


Social and Behavioral Correlates of Sexually Transmitted Infections among Men who Have Sex with Men who Use Alcohol in the San Francisco Bay Area

American Journal of Men's Health
 May-June 1-7
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 DOI: 10.1177/15579883211026830
journals.sagepub.com/home/jmh


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Abstract

The risk of acquiring sexually transmitted infections (STIs) among men who have sex with men (MSM) is driven by various socio-behavioral factors. From 2015-2017, 247 MSM \geq 18 years-old who reported alcohol use in the past year, were recruited into a cross-sectional study in San Francisco. Participants completed a survey assessing socio-demographics, substance use and treatment, sexual behaviors, HIV status and self-reported STI diagnosis in the past 6 months. Multivariable logistic regression models stratified by HIV status were used to identify the correlates of STIs. Of 247 MSM, the prevalence of bacterial STIs were: gonorrhea (12.9%), chlamydia (9.3%) and syphilis (6.0%). Among 177 MSM living without HIV, factors significantly associated with recent STI diagnosis were: current pre-exposure prophylaxis (PrEP) use (aOR = 3.53, 95% CI: 1.42–8.75, $p \leq .01$), popper use during sex in the past 6 months (aOR = 3.16, 95% CI = 1.34–7.47, $p \leq .01$) and a history of alcohol treatment (aOR = 0.17, 95% CI = 0.04–0.68, $p = .01$). Also, in a sensitivity analysis (removing PrEP), any receptive condomless anal sex was independently associated with recent STI diagnosis (aOR = 2.86, 95% CI = 1.15–7.08, $p = .02$). Among 70 MSM living with HIV, factors significantly associated with recent STI diagnosis were: White race/ethnicity (adjusted odds ratio [aOR] = 7.36, 95% confidence interval [CI] = 1.48–36.62, $p = .01$), younger age (aOR = 0.90, 95% CI: 0.84–0.97, $p < .01$) and a higher number of male sexual partners in the past 6 months (aOR = 1.03, 95% CI = 1.00–1.06, $p = .02$). Sexual health interventions that address the unique needs of MSM living with and without HIV who use alcohol in San Francisco are needed to reduce STI acquisition and transmission.

Keywords

Men who have sex with men who use alcohol, HIV and other sexually transmitted infections, poppers, PrEP and receptive condomless anal sex.

Received February 3, 2021; revised April 19, 2021; accepted June 2, 2021

Men who have sex with men (MSM) are disproportionately impacted by HIV and other sexually transmitted infections (STIs) and MSM living with HIV tend to have a higher prevalence of STIs compared to their counterparts (CDC, 2019; Remis et al., 2016). According to the 2019 National HIV Behavioral Surveillance (NHBS) report the prevalence of any bacterial STI (i.e., gonorrhea, chlamydia, and syphilis) was 26% among MSM living with HIV, compared to 18% among MSM living without HIV (CDC, 2019). Similarly, the prevalence of ever being diagnosed with genital warts or herpes simplex virus (HSV) among MSM living with HIV were 12% and 10% respectively, compared to 6% (for both) among MSM living without HIV (CDC, 2019).

STI risk among MSM is often driven by substance use including the use of inhaled nitrates (“poppers”) and methamphetamine, both of which have been linked to

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condomless anal intercourse (CAI) and multiple sexual partnerships (Carey et al., 2009; Hambrick et al., 2018; Sewell et al., 2017). Additionally, a systematic review of different substances used in nightlife settings (“club drugs”) documented their associations with STI incidence (Drumright et al., 2006). Also, epidemiological research has linked heavy alcohol consumption to CAI and HIV infection among MSM (Allen et al., 2015; Santos et al., 2018; Vosburgh et al., 2012; Woolf & Maisto, 2009). However, less is known about how the prevalence and correlates of STIs differ by HIV serostatus among MSM who use alcohol. Findings from such work may help inform the development of targeted interventions strategies for MSM who use alcohol who are living with and without HIV.

To reduce this gap in research, we studied MSM who use alcohol in the San Francisco (SF) Bay Area to estimate the prevalence and identify the correlates of recent STI diagnosis by HIV serostatus. We hypothesized that the correlates of STI diagnosis would differ by HIV status and be shaped by social (e.g., substance use) and behavioral (e.g., CAI) factors. This research may further our understanding of how the socio-behavioral correlates of STIs differ by HIV serostatus among MSM who use alcohol and inform the development of sexual health interventions for this sub-population of MSM.

Methods

The study protocol, eligibility rate and participant flow have been described in full detail elsewhere (Santos et al., 2018). Briefly, data were drawn from a cross-sectional study called *The SEEDS Study*, of 247 MSM recruited using respondent driven sampling (RDS) and enrolled between 2015 and 2017. Participants were eligible if they: (1) were a cisgender man who reported sex with another man (MSM) in the past year, used alcohol in the past year, were ≥ 18 years-old and lived in the SF Bay Area. Participants completed a survey that assessed drug and alcohol use, condomless receptive and insertive anal sex, number of male sex partners, HIV status and self-reported STI (syphilis, gonorrhea, chlamydia, HSV, and genital warts) diagnosis in the past 6 months. All participants provided written informed consent and all study procedures were approved by the IRB at the University of California, San Francisco (IRB study#14-14481).

Statistical Analysis

Bivariate logistic regression was used to identify factors associated with the primary outcome of interest, self-reported STI diagnosis in the past 6 months. Multivariable logistic regression was then used to further examine factors that were significant ($p \leq .05$) in bivariate models

while controlling for age. Final models were built using a backward stepwise selection procedure where variables that did not retain significance (i.e., $p > .05$) were removed one at a time in order to attain the most parsimonious model. Interactions were tested between exposures theorized to interact using the multiplicative scale in order to ensure the integrity of both final models. All models were stratified by HIV serostatus and analyses were conducted on complete cases. Since we conducted stratified analyses, we did not perform RDS adjustment. A sensitivity analysis was also performed exploring multivariable models with and without current PrEP use among MSM living without HIV. All analyses were conducted using Stata 16.1.

Results

Of a total of 247 participants, the median age was 40 years (interquartile range [IQR] = 30,52) and 82 (66.8%) were non-White. The prevalence of STIs were: 32 (12.9%) for gonorrhea, 23 (9.3%) for chlamydia, 15 (6.0%) for syphilis, 9 (3.6%) for genital warts, and 4 (1.6%) for HSV. The median number of male sexual partners in the past 6 months was 4 (IQR = 2,10) and 44 (17.8%) participants reported currently using PrEP. Popper use and alcohol use during sex in the past 6 months were reported by 83 (33.6%) and 180 (84.9%) participants, respectively. A total of 80 (32.3%) individuals reported ever receiving treatment for alcohol use (Table 1).

Results from the multivariable logistic regression analyses show that among MSM living without HIV, factors significantly associated with recent STI diagnosis were current PrEP use (adjusted odds ratio [aOR] = 3.53, 95% confidence interval [CI] = 1.42–8.75, $p < .01$) using poppers during sex in the past 6 months (aOR = 3.16, 95% CI = 1.34–7.47, $p < .01$) and a history of alcohol treatment was negatively associated with the outcome (aOR=0.17, 95% CI = 0.04–0.68, $p = .01$). Results from the sensitivity analysis show that after removing PrEP from the model, any receptive condomless anal sex among MSM living without HIV was independently associated with STI diagnosis (aOR = 2.86, 95% CI = 1.15–7.08, $p = .02$) (Table 2). Among MSM living with HIV, factors significantly associated with STI diagnosis were White race/ethnicity (aOR = 7.36, 95% CI = 1.48–36.62, $p = .01$), having a higher number of male sexual partners in the past 6 months (aOR = 1.03, 95% CI = 1.00–1.06, $p = .02$) and younger age (aOR = 0.90, 95% CI = 0.84–0.97, $p < .01$) (Table 3).

Discussion

In this study, approximately one in five MSM who use alcohol in San Francisco were diagnosed with a bacterial

Table 1. Sociodemographic, Behavioral and Clinical Characteristics of Men Who Have Sex with Men in San Francisco, CA (N = 247).

Sociodemographics	n (%)
Median age in years (interquartile range = IQR)	40 (30, 52)
<i>Education</i>	
Less than high school	19 (7.7)
High school or GED	52 (21.1)
Some college or 2-year degree	81 (32.9)
Bachelor's degree	61 (24.8)
Any post-graduate	33 (13.4)
<i>Race/ethnicity</i>	
White	82 (33.2)
Black/African American	74 (29.9)
Asian/Pacific Islander	33 (13.3)
Hispanic/Latino	38 (15.3)
Mixed/Other	20 (8.1)
<i>Sexually transmitted infections</i>	
Living with HIV	70 (28.3)
Syphilis diagnosis in the past 6 months	15 (6.0)
Gonorrhea diagnosis in the past 6 months	32 (12.9)
Chlamydia diagnosis in the past 6 months	23 (9.3)
Herpes simplex virus diagnosis in the past 6 months	4 (1.6)
Genital warts diagnosis in the past 6 months	9 (3.6)
<i>Sexual behaviors in the past 6 months</i>	
Any insertive condomless anal sex	154 (62.3)
Any receptive condomless anal sex	136 (55.0)
Median number of male sexual partners (IQR)	4 (2, 10)
<i>Medication use</i>	
Currently taking pre-exposure prophylaxis (PrEP)	44 (17.8)
Any viagra use ever	60 (24.2)
<i>Alcohol use</i>	
Frequency of binge drinking in the past 12 months	
Never	28 (11.3)
Less than monthly	58 (23.4)
Monthly	46 (18.6)
Weekly	78 (31.5)
Daily or almost daily	37 (14.9)
<i>AUDIT score risk levels</i>	
Zone I (0–7)	46 (19.0)
Zone II (8–15)	95 (39.2)
Zone III (16–19)	35 (14.4)
Zone IV (20–40)	66 (27.2)
Severity of dependence score of 3 or above	113 (45.7)
<i>Drug and alcohol use during sex in the past 6 months</i>	
Inhaled nitrates/"poppers"	83 (33.6)
Ecstasy	37 (14.9)
Gamma hydroxybutyrate (GHB)	36 (14.5)
Methamphetamine	71 (28.7)
Alcohol	180 (84.9)
<i>Substance use treatment ever</i>	
Treatment for alcohol use	80 (32.3)
Mutual support group attendance (e.g., 12-Step Groups)	55 (22.2)

Note:

Some percentages may reflect denominators smaller than the N given in the column head, due to missing data.

Data that were not normally distributed were described using medians and interquartile ranges.

Binge drinking was defined as consuming five or more drinks on one occasion in the past year.

The 10-item AUDIT was used to measure hazardous alcohol consumption and AUDIT score risk levels were based on a standard cut-off of 16 or greater which represents moderate to high risk of hazardous drinking.

A severity of dependence score of 3 or greater is indicative of alcohol dependence.

STI in the past 6 months, which is similar to that reported among MSM across the United States (CDC, 2019). However, the prevalence of gonorrhea among MSM in this study was higher than that among MSM throughout the United States (CDC, 2019). We also found that the correlates of recent STI diagnosis varied qualitatively by HIV status among MSM in this study. Based on our findings, we recommend that interventions: develop targeted strategies for MSM living with and without HIV who drink alcohol, increase the frequency of STI screening (especially for gonorrhea) leveraging mobile screening models and consider using novel partner notification systems to facilitate STI prevention and treatment efforts (Jain et al., 2017; Rönn et al., 2020).

Among MSM living without HIV, current PrEP use and popper use during sex were associated with recent STI diagnosis. Although, prior research among MSM has shown a higher incidence of STIs among PrEP users compared to non-users, the literature on risk compensation and PrEP use is mixed (McCormack et al., 2016; Traeger et al., 2019). Thus, it is possible that our finding linking PrEP use to recent STI diagnosis may be driven by engagement in regular STI screening services associated with PrEP programs. Regardless of the mechanism, this finding signals the importance of routine STI screening services for MSM on PrEP. It is also important to note that in the sensitivity analysis, after removing PrEP from the multi-variable model, any receptive condomless anal sex was associated with recent STI diagnosis, suggesting that there may be collinearity between these exposures. Popper use among MSM has been linked to: group sex, CAI, serodiscordant CAI, and multiple anal sexual partners, and greater STI incidence (Daskalopoulou et al., 2014; Zhang et al., 2020). Hence, our finding linking popper use to self-reported STI diagnosis is consistent with prior research and underlines the need to integrate substance use treatment services into sexual health programs.

Alcohol treatment's negative association with STI diagnosis among MSM living without HIV, may indicate that substance use treatment has collateral health benefits including reducing the risk of STI acquisition and onward transmission (Mukandavire et al., 2017; Witte et al., 2011). Also, it is possible that reduced alcohol consumption mediates the association between alcohol treatment and decreased STI acquisition. Future studies leveraging longitudinal data should examine potential mediators between alcohol treatment and decreased STI acquisition among MSM. We also recommend that sexual health programs develop streamlined processes to connect clients with alcohol dependence to efficacious treatment programs.

Among MSM living with HIV in this study, those who were younger and those with a higher number of male

Table 2. Sociodemographic and Behavioral Characteristics of Men Who Have Sex with Men Living without HIV Who Did and Did Not Report Being Diagnosed with a Sexually Transmitted Infection, in San Francisco, CA (n = 177).

Variable	No recent STI (n = 138)	Recent STI (n = 39)	Total (n = 177)	OR (95% CI)	P	Model 1 aOR (95% CI)	P	Model 2 aOR (95% CI)	P
Median age in years (interquartile range = IQR)	36 (30.52)	31 (26, 42)	35 (28, 50)	0.96 (0.93–0.99)	.03	1.00 (0.96–1.04)	.71	1.00 (0.9–1.04)	.75
Less than high school	7 (5.0)	3 (7.6)	10 (5.6)	Reference					
High school or GED	32 (23.1)	6 (15.3)	38 (21.4)	0.43 (0.08–2.18)	.31				
Some college or 2-year degree	36 (26.0)	8 (20.5)	44 (24.8)	0.51 (0.10–2.45)	.40				
Bachelor's degree	39 (28.2)	17 (43.5)	56 (31.6)	1.01 (0.23–4.41)	.98				
Any post-graduate	24 (17.3)	5 (12.8)	29 (16.3)	0.48 (0.09–2.55)	.39				
Race/ethnicity									
White	51 (36.9)	14 (35.9)	65 (36.7)	1.97 (0.56–5.97)	.22				
Black/African American	36 (26.0)	5 (12.8)	41 (23.1)	Reference					
Asian/Pacific Islander	23 (16.6)	6 (15.3)	29 (16.3)	1.87 (0.51–6.87)	.34				
Hispanic/Latino	18 (13.0)	9 (23.0)	27 (15.2)	3.6 (1.05–12.32)	.04				
Mixed/Other	10 (7.2)	5 (12.8)	15 (8.4)	3.6 (0.86–14.95)	.07				
Any insertive condomless anal sex	75 (54.3)	30 (76.9)	105 (59.3)	2.80 (1.23–6.33)	.01				
Any receptive condomless anal sex	64 (46.3)	30 (76.9)	94 (53.1)	3.85 (1.70–8.72)	<.01				
Median number of male sexual partners (IQR)	3 (1, 6)	7 (4, 20)	4 (2, 10)	1.05 (1.02–1.09)	<.01				
Currently taking pre-exposure prophylaxis (PrEP)	23 (16.6)	21 (53.8)	44 (24.8)	5.83 (2.69–12.63)	<.001	3.53 (1.42–8.75)	<.01		
Any Viagra use ever	26 (18.8)	14 (35.9)	40 (22.6)	2.41 (1.10–5.26)	.02				
Frequency of binge drinking in the past 12 months									
Never	15 (10.8)	2 (5.1)	17 (9.6)	Reference					
Less than monthly	32 (23.1)	9 (23.0)	41 (23.1)	2.10 (0.40–10.98)	.37				
Monthly	31 (22.4)	5 (12.8)	36 (20.3)	1.20 (0.20–6.97)	.83				
Weekly	40 (28.9)	17 (43.5)	57 (32.2)	3.18 (0.65–15.48)	.15				
Daily or almost daily	20 (14.4)	6 (15.3)	26 (14.6)	2.25 (0.39–12.75)	.36				
AUDIT scores risk levels									
Zone I (0-7)	24 (17.5)	7 (18.4)	31 (17.7)	Reference					
Zone II (8-15)	62 (45.2)	14 (36.8)	76 (43.3)	0.77 (0.27–2.15)	.62				
Zone III (16-19)	17 (12.4)	7 (18.4)	24 (13.70)	1.41 (0.41–4.77)	.57				
Zone IV (20-40)	34 (24.8)	10 (26.3)	44 (25.1)	1.00 (0.33–3.02)	.98				
Severity of dependence score of 3 or above	60 (43.4)	15 (38.4)	75 (42.3)	0.81 (0.39–1.68)	.57				
Inhaled nitrate/“popper” use during sex past six months	31 (22.4)	24 (61.5)	55 (31.7)	5.52 (2.58–11.79)	<.001	3.16 (1.34–7.47)	<.01	4.10 (1.83–9.18)	<.01
Ecstasy use during sex past 6 months	17 (12.3)	14 (35.9)	31 (17.5)	3.98 (1.74–9.12)	<.01				
Gamma hydroxybutyrate (GHB) use during sex past 6 months	10 (7.2)	11 (28.2)	21 (11.8)	5.02 (1.94–12.98)	<.01				
Methamphetamine use during sex past 6 months	27 (19.5)	7 (17.9)	40 (22.6)	0.89 (0.35–2.25)	.82				
Alcohol use during sex past 6 months	97 (81.5)	33 (91.6)	130 (83.8)	2.49 (0.70–8.87)	.15				
Treatment for alcohol use ever	48 (34.7)	3 (7.6)	51 (28.8)	0.15 (0.04–0.53)	<.01	0.17 (0.04–0.68)	.01	0.17 (0.04–0.66)	.01
Mutual support group attendance ever (e.g., Twelve-Step Groups)	31 (22.4)	3 (7.6)	34 (19.2)	0.28 (0.08–0.99)	.05				

Note:

Data that were not normally distributed were described using medians and interquartile ranges.

p-values were generated using logistic regression.

Multivariable models controlled for age in years.

OR = odds ratio, aOR = adjusted odds ratio.

Significant (≤ 0.05) variables from the bivariate analyses were explored further in stratified multivariable analyses.

Some percentages may reflect denominators smaller than the N given in the column head, due to missing data.

HIV status ‘unknown’ (n = 6) included in the HIV-negative category.

Binge drinking was defined as consuming five or more drinks on one occasion.

The 10-item AUDIT was used to measure hazardous alcohol consumption and AUDIT score risk levels were based on a standard cut-off of 16 or greater which represents moderate to high risk of hazardous drinking.

A severity of dependence score of 3 or greater is indicative of alcohol dependence.

The outcome, recent STI diagnosis includes those who reported being diagnosed with any of the following in the past 6 months: syphilis, gonorrhea, chlamydia, herpes simplex virus, and genital warts.

Table 3. Sociodemographic and Behavioral Characteristics of Men Who Have Sex with Men Living with HIV Who Did, and Did Not Report Being Diagnosed with a Sexually Transmitted Infection, in San Francisco, CA (n = 70).

Variable	No recent STI (n = 51)	Recent STI (n = 19)	Total (n = 70)	OR (95% CI)	P	aOR (95% CI)	P
Median age in years (interquartile range = IQR)	50 (44, 55)	37 (29, 47)	47.5 (37, 54)	0.92 (0.88–0.97)	<.01	0.90 (0.84–0.97)	<.01
Less than high school	7 (14.0)	2 (10.5)	9 (13.0)	Reference			
High school or GED	11 (22.0)	3 (15.7)	14 (20.2)	0.95 (0.12–7.22)	.96		
Some college or 2-year degree	28 (56.0)	9 (47.3)	37 (53.6)	1.12 (0.19–6.42)	.89		
Bachelor's degree	3 (6.0)	2 (10.5)	5 (7.2)	2.33 (0.21–25.24)	.48		
Any post-graduate	1 (.0)	3 (15.7)	4 (5.8)	10.5 (0.66–165.11)	.09		
Race/ethnicity							
White	9 (17.6)	8 (42.1)	17 (24.2)	4.97 (1.29–19.13)	.01	7.36 (1.48–36.62)	.01
Black/African American	28 (54.9)	5 (26.3)	33 (47.1)	Reference			
Asian/Pacific Islander	2 (3.9)	2 (10.5)	4 (5.7)	5.6 (0.63–49.47)	.12	2.01 (0.16–24.91)	.58
Hispanic/Latino	8 (15.6)	3 (15.7)	11 (15.7)	2.1 (0.41–10.74)	.37	0.20 (0.01–2.75)	.23
Mixed/Other	4 (7.8)	1 (5.2)	5 (7.1)	1.4 (0.12–15.26)	.78	0.04 (0.00–31.73)	.35
Any insertive condomless anal sex	32 (62.7)	17 (89.4)	49 (70.0)	5.04 (1.04–24.28)	.04		
Any receptive condomless anal sex	26 (50.9)	16 (84.2)	42 (60.0)	5.12 (1.32–19.77)	.01		
Median number of male sexual partners (IQR)	5 (3, 10)	10 (5, 50)	5 (3, 11)	1.02 (1.00–1.05)	.04	1.03 (1.00–1.06)	.02
Any Viagra use	11 (21.5)	9 (47.3)	20 (28.5)	3.27 (1.06–10.03)	.03		
Frequency of binge drinking in the past 12 months							
Never	8 (15.6)	3 (15.7)	11 (15.7)	Reference			
Less than monthly	9 (17.6)	8 (42.1)	17 (24.2)	2.37 (0.46–12.13)	.30		
Monthly	9 (17.6)	1 (5.2)	10 (14.2)	0.29 (0.025–3.45)	.33		
Weekly	17 (33.3)	4 (21.0)	21 (30.0)	0.62 (0.11–3.49)	.59		
Daily or almost daily	8 (15.6)	3 (15.7)	11 (15.7)	1.00 (0.15–6.52)	1.00		
AUDIT scores risk levels							
Zone I (0–7)	9 (18.7)	6 (31.5)	15 (22.3)	Reference			
Zone II (8–15)	16 (33.3)	3 (15.7)	19 (28.3)	0.28 (0.05–1.40)	.12		
Zone III (16–19)	6 (12.5)	5 (26.3)	11 (16.4)	1.25 (0.25–6.02)	.47		
Zone IV (20–40)	17 (35.4)	5 (26.3)	22 (32.8)	0.44 (0.10–1.85)	.20		
Severity of dependence score of 3 or above	29 (56.8)	9 (47.3)	38 (54.2)	0.68 (0.23–1.96)	.47		
Inhaled nitrate/"popper" use during sex past 6 months	17 (33.3)	11 (57.8)	28 (40.0)	2.75 (0.93–8.10)	.06		
Ecstasy use during sex past 6 months	3 (5.8)	3 (15.7)	6 (8.5)	3.00 (0.54–16.37)	.20		
Gamma hydroxybutyrate (GHB) use during sex past 6 months	9 (17.6)	6 (31.5)	15 (21.4)	2.15 (0.64–7.19)	.21		
Methamphetamine use during sex past 6 months	23 (45.1)	14 (73.6)	40 (57.1)	3.40 (1.06–10.87)	.03		
Alcohol use during sex past 6 months	35 (87.5)	15 (88.2)	50 (87.7)	1.07 (0.18–6.15)	.93		
Treatment for alcohol use ever	22 (43.1)	7 (36.8)	29 (41.4)	0.76 (0.25–2.27)	.63		
Mutual support group attendance ever (e.g., Twelve-Step Groups)	17 (33.3)	4 (21.0)	21 (30.0)	0.53 (0.15–1.85)	.32		

Note: Data that were not normally distributed were described using medians and interquartile ranges.

p-values were generated using logistic regression.

Multivariable models controlled for age in years.

OR = odds ratio, aOR = adjusted odds ratio.

Significant (≤ 0.05) variables from the bivariate analyses were explored further in stratified multivariable analyses.

Some percentages may reflect denominators smaller than the N given in the column head, due to missing data.

Binge drinking was defined as consuming five or more drinks on one occasion.

The 10-item AUDIT was used to measure hazardous alcohol consumption and AUDIT score risk levels were based on a standard cut-off of 16 or greater which represents moderate to high risk of hazardous drinking.

A severity of dependence score of 3 or greater is indicative of alcohol dependence.

The outcome, recent STI diagnosis includes those who reported being diagnosed with any of the following in the past 6 months: syphilis, gonorrhea, chlamydia, herpes simplex virus, and genital warts.

sexual partners had a higher odds of STI diagnosis, compared to their counterparts which is consistent with prior research (Dean et al., 2017; Grewal et al., 2017). MSM living with HIV, may be at increased risk of STI acquisition due to immunosuppression (McClelland et al., 2005). Additionally, the co-occurrence of HIV and other STIs may increase HIV viral replication and potentiate onward transmission (Dean et al., 2017). As such, sexual health interventions in the SF Bay Area should actively engage MSM living with HIV who use alcohol in comprehensive HIV care and STI prevention and treatment efforts. Moreover, based on our findings regarding younger MSM we recommend adapting existing mobile health platforms designed for young MSM, to deliver STI prevention messages that address relevant STI risks such as those associated with multiple sexual partnerships (Daher et al., 2017; Leluțiu-Weinberger et al., 2018; Mayer & Fontelo, 2017).

This study has limitations. We used cross-sectional data which limits our ability to draw causal inferences. Specifically, we do not know the temporal sequence between the correlates we identified and self-reported STI diagnosis in the past 6 months. Hence, further analysis using longitudinal data are needed to confirm and build on our findings. The outcome of interest was based on self-reported data and thus may not include asymptomatic or undiagnosed STIs. It is also possible that STI prevalence may falsely appear higher among MSM living with HIV and those on PrEP due to regular screening procedures associated with HIV treatment and preventative care services. There were few participants who reported recent STI diagnosis among MSM living with HIV, which may have increased our chances of committing a type II error. In addition, we relied on self-reported data of sensitive behaviors (e.g., sexual behaviors and substance use) which are subject to social desirability bias however our use of ACASI has been shown to reduce this bias compared to face-to-face interviews (Beauclair et al., 2013).

Despite these limitations, this study provides important information on the prevalence and correlates of STIs among MSM living with and without HIV who use alcohol in the San Francisco Bay Area. The high prevalence of STIs in this population underscores a persistent public health problem. Also, the correlates of STIs differed qualitatively by HIV status, highlighting the need for sexual health interventions to address the unique needs of MSM living with and without HIV.

Acknowledgments

The authors gratefully acknowledge the valuable contributions made by all research staff and study participants.

Abbreviations

Men who have sex with men (MSM), sexually transmitted infections (STIs), San Francisco (SF), and National HIV Behavioral Surveillance (NHBS)

Author Contributions

JPJ and GMS conceptualized the study design. JPJ conducted the analysis and wrote the paper, with assistance from AG, GB, GMS. JI provided edits and oversaw primary data collection.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: Dr. Jain is support by a postdoctoral fellowship award program from the National Institute on Drug Abuse (T32DA007250), this work was also funded by a National Institutes of Health grant (DP5OD019809).

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