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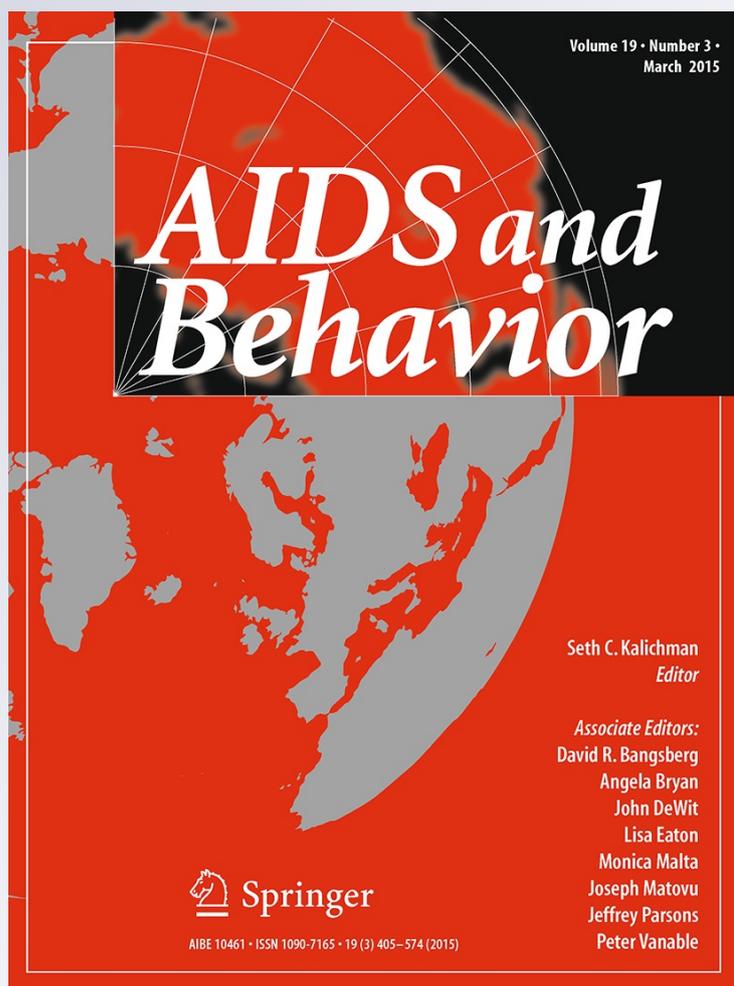
Bram Heidinger · Kim Gorgens · Jon Morgenstern

Abstract Men who have sex with men (MSM) remain most at risk for developing HIV infection. The best prevention in this population is to identify risk factors associated with unprotected sex. Recent research suggests that sexual sensation seeking (SSS) and level of average drinking moderates the relationship between drinking alcohol in the context of sex and risky sexual behavior in a young MSM population (ages 16–20 years). Current study is an exploratory analysis using multilevel modeling to examine if these results are consistent across a MSM population with a wider range of ages who are also heavy drinkers. Participants (n = 181) included MSM (ages 18–75 years) from a longitudinal clinical research trial. Results indicate that MSM with higher SSS were more likely to have unprotected anal sex if they drank alcohol 3 h prior to sex than those who did not, (OR = 1.07; 95 % CI 1.03–1.12). There was no significant interaction effect for average levels of drinking.

Keywords HIV · MSM · Alcohol · Sexual sensation seeking

Introduction

The Centers for Disease Control (CDC) has identified men-who-have-sex-with-men (MSM) as the population most at risk for HIV infection in the United States [1]. The CDC estimates that MSM account for 2 % of the U.S. population and 63 % of all new HIV infections in 2010 [1]. Despite current efforts at prevention, the rates of new infections among MSM continue to remain high. The best prevention in this population is to identify risk factors that contribute to risky sexual behavior.

In order to address HIV risk in MSM, researchers have examined the relationship between risky sexual behavior (most commonly, unprotected anal intercourse) and other risk factors such as personality traits and substance use [2]. Alcohol has been implicated as an important risk factor for study due to high alcohol use prevalence rates in MSM, and because many MSM meet potential sex partners at social venues where there is alcohol [3]. However, the research examining risky sexual behavior and alcohol use among MSM is inconsistent [3]. Some of the studies support a relationship between alcohol use and risky sexual behavior, while other studies report null findings.

Woolf and Maisto [3] reviewed fifty-one quantitative studies involving MSM from 1991 to 2007 with the purpose of examining these inconsistencies in order to guide future research. The authors suggest that one reason for the inconsistency may be the different types of research methodology used in those studies. They emphasize the strength in using experimental research designs; however, they recognize the difficulty in carrying out this type of research due to the ethical prohibitions against manipulating a variable like unprotected anal intercourse. In lieu of an experimental design, the authors suggest event-level studies of multiple sexual encounters as advantageous

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because this methodology can account for within-persons variability as well as between-persons variability. Specifically, event-level studies in this area of research can explore the function of alcohol use within specific sexual encounters over time. Additionally, the authors note that the relationship between alcohol use and risky sexual behavior can vary depending on a variable like partner type (primary or non-primary). Vanable et al. [4] found that alcohol use in the context of sex is less likely to alter safe sex practices with a primary partner; whereas heavy alcohol use in the context of sex with a non-primary partner was associated with an increase in risky sexual behavior.

The authors suggested that another possible explanation for inconsistencies in the research is the lack of theory or conceptual-based hypotheses [3]. They reported that, of the studies reviewed from 1991 to 2007, only a few used theory or conceptual-based methodology in their research design and interpretation of the results. They recommend that future research continue to incorporate theory or conceptually driven methodology by examining relevant variables like personality characteristics in order to improve future research. This recommendation is consistent with the observations of Hoyle [5] who pointed out the lack of research examining personality characteristics as moderators in models of sexual risk taking. Principal among promising personality characteristics related to risky sexual behavior and alcohol is sexual sensation seeking [3, 6].

Kalichman et al. [7] defines sexual sensation seeking as "the tendency to prefer exciting, novel, and optimal levels of stimulation or arousal" (p. 386). Woolf and Maisto [3] describe sexual sensation seeking as a personality-driven characteristic related to high risk behaviors of heavy drinking and risky sexual behavior. The theory that sensation seeking is related to risky behaviors was initially based on research conducted by Zuckerman et al. [8] which found that participants high in sensation seeking were less concerned with the consequences of their behavior. Subsequently, Fisher and Misovich [9] examined the relationships between scores on the sensation seeking measure created by Zuckerman et al. [8] and risky sexual behavior in a group of men. Results from the Fisher and Misovich [9] study indicated a positive correlation between sensation seeking and risky sexual behavior. Subsequently, Kalichman et al. [7] updated the language of the Zuckerman Sensation Seeking Scale to form the Sexual Sensation Seeking Scale (SSSS). Kalichman et al. [7] then administered the SSSS along with self-report measures capturing substance use and sexual behavior to 106 gay men. Those results indicated that sexual sensation seeking accounted for variance in sexual risky behavior, even when controlling for substance use and age. In a later study, Kalichman and Rompa [10] administered the SSSS and standardized self-report measures of sexual behavior to 296 gay men, and 158 low income men and women. Results indicated that those scoring higher on the SSSS showed a greater number of unprotected anal intercourse acts, and a greater number of sexual partners. Since prior research has also indicated a positive correlation between alcohol use and acts of unprotected anal intercourse among MSM [11], sexual sensation seeking merits study as a potential moderator of alcohol use in the context of a sex act and risky sexual behavior. Moreover, Woolf and Maisto [3] also identify sexual sensation seeking as an area of promise to improve research related to substance use and risky sexual behavior.

Newcomb et al. [6] addressed Woolf and Maisto's [3] recommendations in a study of young MSM (ages 16–20 at baseline) using event-level methodology to examine the role of sensation seeking in the context of a sexual partnership and risky sexual behavior. The data were collected between 2007 and 2010 and the researchers used a retrospective approach to collect data across three waves. To account for within-person variability in the frequency of unprotected anal intercourse, the researchers measured substance use as a characteristic of a sexual partnership, and modeled sexual risk within-persons across multiple partnerships. The personality characteristic of sexual sensation seeking was used as a between-persons variable. Results revealed evidence of an interaction effect, wherein sexual sensation seeking increased the positive situational effects of alcohol use prior to sex on frequency of unprotected sex with partners. Average rates of alcohol use were also found to decrease the positive association between situational use and sexual risk; meaning that there was a stronger positive association between situational alcohol use and sexual risk among young MSM who on average drink less alcohol. In sum, alcohol use prior to sex was not related to frequency of unprotected anal intercourse in a sample of young MSM, unless moderated by sexual sensation seeking or average rates of alcohol use.

A limitation to the Newcomb et al. [6] study is that they examined the relationship between sexual sensation seeking, alcohol use and unprotected anal intercourse among young MSM (ages 16–20) only. Therefore, results may not be representative of MSM of varying ages; although there is more recent research examining this relationship along with developmental differences in a MSM sample of ages 16–40 years [12]. The present study contributes to the emerging line of inquiry concerning adults. Moreover, the Newcomb et al. [6] sample did not identify heavy drinking MSM, and the authors indicated that those who drink more on average may be less affected by alcohol when engaging in risky sexual behavior. The Newcomb 2013 study [12] did use a sample consisting of heavier drinking MSM and results supported a moderating affect of alcohol. The

present study generates information about heavy drinking MSM and is distinct in that participants in the sample were also diagnosed with Alcohol Use Disorder.

Present Study

The present study is an exploratory analysis examining the degree to which the results from the Newcomb et al. [6] study apply to a heavy drinking MSM sample with a wider range of ages (18–75). Rather than examining frequency of unprotected anal intercourse (UAI), the current study examines the probability, or likelihood, of UAI in the context of alcohol use with information gathered at the level of each sexual encounter. This decision is guided by how UAI is measured in the present study.

There will be two different models to assess the moderating effects of sexual sensation seeking and average alcohol use because of differences in patterns of missing values. Model 1 will examine if sexual sensation seeking (SSS) increases the positive situational effects of alcohol use prior to sex on probability of UAI. It is predicted that SSS will moderate this relationship; meaning, as there is an increase in SSS score there will be an increase in the positive association between drinking 3 h prior to sex and UAI at each time point. Model 2 will examine the moderating effect of average rates of alcohol use on the situational influence of drinking alcohol within 3 h prior to sex on probability of UAI. It is predicted that higher average alcohol use decreases the positive association between UAI and alcohol use within 3 h of sex among an older heavy-drinking MSM population. Simple effects will be examined in both models if the above interaction effects are significant. These interaction hypotheses are being replicated here with an MSM sample of ages ranging from 18 to 75 years. If results are similar to the Newcomb et al. [6] study, prevention efforts can be adjusted to target a more generalizable sample of MSM.

Method

The dataset being examined is from the Informed Choices for Men (IC4M) study [13]. The IC4M study was a randomized clinical trial using Motivational Interviewing and Cognitive-Behavioral Therapy with a focus on alcohol reduction and HIV prevention in heavy drinking MSM ages 18–75. Participants were given the choice to participate in therapy, or be followed in a control group. If a participant agreed to therapy, they were then randomly assigned into either Motivational Interviewing or Cognitive Behavioral Therapy + Motivational Interviewing. Similar to the Newcomb et al. [6] study, the IC4M [13] sample was followed over time, but the former study had no treatment

element. Therefore, treatment effect is being added as a variable in the present study. The present study is longitudinal with follow-up points at 9, 12, and 15 months.

Participants

In the IC4M [13] study, data were collected from 198 participants. Participants were actively recruited in gay bars, sex clubs, cruising parks, bathhouses, gay community events, and gay internet chat rooms. Additional passive recruitment strategies included mass-mailings and advertisements targeting gay consumers. Participants were recruited between January, 2000 and June, 2002.

Inclusion criteria information in the IC4M study [13] was obtained through a clinical interview and included the following: self-report of negative HIV status, self-report of HIV sexual risk behavior, a diagnosis of Alcohol Use Disorder (abuse or dependence) in the past 12 months, drinking during the past 30 days, sexually active with men during the past 90 days, absence of thought disorder or severe cognitive impairment, and agreement to participate in follow-up assessments for a 15-month period. The informed consent materials were approved by the Mount Sinai Medical Center IRB, and covered the use of de-identified data to examine the subject matter of this study. Informed consent was obtained after the completion of a phone screen, yet prior to the intake assessment.

There were additional inclusion requirements for data in the present study. Since risk for HIV infection contracted by oral sex is comparatively low, the present study will analyze only data involving anal sex [14]. There is evidence of differences between effects of alcohol on UAI with casual and primary sex partners [4]; therefore, the present study will focus on alcohol use in the context of sex with a casual partner. Of the 198 participants from the original study, data from 181 participants were used in the present study. Specifically, 12 participants were excluded because the subjects reported having sex only with a main partner, three participants were excluded due to missing data on influence of alcohol prior to sex, one participant was excluded due to no report of anal sex, and one participant was excluded due to no reported sex at any time.

Measures

Thought Disorder and Substance Use Disorders

The absence of thought disorder was determined by administering the Structured Clinical Interview for DSM-IV Axis 1 disorders [15]. A semi-structured interview using DSM-IV criteria was adapted from the Composite International Diagnostic Interview [CIDI; 16] and used to

screen out participants with drug dependence/abuse. The CIDI was also used to obtain diagnostic criteria of alcohol dependence/abuse for inclusion in the study.

Sexual Sensation Seeking Scale

The sexual sensation seeking scale (SSSS) [7] was administered to measure the degree of sexual sensation seeking. The SSSS is a 9 item Likert-type measure with response options ranging from 1 (*Not at all like me*) to 4 (*Very much like me*). The total score for each participant will be used in analysis and will be centered at the grand mean. The SSSS has demonstrated good reliability and validity within a MSM population [7]. Specifically, internal consistency (Cronbach's alpha) of the SSSS in the IC4M sample (n = 198) was .80 [13]. There was no change in Cronbach's alpha for the present sample (n = 181).

Timeline Follow-Back

Each participant reported an estimated number of drinks per drinking day, acts of unprotected anal intercourse (UAI), and if they were under the influence of alcohol within 3 h of each sexual encounter (INF) during administration of the Timeline Follow-Back interview. Meaning, data were captured for each participant at the event-level of sexual encounters with multiple partners. The Timeline Follow-Back was administered retrospectively at each assessment period spanning the prior 90 days at baseline and end of treatment visits, and then at 9, 12, and 15 months follow-up. The Timeline Follow-Back has demonstrated good reliability and validity for capturing frequency of alcohol use [17, 18] and for capturing risky sexual behavior [11]. For analyses at each assessment period, the calculated mean will be used for drinks per drinking day (total drinks/total drinking days), and this will be centered at the grand mean. Regarding each sexual encounter, the INF variable is dichotomous. It was coded as "yes" if the subject endorsed drinking alcohol within 3 h prior to having the specific sexual encounter, and "no" if they did not. Participants reported the type of sex act (i.e., oral, vaginal, anal…) and type of partner (i.e., main, other, female) for each sexual encounter. If they endorsed anal sex, they were then asked whether or not they used a condom. UAI is dichotomous. It was coded as "yes" if the subject endorsed unprotected anal sex, or "no" if they endorsed protected anal sex for each sexual encounter. These are the only types of sexual encounters included in the current analyses. These data, collected at the event-level (sexual encounter), will be used to assess how drinking 3 h prior to a sexual encounter affects the likelihood of UAI across multiple sexual encounters for each participant.

Procedure

Participants in the original IC4M study [13] met with a research assistant to receive instructions, and complete questionnaires in-person and on an Audio Computer-Administered Self-Interview system during assessments. Assessments took place at the intake (baseline) session, and then at the following intervals: 3-months (end of treatment), 9, 12, and 15-months. Internal validity of the study was ensured through checks on therapist adherence to protocol.

The present study will explore the role of SSS in relation to alcohol use disorders and risky sexual behavior. This is a secondary exploratory analysis of the database that was created in the IC4M study [13]. The present study will use data from the Sexual Sensation Seeking Scale [7] and the Timeline Follow-Back [11, 17, 18].

Study Design/Analyses

The data were examined using hierarchical or multilevel modeling. Multilevel modeling is ideal for the examination of multiple observations of each individual. The data were analyzed using MI, MIANALYZE, and GLIMMIX procedures in the SAS/STAT 12.1 software (SAS Institute, Inc., Cary, NC). These statistical procedures were chosen because they can account for the following characteristics of this dataset: (1) The outcome variable is being modeled as a probability and the observed data come in the form of proportions; therefore, a binomial distribution will be specified during analyses. Such data cannot be analyzed through methods such as linear regression, because this requires the residuals to have a normal distribution; (2) Multilevel modeling can account for dependency that exists between observations with groups; (3) Multilevel modeling can also account for missing data across time points; and (4) The data are nested, that is, within each time point there are multiple observations of sexual encounters for each participant, and this accounts for the within-person variability. Characteristics of each sexual encounter such as drinking 3 h prior to sex (INF) and UAI are both Level 1 variables that are nested within individuals (Level 2). SSS (Level 2) will be examined as a moderator of Level 1 effects. Treatment type is being added as a Level 1 variable to control for treatment group effects in both models.

Results

Participant demographics reported in the present study were as follows: 18–75 years old (M = 36, SD = 9.2); 40 % White, 27 % Black, 25 % Hispanic/Latino, 2 %

Native American, 2 % Asian/Pacific Islander, 4 % Other; and 53 % had a Bachelor's degree or above. See Table 1 for demographic comparisons. Chi square tests and an ANOVA revealed no demographic differences between control and treatment groups. The 181 participants reported a combined total of 8,629 observations of anal sex with a casual male partner across time. Of those reported 8,629 observations, 923 (10.7 %) of them were acts of unprotected anal intercourse and 7,706 (89.3 %) were acts of protected anal intercourse. Of the 8,629 observations of anal sex, 4,770 (55.3 %) of them were in the context of consuming alcohol 3 h prior to sex and 3,859 (44.7 %) were not. In the remainder of analyses, odds ratios are used to describe the effects of the predictors.

Model 1 Sexual Sensation Seeking and Drinking 3 h Prior to Sex

Model 1 predicted the probability of UAI from: treatment condition, SSS, INF, and the interaction of SSS and INF. The mean SSS score for all 181 participants was 22.52 (SD = 5.3) and was centered at the grand mean. The GLIMMIX statistical procedure was used in this analysis since there were no missing values across variables. See Table 2 for moderating and simple effects. The treatment conditions and the control group were analyzed, and results yielded no significant group differences in the probability of UAI across time; MI vs. control group (OR = .91; 95 % CI .504–1.65) and MI + CBT versus control group (OR = .97; 95 % CI .558–1.71). As predicted, there was a significant and positive interaction effect between SSS and INF in predicting the probability of UAI (OR = 1.07; 95 % CI 1.03–1.12). This means that for individuals with higher sensation seeking scores, they were more likely to engage in UAI if they drank 3 h prior to sex. To clarify this finding, analyses of simple effects were examined. Simple effects of INF were examined at the mean of SSS, and one standard deviation above and below the mean of SSS. At one standard deviation below the mean of SSS, the effect of INF was not significant (OR = 1.29; 95 % CI .929–1.78). This means that for individuals with low sensation seeking scores, there was no significant difference in predicting UAI for those who did or did not drink alcohol 3 h prior to sex. Specifying SSS at the mean for the sample, the effect of INF was significant and positive (OR = 1.86; 95 % CI 1.503–2.274). This means that for individuals in this sample with an average sensation seeking score, the odds of UAI for those who drank 3 h prior to sex were 1.86 times the odds of those who did not drink 3 h prior to sex. Specifying SSS at one standard deviation above the mean of SSS, the effect of INF was also significant, positive, and stronger (OR = 2.66; 95 % CI 2.011–3.526). This means that for individuals with higher sensation seeking scores,

the odds of UAI for those who drank alcohol 3 h prior to sex were 2.66 times the odds of those who did not drink 3 h prior to sex. For those who did not drink 3 h prior to sex the effect of SSS was not significant (OR = .98; 95 % CI .924–1.029). That is, for those who did not drink 3 h prior to sex, sexual sensation seeking score did not predict UAI.

Model 2 and 2a Average Drinking and Drinking 3 h Prior to Sex

Different statistical procedures were used to run the second model due to missing values across variables. The MI procedure in SAS was used to account for missing average drinking values at certain time points. Fifty imputed data sets were generated using 500 between imputations, and this explains the large degrees of freedom in the reported results. The MIANALYZE procedure in SAS was then used to pool the results. The interaction between average drinking and INF was not significant (OR = 1.02; 95 % CI .999–1.048), see Table 3. The model was rerun (Model 2a; see Table 4) removing the non-significant interaction term to examine for main effects. Similar to Model 1, the treatment conditions and the control group were analyzed and results yielded no group differences in the probability of UAI across time; MI versus control group (OR = 1.03; 95 % CI .582–1.84), and MI + CBT versus control group (OR = 1.05; 95 % CI .607–1.798). There was a significant and positive effect of average drinking on UAI (OR = 1.04; 95 % CI 1.012–1.066). That is, those who had higher average drinking levels also had higher odds of UAI. There was a significant positive effect of INF on UAI (OR = 1.98; 95 % CI 1.609–2.427). This indicates that the odds of UAI for those who drank prior to sex were almost double the odds for those who did not drink prior to sex. SSS was not included in the second model.

Discussion

As predicted, sexual sensation seeking did moderate the relationship between drinking alcohol 3 h prior to having sex and unprotected anal intercourse in this sample of MSM with ages ranging from 18 to 75. Not only do these analyses address some methodological concerns of prior research in this area [3], they better specify which subgroups of MSM are more likely to engage in risky sexual behavior. In this sample, MSM with lower sensation seeking scores are no more likely to engage in unprotected anal intercourse whether they drink 3 h prior to sex or not. However, this relationship progressively changes for those with average and high scores of sensation seeking. Those with average sensation seeking scores are 1.86 times more likely to have unprotected anal intercourse if they drank

Table 1 Comparisons of demographic variables across MSM in the control group (n = 95), Tx1 group (n = 39), and Tx2 group (n = 47)

Comparison variable	Control		Tx1		Tx2		F	p value
	M	SD	M	SD	M	SD		
Age	35.87	10.56	35.46	7.34	36.26	7.73	.078	.925
Comparison variable	Control		Tx1		Tx2		χ^2	p value
	M n (%)	SD	M n (%)	SD	M n (%)	SD		
Ethnicity							9.19	.51
White	33 (34.7)		17 (43.6)		22 (47.8)			
African/American	30 (33.3)		9 (23.1)		9 (19.6)			
Hispanic/Latino	26 (28.8)		8 (20.5)		11 (23.9)			
Asian/Pac Islander	3 (.03)		1 (2.6)		0 (0)			
Native American	1 (.01)		2 (5.1)		1 (2.2)			
Other	2 (.02)		2 (5.1)		3 (6.5)			
Education							12.16	.06
No HS diploma	4 (4.2)		2 (5.1)		2 (4.3)			
HS diploma	13 (13.7)		3 (7.7)		2 (4.3)			
<Bachelor's degree	38 (40)		8 (20.5)		12 (25.5)			
Bachelor's degree ≤	40 (42.1)		26 (66.7)		31 (65.9)			
Employment							8.09	.42
Full-time	31 (32.6)		19 (48.7)		23 (48.9)			
Part-time	28 (29.5)		9 (23.1)		8 (17)			
Unemployed	19 (20)		6 (15.4)		12 (25.5)			
Disabled	4 (4.2)		1 (2.6)		1 (2.1)			
Student	13 (13.7)		4 (10.3)		3 (6.4)			
Income							15.20	.13
<10 K	17 (18)		6 (15.4)		6 (13)			
10–20 K	30 (31.9)		7 (17.9)		5 (13.9)			
20–40 K	29 (30.8)		12 (30.7)		19 (52.8)			
40–75 K	12 (12.8)		10 (25.6)		10 (21.7)			
75–100 K	2 (2.1)		3 (7.7)		2 (4.3)			
100 K<	4 (4.3)		1 (2.6)		4 (8.7)			

prior to sex, and those with higher sensation seeking scores are 2.66 times more likely than those who did not drink 3 h prior to sex to have UAI. The sexual sensation seeking results support previous findings [6, 12], and further extend those findings to an MSM group with a wider age range (18–75).

However, contrary to results from Newcomb, Clerk, and Mustasnski [6] and Newcomb [12], there was no significant interaction effect between average drinking levels and drinking 3 h prior to sex on unprotected anal intercourse. This suggests that there is a consistent positive relationship between drinking 3 h before sex and unprotected sex regardless of average level of drinking. Contrary also to the results with a younger MSM group [6], there was a significant positive relationship between higher average

drinking levels and engaging in unprotected anal intercourse. One possible account for the discrepancy between the current results and prior research [6] is that there is a difference in overall drinking levels between the samples, and this may be attributed to the differences in age ranges between the samples. For example, inclusion criteria in the IC4M study [13] included a diagnosis of alcohol abuse or dependence within the last 12 months, and individuals in this sample had high average drinking levels overall. Participants in the Newcomb et al. [6] study were under the legal drinking age, and whereas some of the participants aged into legal drinking age as the study progressed, it is likely their overall drinking levels were not as high as the IC4M sample. It is important to note that the follow-up Newcomb study [12] produced similar results to the

Table 2 Odds ratios and significance tests for risk of unprotected anal intercourse among MSM in model 1

Fixed effects	Odds ratio	95 % Confidence interval	F	t	df	p value
Intercept	.05	.03–.07	–	−17.10	220.5	<.001*
SSS × INF interaction	1.07	1.03–1.12	10.40	–	664	<.01*
INF at 1SD below mean of SSS	1.29	.93–1.78	2.29	–	659	.13
INF at mean of SSS	1.86	1.50–2.27	33.66	–	659	<.001*
INF at 1 SD above mean of SSS	2.66	2.01–3.53	46.91	–	659	<.001*
SSS at INF = 0	.98	.92–1.03	.77	–	310.8	.38
Random effect	Estimate	Standard error				
Intercept	1.61	.25				

INF represents those under the influence of alcohol 3 hours prior to having sex. INF = 0 represents those who did not have alcohol 3 hours prior to having sex. SSS is sexual sensation seeking score

Table 3 Odds ratios and significance tests for risk of unprotected anal intercourse among MSM in model 2, including interaction effect

Fixed effects	Odds ratio	95 % Confidence interval	t	df	p value
Average drinking × INF interaction	1.02	.99–1.05	1.94	674.74	= .05
Random effect	Estimate	Standard error			
Intercept	1.52	1.23			

INF is under the influence of alcohol 3 h prior to having sex

Newcomb et al. [6] study. The sample in the follow-up study [12] consisted of a wider age range (16–40 years) and had higher average levels of alcohol consumption. These differences may still be explained by the inclusion criteria of Alcohol Use Disorder in the present study. Restricting the current sample to those with Alcohol Use Disorder may not allow for enough variability in levels of average alcohol consumption which could make an interaction effect difficult to detect.

Another problem with interpretation of the Model 2 interaction result in the current study is that it may not appropriately address the suggestions posited by Newcomb et al. [6] as to why average drinking may be considered as a moderator. One of their suggestions was that higher average drinking levels may decrease the relationship between situational alcohol use and unprotected anal intercourse, because those who drink less on average may not have developed as many routines while drinking. They support this idea with research suggesting that people are more likely to engage in different behaviors while intoxicated, if they do not have a history of firmly established routines while under the influence of alcohol [19, 20]. Conversely, those who drink more on average may have more established routines and are therefore not as easily influenced by the situational effects of alcohol. Whereas the current study consisted of an older MSM sample, it would be erroneous to assume they have had more opportunity to set established routines while drinking alcohol, since information was only collected on drinking within a 15 month time span. Prior history of drinking, including the length of time a participant had been drinking heavily, was not examined. It is possible that some of the older participants had recently started drinking heavily, and that not enough time

Table 4 Odds ratios and significance tests for risk of unprotected anal intercourse among MSM in Model 2a, including main effects with interaction removed

Fixed effects	Odds ratio	95 % Confidence interval	t	Df	p value
Intercept	.03	.02–.05	−15.97	1,447.4	<.0001
INF	1.98	1.61–2.43	6.50	637,697	<.001
Average drinking	1.04	1.01–1.07	2.88	167.04	<.01
Control grp. versus Tx1 grp	1.03	.58–1.84	.11	4,530,000	.91
Control grp. versus Tx2 grp	1.05	.61–1.80	.16	446,000,000	.87
Random effect	Estimate	Standard error			
Intercept	1.52	1.23			

INF is under the influence of alcohol 3 hours prior to having sex. INF = 0 is those who did not have alcohol 3 hours prior to having sex. Degrees of freedom are large due to multiple imputation

had passed for them to establish set routines while drinking alcohol. However, the current study required inclusion of an Alcohol Use Disorder, and it is feasible to consider that an Alcohol Use Disorder takes time to develop.

It is also possible that analyses yielded different results based on how the average drinking variable was measured. Average drinking levels in the Newcomb et al. [6] study were measured on a Likert-type scale; whereas average drinking levels in the present sample were measured as an average of drinks per drinking day within each time period. In a more recent study, Newcomb [12] used a quantity/frequency variable to measure average drinking levels; however, the top limit of measuring quantity was "6 or more drinks." In the current sample, the top limit of measuring quantity using the Timeline Follow-Back was the reported consumption per day which captured quantities up to an average of 40 drinks per drinking day. Additionally, Newcomb et al. [6] reported that their sample had infrequent use of alcohol prior to sex. In the present study, over half (55.3 %) of sexual events that included anal intercourse involved use of alcohol 3 h prior to sex. It is important to note that the more recent Newcomb study [12] sample reported rates of drinking prior to sex that were similar to the present study sample, yet their results are similar to the Newcomb et al. [6] results.

This study has some particular strengths and weaknesses. This study aimed to follow methodological recommendations for improving research in this area. This was accomplished by using event-level or multilevel modeling to account for both within and between-persons variability, and the analyses included a previously researched theory-driven personality element. Results from this study expand upon recent research [6] by sampling a wider age range of MSM. These results also contribute to an emerging line of inquiry regarding adults [12]. Based on that line of research, adding age as a covariate is a direction for future analyses of this dataset and other samples. Similar to prior research [6, 12], these results predict the conditions under which MSM are more likely to engage in risky sexual behavior; albeit, some discrepancies in results between research studies remain. Because the current study is an exploratory analysis, results do not address the causality of risky sexual behavior.

Furthermore, these results are specific to MSM sexual behavior in the context of casual male partners and situational alcohol use. The MSM sampled in this study were also heavy alcohol drinkers, on average. These results do not account for MSM risky sexual behavior with women, nor do they address MSM risky sexual behavior in the situational context of drugs. The variable assessing participant alcohol consumption within the last 3 h did not measure quantity during that time. Information about how much alcohol a person consumed within 3 h prior to sex

may strengthen future studies. There are likely differences between someone who has one beer and someone who has six beers in the 3 h prior to sex. The present study also did not control for the number of different sex partners, and that information should be examined in future studies to assess how that count may affect risk. These are all topics for future inquiry. Another weakness is that this research did not examine the relationship between SSS and average levels of drinking, and future analyses should incorporate this with other samples or Model 2 here. Furthermore, data on the current sample were collected between the years 2000–2002, and this may affect external validity given the passage of time.

Conclusion

These results suggest that there is a significant and positive connection between situational alcohol use and unprotected anal sex among MSM; however, this relationship is moderated by sexual sensation seeking. MSM with higher levels of sexual sensation seeking are more likely to engage in risky sexual behavior while under the influence of alcohol. This study did not examine developmental differences in the sample, and emerging research suggests this is an area of promise [12]. As was suggested by Newcomb et al. [6], it is especially important to assess sexual sensation seeking since members of this population with higher sexual sensation seeking scores are more likely to engage in risky sexual behavior when drinking alcohol prior to sex.

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