more than doubles the odds of sexual activity relative to no drinking in the past month. Likewise, relative to no drug use, marijuana use, hard drug use, and current drug dependence each substantially increases the odds of sexual activity for MSM (by two- to nearly fourfold). Hard drug use significantly increases the odds of sexual activity among heterosexuals. Tests of the interactions between each substance use variable and HIV exposure group confirm that there is a persistently strong association between substance use variables and sexual activity among gay men compared with IDUs. The odds of sexual activity associated with moderate alcohol use and hard drug use are significantly higher

**Table III.** Associations Between Substance Use and Sexual Activity by HIV Exposure Group (Odds Ratios)<sup>a</sup>

Risk factor <sup>a</sup>	Gay/bisexual men	Injecting drug users	Heterosexuals
Alcohol consumption (drinks per month)			
<i>None</i>			
1–5	1.1	0.9	1.2
6–29	2.1 <sup>b,*</sup>	1.0 <sup>c,†</sup>	2.3
30+	1.0	0.8	0.8
Marijuana use	2.0 <sup>b,**</sup>	1.4	1.2
Hard drug use	3.9 <sup>b,***</sup>	1.4 <sup>c,††</sup>	2.4 <sup>b,**</sup>
Drug dependence history			
<i>Never</i>			
Previous	1.3	1.3	1.4
Current	2.6 <sup>b,**</sup>	1.4	3.1
Full sample (unweighted)	562	362	354

<sup>a</sup>Omitted categories in *italics*.

<sup>b</sup>Bivariate two-tailed test OR ≠ 1: \*  $p \leq .05$ ; \*\*  $p \leq .01$ ; \*\*\*  $p \leq .001$ .

<sup>c</sup>Based on two-tailed Z test for interaction term of substance use variable with HIV exposure group variable (gay/bisexual men is omitted category): †  $p \leq .05$ ; ††  $p \leq .01$ .

for MSM compared with IDUs. Only hard drug use is significantly associated with sexual activity among heterosexuals.

When we stratify the analysis summarized in Table III by gender, we find that the results for men are virtually identical to the overall patterns. For women, the patterns of differences between IDUs and heterosexual exposure are generally the same (though less often attain statistical significance) as reported overall with one noteworthy exception. Alcohol use is monotonically related to any sexual activity for both IDUs and heterosexuals (but is statistically significant only for heterosexual women). Among heterosexual women, consumption of 1–5 drinks in the past month increased the odds of sexual activity twofold over those obtained for women who did not drink in the past 6 months and consumption of 30 or more drinks increased these odds nearly threefold.

Finally, we examined the risk of high-risk sex associated with each substance use risk factor among the sexually active. For the R&P sample in the aggregate, hard drug use, drug dependence history, own or partner's alcohol use in conjunction with sex, and own or partner's hard drug use in conjunction with sex are each associated with higher odds of high-risk sex (not shown). Table IV presents the relationship between substance use and high-risk sex for each of the three exposure groups. There are no significant group differences in these associations. Although there are no significant differences across groups in the association between hard drug use and high-risk sex, within group tests indicated that hard drug use increases the odds of high-risk sex among gay men and IDUs, as does using alcohol (MSM) or hard drugs (MSM and

IDUs) or having a partner who used alcohol (MSM and IDUs) or hard drugs in conjunction with sex (for MSM only). Among heterosexuals, using alcohol in conjunction with sex or having a partner use marijuana in conjunction with sex each increases the odds of high-risk sex.

We also describe (but cannot statistically test) exposure group differences in the types of hard drugs that are used when used in conjunction with sex. Because of sample size issues, we report here rates of hard drugs used in at least 10% of the encounters. There were relatively minor differences across the three groups. Cocaine (MSM: 11%; IDUs: 25%; heterosexual: 15%) and poppers (MSM: 21%; IDUs: 11%) were the most commonly reported hard drugs used in conjunction with sex.

## DISCUSSION

In this paper, we use a nationally representative sample of HIV-infected people undergoing treatment to examine differences across the three major HIV exposure groups in the prevalence of substance use, the association between substance use and sexual activity in the past 6 months, and the relationship between substance use, and high-risk sex. Overall, we find substantial rates of substance use, though these levels vary across the three exposure groups. We find distinct patterns of past and current substance use across groups. Gay men are the heaviest drinkers. IDUs are most likely to report current and ever drug dependence. Heterosexuals report the lowest levels of drug use, including substance use in conjunction with sex. Among people who used hard drugs

**Table IV.** Association Between Substance Use and High-Risk Sex Among the Sexually Active by HIV Exposure Group (Odds Ratio)

Risk factor <sup>a</sup>	Gay/bisexual men	Injecting drug users	Heterosexuals
Alcohol consumption (drinks per month)			
<i>None</i>			
1–5	0.7	1.2	0.7
6–29	1.1	1.1	1.6
30+	1.8	1.0	2.0
Marijuana use	1.3	1.7	1.4
Hard drug use	1.9 <sup>b,*</sup>	2.1 <sup>b,*</sup>	0.9
Drug dependence history			
<i>Never</i>			
Previous	1.3	0.4	1.1
Current	0.8	0.6	2.0
R used alcohol with sex	2.0 <sup>b,*</sup>	2.2	2.3 <sup>b,**</sup>
R used marijuana with sex	1.2	3.0	2.4
R used hard drugs with sex	2.6 <sup>b,**</sup>	3.6 <sup>b,**</sup>	2.0
P used alcohol with sex	1.9 <sup>b,**</sup>	3.4 <sup>b,**</sup>	2.0
P used marijuana with sex	1.3	1.9	2.4 <sup>b,*</sup>
P used hard drugs with sex	2.4 <sup>b,**</sup>	1.8	2.6
Sample who had sex in past 6 moths (unweighted <i>n</i> )	392	227	246

<sup>a</sup>Omitted categories in *italics*. R, Respondent; P, one or more of the respondent's sex partners.

<sup>b</sup>Bivariate two-tailed test OR  $\neq$  1: \*  $p \leq .05$ ; \*\*\*  $p \leq .01$ .

<sup>c</sup>Based on two-tailed *Z* test for interaction term of substance use variable with HIV exposure group variable (gay/bisexual men is omitted category):  $p \leq .05$ .

in conjunction with sex, poppers (MSM and IDUs) and cocaine (MSM, IDUs, heterosexuals) were the most often used hard drugs. This information may be useful for targeting prevention efforts within these exposure group communities.

We find that the strength of the association between substance use and sexual activity is strongest among gay men, followed by IDUs. However, the generally higher levels of substance use among gay men and IDUs relative to persons infected through heterosexual intercourse do not translate into higher rates of sexual activity nor, among the sexually active, high-risk sex. Among the sexually active, between 20% and 25% of each of the three groups reports any high-risk sex in the past year.

Our finding that HIV-infected IDUs are no more likely to use substances in general than MSM and are less likely to consume alcohol than MSM is inconsistent with the "societal perception that IDUs by nature and definition are self-destructive and incapable of sustaining long-term behavioral change" (Metsch *et al.*, 1998). These results suggest that IDUs are able to successfully reduce their drug use over time and, in doing so, may be reducing risk of HIV transmission to uninfected sexual partners, consistent with other research based on smaller convenience samples (Metsch *et al.*, 1998; Kwiatkowski and Booth, 1998). We say "may be" because, like other researchers, we are unable to disentangle the causal relationship(s)

between substance use and high-risk sex. It is just as likely that the same factors leading to a reduction in substance use also reduce the odds of high-risk sex, or that curtailing sexual activity reduces peoples' use of substances.

Our results show that the relationship between substance use in conjunction with sex variables and high-risk sex is more consistent than the relationship between more general substance use variables and high-risk sex. This finding may reflect methodological differences in the reference periods. The substance use in conjunction with sex variables use the same reference period and were asked at the same (R&P) wave as the high-risk sex item. The more general substance use items were asked at an earlier (follow-up 2) wave than the high-risk sex measure *and* use a different recall period (past month for alcohol consumption and past year for illicit drug use). We expect a closer relationship between substance use and high-risk sex behaviors that happen in the same period.

The stronger association between substance use in conjunction with sex variables (*vis-à-vis* general substance use variables) and high-risk sex, on the other hand, may reflect a causal association that is consistent with the alcohol myopia hypothesis. This hypothesis is that alcohol interferes with the ability to suppress arousal and makes risk less salient. A recent review (George and Stoner, 2000) summarized a set of experimental and nonexperimental studies

documenting a solid link between alcohol consumption and proxy measures for risky sex. Among the experimental studies, MacDonald and colleagues (MacDonald *et al.*, 2000) found that among intoxicated men (but not sober men), self-reported sexual arousal was associated with sex-related attitudes and intentions. In other experimental work, men who had consumed alcohol were more willing to engage in forcible sex and were more likely to be sexually aroused by rape scenes relative to men who had not consumed alcohol (Barbaree *et al.*, 1983; Norris and Kerr, 1993). The alcohol myopia hypothesis is a promising explanation for why substance use and risky sex may be linked. However, further work is needed to link substance use to actual risky-sex behaviors and to understand how to apply the hypothesis to illicit drugs.

What are the implications of our analysis? The high rates of substance use among HIV-infected gay and bisexual men relative to IDUs and especially persons exposed through heterosexual sex underscore the health risks associated with substance use among MSM and the need for designing effective substance use intervention programs targeting HIV-infected MSM (Shoptaw and Frosch, 2000; Ostrow, 2000; Stall and Purcell, 2000). Moreover, although we do not find that the risk of HIV transmission to uninfected partners within any of the three major exposure groups is more or less associated with substance use (with the exception of the protective effects of previous drug dependence on high-risk sex among IDUs), the considerably higher rates of all types of use and a stronger association between substance use and being sexually active among MSM suggest a stronger need for substance-use-related transmission prevention intervention in this exposure group than in the other two. Together, MSM substance use patterns and their particular association with sex create a higher base rate of sexual activity involving substance use in that group. Whereas only 19% of sexually active MSM have high-risk sex, about the same percentage as others with HIV, the amount of high risk sex that is associated with substance use is much higher in that group. For this reason, we argue that interventions aimed at jointly reducing substance use and high-risk sex behaviors should be targeted particularly toward HIV-positive MSM.

Substance use is a special health problem for HIV-seropositive people. We find that a sizable minority of the exposure groups we examined use substances at a level that could be dangerous to health. Alcohol and certain drugs are counterindicated in combination use with highly active antiretroviral ther-

apy (HAART) medications. Also, overuse of alcohol has been shown in some studies to be associated with nonadherence (Lucas *et al.*, 2001) and may interfere with the provision of necessary social support and home-based care for HIV-seropositive individuals. Health care providers and others who work with the HIV-positive population need to be aware of the high rate of substance use in this population.

Our analysis has several limitations. The sample size was small for certain subgroups, especially when looking at the distribution of risk factors within subgroups. This is seen in our results for persons exposed through heterosexual sex, who are not only a smaller group, but also engage in less drug use, making detection of associations more difficult. Nonetheless, our finding of a difference between this group and MSM is consistent with analyses comparing these groups preinfection (Leigh, 1990). We test the association between substance use and sexual behavior using global and situational measures of association. Global measures, although easy to interpret, do not demonstrate that substance use has a direct effect on risky sex and only assess the general association between substance use and risky sex, not whether risky sex happens in conjunction with substance use (Leigh and Stall, 1994). Situational measures of association address this limitation, but themselves are not without problems. In particular, it is possible that such an association, if present, reflects the fact that certain personality characteristics jointly determine substance use and risky sex behaviors. A limitation of the nationally representative sample we use is that people not in treatment for HIV are excluded. This includes people who are infected but are not aware of their status, who are healthy enough that they do not seek treatment, or who entered treatment after 1996. Finally, we cannot infer causality, that is, we cannot establish that substance use causes high-risk sex. For these reasons, caution is needed in generalizing and applying these findings. Nonetheless, our results have important implications for clinicians and other mental health and health professionals who interact with HIV-infected populations undergoing treatment for their condition, and for those designing prevention interventions for sexual transmission of HIV.

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