Relationship Characteristics Differ Based on Use of Substances with Sex among an Urban Internet Sample of HIV-Discordant and HIV-Positive Male Couples

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ABSTRACT *Previous research with men who have sex with men (MSM) has found that substance use with sex is strongly associated with HIV acquisition and poor adherence to HIV treatments. Although some studies have assessed male couples' use of substances with unprotected anal sex, little is known on whether differences in their relationship dynamics are associated with their usage. Current HIV prevention initiatives underscore the importance of studying male couples' relationship dynamics. Using dyadic data from 28 HIV-positive and 58 HIV-discordant male couples, this analysis sought to: (1) describe, by substance type, whether neither, one, or both partners in the couple used a particular substance with sex within their relationship or outside of the relationship, respectively, and (2) assess, by substance type, whether relationship characteristic differences existed between these three groups of couples with respect to substance use with sex within and outside the relationship. Data from 86 dyads came from a cross-sectional, Internet study. Multivariate multinomial regression models were employed to achieve the aims. Except for alcohol, most did not use substances with sex. Within the relationship, those who used with sex varied by substance type; outside the relationship, most couples had only one partner who used with sex regardless of substance type. Several relationship characteristic differences were noted between the groups of couples. Within the relationship, marijuana and erectile dysfunction medication (EDM) use with sex was associated with having less tangible resources; for outside the relationship, these were associated with perceiving to have greater quality of alternatives. In general, amyl nitrates and party drug use with sex were associated with viewing the main partner as being less dependable for trustworthiness. Marijuana and party drug use with sex within the relationship and EDM use with sex outside the relationship were negatively associated with being able to communicate constructively. Mixed results were noted for relationship satisfaction. Additional research is urgently needed for prevention and promotion of healthy relationships for male couples who use substances with sex.*

KEYWORDS *Substance use with sex, Male couples, Concordant HIV-positive relationships, HIV-discordant relationships, Relationship dynamics*

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INTRODUCTION

In the USA, gay, bisexual, and other men who have sex with men (MSM) remain severely affected by HIV/AIDS. In 2010, MSM accounted for 63 % of all new HIV infections in the USA and 78 % of infections among newly infected men.[1] Prior studies with MSM have identified unprotected anal sex (UAS) as the primary risk behavior for HIV acquisition.[2,3] Prior studies with MSM have also found a strong association between substance use and UAS, yet the casual link between these two behaviors regarding HIV acquisition is much less understood and critically important for HIV prevention.[3–15] Two recent and substantive literature reviews describe how assessment of substance use with or without sex among MSM has been inconsistent among prior studies.[16,17] Despite these inconsistencies, several key themes were noted. Vosburgh and colleagues indicated that event-level use of methamphetamine and binge alcohol use provided the strongest causal link for acquisition of HIV among MSM.[16] Along with methamphetamine use with sex, Drumright and colleagues also found evidence for a causal link of MSM's use of volatile nitrates with sex and increased risk for HIV acquisition.[17]

In addition to the association between the use of substances with sex and HIV acquisition among MSM, the use of stimulant-type drugs, such as methamphetamine, cocaine, crack, amphetamine, and ecstasy, also appears to impair their adherence to antiretroviral treatment (ART) for HIV more than the use of other types of drugs.[18,19]

Studies have also documented characteristics of MSM who use illegal (e.g., methamphetamines) and prescription drugs (e.g., erectile dysfunction medications (EDM)) with sex as gay, white, and/or 40 years of age and older.[5,7,20–22] Younger MSM (i.e., 29 and younger) have also been shown to use substances with sex, and differences in substance use with sex may also exist based on the HIV status of MSM.[23–25] Studies have noted that HIV-positive MSM are more likely to use party drugs (e.g., cocaine, ecstasy, ketamine, gammahydroxybutrate (GHB), methamphetamine) and prescription drugs, including EDM and sleep aids, than HIV-negative MSM.[3,20–22] Moreover, MSM who attend bathhouses, party-oriented events (e.g., circuit parties), and gay-destination vacations and use the Internet to find sexual partners often report using substances with sex.[26–31]

Although prior studies have identified a variety of common risk factors of MSM who use substances with sex, few studies have examined substance use with sex among male couples. For instance, one study described partnered MSM as being more likely to report using substances than those without a main partner; substance use was also associated with main partners having had UAS outside of their relationship.[32] Parsons and Stark recently provided evidence that substance use was strongly interdependent between partners within the couple, and that substance use was predictive of partners having had UAS outside of their relationship when controlling for HIV status, race, age, and relationship length.[33] Other pieces of research have noted that MSM who reported being in a monogamous relationship were less likely to have used substances with sex compared to those who were either single or in some type of a nonmonogamous relationship.[32–34] Although these few studies provide some insight about male couples' use of substances (with sex), additional research with male couples is needed because: (1) substance use with sex is fairly common among MSM, (2) substance use and UAS are strongly correlated and may increase the likelihood of HIV acquisition, (3) substance use may impair adherence to ART among those living with HIV, (4) many US male couples practice

UAS within their relationship[35,36], and (5) between one and two thirds of MSM in the USA acquire HIV from their main partners while in a same-sex relationship (e.g., male couples).[37,38]

Given the public health relevance for studying how substance use may affect male couples' health (e.g., HIV prevention and adherence), research is lacking on how dynamics of their relationships may be impacted by their use of substances with sex. To date, the few studies that have been conducted with male couples have primarily focused on UAS with respect to their use of substances. Examining whether concordant HIV-positive and HIV-discordant male couples' relationship dynamics may be impacted by their use of substances with sex has relevance for primary and secondary HIV prevention along with promotion of healthy satisfying relationships. Prior research with male couples has found that relationship commitment, trust, and communication patterns are important to study and include for HIV prevention efforts.[39–41]

To address this knowledge gap, the present study sought to: (1) describe, by type of substance, whether neither, one, or both partners in concordant HIV-positive and HIV-discordant male couples used that particular substance with sex within their relationship or outside of the relationship, respectively; (2) assess, by substance type, whether relationship characteristic differences existed between three groups of couples: those who did not use substances with sex within the relationship to those with one or both partners who did; and (3) assess, by substance type, whether relationship characteristic differences existed between three groups of couples: those who did not use substances with sex outside the relationship to those with one or both partners who did. Dyadic data for this analysis was collected in the USA from a nationwide cross-sectional Internet survey study about male couples' relationships and behaviors. To accomplish these aims, couple-level descriptive and comparative analyses were conducted along with multivariate multinomial regression models to determine whether differences in relationship characteristics existed among the concordant HIV-positive and HIV-discordant male couples with neither, one partner, or both partners who used a particular substance with sex within their relationship and outside the relationship, respectively. Findings from this study provide new insights about concordant HIV-positive and HIV-discordant male couples' use of substances with sex with a calling for additional research to be conducted since few prevention interventions for substance-using male couples currently exist.[42]

METHODS

Protocol

The Medical College of Wisconsin Institutional Review Board approved the study protocol. Recruitment for this study sample was conducted through *Facebook* banner advertising; methods have been previously described [35,36]. In 2011, advertisements targeted partnered men who reported in their Facebook profile being ≥18 years of age, living in the USA, interested in men, and being in a relationship, engaged, or married. Banner advertisements briefly described the purpose of the study and included a picture of a male couple. Of a total of 7994 Facebook users who clicked on an advertisement, 4056 (51 %) answered eligibility questions; 722 (18 %), representing both men of 361 MSM couples, provided consent and completed the study questionnaire. This secondary analysis

includes 28 concordant HIV-positive and 58 HIV-discordant male couples. Men were eligible to participate if they: were ≥18 years of age, lived in the USA, were in a sexual relationship with another male, and had had oral and/or anal sex with this partner within the previous 3 months. A partner referral system was embedded in the one-time Internet survey to enable data collection from both men in the couple. Post hoc analyses of response consistency were used to verify couples' relationships. Every fifth couple that completed the survey was modestly compensated.

Study Sample

The study sample of 86 male couples were primarily identified as gay (99 %), non-Hispanic (81 %), and lived in an urban environment in the USA (92 %). Approximately half of the couples were nonwhite or mixed race (48 %). The highest education obtained varied with 40 % of couples not having a bachelor's degree while 22 % had both men having earned at least a bachelor's degree. The majority of the couples lived together (77 %) and had been in their relationship, on average, for about 5.6 years. Unprotected anal sex was commonly practiced within the couples' relationship. Thirty-five percent of couples had one or both partners who recently had sex outside of their relationship (n=30); of these couples, 53 % had one partner and 27 % had both partners who recently had UAS with a casual MSM partner. Detailed behavioral, relationship, and other characteristics of this sample have been previously reported [35,36,43,44].

Measures

Outcome Variables Two series of outcomes were created for this analysis: (1) substance use with sex, by type of substance, that occurred within the relationship (i.e., with main partner) and (2) substance use with sex, by type of substance, that occurred outside the relationship (i.e., with casual MSM partner). Participants were asked if they had used any substances with sex, by partner type, during the 3 months prior to assessment. Choosing from of the following categories, "Never used this drug," "Less than half of the time," "About half of the time," and "More than half of the time," participants were asked to report which of the nine substances they had used with sex with their main partner: alcohol, cocaine, crystal methamphetamine, ecstasy, GHB, ketamine, marijuana, amyl nitrates (e.g., poppers), and Viagra or similar (EDM). Using this same measurement item, participants who reported having had sex outside of their relationship were also asked to report their use of substances with sex, but with a casual MSM partner during the same time frame.

Regardless of partner and substance type used with sex, most participants chose the response category "Never used this drug" with sex. This yielded small yet varied response sample sizes for each reported type of substance used with sex for both types of partners (main and casual). For purposes of this study, the three remaining response categories, "Less than half of the time," "About half of the time," and "More than half of the time"—which all describe some level of substance use with sex—were recoded to create a dichotomous dummy variable for each type of substance per partner type. These new dichotomous dummy variables permit direct comparison between men who reported using a particular substance with sex (e.g., marijuana) with their main partner to those who reported never using this particular substance with sex with their main partner.

Some couples had one or both partners who reported using a particular substance with sex within their relationship (i.e., with main partner), and for some, outside their relationship with a casual MSM partner. To describe who used what within each male couple, a categorical dummy variable was created with the dyadic data to capture whether neither, one, or both partners had used a particular type of substance with sex within their relationship. This same approach was used to create a categorical outcome variable to indicate whether neither, one, or both partners had used a particular type of substance with sex outside the relationship with a casual MSM partner. Thus, two categorical outcome variables for each type of substance used with sex were constructed for this analysis.

Independent Variables   A variety of measures were used in the online survey to assess male couples' demographic and relationship characteristics, sexual behaviors, and HIV status. Relationship characteristics assessed were relationship and cohabitation length, and validated scales regarding participant's level of trust,[45] relationship commitment,[46] and communication patterns.[47]

The trust scale was used to assess the degree to which gay men had faith in their main partners and viewed their partners as dependable and predictable.[45] The 17-item validated measure consisted of three subscales: the predictability subscale assessed the consistency and stability of a partner's specific behaviors based on past experience (5 items, $\alpha=0.72$), the dependability subscale assessed the dispositional qualities of the partner which warrant confidence in the face of risk and potential hurt (5 items, $\alpha=0.70$), and the faith subscale assessed feelings of confidence in the relationship and the responsiveness and caring expected from the partner in the face of an uncertain future (7 items, $\alpha=0.90$) [50]. The overall measure had a reliability of 0.89. Response options for each item were captured on a 7-point Likert-type scale ranging from –3=strongly disagree to 3=strongly agree.

The investment model was used to examine the processes in which gay men persist within their sexual relationship with their main partner.[46] The 22-item validated scale consisted of four constructs. Commitment level assessed long-term orientation toward the partnership, intention to remain in a relationship, and psychological attachment to a partner ($\alpha=0.84$). Satisfaction level assessed, in a comparative fashion, the negative and positive outcomes of the relationship ($\alpha=0.91$). Quality of alternatives assessed the perception that being single or an attractive alternative partner existed outside of the main relationship and that this alternative would provide superior outcomes when compared to the current relationship ($\alpha=0.80$). Investment size assessed the existence of concrete or tangible resources in the relationship that would be lost or greatly reduced if the relationship ends ($\alpha=0.74$). The combination of satisfaction level, quality of alternatives, and investment size was an index of the level of commitment existing in interpersonal relationships and, in turn, the probability that the relationship will persist. The overall measure had a reliability of 0.89. Response options for each item were captured on a 7-point Likert-type scale ranging from 0=do not agree at all to 6=agree completely.

The communication patterns scale was used to assess how well couples communicate when an issue or problem arises in their relationship.[47] Two subscales from this questionnaire were used in this study: (a) mutual constructive communication consists of the sum of three items that assess mutual discussion of problems, expression of feelings, understanding of views, negotiation of solutions, and resolution of problems ($\alpha=0.83$); (b) mutual avoidance consists of the sum of eight

items that assess mutual avoidance of discussion, mutual withdrawing after discussion, and mutual withholding after discussion (α=0.85). The overall measure had a reliability of 0.86. Response options for each item were captured on a 9-point Likert-type scale ranging from 1=very unlikely to 9=very likely. Details about these items and validated scales have been reported elsewhere [blinded refs].

Data Analysis

The present study uses data from an original study about male couples' behaviors and relationship characteristics that collected dyadic data from 361 MSM couples (*N*=722 MSM). To accomplish the present aims, this secondary analysis includes 86 male couples comprising 58 HIV-discordant dyads and 28 concordant HIV-positive dyads. Dyadic data from the 86 dyads were analyzed using Stata version 12 (StataCorp, College Station, TX); recommendations provided by Kenny, Kashy, and Cook[48] were followed to calculate an estimated power of 0.80. Descriptive statistics included rates and percentages. Between couple-level variables were constructed for each of the relationship characteristics of relationship commitment, trust, and communication patterns. Specifically, the average score of the couple—i.e., between couple-level factor—was calculated by taking the average between both partners' scores for each specific relationship characteristic (e.g., commitment level).

Several multivariate multinomial regression models were then constructed to determine whether differences in the between couple-level relationship characteristics existed among the male couples with neither, one partner, or both partners who used alcohol and drugs with sex within their relationship and outside the relationship, respectively. Due to a limited sample size, one model was constructed for each of the substances used with sex within the relationship with each of the between-level relationship characteristics investigated. This same approach was used to investigate which of the possible between-level relationship characteristics were associated with the substances used with sex outside the relationship. For all models, the referent category was couples with neither partner who used that particular substance (e.g., alcohol) with sex (within their relationship, outside the relationship, respectively). Relationship length was included as a potential confounder for the multivariate multinomial regression models. Stata provides an option to calculate the relative risk ratio (or RRR) from the multinomial log-odds coefficient. The RRR is interpreted as the change in the outcome relative to the referent group (in this case, couples with neither partner who used alcohol and drugs with sex) for each unit change in the predictor variable given all other variables in the model are held constant.[49] The RRR often is interpreted similarly to an odds ratio when conducting multinomial logistic regression analyses. The RRR, 95 % confidence interval, and statistical significance for the factors (p<0.05) are reported from the multivariate multinomial regression models.

RESULTS

Table 1 compares proportions of couples who had neither, one, or both partners who used a substance with sex within their relationship and outside the relationship, respectively. Except for alcohol, most couples did not use drugs with sex within or outside their relationship. Among those who did use substances with sex within the relationship, who used (one or both partners) varied on the type of substance. For those who did use substances with sex outside the relationship, universally for each type of substance, a higher proportion of male couples with only one partner were

TABLE 1 **HIV-positive and discordant gay male couples' use of substances with sex within and outside their relationship, by substance type**

	Neither partner	Only by one partner	By both partners
	% (N)	% (N)	% (N)
Substance use with sex within the relationship (main partner)			
Sample size: 86 dyads			
Alcohol	23.3 (20)	24.4 (21)	52.3 (45)
Marijuana	58.1 (50)	12.8 (11)	29.1 (25)
Amyl nitrates	70.9 (61)	10.5 (9)	18.6 (16)
EDM	65.1 (56)	18.6 (16)	16.3 (14)
Party drugs[a]	75.6 (65)	18.6 (16)	5.8 (5)
Substance use with sex outside the relationship (outside partner(s))[b]			
Sample size: 30 dyads			
Alcohol	40.0 (12)	43.3 (13)	16.7 (5)
Marijuana	66.7 (20)	26.7 (8)	6.7 (2)
Amyl nitrates	63.3 (19)	26.7 (8)	10.0 (3)
EDM	53.3 (16)	36.7 (11)	10.0 (3)
Party drugs[a]	90.0 (27)	6.7 (2)	3.3 (1)

[a]Represents ecstasy, ketamine, GHB, cocaine, and crystal methamphetamine

[b]Only includes couples with one or both partners who self-reported having had sex with a casual MSM partner outside of the relationship

using compared to those with both partners who used that particular substance with sex.

Table 2 presents results from the multivariate multinomial regression models for comparing relationship characteristic differences between the three groups of male couples for each type of substance used with sex within their relationship. No significant relationship characteristic differences were detected between the three groups of male couples for use of alcohol with sex within the relationship.

Substance Use With Sex Within the Relationship: Neither Partner vs. One or Both Partners

Marijuana, Amyl Nitrates, and EDM   Compared to couples who did not use marijuana with sex within their relationship, those with one and both partners who used marijuana with sex were less likely to have greater access to tangible resources (i.e., investment size) (RRR=0.30 [0.11, 0.81], $p<0.05$; RRR=0.35 [0.13, 0.90], $p<0.05$). Couples with one partner who used marijuana with sex were also less likely to report being able to communicate constructively when a problem arises (RRR=0.63 [0.40, 0.98], $p<0.05$). In addition, couples with one partner who used amyl nitrates with sex within the relationship were less likely to believe their partner was dependable for trustworthiness (RRR=0.22 [0.05, 0.96], $p<0.05$). Further, couples with one partner who used EDM with sex within the relationship were less likely to have greater access to tangible resources (i.e., investment size) (RRR=0.23 [0.07, 0.79], $p<0.05$) yet more likely to report higher levels of relationship satisfaction (RRR=3.25 [1.22, 8.66], $p<0.05$).

Table 3 provides results from the multivariate multinomial regression models for comparing relationship characteristic differences between the three groups of male

TABLE 2 Comparing relationship characteristic differences in HIV-positive and discordant gay male couples who did not use substances with sex within the relationship to those with one or both partners who did

Sample size: dyads	Marijuana		Amyl nitrates	EDM	Party drugs[a]
	By one partner (N=11)	By both partners (N=25)	By one partner (N=9)	By one partner (N=16)	By both partners (N=5)
Between couple-level characteristic	RRR (95 % CI)	RRR (95 % CI)	RRR (95 % CI)	RRR (95 % CI)	RRR (95 % CI)
Investment model					
Relationship satisfaction				3.25 (1.22–8.66)*	
Investment size	0.30 (0.11–0.81)*	0.35 (0.13–0.90)*		0.23 (0.07–0.79)*	
Trust scale					
Dependability			0.22 (0.05–0.96)*		0.01 (0.00–0.42)*
Communication patterns scale					
Mutual constructive		0.63 (0.40–0.98)*			0.48 (0.23–0.99)*

Findings in this table were produced from couple-level multinomial logistic regression analyses which controlled for relationship length

EDM erectile dysfunction medications

*p<0.05

[a]Represents ecstasy, ketamine, GHB, cocaine, and methamphetamine

TABLE 3 Comparing relationship characteristic differences in HIV-positive and discordant gay male couples who did not use substances with sex outside the relationship to those with one or both partners who did

Between couple-level characteristic	Marijuana	EDM		Party drugs[a]	
Sample size: dyads	By one partner (N=8) RRR (95 % CI)	By one partner (N=11) RRR (95 % CI)	By both partners (N=3) RRR (95 % CI)	By one partner (N=2) RRR (95 % CI)	By both partners (N=1) RRR (95 % CI)
Investment model					
Relationship satisfaction					0.22 (0.05–0.92)*
Quality of alternatives	2.56 (1.00–6.54)*	3.09 (1.08–8.82)*			
Trust scale					
Dependability		3.34 (1.13–9.90)*		0.03 (0.01–0.11)**	
Communication patterns scale					
Mutual constructive			0.51 (0.26–1.01)*		

Findings in this table were produced from couple-level multinomial logistic regression analyses which controlled for relationship length and only included couples who had one or both partners that had sex outside the relationship

EDM erectile dysfunction medications

*p<0.05; **p<0.01

[a]Represents ecstasy, ketamine, GHB, cocaine, and methamphetamine

couples for each type of substance used with sex outside the relationship. Among the three groups of male couples, no significant differences in relationship characteristics were detected for alcohol and amyl nitrate use with sex outside the relationship.

Substance Use With Sex Outside the Relationship: Neither Partner vs. One or Both Partners

Marijuana, EDM, and Party Drugs Compared to couples who did not use marijuana with sex outside the relationship, those with one partner who did use were more likely to perceive they had greater quality of alternatives to their current relationship (e.g., being single or with someone else) (RRR=2.56 [1.00, 6.54], $p<0.05$). Moreover, compared to couples who did not use EDM with sex outside the relationship, couples with one partner who used were more likely to perceive they had greater quality of alternatives to their current relationship (e.g., being single or with someone else) (RRR=3.09 [1.08, 8.82], $p<0.05$) and/or view their partner as dependable for trustworthiness (RRR=3.34 [1.13, 9.90], $p<0.05$). Couples with both partners who used EDM with sex outside the relationship were less likely to report being able to communicate constructively when a problem arises in their relationship (RRR=0.51 [0.26, 1.01], $p<0.05$). Additionally, couples with one partner who used party drugs with sex outside the relationship were less likely to believe their partner was dependable for trustworthiness (RRR=0.03 [0.01, 0.11], $p<0.01$) than those who did not use party drugs with sex outside their relationship. Couples with both partners who used party drugs with sex outside the relationship were less likely to report greater levels of relationship satisfaction (RRR=0.22 [0.05, 0.92], $p<0.05$).

DISCUSSION

The present secondary analysis uses dyadic data collected from a national convenience sample of concordant HIV-positive and HIV-discordant male couples to assess relationship characteristic differences based on who in the couple used substances with sex within and outside the relationship, respectively: neither partner, only one partner, and both partners. With the exception of alcohol, the majority did not use substances with sex within or outside of their relationships. Further, whether one or both partners used substances with sex within the relationship appeared to vary by substance type. This variation may highlight individual differences and preferences for using substances with sex, such that each partner of the couple may have similar and/or different preferences for which substance(s) they use with sex within their relationship. Among those who did use substances with sex outside the relationship, a larger proportion of couples were those who had only one partner using substances with sex; this was true for all substance types assessed. This finding may speak to the type of sexual and romantic relationships that some male couples establish regarding sex and substance use with casual MSM partners. For some, they may permit sex outside the relationship, but only as a couple (i.e., threesome) whereas others may allow sex with outside partners to occur independently (i.e., main partner is not present) with or without the use of substances. Prior research has noted that male couples form a variety of different types of relationships and sexual agreements[35,50]; a sexual agreement is an explicit mutual understanding about which sexual and other behaviors are

allowed to occur within the relationship and, if applicable, outside the relationship. In addition to investigating what motivates male couples to use substances with sex, further research is warranted to determine whether male couples discuss and permit the use of substances with sex within and/or outside of their relationship and the motivating factors that influence these decisions.

Several key differences in relationship characteristics were found among the three groups of concordant HIV-positive and HIV-discordant male couples regarding their use of substances with sex. Compared to male couples who did not use marijuana and/or EDM with sex, those with one or both partners who did use within the relationship reported having less tangible resources (investment size), as well as perceived to have greater quality of alternatives among those who used these substances with sex outside the relationship. Being satisfied in the relationship had mixed results; higher levels were positively associated with EDM use with sex within the relationship while a negative association existed with party drug use with sex outside the relationship.

Investment size in a relationship may come in various forms from tangible goods (e.g., house) to social benefits (e.g., greater access to different social networks). Interpretations of these associations are limited without additional information about the social contexts and environments in which male couples use substances with sex. One possibility may include that the financial costs of some substances are not equivalent across the different substance types. Some drugs may be easier to obtain and afford (e.g., marijuana) than others (e.g., ecstasy). For quality of alternatives, the use of substances with sex is sometimes referred to as "sex drugs"[3] within the gay male community. Sex drugs may affect how partnered men evaluate how satisfied they are with their current relationship with respect to the other options (e.g., being single, dating someone else). Relatedly, there was some support for this notion because couples who used party drugs with sex outside their relationship were less likely to report having higher levels of relationship satisfaction. However, further research is warranted to examine whether male couples' relationship satisfaction and how they evaluate their relationship are affected by the use of substances with sex with casual MSM partners.

Furthermore, trust between main partners of the couple also seems to be impacted by the use of substances with sex—both within and outside the relationship. Specifically, the use of amyl nitrates and party drugs with sex were negatively associated with viewing one's main partner as being dependable for trustworthiness. The use of certain substances with sex may in turn produce unpredictable experiences, which may lessen the extent that partnered men trust their main partners. Communication between partners of the male couple may also be impacted by their use of substances with sex. We found that the use of marijuana and party drugs with sex within the relationship and EDM use with sex outside the relationship were negatively associated with being able to communicate constructively. Further inquiry is needed to examine how substance use with sex affects male couples' establishment and maintenance of trust in their relationship as well as how it impacts their ability to communicate constructively.

To further explore how and to what extent substance use with sex may affect male couples' relationships, future research should incorporate a longitudinal mixed methods study design that includes a theoretical framework that focuses beyond the individual level. The theory of interdependence (TI) may provide a

useful theoretical framework to better understand how substance use may change the relationship dynamics of male couples' relationships. The TI suggests that behaviors among couples are interdependent because each member has a certain amount of control and influence on the outcome in the behavioral interaction that they have together.[51] This outcome depends on each member's option, value, and assessment of the particular behavior and whether that behavior (e.g., substance use with sex) is important to their relationship. By using the TI, researchers could use the actor-partner interdependence model (APIM) to measure how partners interact and influence their outcomes and behaviors within the context of a relationship.[48] Prior research has used TI as a theoretical framework to specifically understand health behavior change within couples. Lewis et al. used interdependence and communal coping approaches to understand how health behavior change occurs among couples, including health-enhancing and health-compromising behaviors related to HIV among gay male couples.[52,53] Research that applies the TI with the APIM to assess dynamics of substance use with and without sex within male couples' relationships is warranted and timely to help advance HIV and substance abuse prevention efforts as well as the promotion of healthy satisfying relationships.

The limitations of this study are important to acknowledge. The use of a cross-sectional study design with dyadic data from a convenience online sample precludes us from making casual inferences and generalizing our findings to all male couples living in the USA, as well as those who do and do not use the Internet and/or Facebook. Although we did not collect identifying information, participation, social desirability, and recall biases may have influenced the men to inaccurately report information about them, including their use of substances with sex. We also did not assess couples' motivations for using substances and whether both partners within the couple are aware of each other's use of substances with sex within and/or outside of their relationship. In addition, participants may have completed the survey with their main partners, despite our request for them to complete it independently and separately, and therefore potentially causing some bias, which may have resulted in underreporting of substance use with sex. Our survey also did not assess nonmedical use of controlled medications such as prescription anti-anxiety, opioid, stimulant, and sleeping medications or record event-level usage of substances with sex. Future research that examines HIV-positive and HIV-discordant male couples' use of substances with sex should specifically address these limitations, particularly with a larger sample size.

Limitations notwithstanding, results of the present study provide new important data about relationship characteristic differences among concordant HIV-positive and HIV-discordant gay male couples who did not use substances with sex within and/or outside their relationship to those with one or both partners who did. These findings highlight the critical and timely need to conduct additional research toward development of prevention interventions that consider the intersection of substance use, sex, and relationship dynamics within this population.

ACKNOWLEDGMENTS

REFERENCES

1. Centers for Disease Control and Prevention [CDC]. 2013. HIV among gay and bisexual men. Accessed from http://www.cdc.gov/hiv/topics/msm/pdf/msm.pdf. Accessed 25 Nov 2014.

2. Coates TJ. What is to be done? *AIDS*. 2008; 22: 1079–1080.

3. Ostrow DG, Stall R. Alcohol, tobacco, and drug use among gay and bisexual men. In: Wolitski RJ, Stall R, Valdiserri RO, eds. *Unequal opportunity*. Oxford: Oxford University Press; 2008: 121–158.

4. Aguinaldo JP, Myers T, Ryder K, Haubrich DJ, Calzavara L. Accounts of HIV seroconversion among substance-using gay and bisexual men. *Qual Health Res*. 2009; 19: 1395–1406.

5. Carey JW, Mejia R, Bingham T, et al. Drug use, high-risk sex behaviors, and increased risk for recent HIV infection among men who have sex with men in Chicago and Los Angeles. *AIDS Behav*. 2009; 13: 1084–1096.

6. Dirks H, Esser S, Borgmann R, et al. Substance use and sexual risk behavior among HIV-positive men who have sex with men in specialized out-patient clinics. *HIV Med*. 2012; 13: 533–540.

7. Heath J, Lanoye A, Maisto SA. The role of alcohol and substance use in risky sexual behavior among older men who have sex with men: a review and critique of the current literature. *AIDS Behav*. 2012; 16: 578–589.

8. Hirschfield A, Remien RH, Humberstone M, Walavalkar I, Chiasson MA. Substance use and high-risk sex among men who have sex with men: a national online study in the USA. *AIDS Care*. 2004; 16: 1036–1047.

9. Koblin BA, Husnik MJ, Colfax G, et al. Risk factors for HIV infection among men who have sex with men. *AIDS*. 2006; 20: 731–739.

10. Mansergh G, Colfax GN, Marks G, et al. The Circuit Party Men's Health Survey: findings and implications for gay and bisexual men. *Am J Public Health*. 2001; 91: 953–958.

11. Mansergh G, Flores SA, Koblin B, et al. Alcohol and drug use in the context of anal sex and other factors associated with sexually transmitted infections: results from a multi-city study of high-risk men who have sex with men in the USA. *Sex Transm Infect*. 2008; 84: 509–511.

12. Ostrow DG, Plankey MW, Cox C, et al. Specific sex drug combinations contribute to the majority of recent HIV seroconversions among MSM in the MACS. *J Acquir Immune Defic Syndr*. 2009; 51: 349–355.

13. Prestage G, Grierson J, Bradley J, Hurley M, Hudson J. The role of drugs during group sex among gay men in Australia. *Sex Health*. 2009; 6: 310–317.

14. Prestage G, Jin F, Kippax S, et al. Use of illicit drugs and erectile dysfunction medications and subsequent HIV infection among gay men in Sydney, Australia. *J Sex Med*. 2009; 6: 2311–2320.

15. Stall R, Paul JP, Greenwood G, Pollack LM, Bein E. Alcohol use, drug use and alcohol-related problems among men who have sex with men: the Urban Men's Health Study. *Addiction*. 2001; 96: 1589–1601.

16. Vosburgh HW, Mansergh G, Sullivan PS, Purcell DW. A review of the literature on event-level substance use and sexual risk behavior among men who have sex with men. *AIDS Behav*. 2012; 16: 1394–1410.

17. Drumright LN, Patterson TL, Strathdee SA. Club drugs as causal risk factors for HIV acquisition among men who have sex with men: a review. *Subst Use Misuse*. 2006; 41: 1551–1601.

18. Hinkin C, Barclay T, Castellon S, et al. Drug use and medication adherence among HIV-1 infected individuals. *AIDS Behav*. 2007; 11(2): 185–194.

19. Carrico AW, Johnson MO, Colfax GN, Moskowitz JT. Affective correlates of stimulant use and adherence to anti-retroviral therapy among HIV-positive methamphetamine users. *AIDS Behav*. 2010; 14(4): 1–9.

20. Kelly BC, Parsons JT. Prevalence and predictors of non-medical prescription drug use among men who have sex with men. *Addict Behav*. 2010; 35: 312–317.

21. Kelly BC, Parsons JT. Prescription drug misuse and sexual risk taking among HIV-negative MSM. *AIDS Behav*. 2013; 17: 926–930.

22. Pantalone DW, Bimbi DS, Holder CA, Golub SA, Parsons JT. Consistency and change in club drug use by sexual minority men in New York City, 2002 to 2007. *Am J Public Health*. 2010; 100: 1892–1895.

23. Halkitis P, Moeller R, Siconolfi D, et al. Methamphetamine and poly-substance use among gym attending men who have sex with men in New York City. *Ann Behav Med*. 2008; 35: 41–48.

24. Parsons JT, Lelutiu-Weinberger C, Botsko M, Golub SA. Predictors of day-level sexual risk for young gay and bisexual men. *AIDS Behav*. 2013; 17: 1465–1477.

25. Thiede H, Valleroy LA, MacKellar DA, et al. Regional patterns and correlates of substance use among young men who have sex with men in 7 US urban areas. *Am J Public Health*. 2003; 93: 1915.

26. Fisher MP, Ramchand R, Bana S, Iguchi MY. Risk behaviors among HIV-positive gay and bisexual men at party-oriented vacations. *J Stud Alcohol Drugs*. 2013; 74: 158–167.

27. Grov C. HIV risk and substance use in men who have sex with men surveyed in bathhouses, bars/clubs, and on craigslist.org: venue of recruitment matters. *AIDS Behav*. 2012; 16: 807–817.

28. O'Byrne P. Examining the intersection of desire, drugs and place among gay men. *J Res Nurs*. 2011; 18: 265–276.

29. Ramchand R, Becker K, Ruder T, Fisher MP. PartyIntents: a portal survey to assess gay and bisexual men's risk behaviors at weekend parties. *Eval Rev*. 2011; 35: 428–451.

30. Ramchand R, Fisher MP, Griffin BA, Becker K, Iguchi MY. Drug use among gay and bisexual men at weekend dance parties: the role of intentions and perceptions of peers' behaviors. *AIDS Behav*. 2013; 17: 1540–1549.

31. Weidel JJ, Provencio-Vasquez E, Grossman J. Sex and drugs: high-risk behaviors at circuit parties. *Am J Men's Health*. 2008; 2: 344–352.

32. Mor Z, Davidovich U, McFarlane M, Feldshtein G, Chemtob D. Gay men who engage in substance use and sexual risk behavior: a dual risk-group with unique characteristics. *Int J STD AIDS*. 2008; 19: 698–703.

33. Parsons JT, Starks TJ. Drug use and sexual arrangement among gay couples: frequency, interdependence, and associations with sexual risk. *Arch Sex Behav*. 2014; 43: 89–98.

34. Parsons JT, Starks TJ, DuBois S, Grov C, Golub SA. Alternatives to monogamy among male couples in a community survey: implications for mental health and sexual risk. *Arch Sex Behav*. 2013; 42: 303–312.

35. Mitchell JW. Characteristics and allowed behaviors of gay male couples' sexual agreements. *J Sex Res*. 2014; 51(3): 316–328.

36. Mitchell JW, Petroll AE. Patterns of HIV and sexually transmitted infection testing among men who have sex with men couples in the United States. *Sex Transm Dis*. 2012; 39(11): 871–876.

37. Goodreau SM, Carnegie NB, Vittinghoff E, Lama JR, Sanchez J. What drives the US and Peruvian epidemics in men who have sex with men (MSM)? *PLoS ONE*. 2012; 7: e50522.

38. Sullivan PS, Salazar L, Buchbinder S, Sanchez TH. Estimating the proportion of HIV transmissions from main sex partners among men who have sex with men in five US cities. *AIDS*. 2009; 23: 1153–1162.

39. Darbes LA, Chakravarty D, Neilands TB, Beougher SC, Hoff CC. Sexual risk for HIV among gay male couples: a longitudinal study of the impact of relationship dynamics. *Arch Sex Behav*. 2014; 43(1): 47–60.

40. Hoff CC, Chakravarty D, Beougher SC, Neilands TB, Darbes LA. Relationship characteristics associated with sexual risk behavior among MSM in committed relationships. *AIDS Patient Care STDS*. 2012; 26(12): 738–745.

41. Mitchell JW, Harvey SM, Champeau D, Seal DW. Relationship factors associated with HIV risk among a sample of gay male couples. *AIDS Behav*. 2012; 16: 404–411.

42. Santos GM, Das M, Colfax GN. Interventions for non-injection substance use among US men who have sex with men: what is needed. *AIDS Behav*. 2011; 15: S51–S56.

43. Mitchell JW. Differences in gay male couples' use of drugs and alcohol with sex by relationship HIV status. *Am J Men's Health*. 2014; ePub. doi:10.1177/1557988314559243.

44. Mitchell JW, Boyd C, McCabe S, Stephenson R. A cause for concern: Male couples' sexual agreements and their use of substances with sex. *AIDS Behav*. 2014; 18(7): 1401–11. doi:10.1007/s10461-014-0736-9.

45. Rempel JK, Holmes JG, Zanna MP. Trust in close relationships. *J Pers Soc Psychol*. 1985; 49(1): 95–112.

46. Rusbult CE, Martz JM, Agnew CA. The investment model scale: measuring commitment level, satisfaction level, quality of alternatives, and investment size. *Pers Relat*. 1998; 5: 357–391.

47. Christensen A, Shenk JL. Communication, conflict, and psychological distance in nondistressed, clinic, and divorcing couples. *J Consult Clin Psychol*. 1991; 59(3): 458–463.

48. Kenny D, Kashy D, Cook W. *Dyadic data analysis*. New York, NY: Guilford Press; 2006.

49. UCLA Institute for Digital Research and Education. 2014. Stata annotated output multinomial logistic regression. Available at: http://www.ats.ucla.edu/stat/stata/output/stata_mlogit_output.htm. Accessed 25 Nov 2014.

50. Hoff CC, Beougher SC. Sexual agreements among gay male couples. *Arch Sex Behav*. 2010; 39(3): 774–787.

51. Kelley HH, Thibaut JW. *Interpersonal relations: a theory of interdependence*. New York, NY: Wiley; 1978.

52. Lewis MA, Gladstone E, Schmal S, Darbes LA. Health-related social control and relationship interdependence among gay couples. *Health Educ Res*. 2006; 21: 488–500.

53. Lewis MA, McBride CM, Pollak KI, et al. Understanding health behavior change among couples: an interdependence and communal coping approach. *Soc Sci Med*. 2006; 62: 1369–1380.