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ORIGINAL PAPER

The Contribution of Male and Female Partners' Substance Use to Sexual Risks and STDs Among African American HIV Serodiscordant Couples

The NIMH Multisite HIV/STD Prevention Trial for African American Couples Group

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Abstract Growing evidence suggests that drug and alcohol use are fueling the heterosexual transmission of HIV among African Americans. This study aims to examine the relative contribution of drug and alcohol use of male and female partners to risks of heterosexual transmission of HIV among 535 African American HIV serodiscordant couples ($N = 1{,}070$ participants) who participated in an HIV prevention trial. Associations found between use of drugs and alcohol by one or both partners and sexual risk indicators varied by type of substance and whether male or female partner or both partners reported use. The findings suggest multiple ways in which substance use of male and female partners may be contributing to the heterosexual transmission of HIV and other STDs among African Americans and underscore the need for HIV prevention strategies to address dyadic patterns of substance use that lead to sexual risks.

The NIMH Multisite HIV/STD Prevention Trial for African American Couples Study Group

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Introduction

The epidemic of HIV among African Americans in the United States has continued unabated. African Americans or blacks represented 51% of all HIV/AIDS cases even though they represented less than 13% of the U.S. population in 2006 [1]. Estimated HIV/AIDS diagnosis rates among African American men were 7 times higher than for white men; rates for African American women were 20 times higher than rates than for white women [1]. Two features distinguish the epidemic in black Americans: the high rate of infection in women and the high proportion of HIV cases attributed to heterosexual transmission; both are also characteristic of the epidemic in Africa. From 2001 to 2005, CDC surveillance data indicate that almost one-quarter (24%) of HIV positive African American men were infected by heterosexual contact compared to 6% of white men, while 80% of African American women were infected through heterosexual contact compared to 53% of white women [1]. Growing evidence suggests that drug and alcohol use may be fueling the heterosexual transmission of HIV among African American men and women. To date, however, few studies have examined how the drug and alcohol use patterns of male and female partners contribute to sexual risk behaviors that result in HIV infection among African American heterosexual couples.

Understanding the role of alcohol and various drugs in contributing to male and female partners' individual and shared sexual risk behaviors among African American HIV serodiscordant couples may inform the design of more effective prevention strategies to stem the epidemic among African Americans. Accumulating research over the past two decades has found that drug and alcohol use are associated with having unprotected sex, having concurrent sexual partners, and contracting HIV and other sexually transmitted diseases (STDs) among African American men and women [2–5]. This research, however, suggests that these associations vary substantially by type of substance use. Unclear, however, is the extent to which the use of different drugs and alcohol by the male partner, by the female partner or by both partners may contribute to inconsistent condom use, sex with outside partners and other sexual risks that may increase the likelihood of HIV and STD acquisition.

Substantial evidence indicates alcohol use and binge drinking are consistent predictors of having sex with multiple partners [4, 6, 7], not using condoms [7] and testing positive for HIV or STDs [4] in several populations, including African Americans. Binge drinking was found to be associated with engaging in sex with multiple concurrent partners in a study of 206 African American HIV positive men and women [6]. In a recent study of 672

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heterosexual African American men, binge drinking was associated with having unprotected sex, sex trading and recent HIV/STD diagnosis [4]. While these studies suggest that alcohol use indicators are associated with a range of sexual risk behaviors among both men and women, the effect of different couple drinking patterns (i.e. whether one or both partners use alcohol) on sexual risk behaviors has not yet been adequately researched.

Crack cocaine use has also been identified as importantly contributing to the disproportionately high rates of HIV infection and other STDs among heterosexual African Americans [2, 3, 8]. Substantial evidence indicates that crack cocaine use among African Americans and mixed populations increases the likelihood of a range of sexual risk behaviors, including having unprotected sex [8, 9], having multiple partners [3, 5], and exchanging sex for money or drugs [10, 11]. Crack cocaine use is also associated with a higher incidence of testing positive for HIV among heterosexual African Americans [2, 12, 13].

Research findings on the relationship between use of illicit drugs other than crack cocaine and sexual risks are sparser and have not focused specifically on African Americans. Studies of injecting drug users (IDUs) have found low rates of condom use, high rates of having multiple sexual partners and high rates of STDs [14–16], suggesting that sexual transmission may be accounting for a substantial portion of HIV incidence among IDUs. Some evidence also has linked non-injection opiate use to inconsistent condom use, multiple sexual partners and STDs [14–16]; however, other studies have found no significant associations between non-injection opiate use and condom use or having multiple sexual partners [17]. Although several studies have found that marijuana use increases the likelihood of inconsistent condom use, multiple sexual partners, and STDs among adolescents [18–20], few studies have examined the relationship between marijuana use and sexual HIV risk behaviors and STDs among adults.

This study aims to address some of the gaps in the research. We examined the effect of use of alcohol and drugs on a range of sexual risk behaviors and biological prevalence of STDs in a sample of 535 African American HIV serodiscordant couples ($N = 1070$). By using couple-level data from both male and female partners on patterns of different types of substance use and sexual risk behaviors and biologically confirmed STDs, this study aims to examine the relative contribution of the drug and alcohol use of male and female partners to the risk of HIV/STD transmission in heterosexual African American HIV serodiscordant couples. By differentiating drug use by type and severity of use for both partners and using multiple sexual risk indicators, this study seeks to advance a more nuanced understanding of the relative contribution of both partners' substance use to HIV/STD transmission risks. The specific purpose of this study is twofold: (1) to describe the prevalence of use of different drugs and alcohol, sexual HIV risk behaviors, and biologically confirmed STDs (i.e., Chlamydia, gonorrhea, and trichomoniasis) among African American HIV serodiscordant couples; and (2) to examine the multivariate associations between the use of alcohol and various drugs by male and female partners and three outcomes: frequency of condom use, having sex with outside partners, and biological STD prevalence, adjusting for the sociodemographics of the couples.

Methods

Study Design

This article used baseline data from the Eban study, a two-arm, couples-based randomized controlled intervention trial of HIV serodiscordant African-American couples from four cities in the U.S. (Atlanta, GA, Los Angeles, CA, New York, NY, and Philadelphia, PA). The study tested the efficacy of a couple-focused HIV/STD risk reduction intervention versus an individual-focused health promotion intervention in reducing sexual risk behaviors and STD incidence [21]. The study design and details are described in the NIMH Multisite HIV/STD Prevention Trial [22] in this issue. For more detail on study design, see also Bellamy et al. [23] and NIMH Multisite HIV/STD Prevention Trial for African American Couples Group [21].

The Study Sample and Recruitment of the Couples

The study includes 535 couples (1,070 individuals) enrolled at four different urban study sites in the U.S.—Atlanta, Los Angeles, New York and Philadelphia. Couples at all four sites were recruited from HIV care clinics, HIV testing and counseling sites, primary care clinics, AIDS services organizations, substance abuse treatment programs, churches and HIV/AIDS ministries, HIV/AIDS providers and community-based coalitions and advocacy organizations. Study recruitment procedures and eligibility criteria are described in NIMH Multisite HIV/STD Prevention Trial [22] in this issue.

Data Collection

Participants completed an Audio Computer-Assisted Survey Interview (ACASI), which assessed socio-demographics, relationship characteristics, frequency of use of different

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drugs in the past 90 days, drug dependency, alcohol dependency, and sexual behaviors. Males provided a urine specimen and women provided two self-obtained vaginal swab specimens that were assayed for three STDs (chlamydia, gonorrhea, and trichomonas). The data summarized in this article were obtained exclusively from ACASI and from biologically confirmed STDs.

Assessment of Self-Report Measures

The socio-demographic and sexual behavior measures are described in detail in NIMH Multisite HIV/STD Prevention Trial [22] in this issue. The Cutting down, Annoyance by criticism, Guilty feeling and Eye-openers (CAGE) brief screener was used to assess lifetime alcohol dependence [24] and the Texas Christian Drug Screen II (TCUDS) [25] to identify individuals with a history of heavy drug use and dependence. Alcohol and drug problems were denoted by CAGE scores greater than or equal to 2 and by TCUDS scores greater than or equal to 3, respectively.

Statistical Analysis Methods

Descriptive summaries were calculated for sociodemographic characteristics and sexual behaviors, and appropriate paired two-sample methods were employed to compare male and female participants. Table 1 presents means and standard deviations for continuous measures, with paired t-tests and the resulting *P*-values comparing mean male and female measures. Similarly, categorical measures are summarized by frequencies and percents and corresponding Cochran–Mantel–Hansel (χ^2_{CMH}) chi-squared tests with appropriate degrees of freedom comparing the distribution of those frequencies in men and women. Table 2 summarizes the couple distributions of all substance use variables of interest. Additionally, this table presents the average Cochran-Mantel-Hansel estimated odds ratio (OR), 95% confidence interval (CI) and associated p-value from testing the null hypothesis that if one and only one partner in a couple is alcohol- or drug-dependent, the probability that it is the male equals the probability that it is the female.

Table 3 presents estimated ORs and corresponding 95% CIs resulting from logistic regression modeling of each binary outcome (proportion condom-protected sex, presence of STDs, and concurrent sexual partners) versus couple response (whether both partners reported 'yes' for the outcome, the male only reported 'yes', the female only reported 'yes', or neither partner reported 'yes' [the reference group]) for various substance-use measures. Similarly, ordinary linear regression was used to estimate mean differences and corresponding 95% CIs for the log-frequency of unprotected sexual episodes with study partner in the past 90 days versus the drug and alcohol outcomes of interest. If participants reported no unprotected sexual episodes with their partners in the past 90 days, we imputed 0.01 for those responses so they would be represented in the fitted model. Finally, adjusted models were also fit, modeling each outcome versus each substance abuse measure, adjusting for the following couple-level variables: gender of the HIV positive partner; the couple's age difference, (male partner's age–female partner's age), relationship length, marital status, employment status and whether both partners were African American.

Because unadjusted and adjusted analyses were similar, we only report the adjusted analyses (adjusted for gender of HIV positive partner, couple age difference, relationship length, marital status, employment status, and whether both partners were African American) in the text; however, both unadjusted and adjusted analyses are presented in Table 3.

All analyses were completed using SAS Version 9 (SAS Institute, Cary NC).

Results

Sociodemographics

Table 1 summarizes baseline sociodemographics, relationship characteristics, alcohol and drug dependency characteristics of the sample. Additionally, this table summarizes the sexual risk behaviors (proportion of condom-protected sex, frequency of unprotected sex, prevalence of concurrent sexual partners), and prevalence of STDs. Participants were on average in their low to mid-forties, a little more than a one-quarter were employed (28.4%), 71.0% were earning less than $850 per month, and nearly a third (30.7%) did not have a high school degree. Compared with male partners, females were significantly younger (mean age 41.7 (sd = 7.68) vs. 45.09 (sd = 8.13); paired $t = 9.95$, $P < 0.0001$), less likely to be employed (22.8 vs. 34.1%, $\chi^2_{CMH} = 19.89$, $P < 0.0001$), reported significantly shorter times being in a relationship with their study partners (mean years 6.74 (sd = 6.44) vs. 7.09 (sd = 6.68); paired $t = 3.22$, p = 0.0014), more likely to have health insurance (81.9 vs. 68.9%, $\chi^2_{CMH} = 25.98$, $P < 0.0001$), and less likely to have been incarcerated (48.5 vs. 76.4%, $\chi^2_{CMH} = 90.24$, $P < 0.0001$).

Female participants were significantly less likely to score positive for alcohol dependency (CAGE $\geq$ 2) than were their male partners (13.15 vs. 19.02%, $\chi^2_{CMH} = 7.57$, $P = 0.0059$), however there were no gender of partner differences in drug dependency (TCUDS $\geq$ 3; 15.31% vs. 19.09% for females and males, respectively; $\chi^2_{CMH} = 3.33$, $P = 0.07$). The average proportion of condom-protected sex was 0.44 (sd = 0.43); however, female participants

Table 1 Demographic characteristics of study population

	Males ($n = 535$)	Females ($n = 535$)	Total ($N = 1,070$)	Statistic
Age	45.09 ± 8.13	41.73 ± 7.68	43.41 ± 8.08	9.95****
Education				15.38***
<HS graduate	141 (26.55%)	185 (34.77%)	326 (30.67%)	
HS graduate/GED	249 (46.89%)	188 (35.34%)	437 (41.11%)	
Some college	141 (26.55%)	159 (29.89%)	300 (28.22%)	
Employed	181 (34.09%)	121 (22.83%)	302 (28.4%)	19.89****
Income				3.47
<$400/month	158 (29.81%)	149 (28.11%)	307(28.96%)	
$400–850/month	212 (40.00%)	234 (44.15%)	446 (42.08%)	
$851–1,650/month	103 (19.43%)	102 (19.25%)	205 (19.34%)	
$1,651+/month	57 (10.75%)	45 (8.49%)	102 (9.63%)	
Insured	365 (68.87%)	435 (81.92%)	800 (75.40%)	25.98****
Years lived in U.S.	44.25 ± 9.73	40.31 ± 10.01	42.29 ± 9.89	8.18****
Living arrangement				0.96
My own/family home/Apt	446 (83.99%)	452 (84.96%)	898 (84.48%)	
Someone else/not family	24 (4.52%)	25 (4.70%)	49 (4.61%)	
Rooming/welfare resident	59 (11.11%)	52 (9.77%)	111 (10.44%)	
Homeless	2 (0.38%)	3 (0.56%)	5 (0.47%)	
Living with study partner	405 (76.42%)	401 (75.52%)	806 (75.97%)	0.71
Time with study partner	7.09 ± 6.68	6.74 ± 6.44	6.91 ± 6.56	3.22**
Married to study partner	175 (32.97%)	170 (32.02%)	345 (32.49%)	0.95
Previously incarcerated	405 (76.42%)	256 (48.48%)	661 (62.45%)	90.24****
Alcohol dependency (CAGE ≥ 2)	101 (19.02%)	70 (13.15%)	171 (16.10%)	7.57**
Drug dependency (TCUDS ≥ 3)	101 (19.09%)	81 (15.31%)	192 (17.20%)	3.33^{+}
Outcomes of interest				
Proportion condom-protected sex	0.46 ± 0.43	0.42 ± 0.43	0.44 ± 0.43	3.14**
Unprotected Sex	14.57 ± 25.25	16.57 ± 35.36	15.57 ± 30.71	-1.26
Any STD	28 (5.27%)	120 (22.51%)	148 (13.91%)	75.60****
Concurrent sexual partner	56 (10.59%)	52 (9.77%)	108 (10.18%)	0.29

Values shown are N (%) or mean ± stddev. P-values for continuous variables were determined by paired t-tests; pvaluesfor categorical variables were determined by CMH tests

$^{+}$ $P < 0.10$; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$; **** $P < 0.0001$

Table 2 Alcohol and drug dependency and use of different substances among both partners, male partner only and female partner only ($N = 535$ couples)

Frequency (%)	Neither	Female only	Male only	Both	OR_{CMH} (95% CI)
Alcohol dependency	379 (71.78%)	48(9.09%)	79(14.96%)	22(4.17%)	1.65(1.15, 2.36)**
Drug dependency	374(71.37%)	50(9.54%)	70(13.36%)	30(5.73%)	1.40(0.97, 2.01)$^{+}$
Substance use in the past 90 days					
Used any substances to get high or relax	240(45.80%)	60(11.45%)	119(22.71%)	105(20.04%)	1.98(1.45, 2.71)****
Smoked marijuana	318(61.15%)	56(10.77%)	92(17.69%)	54(10.38%)	1.64(1.18, 2.29)**
Injected heroin, cocaine or any other drugs	480(92.84%)	11(2.13%)	21(4.06%)	5(0.97%)	1.91(0.92, 3.96)$^{+}$
Used any other illegal drugs	337(65.31%)	50(9.69%)	78(15.12%)	51(9.88%)	1.56(1.09, 2.23)*

Odds ratios for males only versus females only (OR), confidence intervals (CI) and *P*-values are from the Cochran–Mantel–Haenszel (CMH) chi-square test for categorical variables

$^{+}$ $P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$, **** $P < 0.0001$

Table 3 Associations between substance use exposure variables (*rows*) and sexual behavioral and STD outcomes (*columns*)

Sexual behaviors and STD outcomes (*columns*) Substance abuse exposures (*rows*)	Condom-protected sex[a]		(log)Unprotected sex[b]		STD[a]		Concurrent sexual partner[a]	
	Unadjusted	Adjusted[c]	Unadjusted	Adjusted[c]	Unadjusted	Adjusted[c]	Unadjusted	Adjusted[c]
Alcohol dependent								
Female only[d]	1.52(0.83, 2.79)	1.46(0.83, 2.58)	0.24(−0.40, 0.88)	0.19(−0.46, 0.84)	1.20(0.61, 2.34)	1.18(0.59, 2.35)	2.85(1.49, 5.47)	2.53(1.27, 5.06)
Male only[d]	0.67(0.38, 1.16)	0.69(0.38, 1.25)	−0.20(−0.89, 0.50)	−0.15(−0.84, 0.54)	1.09(0.65, 1.84)	1.09(0.63, 1.88)	1.39(0.73, 2.64)	1.57(0.81, 3.05)
Both[d]	1.32(0.49, 3.54)	1.61(0.61, 4.24)	−0.42(−1.71, 0.88)	−0.14(−1.41, 1.13)	1.49(0.60, 3.71)	1.24(0.46, 3.37)	1.14(0.38, 3.44)	1.26(0.39, 4.04)
Drug dependent								
Female only[d]	1.05(0.61, 1.80)	1.46(0.81, 2.63)	0.52(−0.26, 1.29)	0.29(−0.46, 1.03)	2.11(1.13, 3.95)	2.13(1.09, 4.16)	2.23(1.20, 4.14)	1.99(1.00, 3.96)
Male only[d]	0.92(0.47, 1.79)	0.86(0.45, 1.63)	−0.11(−0.84, 0.62)	0.14(−0.64, 0.91)	2.49(1.43, 4.34)	2.57(1.41, 4.69)	1.54(0.85, 2.81)	1.51(0.79, 2.89)
Both[d]	0.71(0.34, 1.50)	0.70(0.30, 1.65)	0.97(0.12, 1.83)	1.27(0.45, 2.09)	0.74(0.29, 1.92)	0.56(0.20, 1.58)	3.40(1.59, 7.26)	3.73(1.63, 8.58)
Used any substance to get high/relax								
Female only[d]	1.18(0.66, 2.10)	1.47(0.78, 2.77)	0.27(−0.38, 0.93)	0.24(−0.39, 0.88)	2.89(1.47, 5.67)	2.86(1.39, 5.87)	2.39(1.17, 4.91)	2.18(1.01, 4.72)
Male only[d]	0.83(0.50, 1.38)	0.78(0.47, 1.27)	0.04(−0.58, 0.66)	0.18(−0.43, 0.79)	1.91(1.13, 3.23)	1.75(1.02, 3.00)	2.05(1.19, 3.53)	1.71(0.96, 3.04)
Both[d]	0.61(0.36, 1.03)	0.69(0.40, 1.20)	0.71(0.13,1.28)	0.87(0.29, 1.46)	2.49(1.51, 4.12)	2.18(1.28, 3.72)	2.09(1.15, 3.82)	1.74(0.93, 3.26)
Smoked marijuana								
Female only[d]	1.11(0.62, 1.99)	1.37(0.72, 2.61)	0.40(−0.26, 1.06)	0.42(−0.25, 1.08)	1.76(0.91, 3.40)	1.63(0.82, 3.26)	2.79(1.48, 5.25)	2.77(1.42, 5.40)
Male only[d]	1.13(0.64, 1.98)	1.07(0.60, 1.89)	0.37(−0.21, 0.96)	0.45(−0.10, 1.00)	1.42(0.80, 2.54)	1.27(0.71, 2.28)	1.30(0.69, 2.44)	1.07(0.55, 2.08)
Both[d]	0.71(0.39, 1.30)	0.76(0.42, 1.40)	1.02(0.32, 1.73)	1.12(0.40, 1.83)	2.99(1.70, 5.25)	2.86(1.61, 5.06)	1.84(0.91, 3.74)	1.89(0.91, 3.92)
Injected heroin, cocaine, other								
Female only[d]	0.56(0.20, 1.58)	0.60(0.20, 1.80)	1.59(0.89, 2.28)	1.54(0.76, 2.32)	0.29(0.04, 2.40)	0.26(0.03, 2.22)	1.02(0.25, 4.18)	0.84(0.18, 3.97)
Male only[d]	0.71(0.26, 1.96)	0.61(0.19, 1.97)	0.69(−0.31, 1.70)	0.97(−0.05, 1.99)	0.70(0.24, 1.99)	0.60(0.20, 1.78)	1.51(0.58, 3.93)	1.34(0.47, 3.88)
Both[d]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Used other illicit drugs								
Female only[d]	1.74(1.00, 3.02)	2.33(1.31, 4.16)	−0.07(−0.81, 0.66)	−0.16(−0.85, 0.53)	1.84(0.94, 3.61)	1.69(0.81, 3.50)	1.83(0.91, 3.67)	1.79(0.85, 3.76)
Male only[d]	0.62(0.38, 1.01)	0.69(0.43, 1.12)	−0.10(−0.82, 0.63)	−0.02(−0.74, 0.70)	2.05(1.16, 3.63)	1.84(1.03, 3.29)	1.85(1.05, 3.25)	1.70(0.92, 3.15)
Both[d]	0.52(0.26, 1.03)	0.64(0.32, 1.30)	0.82(0.11, 1.54)	0.82(0.08, 1.55)	1.33(0.64, 2.75)	1.28(0.62, 2.66)	1.97(1.00, 3.88)	1.81(0.87, 3.77)

($n = 1{,}070$ participants; 535 couples)

[a] Odds ratio (OR) and corresponding 95% CI presented

[b] Mean difference and corresponding 95% CI presented

[c] Adjusted for gender of the HIV positive partner; the couple's age difference, relationship length, marital status, employment status and whether both partners were African American

[d] Partner(s) reporting the given substance use exposure behavior, compared to the reference category, which is defined as neither partner reporting the given substance use exposure behavior

reported significantly lower proportions than their male partners (0.42 (sd = 0.43) vs. 0.46 (sd = 0.43), paired $t = 3.14$; p = 0.0018). The prevalence of STDs was significantly higher in females than in males (22.51 vs. 5.27%, $\chi^2_{CMH} = 75.60$; $P < 0.0001$). There were no gender-of-partner differences in reported frequency of unprotected sex or prevalence of concurrent sexual partners.

Substance Use

Table 2 presents cross classification summaries of each binary substance abuse variable (e.g., drug dependency, alcohol dependency, any drug use in the past 90 days, sniffed or smoked heroin in the past 90 days, smoked marijuana in the past 90 days, injected drugs in the past 90 days, or used any other illicit drug in the past 90 days) with the 4 level variable characterizing the gender of the affected partner (e.g., neither partner affected, female partner only affected, male partner only affected, or both partners affected). Additionally, average OR_{CMH}, 95% CI and corresponding p-values are also presented to address the hypothesis that if one and only one partner in a couple is alcohol- or drug-dependent, the probability that it is the male equals the probability that it is the female. There were no gender-of-partner differences in the prevalence of injection drug use ($OR_{CMH} = 1.91$, 95% CI: 0.92, 3.96) or drug dependency ($OR_{CMH} = 1.40$, 95% CI: 0.97, 2.01). However, male partners were significantly more likely than female partners to be the only one in the couple who was alcohol dependent ($OR_{CMH} = 1.65$, 95% CI: 1.15, 2.36), to have used drugs in the past 90 days to get high or to relax ($OR_{CMH} = 1.98$, 95% CI: 1.45, 2.71), to have sniffed or smoked heroin ($OR_{CMH} = 2.00$, 95% CI: 1.00, 4.00), to have smoked marijuana in the past 90 days ($OR_{CMH} = 1.64$, 95% CI: 1.18, 2.29), or to have used some other illicit drug in the past 90 days ($OR_{CMH} = 1.56$, 95% CI: 1.09, 2.23).

Table 3 summarizes the results from fitted regression models which examine the associations between different substance use variables and four sexual risk outcomes: (1) condom-protected sex, (2) (log) frequency of unprotected sexual episodes with study partner in the past 90 days, (3) presence of an STD, and (4) at least one concurrent sexual partner. The adjusted models include the following covariates: gender of HIV positive partner, couple age difference, relationship length, marital status, employment status, and whether both partners were African American.

Alcohol Dependency and Sexual HIV Risks

There were no observed differences in likelihood of condom-protected sex, frequency of unprotected sex or prevalence of STDs based on which partner(s) if any, in a couple had alcohol dependency. However, couples where the female partner (only) scored positive for alcohol dependency were more likely to report concurrent sexual partners than couples where neither partner scored positive for alcohol dependence (OR = 2.53; 95% CI: 1.27, 5.06).

Drug Dependency and Sexual HIV Risks

Couples where both partners scored positive for drug dependence had approximately 3.56 more unprotected sexual episodes in the past 90 days, compared with couples where neither partner was drug dependent ({log} unprotected sex D = 1.27; 95% CI: 0.45, 2.09). Couples where only the female partner or only the male partner was drug dependent were more likely to test positive for an STD, compared with couples where neither partner was drug dependent (AOR = 2.13; 95% CI: 1.09, 4.16, and AOR = 2.57; 95% CI: 1.41, 4.69, respectively). Couples where only the female partner or where both partners were drug dependent were more likely to report concurrent sexual partners compared with couples where neither partner scored positive for drug dependency (AOR = 1.99; 95% CI: 1.00, 3.96, and OR = 3.73; 95% CI: 1.63, 8.58, respectively).

Use of any Substance to Get High/Relax and Sexual HIV Risks

Couples' reported use of any substance to get high or relax in the past 90 days was associated with increased STD prevalence. Couples where the female partner only, the male partner only, or both partners reported such substance use in the past 90 days were more likely to be STD positive, compared with couples where neither partner reported drug use (AOR = 2.86; 95% CI: 1.39, 5.87, AOR = 1.75; 95% CI: 1.02, 3.00, and AOR = 2.18; 95% CI: 1.28, 3.72, respectively). Couples where only the female partner reported substance use in the past 90 days were more likely to report concurrent sexual partners than couples where neither partner reported substance use in the past 90 days (AOR = 2.18; 95% CI: 1.01, 4.72). Compared with couples where neither partner reported using substances to get high or to relax in the past 90 days, couples where both partners reported substance use had 2.39 more unprotected sexual episodes ({log} unprotected sex D = 0.87; 95% CI: 0.29, 1.46).

Marijuana Use and Sexual HIV Risks

Couples where both partners reported marijuana use in the past 90 days had approximately 3.06 more unprotected sexual episodes than did couples where neither partner reported marijuana use ((log) unprotected sex D = 1.12; 95% CI: 0.40, 1.83). Couples where both partners reported

marijuana use were more likely to test positive for an STD than were couples where neither partner reported marijuana use (AOR = 2.86; 95% CI: 1.61, 5.06), and couples where only female partners reported using marijuana were more likely to have concurrent sexual partners (AOR = 2.77; CI: 1.42, 5.40).

Injection Drug Use and Sexual HIV risks

Because there were so few couples (<1%) where both partners reported injection drug use, this group was excluded from regression analyses. Couples where females were the only partner to report injection drug use had an average of 4.66 more unprotected sexual episodes than couples where neither partner reported use ({log} unprotected sex D = 1.54; 95% CI: 0.76, 2.32).

Use of Other Illicit Drugs and Sexual HIV Risks

Couples where female partners reported using other illicit drugs (not including marijuana or injection drug use) in the past 90 days were more likely to have protected sex (OR = 2.33, 95% CI: 1.31, 4.16); couples where both partners reported using other drugs reported an average of 2.27 more unprotected sexual episodes ((log) unprotected sex D = 0.82; 95% CI: 0.08, 1.55); and couples where only male partners reported other illicit drug use were more likely to test positive for STDs (OR = 1.84, 95% CI: 1.03, 3.29) than couples where neither partner reported other illicit drug use. There were no other observed differences.

Discussion

This study found multiple associations between use of various drugs and alcohol among both partners and a range of sexual HIV risks, including biologically confirmed STDs, among this sample of 535 African American HIV serodiscordant heterosexual couples. These associations varied by type and severity of substance use and type of sexual risk indicator and whether the female partner only, male partner only or both reported substance use. Findings from this study extend previous research on the relative contribution of the female partner's and male partner's use of different drugs and alcohol to increasing the likelihood of sexual risks and STDS among African American HIV serodiscordant couples.

Both the male and female partner's drug dependency increased the likelihood of testing positive for an STD. Drug dependency by the female partner only also increased the likelihood of reporting concurrent sexual partners and reporting a greater number of unprotected sexual episodes. Similarly, self-report of any substance use to get high or relax in the past 90 days by female partner only, male partner only and both partners increased the likelihood of testing positive for an STD. Any substance use by the female partner only was also associated with self-report of having concurrent sexual partners and any substance use by both partners was associated with a greater number of unprotected acts of sexual episodes. Contrary to findings from some previous studies [4, 6, 7], alcohol dependency by one or both partners was not associated with testing positive for STDs or self-reported sexual risk indicators except that female alcohol dependency increased the likelihood of concurrent sexual partners. These findings suggest that substance use in general, and drug dependency in particular, may increase the likelihood of HIV transmission among HIV serodiscordant couples who report substance use as they are more likely to engage in unprotected sex and more likely to test positive for an STD. Testing positive for an STD not only serves as a biological proxy indicator for HIV risk but the presence of an STD may also facilitate the transmission of HIV through open lesions and sores.

Self-reported marijuana use by either or both partners was linked to a range of sexual risk indicators, consistent with previous findings from studies of adolescents [18–20]. Marijuana use by both partners was associated with reporting a higher number of unprotected sexual acts and testing positive for an STD. Marijuana use by female partners increased the likelihood of concurrent sexual partners. While the role of marijuana use in contributing to HIV/STD transmission among adults is not well understood, these results suggest that there are multiple ways in which marijuana use by both partners or by the female partner may increase the likelihood of transmission. The rate of injection drug use was relatively low in this sample and did not increase the likelihood of HIV/STD transmission risks with the exception that injection drug use by the female partner was associated with a greater number of unprotected sexual acts. Use of other illicit drugs by both partners was associated with a higher number of unprotected sex acts and use of other illicit drugs by the male partners increased the likelihood of concurrent sexual partners. The combination of these findings suggests that use of other illicit drugs, like crack cocaine, may also contribute to HIV/STD transmission among this sample of African American HIV serodiscordant couples.

Several limitations of this study should be acknowledged. Because various drugs and alcohol were often used in combination, it was not possible to isolate the specific effects of individual drugs or alcohol on HIV/STD transmission. In addition, there was no separate indicator for crack cocaine use (crack cocaine use was included in "other illicit drug use"), which has been found to be associated with a range of sexual risk behaviors and HIV/

STDs [2, 12, 13]. Second, the study was not able to account for a broader range of psychosocial covariates that may have influenced the relationship between substance use and HIV risk indicators. Third, because this is not a random sample and because there may be selection bias, there are limits to the generalizability of these study findings. Finally, the inability to establish temporal sequencing between substance use and sexual risk indicators in this cross-sectional sample limits our ability to interpret study findings. These limitations should be addressed in future research.

In spite of these limitations, this study represents several methodological improvements over previous studies by: (1) examining a range of self-reported sexual risk indicators and biologically confirmed prevalence of three different common STDs; (2) collecting self-reported data on substance use and HIV risks from both partners and using couple-level risk behavioral indicators and controlling for couple-level socio-demographics; (3) enrolling African American HIV serodiscordant couples from four different urban locations across the U.S.

The study findings have several implications for policy and programs to prevent HIV/STD transmission among African American HIV serodiscordant heterosexual couples. First, the high rates of substance use, particularly among male partners, and their associations with multiple sexual risk indicators underscore the need to conduct routine screening for substance misuse in HIV treatment and care services and to improve service linkages to appropriate substance abuse treatment programs. More than one-quarter (28.6%) of the couples indicated that one or both partners scored positive for drug dependency, and 28.2% scored positive for alcohol dependency. Reversing drug and alcohol dependency in both female and male partners is likely to have numerous health benefits, including lowering the risk for HIV/STD transmission and increasing adherence to HIV medication. Second, the relatively high rate of biologically confirmed STDs found among this sample, which is consistent with STD rates in another recent study of African American drug users [12], also suggests the need to conduct routine screening for STDs among HIV positive men and women receiving HIV treatment and their HIV negative sexual partners. Failure to detect STDs in these HIV serodiscordant couples is likely to increase their risk of HIV transmission, as open lesions and sores from STDs can facilitate the transmission of HIV. Third, there are multiple contexts in which use of various drugs and alcohol and substance misuse may contribute to HIV/STD transmission in HIV serodiscordant couples, including: having sex with multiple concurrent partners, having sex under the influence of drugs with impaired ability and judgment to negotiate safer sex and to use condoms, trading sex for money or drugs to satisfy addiction needs and avoid going through withdrawal for self or partners, and contracting STDs. Finally, the study findings underscore the need for couple-based HIV prevention interventions that address the different drug-related triggers for sexual HIV risk behaviors among African American HIV serodiscordant heterosexual couples. Such couple-based HIV prevention strategies may synergistically address dyadic patterns of drug involvement and substance misuse that lead to inconsistent condom use and having multiple concurrent sexual partners. In sum, these study findings build upon previous research that suggests that drug and alcohol use may be playing a significant role in the spread of HIV and other STDs among African Americans. Effective intervention strategies to reduce drug involvement and substance misuse while addressing co-occurring HIV risks in this population are urgently needed in the public health arena. Such strategies may ultimately help curb the HIV epidemic among African American heterosexual men and women.

References

1. CDC. Racial/Ethnic disparities in diagnoses of HIV/AIDS—33 States, 2001–2005. MMWR. 2007;56(09):189–193.
2. Adimora AA, Schoenbach VJ, Martinson FE, et al. Heterosexually transmitted HIV infection among African Americans in North Carolina. J Acquir Immune Defic Syndr. 2006;41(5):616–23.
3. Bowen A, Williams M, Dearing E, Timpson S, Ross M. Male heterosexual crack smokers with multiple sex partners: between- and within-person predictors of condom use intention. Health Educ Res. 2006;21(4):549–59.
4. Raj A, Reed E, Santana MC, et al. The associations of binge alcohol use with HIV/STI risk and diagnosis among heterosexual African American men. Drug Alcohol Depend. 2009;101(1–2):101–6.
5. Wingood GM, DiClemente RJ. Partner influences and gender-related factors associated with noncondom use among young adult African American women. Am J Community Psychol. 1998;26(1):29–51.
6. Adimora AA, Schoenbach VJ, Martinson FE, Donaldson KH, Stancil TR, Fullilove RE. Concurrent partnerships among rural African Americans with recently reported heterosexually transmitted HIV infection. J Acquir Immune Defic Syndr. 2003;34(4):423–9.
7. Theall KP, Clark RA, Powell A, Smith H, Kissinger P. Alcohol consumption, ART usage and high-risk sex among women infected with HIV. AIDS Behav. 2007;11(2):205–15.
8. Schonnesson LN, Atkinson J, Williams ML, Bowen A, Ross MW, Timpson SC. A cluster analysis of drug use and sexual HIV risks and their correlates in a sample of African-American crack cocaine smokers with HIV infection. Drug Alcohol Depend. 2008;97(1–2):44–53.
9. Edlin BR, Irwin KL, Faruque S, et al. Intersecting epidemics–crack cocaine use and HIV infection among inner-city young adults. Multicenter Crack Cocaine and HIV Infection Study Team. N Engl J Med. 1994;331(21):1422–7.
10. Buchanan D, Tooze JA, Shaw S, Kinzly M, Heimer R, Singer M. Demographic, HIV risk behavior, and health status characteristics

of "crack" cocaine injectors compared to other injection drug users in three New England cities. Drug Alcohol Depend. 2006;81(3):221–9.
11. Logan TK, Cole J, Leukefeld C. Women, sex, and HIV: social and contextual factors, meta-analysis of published interventions, and implications for practice and research. Psychol Bull. 2002;128(6):851–85.
12. Miller M, Liao Y, Gomez AM, Gaydos CA, D'Mellow D. Factors associated with the prevalence and incidence of *Trichomonas vaginalis* infection among African American women in New York city who use drugs. J Infect Dis. 2008;197(4):503–9.
13. Plitt SS, Garfein RS, Gaydos CA, Strathdee SA, Sherman SG, Taha TE. Prevalence and correlates of *Chlamydia trachomatis*, *Neisseria gonorrhoeae*, *Trichomonas vaginalis* infections, and bacterial vaginosis among a cohort of young injection drug users in Baltimore, Maryland. Sex Transm Dis. 2005;32(7):446–53.
14. Burt RD, Thiede H, Barash ET, Sabin K. Recent condom use by arrested injection drug users in King County, Washington, USA. Int J Drug Policy. 2006;17(3):222–9.
15. Flom PL, Friedman SR, Kottiri BJ, et al. Stigmatized drug use, sexual partner concurrency, and other sex risk network and behavior characteristics of 18- to 24-year-old youth in a high-risk neighborhood. Sex Transm Dis. 2001;28(10):598–607.
16. Latka MH, Metsch LR, Mizuno Y, et al. Unprotected sex among HIV-positive injection drug-using women and their serodiscordant male partners: role of personal and partnership influences. J Acquir Immune Defic Syndr. 2006;42(2):222–8.
17. Castilla J, Barrio G, Belza MJ, de la Fuente L. Drug and alcohol consumption and sexual risk behaviour among young adults: results from a national survey. Drug Alcohol Depend. 1999; 56(1):47–53.
18. Bailey SL, Camlin CS, Ennett ST. Substance use and risky sexual behavior among homeless and runaway youth. J Adolesc Health. 1998;23(6):378–88.
19. Boyer CB, Sebro NS, Wibbelsman C, Shafer MA. Acquisition of sexually transmitted infections in adolescents attending an urban, general HMO teen clinic. J Adolesc Health. 2006;39(2):287–90.
20. Liau A, Diclemente RJ, Wingood GM, et al. Associations between biologically confirmed marijuana use and laboratory-confirmed sexually transmitted diseases among African American adolescent females. Sex Transm Dis. 2002;29(7):387–90.
21. NIMH Multisite HIV/STD Prevention Trial for African American Couples Group. Special issue. J Acquir Immune Defic Syndr. 2008;49(Suppl 1):S1–74.
22. NIMH Multisite HIV/STD Prevention Trial for African American Couples Group. Risky sexual behavior and correlates of STD prevalence among African American HIV serodiscordant couples. AIDS Behav.
23. Bellamy SL, NIMH Multisite HIV/STD Prevention Trial for African American Couples Study Group. A dynamic block-randomization algorithm for group-randomized clinical trials when the composition of blocking factors is not known in advance. Contemp Clin Trials. 2005;26(4):469–79. doi:10.1016/j.cct.2005.02.005.
24. Ewing JA. Detecting alcoholism. The CAGE questionnaire. JAMA. 1984;252(14):1905–7.
25. Peters RH, Greenbaum PE, Steinberg ML, et al. Effectiveness of screening instruments in detecting substance use disorders among prisoners. J Subst Abuse Treat. 2000;18(4):349–58.