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Sexual Behaviors Linked to Drug and Alcohol Use Among Men Who Have Sex With Men in China

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Abstract

Background—High-risk sexual behaviors drive the HIV epidemic among men who have sex with men (MSM). Alcohol consumption and use of club drugs may increase sexual risk behaviors. We evaluated effects of drug and alcohol use on sexual behaviors with both their male and female partners as well as on HIV and syphilis infections among MSM in China.

Methods—As the part of a community randomized clinical trial that conducted among MSM in Beijing from 2013 to 2015, we recruited a total of 3,680 participants cross-sectionally. A self-administered questionnaire was employed to collect information regarding demographics, sexual behaviors, and a history of alcohol and drug use. Blood sample was collected for HIV and syphilis testing.

Results—A total of 3,588 MSM completed the survey and were included in the data analysis. The mean age was 29.9 with 97.3% of Han-ethnicity and 85.0% unmarried. The HIV and syphilis prevalence was 12.7% and 7.4%, respectively. Drug use was significantly associated with higher odds of HIV infection (aOR = 1.3, 95% Confidence Interval [CI] = 1.0,1.6), but not associated with syphilis. A higher level of alcohol consumption was similarly associated with higher odds of HIV risks with both male (e.g., condomless sex acts) and female partners (e.g., numbers of sexual partners).

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Conclusion—The association between drug and alcohol use and high-risk behaviors is notable among MSM in China. Integrated HIV interventions that target substance use among MSM may be more effective than programs that only target HIV alone.

Keywords

Alcohol use; China; drug use; HIV; sexual behavior; men who have sex with men

HIV epidemics continue to expand among men who have sex with men (MSM) in China. National sentinel surveillance data document that the HIV prevalence among MSM has increased from 0.9% in 2003 to nearly 8.0% in 2014 (NHFP, 2015). Meanwhile, an estimate of 2%–4% of males self-reported having sex with males in their lifetime in China (Chow, Lau, & Zhuang, 2014). Although the absolute percentage is similar to that in Western countries, the large 1.4 billion population in China and the rapidly increasing epidemic among MSM presents an immense challenge to curbing HIV in China.

In China, MSM preferentially live in large cities where they can more easily find male friends and sexual partners with less fear of publicly disclosing their sexual identity (Lu, Han, et al., 2013; Ye et al., 2012). The primary risk for HIV transmission among this vulnerable group is condomless anal intercourse (Lu, Han, et al., 2013; Lu, Liu, et al., 2013). In addition, due to prevalent homophobia and traditional social values, many MSM have to disguise their true sexual identity by marrying women (Chow, Wilson, & Zhang, 2011; Lau et al., 2008; Wang et al., 2015). Studies showed that more than two-third of Chinese MSM have engaged in bisexual behaviors, which is much higher compared to their western counterparts (Chow et al., 2011). MSM who have sex with women usually pose a bridging role of HIV transmission between high-risk and low-risk populations via condomless sex with both female and male sexual partners (Chow et al., 2011; Lau et al., 2008).

Although injecting drugs is a rare practice among MSM in urban areas in China, use of club drugs such as Poppers (alkyl nitrites), Crystal meth (crystal methamphetamine), Ecstasy (MDMA), ketamine, amphetamines, or other amphetamine-based stimulants is common (Xu, Qian, et al., 2014; Xu, Zhang, et al., 2014). A study in Changsha city reported that about 21.4% of MSM used club drugs at some time before or during sex in the past six months (Chen et al., 2015). Meanwhile, alcohol drinking is a common behavior at social settings. A meta-analysis showed that alcohol use prevalence among Chinese MSM was 32%, with 23% reporting alcohol use before sex with male partners (Y. Liu & Qian, 2014).

There is considerable evidence to illustrate the pharmacological, neurological, and psychological mechanisms on how substance use is associated with sexual risk behaviors by modifying cognitive-motivational paths including increased sexual desire, decreased sexual inhibition, and reduced physical pain during sexual activities (Yang & Xia, 2010). These combined mechanisms of substance use can lead to increased number of casual sexual partners as well as increased amount and length of sexual intercourse, which in turn, will escalate the risk of infection of HIV and other sexually transmitted diseases (STD).

An upsurge in club drugs and alcohol use in China has been observed as a consequence of a series of social, cultural, behavioral, psychological, and biological factors (Colfax & Guzman, 2006; Yang & Xia, 2010). From the social-cultural perspective, the rapid social and economic transformation has reshaped social infrastructure and social values. As a result, younger generations have replaced traditional Chinese values focusing on social obedience with individualism emphasizing personal pleasures by excessively using both legal and illegal substances (H. Liu, Li, Lu, Liu, & Zhang, 2010; Yang & Xia, 2010). Meanwhile, the culture of alcohol drinking has been closely embedded within daily social lives of Chinese men for thousands of years (Lu, Han, et al., 2013; Stall et al., 2001). The pro-alcohol-use environment nourishes the prevalence of alcohol drinking problem among Chinese MSM. From psychosocial and behavioral perspective, many substance-using MSM reported peer influence as the key for their initiation, especially for members within an isolated group (e.g., MSM), within which they have faced prevalent stigma and discrimination, and use substance as a maladaptive coping strategy (Berg, 2009; He, Wong, Huang, Thompson, & Fu, 2007; S. Li et al., 2013; Stall et al., 2001). In addition, the sensation-seeking personality was also a key for substance use (Yang & Xia, 2010). From biological perspective, the hormone-facilitated substance use-rewarding system acts particularly strong among males (Fattore, Melis, Fadda, & Fratta, 2014).

Although the association between substance use and HIV risk has been well-established among Chinese MSM, most studies employed “condom use” as the single indicator for the HIV risk among MSM (Guo, Li, & Stanton, 2011). There is a lack of a comprehensive evaluation of sexual risk behaviors with both male and female sexual partners among Chinese MSM (Guo et al., 2011). Although alcohol and drug use have individually been linked to HIV risk, there is scarce literature examining their interaction (Lee et al., 2015; Ludford et al., 2013; Tobin, Latkin, & Curriero, 2014). Using the baseline HIV testing data from a community randomized clinical trial, we examined the individual and joint effects of alcohol drinking and drug use on infections of HIV and syphilis as well as a series of sexual risk behaviors among MSM in Beijing, China.

Methods

Study site and study participants

Between March 2013 and March 2015, we conducted a community randomized clinical trial (The China-MP3; R01AI094562) in Beijing, China to evaluate a multicomponent intervention package on Phase I expanding HIV testing and Phase II enhancing linkage-to-care among HIV positive MSM diagnosed in Phase I. Participants in the current study were recruited in the Phase I. The study site, Beijing, has a population of 23 million including 8 million local and 17 million migrant residents (WPR, 2016). HIV incidence among MSM in Beijing ranged from 5.9 to 9.1 per 100 person-years in the past several years (D. Li et al., 2012; G. Liu et al., 2015; Mao et al., 2014).

Based upon a pre-established sampling scheme, we collaborated with a community-based organization which has an outreach of 50,000 MSM out of a total of 300,000 in Beijing. Participants were recruited via website advertisement, peer referral, short message service, and community outreach. Inclusion criteria for the current study were: (1) men; (2) aged 18

years or older; (3) having sex with men in the past 12 months; (4) living in Beijing during the study period; and (5) willing and able to provide written informed consent. Eligible men complete an online form to schedule their HIV testing. On the scheduled day, MSM completed a self-administered questionnaire collecting information of their demographics, sexual behaviors, and a history of substance use as well as got their blood drew for HIV/syphilis testing. The study protocol was reviewed and approved by the institutional review boards of Vanderbilt University in the United States, and the National Center for AIDS/STD Control and Prevention (NCAIDS) of the China Center for Disease Control and Prevention.

Measurements

Demographics—Participants were asked to provide information regarding their age (years), marital status (ever vs. never), education (college or above vs. high school or less), employment status (employed vs. unemployed), monthly income (≥ 5,000 yuan vs. <5,000 yuan [about US \$800]), duration of living in Beijing (years), age of sex debut (years), and having health insurance (vs. no insurance).

Exposure variables—The primary exposure variables were use of alcohol and other drugs. *Drug use* was measured by a question asking if participants had ever used illegal drugs (e.g., methamphetamine, ecstasy [MDMA], rush [amyl nitrites], magu [a stimulant consisting of methamphetamine and caffeine], ketamine, cannabis or marijuana, cocaine, opium, heroin, morphine, others) in the past three months. If participants answered “yes” to any of the drugs, they were labeled as “drug user.” Alcohol use was measured as frequency of use (e.g., never, 1 time/month; 2-4 times/month; >2-3 times/week) in the past three months. For the purpose of data analysis, alcohol use was further dichotomized as “ever use” versus “never use.” The ordinal format of alcohol use was used for the “dose-response” association assessment. And the dichotomized format was used to examine the odds of HIV risk among alcohol using MSM in the data analyses.

Outcome variables—The primary outcome variables were sexual risk behaviors and infection status. Sexual risk behaviors included those with male and female partners. With male partners, we asked about the number of both lifetime and past three months male sexual partners, and also about ever having condomless receptive anal intercourse (RAI) or insertive anal intercourse (IAI) in the past three months. We asked MSM about the number of lifetime and past three months female sexual partners, and ever having condomless vaginal sex in the past three months. For the purpose of data analysis, we dichotomized responses to the number of lifetime male sexual partners as <10 vs. ≥10. For participants who reported having sex with ≥2 male partners in the past three months, we coded them as having “multiple partners.” For those who reported having sex with female partners in the past three months or over the lifetime, the answer was coded as “ever” having sex with female partners. Participants' infection status for HIV and syphilis was labeled as “positive” vs. “negative” based on laboratory testing.

Laboratory testing—HIV rapid tests were performed using Alere Determine HIV1/2 (Colloidal Selenium Device; Alere Medical Co, Ltd., Waltham, MA, USA). Venous specimens were further screened for HIV antibody using ELISA (HIV ELISA testing kit 1,

ZHUHAI LIVZON Diagnostics Inc., Zhuhai, Guangdong Province, China). If positive by ELISA screening, the specimen was double tested using the same ELISA kit and another ELISA kit (HIV ELISA testing kit 2, Beijing WANTAI Biological Pharmacy Enterprise Co. Ltd., Beijing, China). A specimen with a positive reaction in either ELISA testing kits was confirmed by Western blot test (HIV Blot 2.2 WB; MP Biomedicals Co, Ltd., Shanghai, China). Syphilis rapid tests were conducted using One-Step Syphilis Anti-TP Test (Colloidal Gold Device, Standard Diagnostics, Inc., Gyeonggi-do, Korea). Syphilis serology was determined through the Syphilis Toluidine red unheated serum test (Beijing WANTAI Biological Pharmacy Enterprise Co. Ltd., Beijing, China) and confirmed by the *Treponema palladium* particle assay (Fujirebio Inc., Tokyo, Japan).

Data analytical plan

A total of 3,680 participants completed the questionnaire, and 3,588 (97.5%) were included in the data analysis after removing ineligible participants (Y. Liu et al., 2015). Chi-square tests for categorical variables and ANOVA tests for continuous variables were employed to assess differences in drug and alcohol use behaviors by various demographic and behavioral measures. Trend tests were employed to assess if there are any significant trends across different frequencies of alcohol use. Multivariate regression models were employed to assess the association between drug or alcohol use and sexual risk behaviors with male and female partners separately. Ordinal regression analyses were employed to explore the dose-response association between frequency of alcohol use and risky behaviors among Beijing MSM. Adjusted odds ratio (aOR) and 95% confidence intervals (CIs) were reported for each outcome. In addition, interaction analyses between drug and alcohol use were employed to assess their individual and synergistic effects on MSM's sexual behaviors. Likelihood ratio tests (LRTs) were employed to assess whether the addition of the interaction term provided a significantly better fitting model compared to a model without the interaction term (Rothman, Greenland, & Lash, 2008). If the p -value is less than 0.20, we consider the interaction term contributes the model significantly and make the model a better fit. The higher p -value can be more conservative to capture all possible interaction effects (Greenland, 2009; Kaufman, 2009; Knol, Egger, Scott, Geerlings, & Vandenbroucke, 2009).

Results

Demographics of participants

Of the 3,588 MSM who were included in the data analysis (Table 1), the mean age was 29.9 years, and the majority were of Han ethnicity (93.7%) and were unmarried (85.0%). Over two-thirds received college education and 82.5% were employed. Average time living in Beijing was 9.5 years and 38.9% did not have a health insurance plan. Compared to non-drug users ($n = 2600$), drug users ($n = 988$) were younger, more likely to be unmarried, to be employed, to have health insurance, and to have higher monthly income ($p < 0.05$). Compared with nonusers ($n = 1574$), alcohol users ($n = 2014$) were younger, more likely to be employed and less likely to have lower income and more likely to have a health insurance plan ($p < 0.05$).

Prevalence of drug and alcohol use

In the past three months, over half (56.1%) of men reported drinking alcohol, and 27.5% reported using drugs. Specifically, rush was the most frequently used drug (26.8%), followed by methamphetamine (1.5%), cannabis or marijuana (0.3%), MDMA (0.22%), ketamine (0.2%), Magu (0.08%), and heroin (0.03%). No one reported past three-month use of cocaine, opium or morphine.

Prevalence of sexual behaviors and HIV/syphilis infections

Nearly half (49.4%) of participants had 10 male partners in their lifetimes; 47.6% had multiple male partners in the past three months. About one-fifth reported condomless IAI (21.9%) and RAI (20.4%), respectively. About 40% of MSM had female sexual partners in their lifetimes, and 10.5% in the past three months; 6.6% reported condomless sex with female sexual partners in the past three months (Table 1).

The prevalence of HIV and syphilis was 12.7% and 7.4%, respectively. HIV prevalence was significantly higher among drug users than non-users (16.0% vs. 11.4%, $p < 0.05$), while syphilis prevalence was similar (7.6% vs. 7.3%, $P > 0.05$; Table 1).

Relationship between drug or alcohol use, and sexual behaviors and HIV/syphilis infections

While drug users generally had a higher frequency of sexual risk behaviors with male partners compared to non-user counterparts, drug users were less likely to report having sex with female partners both in the past three months and over the lifetime. Similarly, alcohol-drinking men were more likely to engage in high-risk behaviors than non-drinkers, such as condomless anal sex ($p < 0.05$) ($p < 0.05$; Table 1).

Multivariate analyses showed that drug use was significantly associated with higher odds of sexual risk behaviors with male partners, including condomless IAI (adjusted odds ratio [aOR] = 1.2, 95% CI = 1.0–1.5), condomless RAI (aOR = 1.9, 95% CI = 1.6–2.2), over than 10 male partners over the lifetime (aOR = 2.1, 95% CI = 1.8–2.4) and multiple male partners in the past three months (aOR = 2.3, 95% CI = 2.0–2.7). However, drug use was significantly associated with the lower odds of having female partners in the past three months (aOR = 0.7, 95% CI = 0.5–0.9). In addition, drug use was associated with a higher odds of HIV infection (aOR = 1.3, 95% CI = 1.0–1.6), but not syphilis (aOR = 1.0, 95% CI = 0.8, 1.4) (Table 2).

The multivariable analyses also showed that alcohol drinking was associated with higher odds of condomless IAI (aOR = 1.7, 95% CI = 1.5, 2.0) and RAI (aOR = 1.3, 95% CI = 1.1, 1.6), more lifetime male partners (aOR = 1.2, 95% CI = 1.0, 1.4), and having sex with female partners in the past three months (aOR = 1.5, 95% CI = 1.2, 1.9) and over the lifetime (aOR = 1.9, 95% CI = 1.6–2.2) ($p < 0.05$) (Table 2). There was a dose-response relationship between frequency of alcohol drinking and condomless IAI as compared with never drinkers for drinking less than once a month (aOR = 1.5 [95% CI = 1.2–1.8]; aOR = 2.0 [95% CI = 1.6–2.5] for 2–4 times/month; and aOR = 2.3 [95% CI = 1.7–3.0] for 2–3 times/week). A similar trend was also observed for the odds of having sex with female

partners over the lifetime and in the past three months. Nonsignificant associations have been identified between alcohol and HIV as well as syphilis (Table 2).

In the interaction analysis between alcohol and drug use, we found the joint effects increased the risk of having a higher number of male sexual partners over the lifetime (aOR = 2.6, 95% CI = 2.1–3.2) and in the past three months (aOR = 2.4, 95% CI = 2.0–2.9) with significant LRTs ($p < 0.20$). However, as only two out of nine interaction tests show the significance, the findings may be spurious as the result of the Type 1 error (Rothman et al., 2008; see Table S1 in the online supplementary materials).

Discussion

Our findings indicate that drug and/or alcohol use was associated with higher odds of high-risk sexual behaviors and HIV infection, but not with syphilis infection, among Beijing MSM. Sexual disinhibition is associated with substance use among MSM, as is often the case for heterosexuals (Du et al., 2012; Hart et al., 2012; Stall et al., 2001). When judgment is impaired by intoxication, risky behaviors may not be perceived as such, and men may practice risky sex that they would be reluctant to engage if they were sober (Xu, Zhang, et al., 2014). MSM who engage in riskier sexual behaviors may also be more likely to use drugs or alcohol as a venting channel to blunt fears of contracting HIV or other sexually transmitted infections (Stall et al., 2001; Xu, Zhang, et al., 2014). Finally, drugs and alcohol are a fixture of the “party scene” and they may be used as a part of a preferred lifestyle (Coates, McKusick, Kuno, & Stites, 1989; Sabin et al., 2008). A longitudinal study design to make causal inference between substance use and HIV risk behaviors among MSM may be able to distinguish their potential risk patterns, i.e., whether drug/alcohol use contributes to risk or whether sexual risk behaviors that occur with drugs/alcohol are just accompanying features that are not particularly contributory.

Our data revealed that drug use by MSM was associated with lower odds of having sex with female partners. Perhaps bisexual MSM (some married to women) are not using drugs as often in their heterosexual contexts. Many MSM drug users in our study used rush; this can relax muscles and facilitate anal intercourse by relaxing the internal and external anal sphincter muscles (Baker, Kochan, Dixon, Wodak, & Heather, 1994; Ding, He, Zhu, & Detels, 2013). A more complex analysis for future work might be to examine large samples to try to distinguish drugs with different influences on sexual functions that might inhibit vs. promote different types of sex (e.g., receptive anal vs. insertive anal/vaginal).

Although we found a potentially spurious synergistic effect between drug and alcohol use, our findings illustrated those dual users in this population may be more vulnerable in terms of higher HIV risk compared to the effect of using single substance alone. Among existing interventions, most protocols focus either on alcohol or drug use (Wray et al., 2015; Yu, Clatts, Goldsamt, & Giang le, 2015). For instance, a systematic review of interventions to reduce problematic alcohol use among the MSM population concluded that motivational interventions work effectively for heavy-drinking subgroups (Wray et al., 2015). Carrico and colleagues (2014) have shown that drug use can be restrained by employing cognitive-based behavioral harm reduction approaches among African MSM (Carrico et al., 2014). Our

findings shed lights on the importance launching interventions targeting the use of multiple substances. In future research, how drug and alcohol interacts to each other should be further studied.

This study also confirmed our previous projection of a rapid rise in HIV prevalence among Beijing MSM (Lou et al., 2014). In the current sample, HIV and syphilis prevalence was 12.7% and 7.4%, respectively. This HIV prevalence was almost as doubled as the national average (6.5%) (Zhou et al., 2014), and the data in Beijing in 2008 (6.6%) (Mao et al., 2014). The rapidly climbing trend of HIV among MSM in Beijing may be the result of the fact that large metropolitan cities are more tolerant to male-to-male sexual activities than smaller cities and rural areas. Sexual networks among MSM in bigger cities are more complex and sex may be more likely to be casual and even anonymous. On the other hand, syphilis prevalence in Beijing is lower than other cities. For instance, the syphilis prevalence of MSM from a cross-sectional study conducted among seven cities was as high as 14.3% (Tang et al., 2015). In a study conducted among 1,312 MSM in Beijing from 2009 to 2010, syphilis prevalence (15.4%) was even higher in this study (Zhao et al., 2015). The reduced syphilis prevalence among this population may suggest that our population has higher access to health care than other populations, and that syphilis is easily treated. Some studies have indicated that HIV testing is a protective factor for syphilis infection (Zhong et al., 2014). Expansion of affordable and available HIV testing programs in China may be contributing to the reduced syphilis epidemic in Beijing. However, a 7.4% prevalence of syphilis is still a worrisome level of infection and suggests that Beijing MSM are vulnerable to sexually transmitted infections, including HIV. More frequent syphilis screening and treatment services for this at-risk population should be accompanied by intense HIV services and condom promotion, perhaps also including pre-exposure prophylaxis with antiretroviral therapy (A. Liu et al., 2014; Mayer et al., 2015).

Strengths of our study are its large size, the high participation rate, recruiting participants via multiple approaches to increase representativeness of the sample, strict quality control in data collection, confirmatory laboratory testing, and our comprehensive questionnaire administered in concert with a gay-friendly community organization. Limitations include the cross-sectional study design, such that casual inference between substance use and high-risk behaviors cannot be established. We only examined MSM's general drug use behaviors, but did not investigate whether drug use was associated with specific sex episodes (e.g., drug use before, during or after having sex). Polydrug use is prevalent and is also a stronger predictor of HIV risk among this group (Chen et al., 2015), but we did not examine synergistic effects among multiple illegal drugs. The measurement of alcohol use cannot capture the quantity consumed or frequency of heavy drinking, which may constrain the ability to detect how the dose of alcohol is associated with the likelihood of sexual risk behaviors in MSM. Also, we relied solely on self-report instead of urine drug testing or alcohol respiratory testing. Collected information may be subject to social desirability bias as participants may have tended to underreport their substance use behaviors.

HIV/syphilis prevention interventions that target substance use may be more effective in curbing the HIV Epidemic among MSM in China. It is critical to learn how to endorse positive social norms around condom use within the MSM community to effectively control

the HIV epidemic in China (Fan et al, 2012). Male circumcision, pre-exposure prophylaxis, and universal test and treat programs may also reduce transmission (Qian & Vermund, 2012; Vermund & Qian, 2008), but all these prevention strategies may need to consider drug and alcohol-related issues.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Demographics, sexual behaviors and HIV/syphilis infections by substance use status among 3,588 MSM in Beijing, China.

Variable	Drug use (binary)			Alcohol use (binary)		Frequency of alcohol use				p for trend ^a
	Overall (N = 3588), %	Never (N = 2600), %	Ever (N = 988), %	Never (N = 1574), %	Ever (N = 2014), %	Never (N = 1574), %	1/month (N = 1108), %	2-4/month (N = 594), %	>2-3/week (N = 312), %	
Demographics	100.0	72.5	27.5	43.9	56.1	43.9	30.9	16.6	8.7	
Age, mean (SD)	29.9 (7.8)	30.39 (8.45)	28.41 (5.71) ***	30.3 (8.6)	29.5 (7.2) **	30.3 (8.6)	29.0 (6.9)	29.3 (6.8)	31.4 (8.2) ***	0.214
Han-ethnic (%)	93.7	94.5	91.6 **	93.7	93.6	93.7	94.5	93.4	91.0	0.191
Not married (%)	85.0	82.7	91.0 ***	84.6	85.3	84.6	87.5	84.3	79.2 **	0.097
College or above education (%)	71.9	68.8	80.0 ***	71.1	72.5	71.1	76.7	73.4	55.8 ***	0.002
Employed (%)	82.5	81.3	85.7 **	80.9	83.8 *	80.9	81.2	87.5	85.6 ***	0.001
5000 yuan/monthly income (%)	52.7	48.0	65.0 ***	48.7	55.8 ***	48.7	53.4	60.4	55.1 ***	0.000
Having a health insurance plan (%)	61.1	58.9	67.0 ***	59.3	62.6 *	59.3	65.4	64.0	49.7 * «	0.370
Having Beijing Hukou	24.8	24.8	24.8	25.4	24.3	25.4	24.6	25.3	21.2	0.235
Duration of living in Beijing (year) mean, SD	9.5 (11.4)	9.6 (11.8)	9.2 (10.0)	9.9 (11.6)	92 (11.1) *	9.9 (11.6)	8.7 (10.7)	9.4 (11.4)	10.9 (12.0) **	0.382
Age of sex debut (year) mean, SD ^b	20.8 (4.0)	21.0 (4.2)	20.04 (3.16) ***	20.8 (4.3)	20.7 (3.8)	20.8 (4.2)	21.0 (3.5)	20.7 (4.5)	19.9 (3.4) ***	0.005
Outcomes										
HIV infection	12.7	11.4	16.0 ***	12.9	12.5	12.9	10.9	14.7	14.1	0.376
Syphilis infection	7.4	7.3	7.6	7.4	7.3	7.4	6.3	7.7	9.9	0.257
Sexual Behaviors with Male Partners										
Condomless RAI in the past 3m	20.4	17.6	27.8 ***	18.0	22.3 **	18.0	21.9	22.1	24.0 *	0.003
Condomless IAI in the past 3m	21.9	21.3	23.7	17.2	25.7 ***	17.2	22.5	28.1	32.4 ***	0.000
Number of lifetime male sexual partners (<10persons)	50.6	555	37.7 ***	52.5	49.1	52.5	53.3	45.1	41.4	0.000
Number of male partners in the past 3 months (1person)	52.4	57.6	38.7 ***	53.1	51.8	53.1	55.5	48.8	44.2 **	0.004

Variable	Drug use (binary)			Alcohol use (binary)		Frequency of alcohol use				<i>p</i> for trend ^a
	Overall (<i>N</i> = 3588), %	Never (<i>N</i> = 2600), %	Ever (<i>N</i> = 988), %	Never (<i>N</i> = 1574), %	Ever (<i>N</i> = 2014), %	Never (<i>N</i> = 1574), %	1/month (<i>N</i> = 1108), %	2-4/month (<i>N</i> = 594), %	>2-3/week (<i>N</i> = 312), %	
Sexual Behaviors with Female Partners										
Having sex with female partners in the past 3 months	10.5	11.9	6.8***	8.5	12.1***	8.5	9.4	13.8	18.3***	0.000
Having sex with female partners in lifetime	39.6	41.4	34.7***	34.2	43.7***	34.2	37.4	46.1	61.5***	0.000
Having condomless sex with female partners in the past 3 months	6.6	7.4	4.4**	5.6	7.3*	5.7	5.9	7.2	12.8***	0.000

SD: standard deviation; RAI: receptive anal intercourse; IAI: insertive anal intercourse.

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$ (for ANOVA and Chi-square tests);

^a *P*-value for trend tests.

Table 2

Multivariate analyses of the relationship between substance use and high-risk sexual behaviors among 3,588 MSM in Beijing, China.

Drug and alcohol use	Infection status		Sexual risk behaviors with male partners				Sexual risk behaviors with female partners			
	HIV infection ^a	Syphilis infection ^a	Condomless IAI in the past 3 months ^a	Condomless RAI in the past 3 months ^a	Lifetime male sexual partners (<10 vs. 10) ^a	Multiple male partners in the past 3 months (1 vs. 2) ^a	Having sex with female partners in the past 3 months ^a	Having sex with female partners in the past 3 months ^a	Having condomless sex with female partners in the past 3 months ^a	Having condomless sex with female partners in the past 3 months ^a
	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)	aOR(95% CI)
Drug use (binary)	1.5 (1.2,1.8) **	1.2(0.9,1.7)	1.2(1.0,1.5) *	1.9(1.6,2.2) ***	2.1(1.8,2.4) ***	2.3(2.0,2.7) ***	1.0(0.8,1.2)	0.7(0.5,0.9) **	0.8(0.5,1.1)	0.8(0.5,1.1)
Alcohol (binary)	1.0(0.8,1.2)	1.1(0.8,1.4)	1.7(1.5,2.0) ***	1.3(1.1,1.6) ***	12(10,1.4) *	1.1(0.9,1.2)	1.9(1.6,2.2) ***	1.5(1.2,1.9) **	1.3(1.0,1.8)	1.3(1.0,1.8)
Alcohol (ordinal)										
Never	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1/month	0.8(0.7,1.0)	1.0(0.7,1.3)	1.5(1.2,1.8) ***	1.3(1.1,1.6) **	1.1(0.9,1.3)	1.0(0.8,1.1)	1.5(1.3,1.9) ***	12(0.89,1.6)	12(0.8,1.7)	12(0.8,1.7)
2-4/month	1.2(0.9,1.6)	1.2(0.8,1.7)	2.0(1.6,2.5) ***	1.3(1.05,1.7) *	1.4(1.1,1.7) **	12(1.0,1.5)	2.1(1.7,2.7) ***	1.8(1.25,2.4) ***	12(0.8,1.8)	12(0.8,1.8)
>2-3/week	1.1(0.8,1.5)	1.2(0.8,1.8)	2.3(1.7,3.0) ***	1.4(1.1,1.9) *	1.3(1.0,1.7) *	1.3(1.0,1.6)	3.0(2.2,4.0) ***	1.9(1.3,2.8) ***	1.8(1.2,2.8) **	1.8(1.2,2.8) **

aOR, adjusted odds ratio; CI, confidence interval; RAI: receptive anal intercourse; IAI: insertive anal intercourse.

^a Adjusted for demographic variables (age, ethnicity, marriage, education, employment, income, years of living in Beijing, Beijing Hukou (or household registration), age of sex debut, health insurance).

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.