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

Jennifer P. Jain¹, Akua O. Gyamerah², Glenda N. Baguso², Carol Dawson-Rose¹, Janet Ikeda³, and Glenn-Milo Santos¹,³

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 ≥ 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 sociodemographics, 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, \( p \leq 0.01 \)), 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, \( p \leq .01 \)). 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.

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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...
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 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 ≤ .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
A severity of dependence score of 3 or greater is indicative of alcohol dependence, which represents moderate to high risk of hazardous drinking. AUDIT score risk levels were based on a standard cut-off of 16 or greater. The 10-item AUDIT was used to measure hazardous alcohol consumption and binge drinking was defined as consuming five or more drinks on one occasion in the past year.

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### 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) |
| Education                                |       |
| 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) |
| Race/ethnicity                           |       |
| 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) |
| Sexually transmitted infections          |       |
| 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) |
| Sexual behaviors in the past 6 months    |       |
| 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) |
| Medication use                           |       |
| Currently taking pre-exposure prophylaxis (PrEP) | 44 (17.8) |
| Any viagra use ever                      | 60 (24.2) |
| Alcohol use                              |       |
| Frequency of binge drinking in the past 12 months | 28 (11.3) |
| Never                                    |       |
| Less than monthly                        | 58 (23.40 |
| Monthly                                  | 46 (18.6) |
| Weekly                                   | 78 (31.5) |
| Daily or almost daily                    | 37 (14.9) |
| AUDIT score risk levels                  |       |
| 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 (27.28) |
| Severity of dependence score of 3 or above | 113 (45.7) |
| Drug and alcohol use during sex in the past 6 months |       |
| Inhaled nitrates\"poppers\"              | 83 (33.6) |
| Ecstasy                                  | 37 (14.9) |
| Gamma hydroxybutyrate (GHB)              | 36 (14.5) |
| Methamphetamine                         | 71 (28.7) |
| Alcohol                                  | 180 (84.9) |
| Substance use treatment ever             |       |
| 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.

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 multivariable 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 (0.95–1.04) | .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) | 6 (15.3) | 41 (22.9) | 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 | | | | |
| 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) | 2.23 (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 (35.9) | 76 (43.3) | 0.77 (0.27–2.15) | .62 | | | | |
| Zone III (16-19) | 17 (12.4) | 7 (18.4) | 24 (13.7) | 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) | 44 (25.1) | 0.89 (0.35–2.25) | .82 | | | | |
| Alcohol use during sex past 6 months | 97 (81.5) | 33 (86.1) | 130 (73.8) | 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 (≤.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.
| 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                            | 6 (12.0)               | 2 (10.5)            | 8 (13.0)       | 2.33 (0.21-25.24) | .48   |             |       |
| Any post-graduate                            | 1 (1.0)                | 0 (0.0)             | 1 (1.0)        | 4.58 (1.06-16.11) | .59   |             |       |
| 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)                | 1 (5.2)             | 3 (4.3)        | 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   |
| Misc’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)           | 15 (2.11)      | 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 (0.02-3.45) | .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) | .60   |             |       |
| Zone III (16-19)                             | 6 (12.5)               | 5 (26.3)            | 11 (16.4)      | 1.25 (0.25-6.02) | .52   |             |       |
| Zone IV (20-40)                              | 17 (35.4)              | 5 (26.3)            | 22 (32.8)      | 0.44 (0.10-1.85) | .12   |             |       |
| 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)           | 37 (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 (0.18-7.16) | .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; Leluju-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 in the 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.

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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.

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ORCID iDs
Jennifer P. Jain https://orcid.org/0000-0002-6339-1649
Carol Dawson-Rose https://orcid.org/0000-0001-6066-1853
Glenn-Milo Santos https://orcid.org/0000-0003-1009-5317

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