



Prevalence and Correlates of Unhealthy Alcohol and Drug Use Among Men Who Have Sex with Men Prescribed HIV Pre-exposure Prophylaxis in Real-World Clinical Settings

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Abstract

Pre-exposure prophylaxis (PrEP) is effective in preventing HIV acquisition among men who have sex with men (MSM). However, little is known about unhealthy substance use among MSM initiating PrEP in real-world settings. Unhealthy substance use is a risk factor for HIV acquisition and non-adherence to treatment, and may also impact PrEP use. MSM who were prescribed PrEP from 2015 to 2017 at clinics in Providence, Rhode Island and New Haven, Connecticut were recruited to participate in a prospective observational study. Structured clinical assessments were used to assess demographics, HIV risk behaviors, and unhealthy alcohol (alcohol use disorders identification test [AUDIT]-C scores ≥ 4) and drug use (use of any drugs in the past 3 months). Bivariate and multivariate analyses were performed to determine demographics and behaviors associated with unhealthy alcohol and drug use. Among 172 MSM initiating PrEP, 64% were white and 40% were 25–34 years old. Participants reported a median of 3 (IQR 2–7) sexual partners in the last 3 months; 20% reported an HIV positive partner. Unhealthy alcohol and any drug use were reported by 54 and 57%, respectively, and 76% reported at least one of the two. The majority of drug use reported was marijuana and poppers (41 and 26% of participants, respectively). Relative to those without unhealthy alcohol use, unhealthy alcohol use was independently associated with any drug use (adjusted odds ratio [AOR] = 2.57, 95% CI 1.32–5.01). Frequent drug use was associated with younger age (< 25 years, AOR 4.27, 95% CI 1.51–12.09). Unhealthy alcohol use is common among MSM taking PrEP. Drug use other than marijuana and poppers was uncommon among our cohort. Further efforts may be needed to understand the influence of unhealthy alcohol and other substance use on PrEP outcomes and to engage MSM who use drugs for PrEP.

Keywords Pre-exposure prophylaxis · Alcohol · Implementation · Men who have sex with men · HIV

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Introduction

Gay, bisexual, and other men who have sex with men (MSM) are disproportionately impacted by the HIV epidemic in the United States (US). In 2016, 27,951 MSM were newly diagnosed with HIV infection [1]. The Centers for Disease Control and Prevention (CDC) estimates that one in six MSM will be diagnosed with HIV during their lifetime, including one in two African American/Black and one in four Hispanic/Latino MSM [2]. These trends suggest that significantly more prevention efforts are needed among MSM.

Pre-exposure prophylaxis (PrEP) is a promising biomedical intervention that has been proven to prevent HIV acquisition among MSM [3–7]. Men who are adherent to PrEP demonstrate a high level of protection against HIV infection in research trials [4, 6], as well as real-world clinical settings [5]. The CDC estimates that there are 492,000 MSM in the US who engage in HIV risk behaviors and meet indications for PrEP [8]. Engaging men who are at the highest-risk for HIV acquisition in prevention services including PrEP remains a significant public health challenge.

One group of MSM at highest-risk of HIV acquisition are those with unhealthy alcohol and drug use. Unhealthy alcohol and drug use among MSM is associated with engaging in risky behaviors such as participation in group sex, condomless sex and having a higher number of sexual partners [9–13]. For alcohol, unhealthy use is defined as the spectrum ranging from drinking over recommended limits to meeting diagnostic criteria for severe alcohol use disorder [14]. For other substances, the spectrum of unhealthy use begins at any time [15]. Multiple studies have shown that unhealthy substance use is prevalent among MSM, and that substance use disorders are up to three times higher than that of the general population [16, 17]. MSM with unhealthy alcohol use, and particularly those who engage in heavy episodic drinking (defined by the National Institute for Alcohol Abuse and Alcoholism as ingesting five drinks or more in a 2 hour period), are at significantly increased risk of HIV acquisition [12, 18]. In the iPrEx study which evaluated the use of PrEP by MSM and transgendered women, over 50% of enrollees reported having more than five drinks per day consistent with binge drinking behavior [4]. However, there is limited data on the prevalence of unhealthy substance use among MSM initiating PrEP in real-world clinical settings.

Unhealthy substance use among people living with HIV (PLWH) negatively impacts each step of the HIV Care continuum [19]. Unhealthy substance use may also affect outcomes across the PrEP care continuum (e.g. PrEP initiation, PrEP adherence, and retention in PrEP care) [20].

Medication adherence, in particular, is a key determinant of PrEP effectiveness. Research trials in which participants had suboptimal PrEP adherence demonstrated reduced efficacy of the intervention [21, 22]. MSM with drug or alcohol use have the potential for significantly reduced PrEP adherence [7, 23]. Among HIV-infected MSM, substance use is strongly associated with reduced antiretroviral (ARV) medication adherence [24]. While MSM who use substances may be more likely to utilize PrEP [25], it is not well established if the use of these substances impacts adherence to PrEP. Because substance use is a known risk factor for HIV transmission, as well as treatment non-adherence [26–29], understanding the prevalence and impact of these behaviors among MSM utilizing PrEP is critical.

The goal of the current study was to determine the prevalence and correlates of unhealthy alcohol and drug use among MSM taking PrEP in real-world clinical programs in Providence, Rhode Island and New Haven, Connecticut to better inform implementation efforts.

Methods

Participants and Procedures

MSM prescribed PrEP at outpatient clinics in Providence, Rhode Island and New Haven, Connecticut were recruited and enrolled into a prospective observational cohort. Both sites are the largest clinical PrEP programs in their respective states. Individuals were referred to the programs from sexually transmitted diseases (STD) clinics, substance use treatment programs, HIV testing sites, community based organizations including AIDS service organizations, online sites such as Craigslist and Facebook, internet hookup sites, public health departments, and by peer or physician referrals. Data was reviewed on participants who had been on or were newly prescribed PrEP from April 2015 through March 2017.

Data Collection

Structured clinical intake forms were used to assess basic demographics (age, gender, race, ethnicity, highest education level, and annual income) and HIV sexual risk behaviors. Specifically, participants were asked to report the number of male and female sex partners they had in the past 3 months. From these data, we constructed a variable representing sexual risk category (e.g., sex with men only, sex with men and women) as well the total number of sex partners in the past 3 months. Participants were also asked to report the number of male sex partners with which they engaged in condomless anal sex, and whether they had sex with a known HIV

positive partner in the past 3 months. Screening for depression was performed using the Patient Health Questionnaire (PHQ-2) with scores ≥ 3 considered major depression [30]. Alcohol use was assessed using the Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) questionnaire [31, 32] with a 3-month timeframe. Three measures were derived from AUDIT-C: (1) unhealthy alcohol use defined as an AUDIT-C score ≥ 4 , a cut-point that maximizes the sensitivity and specificity for identifying unhealthy alcohol use among men, (2) any heavy episodic drinking, based on reporting consuming five or more drinks on any single occasion during the past three months, and (3) frequency of heavy episodic drinking. Drug use was evaluated based on a question that evaluated the frequency of use of the following drugs: marijuana, cocaine, methamphetamine, poppers (amyl nitrate), MDMA/ecstasy/molly, ketamine (special K), heroin, opioids and benzodiazepines. For each substance, a dichotomous measure was derived based on reporting any use in the past 3 months (consistent with American Society of Addiction Medicine definitions), and a combined measure of any drug use was derived based on reporting use of any of the substances in the past 3 months. Frequent drug use was defined as any drug use at least monthly in the past 3 months. Participants were also asked whether they were actively injecting or had ever injected drugs in their lifetime.

Data Analysis

Demographic characteristics, HIV sexual risk behaviors, and measures of unhealthy substance use were analyzed using descriptive statistics and compared across the two study sites. Medians with interquartile ranges, standard deviations and percentages were calculated for continuous variables or they were converted to categories and reported as frequencies along with other categorical variables. Differences between cohort characteristics across both study sites as well as between individuals with or without unhealthy alcohol use (AUDIT-C score ≥ 4), and those with and without unhealthy drug use (defined as any reported use of any of the substances in the past 3 months) as well as those with or without frequent drug use were assessed using Chi square test for categorical variables and the Wilcoxon rank sum test for continuous variables. Fisher's exact test was used when cell sizes were less than five. Finally, we constructed a series of multivariable models, including as independent covariates any variables significant at $p < 0.10$ in the bivariate analysis. Primary outcomes included factors associated with unhealthy alcohol and drug use, as well as frequent drug use. To avoid collinearity, only any drug use was entered into the final model for unhealthy alcohol use and vice versa. Significance was defined as p -values less than 0.05. All statistical analyses were conducted using SAS version 9.4.

Ethical Considerations

All participants provided written informed consent prior to enrollment in the cohort and the study was approved by the local institutional review boards. No reimbursements or incentives were provided to participants.

Results

Cohort Characteristics

A total of 172 MSM were recruited during the study period (124 in Providence, Rhode Island and 48 in New Haven, Connecticut; Table 1); 11% were African American/Black, 22% were Hispanic/Latino, and 64% were white. More African American/Black men were enrolled in Connecticut compared to Rhode Island (23% vs. 7%, $p < 0.001$). Most individuals were between the ages of 25–34 years (40%) with an almost equal distribution between other age groups. Eighty-two percent had at least some college education and 64% of individuals had an annual income of \$30,000 or higher (Table 1).

Six percent of participants reported being bisexual. The median number of sexual partners reported by the cohort within the preceding 3 months was 3 (IQR 2–7), and was not significantly different by site; there was a median of 4 sex partners (IQR 2–12) at the Connecticut site and a median of 3 partners (IQR 2–6) at the Rhode Island site ($p = 0.11$). The median number of sexual partners with whom individuals reported condomless insertive or receptive anal sex within the preceding 3 month period was 1 partner (IQR 1–3) and there were no significant differences between sites. Twenty percent of subjects reported having an HIV-positive sex partner. A small proportion of subjects (4%) screened positive for major depression.

Unhealthy Alcohol and Drug Use

A total of 54% screened positive for unhealthy alcohol use, and 44% reported any heavy episodic drinking. Eight percent reported frequent heavy drinking episodes. Any drug use was reported by 57% of MSM during the 3 month period prior to study enrollment (Table 1). However, most of the reported recreational substances were marijuana (41%) and poppers (26%). Other drugs accounted for a much smaller fraction of unhealthy substance use and included non-prescription benzodiazepines (3%), MDMA/ecstasy/molly (2%), cocaine (2%) and methamphetamines (2%). A past or present history of injection drug use was reported by 4% of participants.

Table 1 Demographic and behavioral characteristics of men who have sex with men (MSM) on pre-exposure prophylaxis (PrEP) (N = 172)

Characteristic	Total (n = 172)		Rhode Island (n = 124)		Connecticut (n = 48)		Test statistic (W or Chi square)	p value
	N	%	N	%	N	%		
Age							2.41	0.492
< 25 year	32	18.6	25	20.2	7	14.6		
25–34 years	68	39.5	49	39.5	19	39.6		
35–44 years	38	22.1	24	19.3	14	29.2		
≥ 45 years	34	19.8	26	21.0	8	16.7		
Race							14.23	<0.001
Black/African American	19	11.1	8	6.5	11	22.9		
White	110	63.9	78	62.9	32	66.7		
Multiracial/other/unknown	43	25.0	38	30.6	5	10.4		
Ethnicity*							0.08	0.786
Not Hispanic/Latino	131	78.4	94	79.0	37	77.1		
Hispanic/Latino	36	21.6	25	21.0	11	22.9		
Annual income							4.63	0.201
Less than \$12,000	35	20.4	29	23.4	6	12.5		
\$12,000–\$29,999	27	15.7	18	14.5	9	18.7		
\$30,000–\$59,999	59	34.3	38	30.6	21	43.8		
\$60,000 or greater	51	29.6	39	31.5	12	25.0		
Education level [†]							3.26	0.196
High school diploma or less	31	18.5	25	20.8	6	12.5		
Some college	94	55.9	62	51.7	32	66.7		
College diploma or higher	43	25.6	33	27.5	10	20.8		
Sexual risk category							1.80	0.340
Sex with men only	161	93.6	118	95.2	43	89.6		
Sex with men and women	11	6.4	6	4.8	5	10.4		
Total number of sex partners, past 3 months (median, IQR)	3	(2–7)	3	(2–6)	4	2 (2–12)	2949.50	0.112
Number of condomless anal sex partners, past 3 months (median, IQR)	1	(1–3)	1.5	(1–3)	1	(1–3)	3485.00	0.436
Sex with a known HIV+ partner, past 3 months	35	20.3	33	26.6	11	22.9	0.25	0.633
Depression								
Positive screen (PHQ-2 of 3+)	7	4.1	5	4.0	2	4.2	<0.01	0.933
Unhealthy alcohol use								
Positive screen (AUDIT-C score of 4+)	93	54.4	71	57.3	22	46.8	1.50	0.221
Drug use (yes/no)								
Any	98	57.0	70	56.5	28	58.3	0.05	0.823
Marijuana	71	41.3	56	45.2	15	31.3	2.76	0.100
Cocaine	3	1.7	3	2.4	0	0.0	1.18	0.277
Methamphetamine	3	1.7	2	1.6	1	2.1	0.05	0.817
Poppers	45	26.2	30	24.2	15	31.3	0.89	0.353
MDMA/Ecstasy/Molly	3	1.7	3	2.4	0	0.0	1.18	0.277
Ketamine/Special K	0	0.0	0	0.0	0	0.0	–	–
GHB	1	0.6	0	0.0	1	2.1	2.60	0.558
Heroin	1	0.6	1	0.8	0	0.0	0.39	1.000
Opioids	0	0.0	0	0.0	0	0.0	–	–
Benzodiazepines	5	2.9	0	0.0	5	10.4	13.30	0.003
Other	3	1.7	1	0.8	2	4.2	2.28	0.377
Injection drug use ever	6	3.5	5	4.1	1	2.1	0.39	0.928

*Represents data on 167 individuals as data were missing for 5 participants

[†]Represents data on 168 individuals as data were missing for 4 participants

Correlates of Unhealthy Alcohol and Drug Use

In the bivariate analysis, the number of sex partners in the past 3 months was greater among those with unhealthy alcohol use than those without (4 vs. 3, $p=0.035$), while those with unhealthy alcohol use had a lower prevalence of having had sex with a known HIV+ partner than those without (13% vs. 30%, $p=0.007$). The median number of condomless sex partners were similar across groups (2 vs. 1, $p=0.440$, Table 2). The prevalence of any drug use was greater among those with unhealthy alcohol use than those without (66% vs. 46%, $p=0.011$), with similar patterns for marijuana use (51% vs. 31%, $p=0.009$). No other factors were associated with unhealthy alcohol use (Table 2). Men with drug use were more likely to report various measures of unhealthy alcohol use (Table 3). No other factors were associated with drug use (Table 3). Younger age and unhealthy alcohol use were associated with frequent drug use (Table 4).

On multivariable analyses (see Table 5), unhealthy alcohol use was significantly and positively associated with any drug use (adjusted odds ratio [AOR] 2.6, 95% CI 1.3–5.0, $p=0.006$). Men reporting unhealthy alcohol use were significantly less likely to report an HIV-positive sex partner in the past 3 months (AOR 0.30, 95% CI 0.13–0.60, $p=0.005$). No risk factors were independently associated with any drug use except for unhealthy alcohol use (as in the first model). Finally, in the third model, age less than 25 years versus 35–44 years was independently associated with frequent drug use (AOR 4.3 95% CI 1.51–12.09, $p=0.017$), while unhealthy alcohol use was not (AOR 1.58, 95% CI 0.83–3.01, $p=0.162$, Table 5).

Discussion

This study is among the first to comprehensively evaluate unhealthy substance use among a cohort of MSM initiating PrEP in real-world clinical settings. Our study found that a high proportion (> 50%) of MSM reported unhealthy alcohol use. Furthermore, more than half of the sample reported any heavy episodic drinking. Drug use was also very common. However, while significant proportions of participants reported use of marijuana (41%) and poppers (26%), less than 5% of the cohort reported other drug use. This spectrum of drug use has also been observed in other cohorts including among PrEP users at a clinic in Los Angeles where marijuana (68%) and poppers (57%) were the most commonly used substances reported [25].

The finding that unhealthy alcohol use, including heavy episodic drinking, was the most prevalent substance use disorder in this cohort is noteworthy. Other studies of MSM populations have shown that the prevalence of heavy episodic drinking (≥ 5 drinks per day) ranges from 20%

among PrEP eligible individuals described in one study to 53% among MSM initiating PrEP in the iPrEx trial [4, 7]. Importantly, alcohol use among MSM is associated with increased sexual risk behaviors such as having multiple sex partners, engaging in unsafe sexual practices including condomless anal sex [18, 33], and may potentially impact an individual's ability to adhere to PrEP. Moreover, alcohol use may also impair judgment, alter cognition, induce short term memory loss and result in disruption of an individual's daily schedule, all of which negatively impact medication adherence [24]. Thus, the high observed prevalence of unhealthy alcohol use in our sample suggests there may be a critical need for interventions designed to identify and address unhealthy alcohol use among PrEP-using MSM to promote HIV prevention.

Our study did not find a statistically significant difference between HIV risk behaviors among MSM who reported unhealthy substance use compared to those who did not report unhealthy substance use though there was a trend among MSM who reported unhealthy alcohol use having an increased number of sexual partners. This was unexpected but it is possible that our study was underpowered to detect differences between these groups. Also, some of the study participants who were already on PrEP had received HIV risk reduction counseling such that their risk behavior profile and/or its reporting might have been modified based on counseling and/or social desirability. The finding that individuals who had unhealthy alcohol use reported fewer HIV positive sex partners than those without unhealthy alcohol use was also unexpected but possible explanations are that this may have been impacted by engagement in sex with anonymous partners or individuals who did not disclose their HIV status [34]. Thus, given the high prevalence of unhealthy alcohol and other substance use identified in this study, further research is needed to understand their influence on HIV risk behaviors and PrEP outcomes among MSM initiating PrEP.

We observed very few individuals who reported opioid, cocaine or methamphetamine use among patients prescribed PrEP in this study. Only 4% reported injection drug use. While this finding may be specific to our settings, or represent under-reporting of drug-using behaviors, it suggests that these two PrEP programs may not be reaching populations at greatest risk [35, 36]. Expanding PrEP outreach efforts to substance use treatment programs or integrating PrEP within such programs may be an important approach to improve PrEP delivery among these populations [37, 38]. Innovative community-based outreach efforts that either engage individuals directly in the community or link them to PrEP service sites, as has been successfully employed in HIV treatment of people with substance use, may need to be employed [39, 40].

Table 2 Demographic and behavioral characteristics of men who have sex with men (MSM) on pre-exposure prophylaxis (PrEP), stratified by unhealthy alcohol use (N = 172)

Characteristic	Unhealthy alcohol use (AUDIT-C \geq 4) (n = 93)		No unhealthy alcohol use (AUDIT-C < 4) (n = 78)		Test statistic (W or Chi square)	p-value
	N	%	N	%		
Age					3.60	0.309
< 25 year	22	23.7	10	12.8		
25–34 years	36	38.7	32	41.0		
35–44 years	19	20.4	18	23.1		
\geq 45 years	16	17.2	18	23.1		
Race					0.74	0.692
Black/African American	11	11.8	8	10.3		
White	61	65.6	48	61.5		
Multiracial/other/unknown	21	22.6	22	28.2		
Ethnicity*					1.29	0.256
Not Hispanic/Latino	74	82.2	57	75.0		
Hispanic/Latino	16	17.8	19	25.0		
Annual income					1.61	0.658
Less than \$12,000	20	21.5	15	19.2		
\$12,000–\$29,999	12	12.9	15	19.2		
\$30,000–\$59,999	31	33.3	27	34.6		
\$60,000 or greater	30	58.8	21	41.2		
Education level [†]					0.52	0.772
High school diploma or less	17	18.9	14	18.2		
Some college	48	53.3	45	58.4		
College diploma or higher	25	27.8	18	23.4		
Sexual risk category					0.10	0.752
Sex with men only	87	93.6	72	92.3		
Sex with men and women	6	6.4	6	7.7		
Total number of sex partners, past 3 months (median, IQR)	4	(2–8)	3	(1–5)	5848.50	0.035
Number of condomless anal sex partners, past 3 months (median, IQR)	2	(1–3)	1	(1–3)	5807.00	0.440
Sex with a known HIV+ partner, past 3 months	12	12.9	23	29.5	7.17	0.007
Depression						
Positive screen (PHQ-2 of 3+)	3	3.2	4	5.1	0.39	0.569
Unhealthy alcohol use						–
Any heavy episodic drinking	67	72.0	8	10.2	65.77	< 0.001
Frequent heavy episodic drinking	13	14.0	0	0.0	11.80	< 0.001
How often did you have 6 + drinks at one time (last 3 months)					N/A	N/A
Never	26	28.0	70	89.7		
Less than monthly	27	29.0	8	10.3		
Monthly	27	29.0	0	0.0		
Weekly	13	14.0	0	0.0		
Daily or almost daily	0	0.0	0	0.0		
Drug use (yes/no)						
Any	61	65.6	36	46.2	6.53	0.011
Marijuana	47	50.5	24	30.8	6.83	0.009
Cocaine	3	3.2	0	0.0	2.56	0.110
Methamphetamine	1	1.1	2	2.5	0.55	0.534
Poppers	28	30.1	16	20.5	2.04	0.158
MDMA/Ecstasy/Molly	2	2.2	1	1.3	0.19	1.000

Table 2 (continued)

Characteristic	Unhealthy alcohol use (AUDIT-C ≥ 4) (n = 93)		No unhealthy alcohol use (AUDIT-C < 4) (n = 78)		Test statistic (W or Chi square)	p-value
	N	%	N	%		
Ketamine/Special K	0	0.0	0	0.0	–	–
GHB	0	0.0	1	1.3	1.20	0.456
Heroin	1	1.1	0	0.0	0.84	1.000
Opioids	0	0.0	0	0.0	–	–
Benzodiazepines	1	1.1	4	5.1	2.46	0.152
Other	2	2.2	1	1.3	0.19	1.000
Injection drug use ever	2	2.2	4	5.1	1.11	0.284

AUDIT-C score was not computed for one participant

*Represents data on 167 individuals as data were missing for 5 participants

†Represents data on 168 individuals as data were missing for 4 participants

Not surprisingly, those with unhealthy alcohol use also had higher frequency of using other substances, with marijuana being the most common among our cohort. As others have reported, unhealthy alcohol use may be a marker for drug use [16]. Polysubstance use has been associated with higher rates of HIV risk behaviors including a higher frequency of condomless sex with multiple partners, having multiple new sexual partners, group sex, acquiring other sexually transmitted infections, and use of post-exposure prophylaxis [9]. Specifically, marijuana and poppers, used by a significant number of men in our cohort, are also associated with engagement in more risky sexual practices [41, 42]. These observations highlight the importance of engaging MSM with drug use in PrEP programs.

Despite the high prevalence of unhealthy alcohol use among MSM initiating PrEP, very little is known about how it impacts outcomes such as PrEP adherence and retention in care. Previous studies have shown that unhealthy alcohol use may impact retention in HIV care as well as quality of care [28, 29]. Limited available data suggests that unhealthy alcohol use, particularly binge drinking, has serious implications for PrEP use [43]. In the iPrEX study, individuals who consumed > 5 alcoholic drinks per day were found to have decreased protection from PrEP against HIV infection (HR 0.63 [95% CI 0.36–1.11]) [4]. Similarly, in a PrEP open label extension study, MSM who reported heavy episodic drinking, compared to those who drank < 5 drinks per day, showed a trend towards being less likely to adhere to PrEP (adjusted OR 0.81 [95% CI 0.65–1.02], $p=0.07$) [7]. Similarly, in another study, drug and/or alcohol use were associated with an almost twofold higher risk of PrEP discontinuation [43]. These data suggest that poor PrEP medication adherence or discontinuation driven by unhealthy substance use may translate to increased risk of HIV infection, although additional research in real-world

clinical settings is needed. Programs which integrate alcohol screening and treatment for MSM prescribed PrEP may need to be considered.

Our study had several limitations. Only MSM were included in the study population and findings may not be extrapolated to other HIV risk groups such as at-risk women, heterosexual individuals, transgendered women (TGW) and people who inject drugs (PWID). In addition, substance use patterns are also known to differ across US cities and our findings may not be generalizable to other settings. Also, factors which are known to impact the accuracy of self-report of substance use and HIV risk behaviors including social desirability response bias, fear of loss of confidentiality and memory or recall may have influenced responses to survey questions [44]. Furthermore, objective biochemical markers of substance use were not utilized to correlate accuracy of self-reported drug use. Another important limitation is that, due to lower than anticipated recruitment, the study may have been underpowered to detect statistically significant associations. We could not examine classes of drug use separately (e.g., stimulants, club drugs) due to the small number of participants reporting those specific substances. We did not characterize marijuana use as recreational or physician prescribed but in our cities (New Haven and Providence), as medical prescription rates for marijuana are so low, it is most likely that marijuana use that we captured represents recreational use.

Conclusion

MSM engaged in PrEP services demonstrated high rates of unhealthy alcohol use while engaging in high-risk sexual behaviors that put them at risk for acquiring HIV infection.

Table 3 Demographic and behavioral characteristics of men who have sex with men (MSM) on pre-exposure prophylaxis (PrEP), stratified by drug use (N = 172)

Characteristic	Drug use (n = 98)		No drug use (n = 74)		Test statistic (W or Chi square)	p-value
	N	%	N	%		
Age					3.33	0.343
< 25 year	22	22.5	10	13.5		
25–34 years	40	40.8	28	37.8		
35–44 years	19	19.4	19	25.7		
≥ 45 years	17	17.4	17	23.0		
Race					4.50	0.105
Black/African American	10	10.2	9	12.2		
White	69	70.4	41	55.4		
Multiracial/other/unknown	19	19.4	24	32.4		
Ethnicity*					1.53	0.216
Not Hispanic/Latino	77	81.9	54	74.0		
Hispanic/Latino	17	18.1	19	26.0		
Annual income					1.25	0.740
Less than \$12,000	22	22.5	13	17.6		
\$12,000–\$29,999	14	14.3	13	17.6		
\$30,000–\$59,999	35	35.7	24	32.4		
\$60,000 or greater	27	27.6	24	32.4		
Education level [‡]					4.19	0.123
High school diploma or less	17	17.9	14	19.2		
Some college	59	62.1	35	48.0		
College diploma or higher	19	20.0	24	32.9		
Sexual risk category					3.66	0.059
Sex with men only	88	89.8	72	97.3		
Sex with men and women	10	10.2	2	2.7		
Total number of sex partners, past 3 months (median, IQR)	4	(2–8)	3	(1–5)	2981.5	0.122
Number of condomless anal sex partners, past 3 months (median, IQR)	1	(1–3)	1	(1–3)	3035.00	0.381
Sex with a known HIV+ partner, past 3 months	20	20.4	15	20.4	<0.01	0.990
Depression						
Positive screen (PHQ-2 of 3+)	6	6.1	1	1.4	2.46	0.135
Unhealthy alcohol use						
Any heavy episodic drinking	53	54.1	23	31.1	9.04	0.003
Weekly or more heavy episodic drinking	11	11.2	3	4.1	2.90	0.095
How often did you have 6+ drinks at one time (last 3 months)					9.82	0.044
Never	45	45.9	51	68.9		
Less than monthly	24	24.5	11	14.9		
Monthly	18	18.4	9	12.2		
Weekly	10	10.2	3	4.1		
Daily or almost daily	1	1.0	0	0.0		

AUDIT-C score was not computed for one participant

*Represents data on 167 individuals as data were missing for 5 participants

[‡]Represents data on 168 individuals as data were missing for 4 participants

Table 4 Demographic and behavioral characteristics of men who have sex with men (MSM) on pre-exposure prophylaxis (PrEP), stratified by frequent drug use in the past 3 months (N = 172)

Characteristic	Frequent drug use (n = 70)		Infrequent drug use (n = 102)		Test statistic (W or Chi square)	p-value
	N	%	N	%		
Age					8.40	0.038
< 25 year	19	27.1	13	12.8		
25–34 years	29	41.4	39	38.2		
35–44 years	10	14.3	28	27.5		
≥ 45 years	12	17.1	22	21.6		
Race					1.01	0.604
Black/African American	9	12.9	10	9.8		
White	46	65.7	64	62.8		
Multiracial/other/unknown	15	21.4	28	27.5		
Ethnicity*					0.74	0.391
Not Hispanic/Latino	54	81.8	77	76.2		
Hispanic/Latino	12	18.2	24	23.8		
Annual income					0.84	0.839
Less than \$12,000	16	22.9	19	18.6		
\$12,000–\$29,999	12	17.1	15	14.7		
\$30,000–\$59,999	23	32.9	36	35.3		
\$60,000 or greater	19	27.1	32	31.8		
Education level [‡]					1.30	0.523
High school diploma or less	13	19.4	18	17.8		
Some college	40	59.7	54	53.5		
College diploma or higher	14	20.9	29	28.7		
Sexual risk category					0.46	0.451
Sex with men only	64	91.4	96	94.1		
Sex with men and women	6	8.6	6	5.9		
Total number of sex partners, past 3 months (median, IQR)	3	(2–7)	3	(2–6.5)	6010.00	0.642
Number of condomless anal sex partners, past 3 months (median, IQR)	1.5	(1–3)	1	(1–3)	5773.50	0.496
Sex with a known HIV+ partner, past 3 months	16	23.5	19	20.0	0.46	0.588
Depression						
Positive screen (PHQ-2 of 3+)	5	7.1	2	1.9	2.86	0.117
Unhealthy alcohol use	43	62.3	20	49.0	31.28	<0.001
Any heavy episodic drinking	34	48.6	42	41.2	0.92	0.343
Weekly or more heavy episodic drinking	9	12.9	20	19.6	1.35	0.231
How often did you have 6+ drinks at one time (last 3 months)					4.54	0.337
Never	36	51.4	60	58.8		
Less than monthly	13	18.6	22	21.		
Monthly	12	17.1	15	14.7		
Weekly	8	11.4	5	4.9		
Daily or almost daily	1	1.4	0	0.0		

AUDIT-C score was not computed for one participant, frequent substance use was defined as at least monthly use

*Represents data on 167 individuals as data were missing for 5 participants

[‡]Represents data on 168 individuals as data were missing for 4 participants

Table 5 Factors associated with unhealthy alcohol and drug use among men who have sex with men (MSM) initiating pre-exposure prophylaxis (PrEP)

	Adjusted odds ratio	95% CI	p-value
Unhealthy alcohol use			
Total number of sex partners, past 3 months (per sex partner)	1.04	0.99–1.09	0.098
Any illicit substance use (yes vs. no)	2.57	1.32–5.01	0.006
Sex with a known HIV+ partner, past 3 months (yes vs. no)	0.30	0.13–0.60	0.005
Drug use			
Sexual risk category (man who has sex with both women and men vs. sex with men only)	4.16	0.85–20.43	0.080
Unhealthy alcohol use (yes vs. no)	2.30	1.23–4.32	0.010
Frequent drug use			
Age (ref: 35–44 years)			
<25 years	4.27	1.51–12.09	0.017
25–34 years	2.32	0.95–5.69	0.560
>45 years	1.74	0.62–4.92	0.610
Unhealthy alcohol use (yes vs. no)	1.58	0.83–3.01	0.162

They also reported high rates of marijuana and popper use, with lower rates of other drug use. The impact of unhealthy alcohol and drug use on adherence to PrEP and retention in care are worthy of further exploration. Our findings suggest that integrating alcohol and other substance use assessment and treatment into PrEP services or linkage to substance use treatment are warranted and further efforts are needed to engage MSM who use drugs in PrEP care.

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Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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