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Differences in relationship characteristics between HIV-negative male couples who used and did not use substances with sex

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Abstract

Although substance use is linked to HIV seroconversion, little is known about male couples substance use with sex. The present study sought to: describe whether neither, one, or both partners in the couple used a particular substance with sex within or outside their relationship; assess, by substance type used with sex, whether relationship factors differed between these groups of couples. Dyadic data from 83 behaviorally non-monogamous HIV-negative male couples were used with multinomial regression models. Those who used with sex within the relationship varied by substance type; outside the relationship, most only had one partner who used with sex. Couples with one or both partners who used substances with sex within or outside the relationship were more likely to have higher commitment to their relationship yet less likely to trust their main partner; mixed results were found regarding communication. Further research is warranted toward the need for preventive intervention development.

Keywords

Substance use with sex; HIV-negative male couples; relationship characteristics

INTRODUCTION

In the US, 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, and 78% of infections among newly infected men [1]. Prior studies with MSM have identified condomless anal sex (CAS) as the primary risk behavior for the acquisition of HIV [2, 3], and have also found a strong association between substance use and CAS. However, the 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 amongst prior studies [16, 17]. Despite these inconsistencies, several key themes were noted. Vosburgh and colleagues (2012) indicated that event-level use of methamphetamine and binge alcohol use provided the strongest causal link for acquisition of HIV among MSM [16]. In addition to methamphetamine use with sex, Drumright and

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colleagues found evidence for a causal link of MSM's use of volatile nitrates with sex and increased risk HIV acquisition [17].

Studies have also documented characteristics of MSM who use illegal substances (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, 18-20]. However, younger MSM (i.e., 29 and younger) also report using substances with sex [21-23]. Differences in substance use with sex may exist by MSM's HIV status [21-23]. In general, HIV-positive MSM are more likely to use party drugs (e.g., cocaine, ecstasy, ketamine, GHB, methamphetamine) and prescription drugs, including EDM and sleep aids, than HIV-negative MSM [3, 18-20]. Moreover, MSM who attend bathhouses, party-oriented events (e.g., circuit parties), gay-destination vacations, and use the Internet to find sexual partners often report using substances (e.g., ecstasy, crystal methamphetamine, cocaine, GHB, binge alcohol consumption) with sex [24-29].

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. 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 CAS outside of their relationship [30]. Parsons and Stark (2014) recently provided evidence that substance use was strongly interdependent between partners within the couple, and that substance use, though measured globally, was predictive of partners having had CAS outside of their relationship when controlling for HIV-status, race, age and relationship length [31]. Other research has 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 non-monogamous relationship [30-32]. 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 CAS are strongly correlated and may increase the likelihood of HIV acquisition; 3) many HIV-negative male couples practice CAS within their relationship [33, 34]; 4) between one- and two-thirds of MSM in the US acquire HIV from their main partners while in a same-sex relationship (e.g., male couples) [35, 36].

The few substance use studies conducted with male couples have primarily focused on CAS with respect to their use of substances. To date, researchers have yet to examine the association between couples' relationship dynamics and their use of substances with sex even though prior research has found relationship dynamics associated with sex are important to study and include for HIV prevention efforts targeting male couples [37]. Further, the Interdependence Theory (IT) posits that an ideal relationship is characterized with high levels of rewards and low levels of costs; examples of rewards and costs may be emotional, social, task oriented, and opportunities that arise from being in the relationship [38, 39]. The IT also considers how each member of the couple has a certain amount of control and influence in their behavioral interactions they have together, and that these interactions are constantly being evaluated by both partners [38, 39]. The use of substances with sex may present both rewards and costs (e.g., emotional, social) within male couples'

relationships, which in turn, may affect the couples' relationship dynamics of communication, trust and relationship commitment. However, it remains unknown whether using substances with sex affects couples' relationships, including whether usage is associated with: building trust or creating mistrust; enhancing or inhibiting effective communication; building or diminishing commitment between the two partners. As such, the present study seeks to expand our understanding about this phenomenon with the proposed aims.

Drawing from dyadic data collected from 83 concordant HIV-negative male couples who self-reported as being behaviorally non-monogamous, the present study sought to: 1) describe, by type of substance, whether neither, one or both partners in the male couple 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.

Among substance-using male couples, we hypothesize that a higher proportion of them will have both partners who use substances with sex within their relationship compared to those with only partner using. We also hypothesize that a higher proportion of substance-using male couples will have one partner who uses substances with sex outside of their relationship (i.e., with a casual MSM partner) compared to both partners using. Within the relationship, we hypothesize that male couples with one or both partners who use substances with sex will be less likely to report having higher levels of relationship commitment, trust and communicating constructively compared to non-substance using male couples. Similarly, for substance use with sex outside the relationship, we hypothesize that male couples with one or both partners who used will be less likely to report having higher levels of relationship commitment, trust and communicating constructively compared to male couples who did not use. In other words, we hypothesize that the costs of male couples who used substances with sex within and/or outside of their relationship will outweigh the potential rewards they gained, as reflected through their reports of having lower levels of relationship commitment, trust and constructive communication compared to those who did not use. Findings from this study may provide new insights about HIV-negative male couples' use of substances with sex with a calling for additional research to be conducted since few prevention interventions for substance-using HIV-negative male couples currently exist [40].

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 [33, 34]. In 2011, advertisements targeted partnered men who reported in their Facebook profile being 18 years of age, living in the

US, 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 7,994 *Facebook* users who clicked on an advertisement, 4,056 (51%) answered eligibility questions; 722 (18%), representing both men of 361 MSM couples provided consent and completed the study questionnaire. A total of 550 HIV-negative MSM, representing 275 concordantly negative male couples are included in this secondary analysis. Men were eligible to participate if they: were 18 years of age; lived in the U.S.; were in a sexual relationship with another male and had had oral and/or anal sex with this partner within the previous three 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 83 concordant HIV-negative male couples primarily identified as gay (97%), non-Hispanic (95%), white (85%), living in an urban environment in the US (88%), and cohabitating (81%). Over half of the couples were employed (65%). Couples, on average, had been in their relationship for about 5.9 years ($SD=5.1$, range: 0.25 – 22 yrs) and among those cohabitating, had been doing so for approximately 5.7 years ($SD=5.1$). Condomless anal sex was commonly practiced within couples' relationships (90%). All 83 couples had one or both partners who recently had sex outside of their relationship (i.e., behaviorally non-monogamous): 37% had one partner who had CAS with a casual MSM partner and 23% had both partners who had CAS with a casual MSM partner.

Measures

Outcome variables—Two series of outcomes were created for this analysis: 1) substance use with sex, by type of substance, within the relationship and 2) substance use with sex, by type of substance, outside the relationship. Participants were asked if they had used any substances with sex, by partner type, during the three 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”, “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 type of 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 timeframe.

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”, “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 [41], relationship commitment [42], and communication patterns [43].

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 [41]. 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, $\alpha = 0.90$) [41]. 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 $-3 = \text{Strongly Disagree}$ to $3 = \text{Strongly Agree}$.

The Investment Model was used to examine the processes in which gay men persist within their sexual relationship with their main partner [42]. 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 were 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 $0 = \text{Do Not Agree at All}$ to $6 = \text{Agree Completely}$.

The Communication Patterns Scale was used to assess how well couples communicate when an issue or problem arises in their relationship [43]. Two subscales from this questionnaire were used in this study: (a) Mutual Constructive Communication consisted of the sum of three items that assessed mutual discussion of problems, expression of feelings, understanding of views, negotiation of solutions, and resolution of problems ($\alpha = 0.83$); (b) Mutual Avoidance consisted of the sum of 8 items that assessed mutual avoidance of discussion, mutual withdrawing after discussion, and mutual withholding after discussion ($\alpha = 0.85$). 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 [37].

Data analysis

The present study uses data from an original cross-sectional online study about male couples' behaviors and relationship characteristics that collected dyadic data from 361 male couples ($N = 722$ partnered MSM). To accomplish the present aims, this secondary analysis excludes all couples, except for those who were in a self-reported concordant HIV-negative relationship, and in a behaviorally non-monogamous relationship as indicated by one or both partners who self-reported having had anal sex outside of their relationship within the three months prior to assessment ($N=83$ male couples). Dyadic data from this subsample of 83 dyads were analyzed using Stata Version 12 (StataCorp, College Station, TX). Couple-level descriptive and comparative analyses were conducted along with multivariate multinomial regression models to determine whether differences in relationship characteristics existed among the male couples with neither, one, or both partners who used a particular substance with sex within their relationship, and outside the relationship, respectively. 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. 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, or both partners who used alcohol and drugs with sex within their relationship, and outside the relationship, respectively. Due to a limited sample size, three models were constructed for each type of substance used with sex within the relationship: one model included factors from the Investment model to represent dimensions of relationship commitment; another model for trust, and a third model for communication patterns. Using this same approach, three additional models were constructed for each type of substance 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). Given our limited understanding about the association between male couples substance use with sex and relationship dynamics and the unforeseen sample size for this analysis, only relationship length was included as a potential confounder for the multivariate multinomial regression models [44]. 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 [45]. 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 behaviorally non-monogamous HIV-negative male 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 HIV-negative male couples did not use drugs with sex within their relationship. Among those who did use substances with sex, whether one or both partners had used varied and depended on the type of substance. Most couples also did not use substances with sex outside their relationship (except for alcohol). For those who did use, universally for each substance type a higher proportion of male couples had only one partner who used that particular substance with sex outside of their relationship.

Substance use with sex *within* the relationship: neither partner vs. one or both partners

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 marijuana with sex within the relationship.

Alcohol—Compared to couples who did not use alcohol with sex within their relationship, those with one partner who did use were more likely to view their main partner as predictable for trustworthiness ($RRR = 5.47 [1.22, 24.61], p < 0.05$). Within the relationship, couples with both partners who used alcohol with sex were also more likely to view their main partner as dependable for trustworthiness ($RRR = 5.67 [1.64, 19.62], p < 0.05$) compared to couples who did not use alcohol with sex. Couples with one partner ($RRR = 0.04 [0.01, 0.36], p < 0.01$) and those with both partners who used alcohol with sex ($RRR = 0.04 [0.01, 0.36], p < 0.01$) were less likely to have faith in trusting their main partner compared to couples who did not use.

Amyl nitrates—Compared to couples who did not use amyl nitrates with sex within the relationship, couples with one partner who did use were more likely to report having higher levels of relationship satisfaction ($RRR = 5.03 [1.16, 21.68], p < 0.05$) and less likely to perceive they had greater quality of alternatives to their current relationship (e.g., being single or with someone else) ($RRR = 0.27 [0.10, 0.58], p < 0.05$). Couples with one partner ($RRR = 0.33 [0.14, 0.80], p < 0.05$) and those with both partners ($RRR = 0.48 [0.24, 0.95], p < 0.05$) who used amyl nitrates with sex within the relationship were less likely to view their main partner as predictable for trustworthiness compared to couples who did not use.

EDM—Couples with one partner who used EDM with sex within the relationship were more likely to report having higher levels of relationship commitment (RRR = 9.03 [1.11, 73.37], $p < 0.05$), communicating constructively (RRR = 2.74 [1.22, 6.16], $p < 0.05$) and/or communicating by avoidance (RRR = 1.95 [1.02, 3.72], $p < 0.05$) than couples who did not use EDM. Further, couples with one partner who used EDM with sex within the relationship were less likely to perceive they had greater quality of alternatives to their current relationship (e.g., being single or with someone else) (RRR = 0.19 [0.05, 0.67], $p < 0.01$) compared to those who did not use.

Party drugs—Couples with one partner who used party drugs with sex within the relationship were more likely to report having higher levels of relationship satisfaction (RRR = 7.40 [1.68, 32.66], $p < 0.01$) than couples who did not use party drugs with sex within their relationship.

Substance use with sex *outside* the relationship: neither partner vs. one or both partners

Table 3 provides 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 outside of their relationship.

Alcohol—Couples with one partner who used alcohol with sex outside the relationship were more likely to report having higher levels of communicating by avoidance and withdrawal (RRR = 1.93 [1.15, 3.26], $p < 0.05$) and less likely to perceive they had greater quality of alternatives to their current relationship (e.g., being single or with someone else) (RRR = 0.39 [0.16, 0.96], $p < 0.05$) than couples who did not use alcohol with sex outside of their relationship. Couples with both partners who used alcohol with sex outside of their relationship were more likely to report having higher levels of relationship satisfaction (RRR = 6.06 [1.72, 21.35], $p < 0.01$).

Marijuana—Compared to couples who did not use marijuana with sex outside the relationship, those with one partner who did use were more likely to have higher levels of communicating constructively (RRR = 1.91 [1.15, 3.19], $p < 0.05$). Further, those with both partners who used marijuana with sex outside of their relationship were more likely to report having higher levels of relationship satisfaction (RRR = 5.71 [1.05, 31.07], $p < 0.05$).

Amyl nitrates—Couples with one partner and both partners who used amyl nitrates with sex outside of their relationship were less likely to report viewing their partner as predictable for trustworthiness (RRR = 0.32 [0.14, 0.77], $p < 0.05$; RRR = 0.39 [0.16, 0.93], $p < 0.05$) compared to couples who did not use amyl nitrates with sex outside of their relationship. In addition, couples with one partner who used amyl nitrates with sex outside of their relationship were more likely to report having higher levels of communicating by avoidance and withdrawal (RRR = 1.63 [1.02, 2.61], $p < 0.05$).

EDM—Compared to couples who did not use EDM with sex outside of their relationship, couples with one partner who used were less likely to report perceiving they had greater quality of alternatives to their current relationship (e.g., being single or with someone else)

(RRR = 0.42 [0.18, 0.96], $p < 0.05$) and having greater access to tangible resources (i.e., investment size) (RRR = 0.38 [0.16, 0.94], $p < 0.05$). Couples with both partners who used EDM with sex outside of their relationship were more likely to report having higher levels of relationship satisfaction (RRR = 8.16 [2.21, 30.10], $p < 0.01$).

Party drugs—Couples with one partner who used party drugs with sex outside of their relationship were more likely to report having higher levels of relationship satisfaction (RRR = 2.57 [1.13, 5.85], $p < 0.05$) than those who did not use party drugs with sex outside of their relationship. In contrast, couples with one partner who used party drugs with sex outside of their relationship were less likely to report perceiving their partner as predictable for being trustworthy (RRR = 0.40 [0.18, 0.90], $p < 0.05$).

DISCUSSION

The present investigation uses dyadic data collected from a national convenience sample of behaviorally non-monogamous concordant HIV-negative male couples to assess relationship characteristic differences based on who in the couple used substances with sex within and outside of their relationship, respectively: neither, only one, or both partners. With the exception of alcohol, the majority did not use substances with sex within or outside of their relationships. We found strong support for our first hypothesis: a higher proportion of male couples had both partners who used substances with sex within their relationship compared to those with only one partner; however, EDM was the exception. The opposite was found to be true regarding substance use with sex outside the relationship. These variations – of whether one or both partners used substances with sex within and/or outside the relationship – may highlight individual differences and preferences for substance use with sex. For instance, each partner of the couple may have similar and/or different preferences for which substance(s) they use with sex within their relationship, and these preferences may reflect that men may feel comfortable using substances with sex if and when their main partners are also using with them. 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 relationship 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 [33, 46]; 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. Further research is warranted to determine whether male couples permit the use of substances with sex within and/or outside of their relationship, and the motivating factors that influence these decisions to include or exclude substance use with sex in their relationship.

Several key differences in relationship characteristics were found among the three groups of male couples regarding their use of substances with sex. These findings provide some support of our other two hypotheses: male couples who used substances with sex - within

and/or outside of their relationship – were more likely to report having higher levels of relationship commitment and less likely to report having higher levels of trust with mixed results regarding how well they communicate. Compared to male couples who did not use substances with sex within and/or outside of their relationship, those with one or both partners who did use substances with sex were more committed and satisfied in their relationship, and perceived their relationship to be better than the alternative options (e.g., single, dating others). Partners who support one another's use of substances with sex may in turn experience greater satisfaction (e.g., relationally and/or sexually), be more committed to their relationship, and view the alternative options (e.g., being single, dating others) as unfavorable to their current relationship. It is also possible that partnered men may view their alternative options as unfavorable to their use of substances with sex because other men or being alone may not tolerate or facilitate their usage. As such, these relationship characteristics may reflect the rewards that male couples perceive to have regarding their use of substances with sex.

In contrast, male couples with one or both partners who did use substances with sex were less likely to have faith in trusting their main partner as well as viewing their main partner as predictable for being trustworthy. For some couples, the use of certain substances (e.g., alcohol, amyl nitrates, party drugs) with sex may in turn produce unpredictable experiences, which may lessen the extent that men trust their main partners (i.e., costs [toward relationship] of using substances with sex. However, it is unclear from these findings if the use of certain substances with sex among male couples negatively affects their views and beliefs about trust within their relationships (i.e., between the main partners), or whether it speaks to other instances in which trust could have been affected within their relationship. Additional research is needed to examine how couples substance use with sex may independently affect trust within their relationship, or exasperate existing trust issues. Future HIV and substance use prevention interventions should consider both of these possibilities. For instance, an intervention could focus on helping couples to understand and address the reasons or causes of their relationship issues, whether their issues are related or compounded by their use of substances with sex, and how these issues can be remedied to enhance their relationship and health (e.g., reduce HIV risk).

We also found mixed results regarding couples' use of substances with sex and how well they communicate. Some couples with one or both partners who used substances with sex were more likely to communicate constructively (e.g., EDM, marijuana), while others were more likely to avoid and withdraw during a discussion when a problem occurred (e.g., alcohol, amyl nitrates, EDM). Given the cross-sectional nature of the data, it is uncertain if some of the men in couples had existing problems with communicating in their relationship or whether their use of substances with sex affected their ability to communicate constructively. With consideration of developing preventive interventions, researchers should consider if one or both partners of the couple struggle with communicating constructively in their relationship and if so, how best to improve their communication skills. For instance, researchers could incorporate skill-building exercises about how to communicate effectively in a relationship and use case examples to demonstrate how other couples' experiences (e.g., videos or live stories) of using substances with sex have negatively affected communication within their relationship (e.g., costs).

Because alcohol use within the gay male community is ubiquitous and common [3], some of the study's findings may highlight the "normalcy" that alcohol use represents in gay men's and couples activities, including sex. Some partnered men may also use alcohol with sex in their relationship to compensate (e.g., "liquid medicate") the lack of satisfaction they have about their current relationship. However, it remains unknown on what meaning(s) male couples place on alcohol use (and other substances) with and without sex; future studies which explore this area of research is warranted.

Prior research has documented that among gay men and other MSM, the use of particular substances such as amyl nitrates, EDM, and party drugs are strongly associated with their engagement in CAS and seroconversion of HIV [3-17]. Research indicates that specific substances (e.g. party drugs, methamphetamine, etc.) are often associated with increasing men's intensity and duration of sexual behaviors (e.g., CAS) and the rate in which MSM use these substances with sex also increases [3]. However, it's important to note that the majority of male couples in this sample did not use substances with sex. Additional research that includes a larger sample of substance-using male couples is necessary to help develop future prevention efforts. In future work, researchers could use mixed methods with a longitudinal study design to assess how male couples' relationship dynamics and prevention-related behaviors are impacted over time by their use of substances with and without sex. Findings from this type of study would provide essential data to illuminate the casual effect between couples' use of substances, risk for HIV, and dynamics of their relationship.

To address this need for additional prevention research on substance use with sex and potential HIV risk, the Interdependence Theory may provide a useful theoretical framework to better understand HIV risk and changes in relationship dynamics within the context of substance-using male couples. The IT 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 [38]. 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 IT, 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 [47]. Prior research has used IT as a theoretical framework to specifically understand health behavior change within couples. Lewis et al. (2006) 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 [48, 49]. Research that applies the IT 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.

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 causal inferences and generalizing our findings to all male couples living in the US, as well as those who do and do not use the Internet and/or Facebook. Sample size is another consideration for improvement in future work. Recommendations by Hosmer, Lemeshow

and Sturdivant (2013) suggest a minimum sample size of 10 individuals is needed per independent variable when conducting logistic regression, including multinomial regression; future work should take this consideration into account by aiming to enroll a larger sample of substance-using male couples [44]. 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, record event-level usage of substances with sex, or the types of sex and sexual positions that accompanied partnered men's substance use. Future research that examines HIV-negative male couples' use of substances with sex should specifically address these limitations with a larger sample size. Despite these limitations, our study obtained dyadic data from a geographically diverse sample of Internet-using, behaviorally non-monogamous, HIV-negative male couples who reported using substances with sex within and/or outside of their relationship.

Limitations notwithstanding, results of the present study provide new important data about relationship characteristic differences in HIV-negative gay male couples who did not use substances with sex within and/or outside of 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 among male couples.

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Table 1

HIV-negative gay male couples' use of substances with sex within and outside of their relationship, by substance type

Substance use with sex within relationship (main partner) ^a	Neither partner	Only by one partner	By both partners
Sample size: 83 dyads	% (N)	% (N)	% (N)
Alcohol	13.3 (11)	19.3 (16)	67.5 (56)
Marijuana	55.4 (46)	18.1 (15)	26.5 (22)
Amyl nitrates	69.9 (58)	10.8 (9)	19.3 (16)
EDM ^b	71.1 (59)	16.9 (14)	12.1 (10)
Party drugs ^c	83.1 (69)	6.0 (5)	10.8 (9)
Substance use with sex outside relationship (outside partner(s)) ^a	Neither partner	Only by one partner	By both partners
Sample size: 83 dyads	% (N)	% (N)	% (N)
Alcohol	41.0 (34)	32.5 (27)	26.5 (22)
Marijuana	69.9 (58)	20.5 (17)	9.6 (8)
Amyl nitrates	67.5 (56)	18.1 (15)	14.4 (12)
EDM ^b	73.5 (61)	22.9 (19)	3.6 (3)
Party drugs ^c	89.2 (74)	6.0 (5)	4.8 (4)

Notes.

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

^b Erectile dysfunction medication (EDM)

^c Represents ecstasy, ketamine, GHB, cocaine and crystal methamphetamine

Table 2

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

	Alcohol		Amyl nitrates		EDM ^a	Party drugs ^b
Sample size: dyads	By one partner N=16	By both partners N=56	By one partner N=9	By both partners N=16	By one partner N=14	By both partners N=9
Between couple-level characteristic	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)
Investment model						
Commitment level					9.03 (1.11 – 73.37) *	
Relationship satisfaction			5.03 (1.16 – 21.68) *			7.40 (1.68 – 32.66) **
Quality of alternatives			0.27 (0.10 – 0.75) *		0.19 (0.05 – 0.67) **	
Trust scale						
Predictability	5.47 (1.22 – 24.61) *		0.33 (0.14 – 0.80) *	0.48 (0.24 – 0.95) *		
Dependability		5.67 (1.64 – 19.62) **				
Faith	0.04 (0.01 – 0.36) **	0.09 (0.02 – 0.46) **				
Communication patterns scale						
Mutual constructive					2.74 (1.22 – 6.16) *	
Mutual avoidance					1.95 (1.02 – 3.72) *	

Notes.

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

* $P < 0.05$,

** $P < 0.01$

^a EDM denotes Erectile Dysfunction Medication

^b Represents ecstasy, ketamine, GHB, cocaine, and methamphetamine

Table 3

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

	Alcohol		Marijuana		Amyl nitrates		EDM ^a		Party drugs ^b
Sample size: dyads	By one partner r N=27	By both partners N=22	By one partner r N=17	By both partners s N=8	By one partner r N=15	By both partners s N=12	By one partner r N=19	By both partners N=3	By one partner r N=5
Between couple-level characteristic	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)	RRR (95% CI)
Investment model									
Relationship satisfaction		6.06 (1.72 – 21.35) **		5.71 (1.05 – 31.07) *				8.16 (2.21 – 30.10) **	2.57 (1.13 – 5.85) *
Quality of alternatives	0.39 (0.16 – 0.96) *						0.42 (0.18 – 0.96) *		
Investment size							0.38 (0.16 – 0.94)		
Trust scale									
Predictability					0.32 (0.14 – 0.77) *	0.39 (0.16 – 0.93) *			0.40 (0.18 – 0.90) *
Communication patterns scale									
Mutual constructive			1.91 (1.15 – 3.19) *						
Mutual avoidance	1.93 (1.15 – 3.26) *				1.63 (1.02 – 2.61) *				

Notes.

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

* $P < 0.05$,

** $P < 0.01$

^a EDM denotes Erectile Dysfunction Medication

^b Represents ecstasy, ketamine, GHB, cocaine, and methamphetamine

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