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Differences in attitudes about HIV pre-exposure prophylaxis use among stimulant versus alcohol using men who have sex with men

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Abstract

Alcohol and stimulant use are independently associated with increased HIV acquisition among men who have sex with men (MSM). We assessed differences in acceptability and perceived barriers to uptake of pre-exposure prophylaxis (PrEP) among stimulant and alcohol-using MSM in Boston. From September 2012–2013, a quantitative assessment was conducted with 254 MSM respondents who reported recent condomless sex in the context of concurrent stimulant (crack/cocaine and crystal methamphetamine; n=132) or alcohol use (n=122). Thirteen (5.1%) reported previous PrEP use. In multivariable models, stimulant users were more likely to be concerned that substance use would affect PrEP adherence (aRR=2.79, 95% CI 1.63–4.77), and were less concerned about HIV stigma as a barrier to PrEP uptake (aRR=0.52, 95% CI 0.30–0.90) compared to alcohol users. Barriers to PrEP uptake and adherence differ by type of substance used. Different strategies may be required for PrEP implementation among MSM who use stimulants and alcohol.

Keywords

pre-exposure prophylaxis; men who have sex with men; HIV; alcohol; substance use

INTRODUCTION

In the United States, men who have sex with men (MSM) bear a disproportionate burden of the HIV epidemic.⁽¹⁾ Although MSM represent approximately 2–5% of the male population

in the United States, in 2013 it was estimated that 65% of new HIV infections were in MSM. (2) Heavy alcohol use and stimulant drug use have been associated with increased HIV acquisition among MSM(3) and the general population in the United States.(4) Crystal methamphetamine use, in particular, has been associated with low rates of condom use and increased numbers of sexual partners(5,6), as well as with incident HIV infection.(3,7) Furthermore, alcohol and stimulant use have been associated with decreased adherence to antiretroviral therapy among MSM living with HIV(8,9), which may result in reduced viral suppression and increased HIV transmission within networks of substance users.

Despite an increased HIV risk among individuals who use substances, the vast majority of HIV prevention interventions for people who use substances have been developed for people who use injection drugs.(10) Many HIV prevention interventions for non-injection substance users have been behavioral interventions, many of which have demonstrated only modest effects in reducing sexual risk and have limited sustained effects over time.(11) Combination HIV prevention interventions that include post-exposure prophylaxis (PEP) (antiretroviral administered to HIV- uninfected individuals after potential exposure to HIV) may be a viable approach for crystal methamphetamine-using MSM.(12) However, crystal methamphetamine-using MSM who have sought out PEP have also been shown to have higher recurrent exposure to HIV than their non-crystal methamphetamine using counterparts(7), suggesting that longer-term strategies may be needed for this sub-population. In addition, although medications exist to treat alcohol dependency, these medications have not been shown to be associated with reduction in HIV risk.(10)

Pre-exposure prophylaxis (PrEP), in the form of tenofovir/emtricitabine [TDF/FTC], used daily by individuals at higher risk of HIV infection has been shown to be effective in reducing HIV acquisition among MSM(13), heterosexual serodiscordant couples(14), and people who use injection drugs.(15) Despite concern regarding the ability of substance users to adhere to their antiretroviral treatment regimens, evidence from a large open-label cohort study of MSM using PrEP found that neither stimulant use nor alcohol use was associated with poor adherence.(16) These results suggest that PrEP may be a viable HIV prevention strategy for non-injection substance users.

Although non-injection drug users may be a sub-population that could substantially benefit from PrEP, PrEP interventions will need to be specifically tailored to these groups to maximize the effectiveness of the intervention. The goal of the present study was to assess PrEP awareness, use, and intent to use between HIV-uninfected stimulant and alcohol-using MSM who reported engaging in condomless anal intercourse in the context of stimulant and/or alcohol use (categorized as alcohol-using only or stimulant using), with the intention of providing additional insight into the design of future PrEP implementation and adherence interventions with this sub-population of MSM.

METHODS

Study Design

The present study was a cross-sectional quantitative assessment conducted between September 2012 and July 2013 with MSM who reported condomless sex in the context of

simulant (crack/cocaine and crystal methamphetamine) and/or alcohol use. This quantitative assessment was the second phase of a two-phase study aimed at understanding PrEP implementation among alcohol and stimulant using MSM in Boston. The first phase consisted of qualitative in-depth interviews aimed at qualitatively understanding PrEP utilization among substance using MSM in Boston.⁽¹⁷⁾ The qualitative phase was used to inform recruitment and question formulation for the larger quantitative questionnaire. The two-phase approach was used to gain a comprehensive and in-depth understanding of PrEP preferences, given that barriers and facilitators of PrEP use are likely distinct in this sub-population compared to other groups of MSM.

Participants and Procedures

All participants were over the age of 18, born biologically male, identified as male at the time of enrollment and HIV-uninfected (as confirmed by OraQuick ADVANCE ® Rapid HIV-1/2 Antibody Test). Eligible men recruited in venues such as bars and/or clubs reported one or more episodes of condomless sex under the influence of alcohol or stimulants (crack/cocaine and crystal methamphetamine) within the past three months. Because online recruitment was focused on recruiting stimulant users (as discussed below), those recruited online or by convenience sampling were restricted to condomless sex within the context of stimulant use.

Study visits took place in a private interview room at Fenway Health (a large community health organization that focuses on lesbian, gay, bisexual, and transgender healthcare) and all participants provided written informed consent before the start of data collection. For this phase of the study, study visits consisted of a single time-point survey administered on desktop computers via Qualtrics software and included both self-administered for sensitive sexual behaviors questions and interviewer-administered sections. They received up to \$70 for completion of the study, an amount decided upon based on the amount of time expected for the interview to be completed. Staff members underwent training in research ethics, HIV testing counseling and referral, and the quantitative assessment. To ensure confidentiality, data were de-identified and stored on encrypted servers for electronic data and locked file cabinets in locked offices for physical study materials. Study procedures were approved by the Institutional Review Board at Fenway Health.

Recruitment

One hundred and twelve men were recruited at clubs and bars that are frequented by gay, bisexual men and other MSM in the greater-Boston area. Recruiters systematically approached male patrons as they crossed a pre-defined intercept area outside of the venue. After introducing and describing the study, patrons were asked to complete a brief anonymous questionnaire to determine initial eligibility. Tablet devices were used to record responses. Patrons who met the initial eligibility criteria voluntarily provided their telephone number or email address so they could be contacted by a staff member to schedule a study visit.

Our findings from the formative qualitative data collected during the first phase of this two-part study indicated that bars and clubs in Boston did not generally yield high numbers of

stimulant using MSM.(17) In order to recruit this sub-population, recruitment efforts were extended beyond the venue-based sampling technique to include recruitment on the Internet and convenience sampling. A sample of 142 men was recruited through sexual partner-meeting websites for MSM, the research and primary care services at Fenway Health, and at LGBT-oriented community-based organizations in Massachusetts. Interested website users were instructed to click on a link that would lead them to the anonymous pre-screening questionnaire administered through the HIPAA-compliant electronic data capturing tool, Qualtrics. At the completion of the questionnaire, eligible users were directed to a new Qualtrics window where they were asked to voluntarily provide their contact information. Men who expressed interest in the study were pre-screened in person or over the telephone. Due to the sample size and selection procedures, this sample is not a probability sample and thus is non-representative.

Data Collection Tool

The quantitative assessment tool was developed following formative qualitative work with this sub-population.(17)

Socio-demographic characteristics—Participants answered questions on age, race, ethnicity, sexual identity, relationship status, living arrangement, education, and income. Race and ethnicity were categorized as White, Black, Asian, Native American/Native Hawaiian/Pacific Islander, and Latino. Sexual identity was categorized as homosexual/gay, bisexual, heterosexual/straight, or other. Relationship status was categorized as single, in a relationship (including legally married, civil union, monogamous relationship), or in a non-monogamous relationship. Living arrangements were categorized as having unstable housing in the previous 3 months or not. Annual income as an individual before taxes was categorized as less than \$6,000 to \$11,999, \$12,000 to \$23,999, \$24,000 to \$59,999, and \$60,000 or more. Education was dichotomized as having a college degree or higher education versus some college or less.

Substance use—As part of the screening procedure participants were asked about their substance use in the last three months. Alcohol and/or stimulant dependence was assessed using Parts J and K of the Mini International Neuropsychiatric Interview.(18) Participants were categorized as alcohol-using if they reported only using alcohol. Participants were categorized as stimulant-using if they reported stimulant use, regardless of whether or not they used alcohol.

PrEP utilization and interest—Participants were asked about awareness, prior experience with PrEP, the likelihood of using PrEP in the future, and the acceptability of its side effects. The assessment included hypothetical scenarios to examine potential barriers to PrEP adherence and to determine under which conditions participants were more likely to use PrEP. Specifically, participants were asked if they had ever heard of PrEP, if they had ever used antiretroviral medication to prevent HIV, how interested they were in taking PrEP (dichotomized into interested versus neutral or not interested), and preference for PrEP dosing schedule (daily PrEP versus intermittent, defined as taking PrEP right before and after sex). Participants were also asked about a number of potential barriers to PrEP use,

including perception that their substance use would be a barrier to taking PrEP as prescribed, concern related to HIV stigma, and concern about how much PrEP would cost. The barriers that were included in this analysis were *a priori* hypothesized to be important barriers to PrEP use for substance using MSM. Finally, participants were asked about perceived behavioral compensation following initiation of PrEP. Participants were asked how much they agreed with the following questions (on 5-point scale including Disagree, Somewhat Disagree, Neutral, Somewhat Agree, and Agree): 1) “Taking PrEP will let me have more sexual partners”; 2) “I don’t have to worry about having unprotected sex with HIV-infected partners because of PrEP”; and 3) “Taking PrEP will make me have more unprotected sex”. These questions were operationalized as agree versus neutral or disagree.

Sexual behaviors—Participants were asked how many times they had anal sex without a condom with a male sexual partner who was HIV-infected or HIV serostatus unknown in the previous three months. Participants were dichotomized as having three or more instances of condomless anal sex with an HIV-infected or serostatus unknown partner versus fewer than three times. Self-perceived risk of HIV was assessed by asking participants to rate their risk of getting HIV on a scale of 1 to 10, based on their sexual experiences in the previous three months with male sex partners.

Data Analysis

The distribution of characteristics by type of substance used was calculated with proportions for categorical variables and medians and interquartile ranges (IQR) for continuous variables. A modified Poisson generalized linear model (GLM) with a robust error variance was used to estimate the relative risk of each outcome associated with using stimulants as compared to alcohol.⁽¹⁹⁾ This approach has been shown to estimate the relative risk for binomial data efficiently and consistently, and the use of a robust error term via sandwich estimation accounts for underestimated variances with the application of the Poisson distribution to binomial data.⁽¹⁹⁾ A bivariate modified Poisson GLM was first built to assess the association between stimulant use compared to alcohol use and outcomes related to PrEP awareness and use including 1) having heard of PrEP; 2) being interested in taking PrEP; and 3) preferring daily PrEP versus event-driven PrEP); perceived barriers to PrEP use including 1) substance use as a barrier; 2) HIV stigma; and 3) financial concerns), and perceived potential for behavioral compensation following initiation of PrEP, including 1) perception that number of partners would increase; 2) perception that participant would not worry about condomless sex with partners living with HIV; and 3) perception that participant would have more condomless sex. A multivariable modified Poisson GLM was then built for each model, adjusting for potential confounding factors, including age, race/ethnicity, sexual identity, education, housing status, relationship status, income, and health insurance status as well as method of recruitment (venue versus other). Sexual behaviors, self-perceived sexual risk of HIV infection, and dependency versus infrequent use of the substance were conceptualized to be mediators on the pathway between type of substance used and PrEP preferences and were not included in primary models. However, due to the cross-sectional nature of these data and potential differences in participants by recruitment approaches, sensitivity analyses including these variables in multivariable models were also run. The sensitivity analysis approach was used to assess how robust these results were when

adjusting for sexual behaviors. An alpha level of <0.05 was considered statistically significant. All analyses were conducted using Stata 13.1 (StataCorp, College Station, TX).

RESULTS

Of 254 participants enrolled, 132 (52.0%) were stimulant users. Of the stimulants used, 51 used crystal methamphetamine, 84 used cocaine, and 39 used crack within the previous 3 months. Ten participants used all 3 stimulants, 8 used crystal methamphetamine and cocaine, 3 used crystal methamphetamine and crack, and 17 used both crack and cocaine. Twenty-three of the stimulant users also used alcohol, but were classified as stimulant users. Table 1 lists descriptive characteristics by alcohol and stimulant users and in the overall study sample. Alcohol users tended to be younger than stimulant users (median age 27 versus 36), more frequently white (70.5% versus 56.1%), more frequently identified as homosexual/gay (82.0 versus 57.6%), more likely to report having a college degree or higher education (61.5% versus 33.3%), less frequently reported a history of unstable housing (9.0 versus 33.3%), less frequently reported being single (63.1% versus 75.0%), and reported lower income. Most stimulant users (N=118, 89.4%) were recruited via the Internet or through recruitment via Fenway Health or other LGBT organizations, whereas most alcohol users (N=98, 80.3%) were recruited in bars and clubs.

In a multivariable model, stimulant users had 1.74 (95% CI: 1.11 to 2.73, $P=0.02$) times the risk of having engaged in condomless anal intercourse in the previous 3 months with 3 or more HIV-infected or HIV status unknown partners compared to alcohol users. Stimulant users were also more frequently dependent on stimulants (aRR 1.47, 95% CI 1.17 to 1.85, $P<0.001$) than alcohol users were dependent on alcohol. There was a non-significant trend towards stimulant users reporting higher self-perceived HIV risk (aRR 1.84, 95% CI 0.97 to 3.51, $P=0.06$)

Thirteen (5.1%) study participants reported previously using PrEP, all of whom were stimulant users. More than half (58.3%) reported having heard of PrEP and 78.4% reported being interested in taking it. In a multivariable model, there was no difference between stimulant and alcohol user in terms of having heard of PrEP (aRR 1.26, 95% CI 0.94 to 1.70, $P=0.13$) or being interested in taking it (aRR 1.07, 95% CI 0.94 to 1.23, $P=0.30$). Stimulant users more often reported a preference for daily dosing of PrEP versus intermittent dosing of PrEP (aRR 1.45, 95% CI 1.03 to 2.04, $P=0.03$). Results did not change in sensitivity analyses adjusted for serodiscordant condomless anal sex, higher perceived risk of HIV, and substance dependency.

Table 2 shows results of bivariate and multivariable models assessing the association between type of substance used and perceived barriers to PrEP use. Stimulant users more often reported that their substance use would affect their ability to take PrEP as prescribed (aRR 2.79, 95% CI 1.63 to 4.77, $P<0.001$). This relationship persisted after adjusting for serodiscordant condomless anal intercourse with 3 or more partners, higher perceived HIV risk, and substance dependency (aRR 2.05, 95% CI 1.13 to 3.72, $P=0.007$). Stimulant users less often reported concern about HIV stigma as a barrier to taking PrEP than alcohol users (aRR 0.52, 95% CI 0.30 to 0.90, $P=0.02$). This result did not change after adjusting for

serodiscordant condomless anal intercourse with 3 or more partners, higher perceived HIV risk, and substance dependency (aRR 0.52, 95% CI 0.28 to 0.95, P=0.04).

Table 3 shows results models assessing the association between type of substance used and perceived changes in sexual behaviors following initiation of PrEP. Stimulant users more often reported that they would not need to worry about condomless sex with HIV-infected partners following initiation of PrEP (aRR 2.62, 95% CI 1.04 to 6.60, P=0.04) and that they were more likely to have more condomless sex following initiation of PrEP (aRR 1.83, 95% CI 1.10 to 3.07, P=0.02). These effect sizes did not change after adjusting for serodiscordant condomless anal sex with 3 or more partners, higher self-perceived HIV risk, and substance dependency, but they were no longer statistically significant (not needing to worry about HIV: aRR 2.33, 95% CI 0.87 to 6.22, P=0.09; more condomless anal sex: aRR 1.35, 95% CI 0.78 to 2.34, P=0.28).

DISCUSSION

In this study, we demonstrated differences in PrEP use as well as differences in perceived barriers to PrEP uptake, ability to adhere, and behavioral compensation among HIV-uninfected MSM users of stimulants compared to those who used alcohol. Several trials have demonstrated efficacy of PrEP among MSM. However, evidence from trials suggests that use of PrEP by MSM who use cocaine may result in greater population-level effectiveness than by the general population, possibly due to a greater HIV sexual risk.(20) It is likely that the use of PrEP by MSM who use other stimulants, such as crystal methamphetamine, may have similar effects. It has been well established that crystal methamphetamine and cocaine use are associated with higher-risk sexual behavior and incident HIV infection, (5,7,10,12,21) and previous studies have shown stronger associations between stimulant use and serodiscordant condomless anal intercourse than with alcohol use.(22) Stimulant users may therefore be particularly good candidates for PrEP, and understanding perceived barriers and facilitators to uptake and adherence may improve effectiveness of PrEP implementation programs.

In this study, stimulant-using MSM reported engaging in higher risk sex more often than alcohol-using MSM. In addition, stimulant using MSM were more likely to be dependent on stimulants than alcohol-using MSM were likely to be dependent on alcohol. These results further support the potential impact of PrEP in sub-populations of MSM who use stimulants, as previous work has shown a dose-response relationship between frequency of substance use and higher-risk sexual behavior.(22) Cocaine and crystal methamphetamine are both highly addictive, which may explain differences in frequency of use. Increases in condomless sex may be related to both increases in sexual arousal associated with stimulant use(10) and may also be influenced by increased frequency of use. The type of substance use and associated risk-behaviors appear to impact the preferred dosing schedule. For example, in this study stimulant users more often reported a preference for daily versus intermittent dosing of PrEP. It is possible that alcohol using MSM in this study prefer intermittent dosing of PrEP due to lower self-perceived and reduced ongoing risk, whereas stimulant users anticipate increased and continuous risk of HIV infection. PrEP implementation programs

with non-injection substance users will need to consider preferences for dosing schedules as this may impact adherence to PrEP regimens.

Some concern has been expressed about the ability of stimulant users to adhere to medications, including antiretroviral regimens for post-exposure prophylaxis.(7,12) Since optimal adherence is required to achieve PrEP efficacy and subsequently decrease risk of HIV acquisition, substance use could limit the effectiveness of PrEP if substance using MSM are unable to take PrEP as prescribed. Although prior studies have suggested that stimulant use did not affect PrEP adherence(16), in the current study substance users expressed concern about their ability to adhere to treatment. Stimulant using MSM in this study more often agreed that their substance use would affect their ability to take PrEP as prescribed. Thus, behavioral interventions to enhance PrEP adherence for stimulant users could include substance use management, such as behavioral activation(21) or contingency management.(23) In contrast, alcohol-using MSM in this study more often noted that HIV stigma would be a limiting factor in their use of PrEP. Previous work has shown that stigma is associated with decreased adherence to PrEP,(24) and this suggests that interventions to mitigate the impact of perceived stigma as a result of PrEP uptake will be important for alcohol using MSM. Interestingly, there was no association between type of substance used and concern about HIV stigma in bivariate models, but this association was significant in multivariable models. African American race was also associated with concern about HIV stigma, which may suggest that there is a relationship between race, type of substance use, and concern about stigma as a barrier to taking PrEP. Future work should consider the role of race and stigma on PrEP uptake.

MSM who used stimulants in this study more frequently indicated that they would not need to worry about condomless anal sex with HIV-infected partners after initiating PrEP and that they would engage in more condomless anal sex than alcohol using MSM. There is some concern about behavioral compensation following uptake of PrEP, including concern that people who initiate PrEP will decrease condom use. This could lead to increased HIV risk during periods of non-adherence to PrEP, as well as increased risk of sexually transmitted infections.(25) Previous work has demonstrated that substance using MSM who experienced substance use dependence were less likely to report that PrEP would decrease their condom use.(25) In the current study, the association between type of substance used and decreased worry about condomless anal sex did not persist after adjustment for current sexual behaviors. This result may suggest that riskier individuals predict they will be riskier on PrEP, and the association between stimulant use and need to worry about condomless anal sex is being driven by greater risk behaviors among stimulant users compared to alcohol users.

In this study, there were no anticipated differences between alcohol and stimulant using MSM in frequency of condomless sex after PrEP uptake. To date no evidence of behavioral compensation in randomized controlled PrEP trials with MSM has been observed. (26,27) However, evidence outside of clinical trials is limited, particularly among stimulant using MSM. The results of this study may indicate a potential for an increase in condomless anal sex with HIV-infected partners, or that individuals would feel a greater sense of protection against acquisition of HIV. In the iPrEx open label extension study, a cohort study in which

participants in the iPrEx randomized controlled trial received PrEP as an open-label continuation of the trial, participants reported no significant changes in their sexual behaviors, but less HIV-related concern.(16) Future studies are needed to characterize actual self-reported changes in sexual behaviors following initiation of PrEP in non-injection drug using MSM. However, in the interim, PrEP prescribers should provide risk reduction counseling and screen stimulant and other non-injection substance users for STIs and HIV seroconversion on a regular basis.

The results of this study must be considered in the context of several limitations. Given the differing recruitment approaches, there may be differences between crystal methamphetamine-only and cocaine-only using MSM that were masked by this analysis. Although we were able to adjust for venue-based recruitment versus other approaches, there were substantial differences in the number of the two types of substance users by recruitment approach. There may be venue-related factors that influence results, and the relationship between venue, HIV risk, and PrEP preferences are likely complex and highly inter-related. Furthermore, this was a cross-sectional survey, which aimed to investigate hypothetical interest in PrEP among substance using MSM from a single city in the United States, and generalizability may be limited outside of this geographic region. Finally, these data were collected shortly after FDA approval of PrEP. There may have been substantial changes in terms of PrEP availability, acceptability, and awareness since FDA approval. However, despite these limitations, this study represents one of the first assessments of PrEP acceptability and feasibility among stimulant and alcohol using MSM in the United States.

In conclusion, the results of this study demonstrated substantial interest in PrEP among a sample of substance using MSM in Boston, Massachusetts, although awareness of PrEP was suboptimal. Stimulant and alcohol using MSM had different perceptions of barriers to PrEP use and expected changes in sexual behaviors following PrEP uptake, indicating that future PrEP interventions for non-injection drug using MSM will need to be tailored to subgroups of substance users. Stimulant using MSM may be particularly good candidates for PrEP, given increased HIV sexual risk behaviors and higher self-perceived HIV risk. However, for this sub-population to realize the full benefits of PrEP, future interventions will need to incorporate strategies for reducing barriers to PrEP increasing adherence, and decreasing behavioral compensation effects upon PrEP uptake.

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Table 1

Descriptive characteristics by type of substance used

| | Alcohol (N=122) | Stimulant (N=132) | Total (N=254) |
|---|-----------------|-------------------|---------------|
| Age (median, IQR) | 27 (23 to 32) | 36 (28 to 48) | 31 (25 to 43) |
| Race/ethnicity | | | |
| <i>White/Caucasian</i> | 86 (70.5%) | 74 (56.1%) | 160 (63.0%) |
| <i>Black/African American</i> | 7 (5.7%) | 33 (25.0%) | 40 (15.8%) |
| <i>Asian</i> | 5 (4.1%) | 1 (0.8%) | 6 (2.4%) |
| <i>American Indian/Pacific Islander</i> | 4 (3.3%) | 7 (5.3%) | 11 (4.3%) |
| <i>Latino</i> | 20 (16.4%) | 17 (12.9%) | 37 (14.6%) |
| Sexual identity | | | |
| <i>Homosexual/gay</i> | 100 (82.0%) | 76 (57.6%) | 176 (69.3%) |
| <i>Bisexuala</i> | 19 (15.6%) | 52 (39.4%) | 71 (28.0%) |
| <i>Heterosexual/straightt</i> | 0 | 2 (1.5%) | 2 (0.8%) |
| <i>Other</i> | 3 (2.5%) | 2 (1.5%) | 5 (2.0%) |
| College degree or higher | 75 (61.5%) | 44 (33.3%) | 119 (46.9%) |
| Unstable housing in past 3 months | 11 (9.0%) | 44 (33.3%) | 55 (21.7%) |
| Relationship status | | | |
| <i>Single</i> | 77 (63.1%) | 99 (75.0%) | 176 (69.3%) |
| <i>Married/Civil Union/Monogamous</i> | 33 (27.1%) | 20 (15.2%) | 53 (20.9%) |
| <i>Non-monogamous relationship</i> | 12 (9.8%) | 13 (9.9%) | 25 (9.8%) |
| Income | | | |
| <\$12,000 | 27 (22.5%) | 57 (43.2%) | 84 (33.3%) |
| \$12,000 to 23,999 | 22 (18.3%) | 24 (18.2%) | 46 (18.3%) |
| \$24,000 to 59,999 | 50 (41.7%) | 36 (27.3%) | 86 (34.1%) |
| \$60,000 or more | 21 (17.5%) | 15 (11.4%) | 36 (14.3%) |
| Any health insurance | 114 (93.4%) | 121 (91.7%) | 235 (92.5%) |
| Heard of PrEP | 62 (50.8%) | 86 (65.2%) | 148 (58.3%) |
| Used PrEP | 0 | 13 (9.9%) | 13 (5.1%) |
| Interested in taking PrEP in the future | 89 (73.0%) | 110 (83.3%) | 199 (78.4%) |
| Preference for daily PrEP versus non-daily regimen | 38 (31.2%) | 66 (50.4%) | 104 (41.1%) |
| Perception that substance use will affect ability to use PrEP | 20 (16.4%) | 52 (39.4%) | 72 (28.4%) |
| Concern that using PrEP will result in HIV stigma | 36 (29.5%) | 39 (29.6%) | 74 (29.5%) |
| Concern about how much PrEP will cost | 101 (82.8%) | 95 (72.0%) | 196 (77.2%) |

| | Alcohol (N=122) | Stimulant (N=132) | Total (N=254) |
|--|------------------------|--------------------------|----------------------|
| Do not have to worry about condomless sex with HIV-infected partners if using PrEP | 11 (9.0%) | 30 (22.7%) | 41 (16.1%) |
| Taking PrEP will result in having more condomless sex | 30 (24.6%) | 45 (34.1%) | 75 (29.5%) |
| Taking PrEP will let me have more sexual partners | 20 (16.4%) | 34 (25.8%) | 54 (21.3%) |
| Serodiscordant condomless anal sex 3+ times in the previous 3 months | 29 (25.0%) | 62 (54.4%) | 91 (39.6%) |
| High self-perceived risk of HIV | 19 (15.6%) | 50 (38.2%) | 69 (27.3%) |
| Dependence on substance (versus infrequent use) | 69 (55.7%) | 119 (90.2%) | 187 (73.6%) |
| Field-based recruitment method | 98 (80.3%) | 14 (10.6%) | 112 (44.1%) |

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Table 2

Associations between type of substance used (stimulant versus alcohol) and barriers to PrEP use, including: 1) perception that substance use is a barrier to taking PrEP, 2) concerns related to HIV stigma, 3) financial concerns related to PrEP use

| | Substance Use Would Affect PrEP Use | | | Concern about HIV Stigma | | | Concern about Cost of PrEP | | | |
|-----------------------------------|---------------------------------------|--------|--|---------------------------------------|-------|--|---------------------------------------|------------------------|--|------|
| | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) | |
| Stimulant use (vs. alcohol) | 2.40 (1.53 to 3.78) | <0.001 | 2.79 (1.63 to 4.77) | 1.00 (0.68 to 1.47) | >0.99 | 0.52 (0.30, 0.90) | 0.02 | 0.87 (0.76 to 0.99) | 0.89 (0.72, 1.10) | 0.29 |
| Age (years) | | | 1.00 (0.99, 1.02) | | 0.65 | 1.00 (0.98, 1.02) | 0.80 | | 1.00 (0.99, 1.00) | 0.36 |
| Sexual identity | | | | | | | | | | |
| <i>Homosexual/gay</i> | | | Ref | | Ref | Ref | Ref | | Ref | Ref |
| <i>Bisexual</i> | | | 0.87 (0.58, 1.32) | | 0.52 | 1.06 (0.69, 1.64) | 0.78 | | 0.90 (0.75, 1.06) | 0.21 |
| <i>Heterosexual/straight</i> | | | NA | | NA | NA | NA | | 1.66 (1.11, 2.46) | 0.01 |
| <i>Other</i> | | | 1.44 (0.51, 4.07) | | 0.49 | NA | NA | | 0.82 (0.48, 1.39) | 0.46 |
| Race/ethnicity | | | | | | | | | | |
| <i>White</i> | | | Ref | | Ref | Ref | Ref | | Ref | Ref |
| <i>Black</i> | | | 1.41 (0.87, 2.31) | | 0.17 | 2.24 (1.33, 3.75) | 0.002 | | 0.87 (0.70, 1.08) | 0.20 |
| <i>Asian</i> | | | 2.38 (1.05, 5.40) | | 0.04 | 1.65 (0.62, 4.44) | 0.32 | | 0.94 (0.67, 1.32) | 0.71 |
| <i>American Indian</i> | | | NA | | NA | 1.27 (0.39, 4.09) | 0.69 | | 0.61 (0.37, 1.01) | 0.06 |
| <i>Latino</i> | | | 1.0 (0.63, 1.88) | | 0.76 | 1.68 (0.97, 2.93) | 0.07 | | 0.83 (0.66, 1.03) | 0.09 |
| Unstable housing in past 3 months | | | 0.65 (0.43, 0.97) | | 0.04 | 0.85 (0.54, 1.32) | 0.46 | | 1.18 (0.97, 1.44) | 0.10 |
| College degree or higher | | | 1.20 (0.74, 1.96) | | 0.46 | 1.30 (0.79, 2.15) | 0.31 | | 1.03 (0.90, 1.19) | 0.64 |
| Relationship status | | | | | | | | | | |
| <i>Single</i> | | | Ref | | Ref | Ref | Ref | | Ref | Ref |
| <i>Monogamous</i> | | | 1.53 (1.00, 2.35) | | 0.05 | 1.31 (0.84, 2.03) | 0.24 | | 0.82 (0.67, 1.01) | 0.06 |
| <i>Non-monogamous</i> | | | 1.27 (0.74, 2.17) | | 0.38 | 0.56 (0.24, 1.29) | 0.17 | | 1.14 (0.96, 1.35) | 0.15 |
| Annual income | | | | | | | | | | |

| | Substance Use Would Affect PrEP Use | | | Concern about HIV Stigma | | | Concern about Cost of PrEP | | |
|----------------------|---------------------------------------|-------------------|--|---------------------------------------|--|------|---------------------------------------|--|-------|
| | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) | Bivariate ^I RR (95% CI) | Multivariable ^I aRR (95% CI) | P | Bivariate ^I RR (95% CI) | Multivariable ^I aRR (95% CI) | P |
| <\$12,000 | | Ref | Ref | | Ref | Ref | | Ref | Ref |
| \$12,000 to 23,999 | | 0.98 (0.61, 1.59) | 0.94 | | 1.20 (0.72, 2.01) | 0.49 | | 1.23 (1.06, 1.44) | 0.008 |
| \$24,000 to 59,999 | | 0.62 (0.36, 1.06) | 0.08 | | 0.85 (0.48, 1.50) | 0.57 | | 0.93 (0.78, 1.12) | 0.46 |
| \$60,000 or more | | 0.70 (0.32, 1.49) | 0.35 | | 0.89 (0.42, 1.90) | 0.76 | | 0.81 (0.62, 1.05) | 0.11 |
| Any health insurance | | 0.29 (0.07, 1.14) | 0.07 | | 0.66 (0.40, 1.45) | 0.30 | | 0.83 (0.58, 1.20) | 0.32 |
| Field recruitment | | 1.44 (0.82, 2.53) | 0.21 | | 0.45 (0.24, 0.84) | 0.01 | | 0.93 (0.76, 1.13) | 0.46 |

Abbreviations: RR, risk ratio; aRR, adjusted risk ratio; CI confidence interval;

^IModified Poisson generalized linear model with a robust error variance

Table 3

Association between substance used (stimulant versus alcohol) and 1) increase in number of partners, 2) not needing to worry about condomless sex with HIV infected partners, and 3) having more condomless sex following initiation of PrEP

| | Number of Partners Would Increase Following PrEP | | | Do Not Need to Worry About Condomless Sex with HIV Infected Partners Following PrEP Use | | | Would Have More Condomless Sex After Initiating PrEP | | |
|-----------------------------------|--|------|---|---|------|---|--|------|---|
| | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) | Bivariate ^I RR (95% CI) | P | Multivariable ^I aRR (95% CI) |
| Stimulant use (vs. alcohol) | 1.57 (0.96 to 2.58) | 0.07 | 1.31 (0.52, 3.28) | 0.57 | 0.57 | 2.62 (1.04, 6.60) | 0.04 | 0.04 | 1.83 (1.10 to 3.07) |
| Age (years) | | | 1.00 (0.98, 1.03) | 0.70 | 0.70 | 0.99 (0.96, 1.02) | 0.51 | 0.51 | 1.01 (0.99, 1.03) |
| Sexual identity | | | | | | | | | |
| <i>Homosexual/gay</i> | | | Ref | | | Ref | Ref | | Ref |
| <i>Bisexual</i> | | | 1.34 (0.74, 2.41) | 0.33 | 0.33 | 1.32 (0.72, 2.41) | 0.37 | 0.37 | 1.42 (0.91, 2.22) |
| <i>Heterosexual/straight</i> | | | NA | NA | NA | NA | NA | NA | NA |
| <i>Other</i> | | | 1.14 (0.24, 5.51) | 0.87 | 0.87 | NA | NA | NA | 1.05 (0.38, 2.89) |
| Race/ethnicity | | | | | | | | | |
| <i>White</i> | | | Ref | Ref | Ref | Ref | Ref | | Ref |
| <i>Black</i> | | | 1.18 (0.57, 2.44) | 0.66 | 0.66 | 0.84 (0.35, 2.06) | 0.71 | 0.71 | 0.86 (0.47, 1.60) |
| <i>Asian</i> | | | 2.89 (0.90, 9.31) | 0.08 | 0.08 | 2.50 (0.36, 17.6) | 0.36 | 0.36 | 0.73 (0.10, 5.23) |
| <i>American Indian</i> | | | 1.82 (0.68, 4.81) | 0.23 | 0.23 | 2.45 (0.77, 7.83) | 0.13 | 0.13 | 1.86 (0.87, 3.96) |
| <i>Latino</i> | | | 1.51 (0.77, 2.95) | 0.23 | 0.23 | 1.18 (0.57, 2.44) | 0.65 | 0.65 | 0.85 (0.47, 1.54) |
| Unstable housing in past 3 months | | | 1.28 (0.62, 2.64) | 0.50 | 0.50 | 0.94 (0.44, 2.01) | 0.87 | 0.87 | 0.93 (0.55, 1.57) |
| College degree or higher | | | 0.96 (0.53, 1.72) | 0.88 | 0.88 | 1.83 (0.93, 3.58) | 0.08 | 0.08 | 1.31 (0.84, 2.03) |
| Relationship status | | | | | | | | | |
| <i>Single</i> | | | Ref | Ref | Ref | Ref | Ref | | Ref |
| <i>Monogamous</i> | | | 1.27 (0.71, 2.27) | 0.43 | 0.43 | 1.33 (0.70, 2.54) | 0.39 | 0.39 | 1.09 (0.68, 1.75) |
| <i>Non-monogamous</i> | | | 1.41 (0.67, 2.96) | 0.36 | 0.36 | 0.91 (0.32, 2.55) | 0.86 | 0.86 | 1.28 (0.75, 2.17) |
| Annual income | | | | | | | | | |

| | Number of Partners Would Increase Following PrEP | | | Do Not Need to Worry About Condomless Sex with HIV Infected Partners Following PrEP Use | | | Would Have More Condomless Sex After Initiating PrEP | | |
|----------------------|--|---|------|---|---|------|--|---|------|
| | Bivariate ^I RR (95% CI) | Multivariable ^I aRR (95% CI) | P | Bivariate ^I RR (95% CI) | Multivariable ^I aRR (95% CI) | P | Bivariate ^I RR (95% CI) | Multivariable ^I aRR (95% CI) | P |
| <\$12,000 | | Ref | Ref | | Ref | Ref | | Ref | Ref |
| \$12,000 to 23,999 | | 1.53 (0.86, 2.73) | 0.15 | | 1.86 (0.85, 4.07) | 0.12 | | 0.70 (0.37, 1.32) | 0.27 |
| \$24,000 to 59,999 | | 0.84 (0.41, 1.71) | 0.63 | | 0.98 (0.38, 2.51) | 0.97 | | 0.70 (0.41, 1.21) | 0.20 |
| \$60,000 or more | | 1.62 (0.71, 3.67) | 0.25 | | 1.27 (0.46, 3.52) | 0.65 | | 1.38 (0.76, 2.49) | 0.29 |
| Any health insurance | | 2.16 (1.03, 4.55) | 0.04 | | 2.39 (1.18, 4.82) | 0.02 | | 1.29 (0.68, 2.47) | 0.44 |
| Field recruitment | | 0.75 (0.31, 1.86) | 0.54 | | 0.72 (0.32, 1.61) | 0.42 | | 1.74 (1.04, 2.92) | 0.04 |

Abbreviations: RR, risk ratio; aRR, adjusted risk ratio; CI confidence interval;

^I Modified Poisson generalized linear model with a robust error variance