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Alcohol misuse, risky sexual behaviors, and HIV or syphilis infections among Chinese men who have sex with men

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Abstract

Background—Few studies have employed standardized alcohol misuse measures to assess relationships with sexual risk and HIV/syphilis infections among Chinese men who have sex with men (MSM).

Methods—We conducted a cross-sectional study among MSM in Beijing during 2013–2014. An interviewer-administered survey was conducted to collect data on sociodemographics, high-risk behaviors, and alcohol use/misuse patterns (hazardous/binge drinking and risk of alcohol dependence) in the past 3 months using Alcohol Use Disorder Identification Test-Consumption

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Contributors

SMS, HL, KRA, HZQ and SHV conceived of the study; YR, LY, YS, HZQ and SHV participated in its design and coordination; YL and HZQ analyzed data; YL drafted the manuscript; YL, SMS, CZ, HZQ and SHV revised the manuscript. All authors read and approved the final manuscript.

Conflict of interest

The authors have declared that there are conflicts of interest

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(AUDIT-C). We defined AUDIT-C score ≥ 4 as recent hazardous drinkers, and drinking ≥ 6 standard drinks on one occasion as recent binge drinkers.

Results—Of 3,588 participants, 14.4% reported hazardous drinking, 16.8% reported binge drinking. Hazardous and binge drinking are both associated with these factors ($p < 0.05$): older age, being migrants, living longer in Beijing, township/village origin, being employed, higher income, self-perceived low/no HIV risk, and sex-finding via non-Internet venues. Hazardous (vs non-hazardous) or binge (vs. non-binge) drinkers were more likely to use illicit drugs, use alcohol before sex, have multiple partnerships, pay for sex, and have condomless insertive anal intercourse. MSM who reported binge (AOR, 1.34, 95% CI, 1.02–1.77) or hazardous (AOR, 1.36, 95% CI, 1.02–1.82) drinking were more likely to be HIV-infected. MSM at high risk of current alcohol dependence (AUDIT-C ≥ 8) were more likely to be HIV- (AOR, 2.37, 95% CI, 1.39–4.04) or syphilis-infected (AOR, 1.96, 95% CI, 1.01–3.86).

Conclusions—Recent alcohol misuse was associated with increased sexual and HIV/syphilis risks among Chinese MSM, emphasizing the needs of implementing alcohol risk reduction programs in this population.

Keywords

HIV; syphilis; alcohol use/misuse; AUDIT-C; sexual risk; men who have sex with men; China

1. INTRODUCTION

HIV transmission patterns in China have evolved since the initial HIV outbreak in Yunnan Province in 1989 (Zhang et al., 2013), followed by a large epidemic among plasma donors in central China in the early 1990s (Qian et al., 2006), and then wide-spread transmission across the country through sexual contact (Qian et al., 2005). The countrywide scale-up of harm-reduction programs for persons who inject drugs and law enforcement campaigns on banning illegal plasma collection has significantly decreased and stabilized the HIV epidemic among both drug injectors and plasma donors (Shan et al., 2002; Sugimoto et al., 2014; Wu et al., 2007). In contrast, the proportion of new HIV cases due to sexual transmission increased from 33.1% in 2006 to 92.2% in 2014, during which male-to-male sexual transmission surged from 2.5% to 25.8% (Ministry of Health of the People's Republic of China AIDS Response Progress Report, 2015). A recent meta-analysis of 84 studies (January, 2009–April, 2014) showed that the pooled HIV prevalence among Chinese men who have sex with men (MSM) was 6.5% (Zhou et al., 2014), which was much higher than 0.037% in the general population (Ministry of Health of the People's Republic of China AIDS Response Progress Report, 2015). Without effective prevention interventions, the HIV prevalence among Chinese MSM in Beijing may escalate to 21.4% in 2020 (Lou et al., 2014).

Alcohol is widely consumed worldwide as a beverage and for recreation and socialization (Ennett et al., 2016). Very modest alcohol consumption may help reduce morbidity and mortality from several chronic diseases (Walzem, 2008). However, excessive alcohol use and chronic alcohol bingeing are associated with high morbidity and mortality (Stockings et al., 2016). Relevant to risk of sexually transmitted infections, the psychogenic nature of alcohol

may interfere with one's cognitive control and decreasing risk perception, in turn resulting in disinhibition and increasing the likelihood of risky sexual behavior (Rehm et al., 2012; Sales et al., 2012).

In China, overall alcohol consumption as well as high-risk drinking among the general population have increased dramatically since the late 1990s (He et al., 2015; Tang et al., 2013). A recent national survey indicated higher prevalence of alcohol drinking among men (55.6%) than women (15.0%; Li et al., 2011b). Alcohol consumption has also been increasing steadily among Chinese MSM, and reported to be associated with elevated risks of HIV and sexually transmitted infections (Liu et al., 2014). A recent study among Chinese MSM showed that the 12-month prevalence of alcohol use was 58% (Lu et al., 2013a). Psychological stress and its related body's response is considered as one of the major contributors of alcohol and illicit drug use initiation and continuation (Brady and Sonne, 1999). Since homosexuality is culturally dissonant with mainstream Chinese attitudes, the perceived/enacted stigma and social discrimination or isolation may result in psychological burden such as depression, anxiety, and low self-esteem among MSM (Dyer et al., 2013; Liu et al., 2016a; Yu et al., 2013a). Multiple studies have demonstrated the associations of these psychological issues with increased alcohol use and HIV-related risk behaviors among MSM (Carrico et al., 2012; Chen et al., 2012; Dyer et al., 2013). In the meantime, problematic alcohol drinking is also prevalent among Chinese MSM, and is significantly associated with illicit drug use, alcohol use before sex, having condomless sex, and multiple concurrent sexual partnerships (Fan et al., 2016; Liu et al., 2014; Lu et al., 2013a). The synergism of the disinhibited effect of alcohol misuse and high-risk sexual profiles of Chinese MSM may play an important role in exacerbating HIV/STI transmission in this population.

Research on alcohol use and misuse patterns and sexual risk-taking among Chinese MSM is scarce (Lu et al., 2013a). Few studies have employed standardized alcohol screening surveys to quantify problematic drinking and relate it to sexual risk taking, and HIV/syphilis risk (Fan et al., 2016). Using the well-validated Alcohol Use Disorders Identification Test-Consumption (AUDIT-C), we assessed the sociodemographic predictors of recent alcohol misuse and evaluated the association of different alcohol misuse patterns with risky behaviors and HIV/syphilis infection among a large sample who were HIV-negative or status- unknown MSM in Beijing, China.

2. MATERIALS AND METHODS

2.1 Study Design and Participants

This study was based on the cross-sectional baseline survey of a randomized controlled trial entitled "Multi-component HIV Intervention Packages for Chinese MSM – Test, Link and Care" (China-MP3 Project). The details of the parent trial are described elsewhere (Liu et al., 2016b, 2016c). In short, 3,760 HIV-negative and status-unknown MSM were recruited in Phase I for a baseline survey and HIV and syphilis testing via short message service, website advertisement, gay-frequented venues outreach, peer referral, and self-participation. Inclusion criteria for Phase I comprised: men or transgender women who self-reported having sex with another man in the past 12 months, 18 years old, currently living in Beijing, being HIV-negative or status-unknown, having not previously participated in this

study, and able/willing to provide written informed consent. Eligible participants were invited to complete a survey and have blood drawn for HIV and syphilis testing in our collaborated HIV voluntary counselling and testing clinics. The study protocol was approved by the institutional review boards of Vanderbilt University and the National Center for AIDS/STD Control and Prevention (NCAIDS) of Chinese Center for Disease Control and Prevention (China CDC).

2.2 Data collection and measures

An interviewer-administered survey was conducted among participants to collect data on sociodemographic characteristics, including: age, ethnicity, education, employment, marital status, monthly income, household registration status in Beijing (*Hukou*), residence of origin, venue of sex-finding, self-perception of HIV risk, and duration of living in Beijing. The survey also assessed recent (i.e., 3 months prior to the survey) HIV-related risk behaviors, including illicit drug use (intake of any of these illicit drugs: methamphetamine, MDMA, rush, magu, ketamine, cannabis/marijuana, cocaine, opium, heroin, morphine in past 3 months prior to the survey), alcohol use before sex, multiple concurrent partnerships, commercial sex (pay money for sex from a male sex worker), condomless insertive anal intercourse (CIAI) and condomless receptive anal intercourse (CRAI).

The Alcohol Use Disorders Identification Test (AUDIT) is a 10-item standardized screening instrument developed by World Health Organization (WHO) for identifying multiple alcohol drinking problems (Saunders et al., 1993). The Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) contains the first 3 items of the full AUDIT that address alcohol consumption, with scores ranging from 0 to 12 points, and has been demonstrated its effectiveness in screening for hazardous/harmful alcohol drinking and potential alcohol abuse/dependence (Bradley et al., 2003; Bush et al., 1998; Rubinsky et al., 2010). Both the AUDIT and the AUDIT-C have been widely used in clinical and primary care settings worldwide for a variety of alcohol misuse assessments (Seth et al., 2015), and have also been validated in China (Li et al., 2011a) and among Chinese MSM (Fan et al., 2016; Lu et al., 2013a). In this study, AUDIT-C (see Table 1 for details) was used to measure recent problematic alcohol drinking, as in one study it demonstrated better sensitivity and specificity in measuring problematic alcohol drinking than the full AUDIT scale among Chinese MSM (Lu et al., 2013a). We employed four alcohol use classifications in the current analysis. First, we dichotomized participants into recent drinkers (AUDIT-C ≥ 1) vs. non-drinkers (AUDIT-C=0). Second, we used an AUDIT-C score of ≥ 4 to classify participants as recent hazardous drinkers (vs. non-hazardous drinkers with AUDIT-C<4; Bush et al., 1998). Third, we used item-3 of the AUDIT-C to classify participants who reported any episode of drinking 6 or more standard drinks on one occasion in the past 3 months as recent binge drinkers (vs. non-binge drinkers; Lu et al., 2013a). Participants were informed that a standard drink is defined as any drink that contains about 10 grams of pure alcohol (50 ml of spirits; or 40 ml [one small cup] of rice wine; or one can of beer; or 140 ml [one cup] of red wine). Lastly, the bivariate categories (AUDIT-C ≥ 4 vs. <4) were further enhanced by four-category measurement of the risk of current alcohol dependence: non-drinker (AUDIT-C score = 0), low risk (AUDIT-C score = 1–3), moderate risk (AUDIT-C score = 4–7) and high

risk (AUDIT-C score = 8–12) of current alcohol dependence (Harris et al., 2010; Tran et al., 2013).

2.3 Laboratory testing

HIV rapid tests were performed using Alere Determine HIV1/2 (Colloidal Selenium Device; Alere Medical Co, Ltd., USA). HIV antibody was further screened using ELISA (HIV ELISA testing kit 1, Zhuhai Livzon Diagnostics Inc., China). If positive, the specimen was tested again using another ELISA kit (HIV ELISA testing kit 2, Beijing Wantai Biological Pharmacy Enterprise Co. Ltd., China). A specimen with a positive reaction in both or either ELISA tests was confirmed by Western blot test (HIV Blot 2.2 WB; MP Biomedicals Co, Ltd., China). One Step Anti-TP (*Treponema pallidum*/Syphilis) Test (Colloidal Gold Device, Standard Diagnostics, Inc., Korea) was used as a syphilis rapid test. For rapid test positive persons, syphilis serology was determined through Syphilis Toluidine red unheated serum test (Beijing WANTAI Biological Pharmacy Enterprise Co. Ltd., China) and confirmed by the *Treponema palladium* particle assay (Fujirebio Inc., Tokyo, Japan).

2.4 Statistical analysis

First, we used logistic regression models to examine the associations of sociodemographic characteristics with prior alcohol consumption (yes vs. no), and with hazardous drinking and binge drinking. Second, we assessed the association of each alcohol use pattern (ever used alcohol, hazardous drinking, binge drinking and risk of current alcohol dependence) with HIV-related behaviors (illicit drug use, alcohol use before sex, multiple concurrent partnerships, commercial sex, CIAI and CRAI), as well as HIV and syphilis infection using multivariable logistic regression models. We used directed acyclic graphs (DAG), a widely used causal diagram for evaluating confounders based on *a priori* knowledge and mechanism, to select confounders for adjustments in each of the multivariable models (Hernan et al., 2002). Collinearity between covariates was assessed before fitting the final models. We also calculated the predicted probability of being HIV-infected or syphilis-infected across the full spectrum of the AUDIT-C scores (0–12). All data analyses were conducted using Stata 12.0 (StataCorp LP, College Station, Texas, USA).

3. RESULTS

We excluded 172 men from the 3,760 recruited Phase I participants for the following reasons: duplicate participation through multiple clinics (126), confirmed HIV-positive prior to the study (30), non-MSM or transgender woman (5), no blood sample (5), invalid identification number (4), or lack of a questionnaire (2). Thus, 3,588 (95.4%) MSM (transgender women were eligible, but none were recruited) were included in the current analysis. Of the 3,588 participants, the median age was 28 (interquartile range [IQR]: 24–33), 94% were of Han ethnic background, 85% were currently single, 83% were currently employed, 72% had college education or above, and 75% were migrants (no Beijing household registration). The HIV and syphilis prevalence was 12.7% and 7.5%, respectively (Table 4).

AUDIT-C measures and prevalence of alcohol drinking patterns are shown in Table 1. Among 3,588 MSM, 56.1% had recent (in the past 3 months prior to survey) alcohol drinking, 14.4% were recent hazardous drinkers, 16.8% were recent binge drinkers, and 11.6% were both hazardous/binge drinkers. There was also a substantial overlap between recent hazardous and binge drinkers, with 69.3% (418/603) of the binge drinkers were hazardous drinkers and 80.8% (418/517) of the hazardous drinkers were binge drinkers.

Table 2 presents the sociodemographic predictors of ever drinking alcohol, hazardous drinking or binge drinking within 3 months prior to the survey. Significant predictors of ever drinking alcohol included persons 25–34 years of age, being currently employed, having higher monthly income and finding sex via non-Internet venues. For hazardous drinking in the past 3 months, significant associations were found with age group of 25–34 years, having a longer duration of living in Beijing, being migrants, having a residence origin of township/village, having below college education, being currently employed, having higher monthly income, self-perceiving low or no risk of HIV, and finding sex via non-Internet venues. Binge drinking in the past 3 months was associated with persons between the ages of 25–34 years, living longer in Beijing, being migrants, originating from township/village areas, being currently employed, having higher monthly income, perceiving low/no HIV risk and finding sex via non-Internet venues.

The associations of different alcohol drinking patterns with recent illicit drug use and sexual behaviors are presented in Table 3. Overall, ever drinking alcohol in the past 3 months was associated with a significantly higher likelihood of using illicit drugs, using alcohol before sex, and engaging in CIAI and CRAI. Binge and hazardous drinking were each associated with a significantly higher likelihood of illicit drug use, alcohol use before sex, having multiple concurrent partnerships, seeking commercial sex, and engaging in CIAI with men. Compared to non-drinkers, a significantly increased likelihood of risky behaviors were noted in a dose-response fashion among participants of low, moderate and high risk of current alcohol dependence: illicit drug use ($p_{\text{trend}} < 0.001$), alcohol use before sex ($p_{\text{trend}} < 0.001$), having multiple concurrent partnerships ($p_{\text{trend}} = 0.02$), and engaging in CIAI ($p_{\text{trend}} < 0.001$), or CRAI ($p_{\text{trend}} = 0.01$).

Table 4 shows the associations between alcohol drinking patterns and HIV and syphilis infections. HIV was more likely among participants who were binge drinkers (adjusted odds ratio [AOR], 1.34, 95% confidence interval [CI], 1.02–1.77), hazardous drinkers (AOR, 1.36, 95% CI, 1.02–1.82), or at high risk of current alcohol dependence (AOR, 2.37, 95% CI, 1.39–4.04). Syphilis was also more common among participants who were at high risk of current alcohol dependence (AOR, 1.96, 95% CI, 1.01–3.86). As the AUDIT-C score increases, the probability of being HIV- or syphilis-infected also increases significantly (both $p_{\text{trend}} < 0.001$; Figure 1).

4. DISCUSSION

We assessed the prevalence and predictors of a variety of recent alcohol use and misuse patterns and determined their associations with recent HIV-related behaviors as well as HIV and syphilis infection among Beijing MSM in this study. The prevalence of alcohol use in

the past 3 months was 56.1%, substantially higher than previously reported in Beijing MSM (20.7%–42.1%) (Li et al., 2010; Liu et al., 2014; Ruan et al., 2009). We also documented higher prevalence of hazardous drinking (14.4% vs. 8.8%) and binge drinking (16.8% vs. 11.8%) compared to a previous Beijing MSM study, suggesting an urgent need to tackle alcohol misuse problems among Chinese MSM for the prevention of alcohol-induced risky sexual behaviors and subsequent HIV acquisition/transmission (Lu et al., 2013a). Several factors may partially explain the increased prevalence of alcohol use and misuse among Chinese MSM in a large Chinese city like Beijing. First, the steady increase of the alcohol production industry has been accompanied by aggressive marketing tactics, in parallel with increasing incomes in China and minimally regulated alcohol sales. This increases the availability and accessibility of alcoholic products (He et al., 2016; Tang et al., 2013). Second, modern bars/pubs are expanding in large Chinese cities; these venues are often frequented by gay men to socialize and seek sexual partners, and might be associated with increased concomitant alcohol consumption. (Li et al., 2012; Liu et al., 2016c). Third, the population of young migrant men is growing and they are more inclined to engage in harmful drinking (Li et al., 2014). Furthermore, a majority of MSM in Beijing consists of young migrants (Guo et al., 2014). As more migrants relocate to large Chinese cities, this may contribute to increasing prevalence of alcohol use and misuse.

Alcohol misuse has grown to become a public health problem influencing mental/physical health of its population and social functioning in China (Tang et al., 2013). The 2011 World Health Organization (WHO) estimate indicated that the prevalence of alcohol use disorders (AUD) was 6.9% among adult men and 0.2% among adult women in China (World Health Organization Global status report on alcohol and health, 2011). In this study, we found the prevalence of hazardous drinking (14.4%) and binge drinking (16.8%) among Chinese MSM was slightly lower than that from a national survey of 49,527 residents, in which the prevalence of hazardous and binge drinking was 20.5% and 17.1%, respectively (Li et al., 2011b). This might be due to the wider coverage area of the national survey, including substantial rural areas, where excessive and binge alcohol drinking are usually more prevalent than urban settings in China (Tang et al., 2013). Larger scale studies should be implemented among Chinese MSM to determine the magnitude of alcohol misuse problems for bolstering targeted prevention interventions.

Excessive drinking and acute alcohol intoxication may significantly diminish one's cognitive and psychomotor abilities; moderate/heavy drinkers are at a higher risk of impaired judgment, reasoning and decision making, resulting in sexual risk taking (Brumback et al., 2007). This may explain our observation that alcohol use before sex was common among Chinese MSM, especially among binge/hazardous drinkers and those with a moderate-high risk of alcohol dependence. Chinese MSM report psychological tension due to social stigma and cultural discrimination, and perceived self-efficacy in coping with these stresses is low for many MSM (Liao et al., 2014). Stigma, social isolation, and discrimination increase the likelihood that MSM will misuse alcohol for stress relief, which may in turn affect their self-control and sexual or drug-related risk taking (Fan et al., 2016; Yu et al., 2013b).

Consistent with previous studies (Fan et al., 2016; Liu et al., 2014; Lu et al., 2013a), we found that MSM who practiced binge or hazardous drinking were more likely to use alcohol

before sex, have multiple concurrent sexual partners, and engage in condomless anal sex. We also found an increased likelihood of using illicit drugs and engaging in commercial sex with male sex workers among binge and hazardous drinking MSM, and documented a significant increasing trend (dose-response) of multiple sexual risks from the spectrum of non-drinkers (AUDIT-C score=0) to men at high risk of current alcohol dependence (AUDIT-C score ≥ 8). Other Chinese studies have demonstrated associations between these high-risk behaviors and HIV infection (Lu et al., 2013b). Thus, our findings that binge/hazardous drinkers and high-risk alcohol dependence MSM were significantly more likely to be HIV-infected are consistent with the findings of other studies (Hess et al., 2015; Wray et al., 2016).

Our study showed that several sociodemographic subgroups were at greater risk of problematic alcohol drinking. For example, MSM between the ages of 24 and 35 were more likely to use and misuse alcohol. We speculate that this age group might represent both financially independent and sexually/socially active MSM with greater exposure to alcohol use venues (Guo et al., 2014). A higher likelihood of hazardous and binge drinking was also seen among migrant MSM and those originating from township/village residence. Evidence suggests that Chinese migrants are treated as a marginalized population, and are more likely to suffer from mental stress and associated alcohol use disorders (Guo et al., 2014). Moreover, Chinese men of rural origins are more likely to be problem drinkers compared to their urban counterparts, with limited knowledge of alcohol-related harms and culturally acceptable drinking habits (Wu et al., 2008). A majority of our sample were migrants, nearly all of them either single and/or living far from their families. Migrant-associated pressure and stress may accumulate with increasing time of living in Beijing; we found that longer duration of living in Beijing was associated with higher likelihood of problematic alcohol drinking. Finally, those MSM who perceived low or no risk for HIV were more likely to be hazardous or binge drinkers. More effective HIV and alcohol risk awareness campaigns are needed. Future efforts in HIV prevention intervention should consider collaborating with local gay community organizations in designing specific alcohol risk reduction programs that accommodate the personal, social, and cultural needs as well as the individual risk profiles among especially at-risk sociodemographic subgroups.

The current study is one of the very few that have used a standardized measure (AUDIT-C) to assess alcohol use and its correlates among Chinese MSM. This study is also strengthened by its large sample size recruited from various venues, our lab-confirmed infection status for both HIV and syphilis, and rigorous statistical modeling strategies designed to reduce selection bias and increase the accuracy and power of our modeled estimates.

There are also limitations in our study. First, the cross-sectional design may not elucidate temporal relationships such that causality should not be inferred. Second, the self-report manner and culturally sensitive nature regarding homosexual behaviors and illicit drug use questions may subject our data to recall bias and social desirability bias. However, we restricted the data ascertainment to the past 3 months prior to the survey, and all participants were HIV-negative or status unknown before survey completion. Third, the sample sizes of the subgroups with higher AUDIT-C scores (4–7 and ≥ 8) were small, decreasing the precision and the reliability of our multivariable estimates as well as projected probabilities

of HIV or syphilis infection regarding the assessment of moderate-high risk for current alcohol dependence. Therefore, these specific findings should be interpreted with caution, e.g., large effect size regarding alcohol use before sex. Fourth, our findings were based on a convenience sample from the baseline of a randomized controlled trial in Beijing, China, which may limit the generalizability of the study findings to other regions in China. Last, our surveyed sample represents a substantial overlap between current hazardous and binge drinkers among Chinese MSM, which may affect the analytic efficiency and result in similar findings of the associated factors. Future studies are needed to further verify the overlapping features of these subgroups for better designing alcohol misuse-related intervention programs.

Sexual disinhibition from problematic alcohol drinking among Chinese MSM may be a prominent risk factor for driving HIV transmission among MSM. Excessive alcohol consumption is a challenge to the integrity of the HIV care continuum (Myers et al., 2016). Binge and hazardous drinking Chinese MSM are especially at elevated risk of illicit drug use, sexual behaviors and HIV infection, emphasizing future policy establishment to target these specific subgroups for alcohol-related risk reduction strategies. Our current findings also highlight the urgent need to develop screening and intervention programs to enhance self-efficacy in coping with stress and to reduce problematic alcohol use among Chinese MSM. Future studies would do well to employ standard alcohol measures (e.g., AUDIT, AUDIT-C, and AUDIT-3) to screen for alcohol misuse among MSM, its influence in their testing/linkage/engagement/adherence in HIV care, as well as alcohol's impact on other chronic comorbidities in the ART era.

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Highlights

- Alcohol use and misuse remains a critical challenge among Chinese men who have sex with men (MSM)
- Binge/hazardous drinking Chinese MSM are more likely to conduct high-risk behaviors
- Binge/hazardous drinking Chinese MSM are associated with higher HIV risk
- As AUDIT-C score increases, probabilities of HIV/syphilis infection also increase

Figure 1.

Predicted probability of HIV and syphilis infections by AUDIT-C score among men who have sex with men in Beijing, China (N=3,588)

Note: p for trend < 0.01 for both HIV and syphilis

Table 1

Response of AUDIT-C survey and recent alcohol drinking pattern among men who have sex with men in Beijing, China (N=3,588)

	N (%)
Item	
Item 1: How often did you have a drink containing alcohol in the past 3 months? (N=3,588)	
Never (0 point)	1,574 (43.9)
Monthly or less (1 point)	1,108 (30.9)
2–4 times per month (2 points)	594 (16.5)
2–3 times per week (3 points)	185 (5.2)
4 or more times per week (4 points)	127 (3.5)
Item 2: How many standard drinks containing alcohol did you have on a typical day in the past 3 months? (N=2,014)	
1 or 2 (0 point)	1,348 (66.9)
3 or 4 (1 point)	415 (20.6)
5 or 6 (2 points)	186 (9.3)
7 or 9 (3 points)	34 (1.7)
10 or more (4 points)	31 (1.5)
Item 3: How often did you have six or more standard drinks on one occasion in the past 3 months? (N=2,014)	
Never (0 point)	1,411 (70.1)
Less than monthly (1 point)	354 (17.6)
Monthly (2 points)	155 (7.7)
Weekly (3 points)	79 (3.9)
Daily or almost daily (4 points)	15 (0.7)
Recent (in the past 3 months) alcohol consumption	
No	1,574 (43.9)
Yes	2,014 (56.1)
Recent (in the past 3 months) hazardous drinking	
No (AUDIT-C<4)	3,071 (85.6)
Yes (AUDIT-C ≥ 4)	517 (14.4)
Recent (in the past 3 months) binge drinking[†]	
No	2,985 (83.2)
Yes	603 (16.8)
Risk of current alcohol dependence	
Non-drinker (AUDIT-C=0)	1,574 (43.9)
Low (AUDIT-C=1–3)	1,497 (41.7)
Moderate (AUDIT-C=4–7)	441 (12.3)
High (AUDIT-C=8–12)	76 (2.1)

Note: AUDIT-C: Alcohol Use Disorders Identification Test. AUDIT-C score = item 1 + item 2 + item 3.

[†] Having 6 or more standard drinks on one occasion.

Table 2

Sociodemographic predictors of recent alcohol use patterns among men who have sex with men in Beijing, China (N=3,588)

Variable	Total N (Col %)	Ever drinking alcohol (+)		Hazardous alcohol drinking(+) [‡]		Binge drinking (+) [‡]	
		Row % (n/N)	Adjusted OR (95% CI)	Row % (n/N)	Adjusted OR (95% CI)	Row % (n/N)	Adjusted OR (95% CI)
Age, year							
<25	914 (25.5)	56.0 (512/914)	Reference	12.0 (110/914)	Reference	14.9 (136/914)	Reference
25–34	1,927 (53.7)	58.0 (1,118/1,927)	1.09 (1.03,1.27)^a	15.2 (293/1,927)	1.31 (1.04,1.66)^a	18.9 (364/1,927)	1.33 (1.07,1.65)^a
35	747 (20.8)	51.4 (384/747)	0.83 (0.68,1.01) ^a	15.3 (114/747)	1.32 (0.99,1.74) ^a	13.8 (103/747)	0.91 (0.69,1.21) ^a
Ethnicity							
Han	3,361 (93.7)	56.1 (1,886/3,361)	Reference	14.2 (477/3,361)	Reference	16.7 (560/3,361)	Reference
Non-Han	227 (6.3)	56.4 (128/227)	1.01 (0.77,1.33) ^a	17.6 (40/227)	1.29 (0.91,1.84) ^a	18.9 (43/227)	1.17 (0.83,1.65) ^a
Duration of living in Beijing, year							
< 5	1,533 (42.7)	56.5 (866/1,533)	Reference	13.1 (201/1,533)	Reference	16.2 (249/1,533)	Reference
5	2,055 (57.3)	55.9 (1,148/2,055)	1.04 (0.89,1.20) ^b	15.4 (316/2,055)	1.24 (1.01,1.53)^b	17.2 (354/2,055)	1.21 (1.00,1.48)^b
Migrant (No Beijing household registration)							
No	889 (24.8)	55.0 (489/889)	Reference	13.2 (117/889)	Reference	14.6 (130/889)	Reference
Yes	2,699 (75.2)	56.5 (1,525/2,699)	1.06 (0.90,1.25) ^c	14.8 (400/2,699)	1.26 (1.01,1.60)^c	17.5 (473/2,699)	1.31 (1.05,1.64)^c
Residence of origin							
City	2,437 (67.9)	54.0 (1,315/2,437)	Reference	13.8 (336/2,437)	Reference	15.8 (385/2,437)	Reference
Township/village	1,151 (32.1)	60.7 (699/1,151)	1.17 (0.96,1.42) ^d	15.7 (181/1,151)	1.32 (1.14,1.52)^d	18.9 (218/1,151)	1.24 (1.04,1.49)^d
Current marital status							
Single	3,049 (85.0)	56.3 (1,717/3,049)	Reference	13.9 (423/3,049)	Reference	16.7 (512/3,049)	Reference
Married	539 (15.0)	55.1 (297/539)	1.09 (0.89,1.35) ^e	17.4 (94/539)	1.30 (0.98,1.72) ^e	16.9 (91/539)	1.17 (0.89,1.54) ^e
Education, year of schooling							
College and above (>12)	2,579 (71.9)	56.6 (1,460/2,579)	Reference	13.4 (345/2,579)	Reference	16.9 (437/2,579)	Reference
Middle school and below (< 12)	1,009 (28.1)	54.9 (554/1,009)	1.01 (0.85,1.16) ^e	17.1 (172/1,009)	1.33 (1.08,1.64)^e	16.5 (166/1,009)	1.04 (0.85,1.27) ^e
Current employment							
No	628 (17.5)	52.1 (327/628)	Reference	10.7 (67/628)	Reference	11.8 (74/628)	Reference
Yes	2,960 (82.5)	57.0 (1,687/2,960)	1.23 (1.02,1.48)^f	15.2 (450/2,960)	1.38 (1.03,1.84)^f	17.9 (529/2,960)	1.54 (1.17,2.03)^f

Variable	Total		Ever drinking alcohol (+)		Hazardous alcohol drinking(+) [‡]		Binge drinking (+) [‡]	
	N (Col %)	Row % (n/N)	Adjusted OR (95% CI)	Row % (n/N)	Adjusted OR (95% CI)	Row % (n/N)	Adjusted OR (95% CI)	
Monthly income (Chinese Yuan)								
<5000	1,698 (47.3)	52.5 (891/1,698)	Reference	11.8 (201/1,698)	Reference	13.4 (227/1,698)	Reference	
5000	1,890 (52.7)	59.4 (1,123/1,890)	1.31 (1.12,1.54)^g	16.7 (316/1,890)	1.73 (1.37,2.18)^g	19.9 (376/1,890)	1.55 (1.25,1.93)^g	
HIV risk perception								
High/very high	2,126 (59.3)	54.9 (1,168/2,126)	Reference	12.8 (273/2,126)	Reference	14.5 (309/2,126)	Reference	
Low/no risk	1,462 (40.7)	57.9 (846/1,462)	1.12 (0.98,1.29) ^h	16.7 (244/1,462)	1.38 (1.14,1.66)^h	20.1 (294/1,462)	1.48 (1.24,1.77)^h	
Sex-finding venue								
Internet	2,838 (79.1)	55.6 (1,579/2,838)	Reference	13.2 (375/2,838)	Reference	16.4 (465/2,838)	Reference	
Non-Internet ^{**}	750 (20.9)	58.0 (435/750)	1.24 (1.04,1.48)ⁱ	18.9 (142/750)	1.56 (1.24,1.96)ⁱ	18.4 (138/750)	1.32 (1.05,1.65)ⁱ	

Note: IQR, interquartile range; OR, odds ratio; *Hukou*, household registration; 1 Chinese Yuan≈0.15 USD; +, indicates positive for the specific outcome

[‡] Having 6 or more standard drinks on one occasion,

[‡] AUDIT-C score 4,

^{**} Including beach, woods, street, theater, public transportation, hotel and private homes

^a No confounders identified based on direct acyclic graph (DAG);

^b adjusted for age and *Hukou* (household registration);

^c adjusted for age and duration of living in Beijing;

^d adjusted for ethnicity;

^e adjusted for age and ethnicity;

^f adjusted for age, education and *Hukou* (household registration);

^g adjusted for age, employment, education and *Hukou* (household registration);

^h adjusted for age and education;

ⁱ adjusted for age, education, *Hukou* (household registration), income and duration of living in Beijing.

Table 3

Associations of recent alcohol drinking patterns and high-risk behaviors among men who have sex with men in Beijing, China (N=3,588)

Variables	Illicit drug use	Alcohol use before sex	Multiple concurrent partnerships	Commercial sex with male workers	Condomless insertive anal intercourse with men	Condomless receptive anal intercourse with men
	AOR (95% CI) ^a	AOR (95% CI) ^b	AOR (95% CI) ^c	AOR (95% CI) ^c	AOR (95% CI) ^b	AOR (95% CI) ^b
<i>Model 1: Ever drinking alcohol</i>						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.38 (1.19, 1.61)	3.60 (3.25, 3.97)	1.06 (0.93, 1.22)	0.89 (0.60, 1.33)	1.69 (1.43, 2.00)	1.31 (1.11, 1.55)
<i>Model 2: Binge drinking[†]</i>						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.33 (1.10, 1.61)	8.39 (6.90, 10.18)	1.22 (1.02, 1.46)	2.00 (1.28, 3.14)	1.34 (1.09, 1.64)	1.01 (0.81, 1.26)
<i>Model 3: Hazardous drinking</i>						
No (AUDIT-C<4)	Reference	Reference	Reference	Reference	Reference	Reference
Yes (AUDIT-C ≥ 4)	1.39 (1.14, 1.71)	10.72 (8.72, 13.19)	1.34 (1.11, 1.62)	1.82 (1.14, 2.93)	1.30 (1.05, 1.61)	1.10 (0.88, 1.39)
<i>Model 4: Risk of current alcohol dependence</i>						
Non-drinker (AUDIT-C=0)	Reference	Reference	Reference	Reference	Reference	Reference
Low (AUDIT-C=1-3)	1.31 (1.11, 1.54)	17.91 (12.25, 26.19)	0.99 (0.85, 1.14)	0.66 (0.41, 1.06)	1.69 (1.42, 2.02)	1.32 (1.11, 1.58)
Moderate (AUDIT-C=4-7)	1.55 (1.23, 1.95)	74.69 (49.62, 112.42)	1.36 (1.08, 1.64)	1.55 (0.92, 2.60)	1.69 (1.32, 2.15)	1.26 (0.98, 1.63)
High (AUDIT-C=8-12)	2.19 (1.18, 4.05)	244.18 (121.42, 491.07)	1.29 (0.71, 2.33)	1.34 (0.31, 5.75)	1.93 (1.01, 3.72)	1.40 (0.70, 2.79)
<i>p</i> for trend	<0.001	<0.001	0.02	0.32	<0.001	0.01

Note: AOR, adjusted odds ratio; CI, confidence interval;

^a Adjusted for age, education, marital status, income and HIV risk perception^b Adjusted for age, education, marital status and HIV risk perception^c Adjusted for age, education, marital status, income, duration of living in Beijing and HIV risk perception[†] Having 6 or more standard drinks on one occasion

Table 4

Associations of recent alcohol drinking patterns and HIV and syphilis infections among men who have sex with men in Beijing, China (N=3,588)

Variables	HIV infection		Syphilis infection	
	Prevalence=12.7% (455/3,588)		Prevalence=7.5% (269/3,588)	
	% (n/N)	AOR (95% CI) ^a	% (n/N)	AOR (95% CI) ^a
<i>Model 1: Ever drinking alcohol</i>				
No	12.9 (203/1,574)	Reference	7.6 (119/1,574)	Reference
Yes	12.5 (252/2,014)	0.96 (0.78, 1.17)	7.5 (150/2,014)	1.02 (0.80, 1.33)
<i>Model 2: Binge drinking[†]</i>				
No	12.2 (365/2,985)	Reference	7.5 (224/2,985)	Reference
Yes	14.9 (90/603)	1.34 (1.02, 1.77)	7.4 (45/603)	1.02 (0.73, 1.44)
<i>Model 3: Hazardous drinking</i>				
No (AUDIT-C<4)	12.3 (377/3,071)	Reference	7.4 (227/3,071)	Reference
Yes (AUDIT-C ≥ 4)	15.1 (78/517)	1.36 (1.02, 1.82)	8.1 (42/517)	1.07 (0.76, 1.52)
<i>Model 4: Risk of current alcohol dependence</i>				
Non-drinker (AUDIT-C=0)	12.9 (203/1,574)	Reference	7.6 (119/1,574)	Reference
Low (AUDIT-C=1-3)	11.6 (174/1,497)	0.88 (0.71, 1.09)	7.2 (108/1,497)	1.01 (0.77, 1.33)
Moderate (AUDIT-C=4-7)	13.2 (58/441)	1.02 (0.75, 1.40)	7.0 (31/441)	0.93 (0.61, 1.41)
High (AUDIT-C=8-12)	26.3 (20/76)	2.37 (1.39, 4.04)	14.5 (11/76)	1.96 (1.01, 3.86)
<i>p</i> for trend		0.20		0.49

Note: AOR, adjusted odds ratio; CI, confidence interval;

^a Adjusted for age, ethnicity, education, illicit drug use, marital status and HIV risk perception

[†] Having 6 or more standard drinks on one occasion