Marijuana Use and Sexual Risk Behavior Among Young Black Men Who Have Sex with Men in California

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Abstract

Young black men who have sex with men (YBMSM) are disproportionately affected by HIV and continue to experience higher rates of new HIV infections when compared to other population groups. As part of the Peer Promotion of Wellness and Enhanced Linkage to Resources Project, we examined problem marijuana use and the overall sexual risk profile of 250 YBMSM. Eighty percent reported prior use of marijuana in their lifetime ($n = 200$). Among those, problem marijuana use was correlated with problem use of alcohol ($r = 0.51$, $p < 0.001$) and other drugs ($r = 0.29$, $p < 0.001$); lower household income ($r = -.22$, $p < .01$); homelessness ($r = 0.15$, $p < 0.05$); incarceration ($r = 0.16$, $p < 0.05$); exchanging sex for money, drugs, or shelter ($r = 0.18$, $p < 0.05$); having sex with someone known or suspected of having HIV and/or an STI ($r = 0.20$, $p < 0.01$); having sex with someone known or suspected of being an injector ($r = 0.24$, $p < 0.01$); and having unprotected sex while under the influence of alcohol or drugs ($r = 0.32$, $p < 0.001$). The complex relationship between marijuana and sexual risk behavior was examined while accounting for the possible moderating effects of alcohol or other drugs. Problem marijuana, alcohol, and other drug use each made unique contributions to predicting risky sex behavior. A significant marijuana and other drug interaction was found to predict sexual risk behaviors. Future efforts should include holistic intervention approaches for YBMSM that consider factors facilitating high-risk sexual behaviors.

Keywords Sexual risk behaviors · Marijuana use · Substance use · Young black men who have sex with men

Introduction

Black men who have sex with men (BMSM) continue to be disproportionately affected by HIV/AIDS in the USA; BMSM comprise 25% of all new HIV cases, 75% of whom are YBMSM between the ages of 13–34 [1]. In California, despite the 13% decrease in new HIV diagnoses among MSM from 2005 to 2013, YBMSM aged 13–24 years experienced a 16% increase during the same period [2]. In Los Angeles County, where the present study was conducted, BMSM account for only 1% of the population yet they represent 18% of MSM HIV infections [3]. The present study explores the role of

marijuana use as a contributing factor to sexual risk behaviors within this population.

As a group, YBMSM are more likely to use marijuana over other substances when compared to other racial/ethnic MSM groups [4, 5]. The link between drugs and alcohol with sexual risk behavior among young adults is robust and has been well-documented in the literature [6, 7]. This work, however, has primarily focused on college students and not young sexual and racial minority adults in urban settings where structural and social stressors such as poverty, incarceration, dense sexual networks, discrimination, racial segregation, and lack of access to health care are common [8–11]. In fact, rates of condomless sex, high numbers of sex partners, sexually transmitted infections (STIs), and pregnancy are extremely high in urban settings compared to national averages [12].

Prior research has documented that marijuana users report using condoms less often than non-users [13–15]. For example, one study documented lower condom use among marijuana-using college students compared to non-users. The authors attributed this finding to the lower use of protective behavioral strategies related to condom use (e.g., talking about condom use with a partner in advance and carrying

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condoms) observed among marijuana users, rather than normative beliefs concerning peer condom use [16]. Another study found that 39% of BMSM who reported having sex in the past 12 months used marijuana monthly or more during sex [17]. Marijuana use has also been associated with high-risk sexual behaviors, such as group sex and unprotected anal sex among MSM [18, 19].

One challenge to understanding the effects of marijuana use on sexual risk behavior is the fact that marijuana is commonly used in combination with alcohol or other drugs [20–24]. It can be difficult to isolate the independent influence of marijuana on sexual behavior among individuals who are polysubstance users, and sexual minority youth are at increased risk for polysubstance use [25, 26]. In one study, polysubstance marijuana users had a greater number of sexual partners, despite their younger age, and a greater frequency of unprotected sex with casual partners than their non-marijuana using counterparts [27]. Studies have reported that mental and cognitive impairment associated with marijuana use results in the increase of risky sexual behaviors, which are then compounded with the influence and effects of additional drugs [28]. Analyses from a study examining the effects of marijuana and alcohol use on unprotected sex found that unprotected sex was linked to alcohol use, but not marijuana use when both were included in the model [28]. Another study of black adolescents found that high-risk sexual behaviors are significantly worse for those who use marijuana and alcohol, and in terms of increased numbers of sexual partners, this is especially true for those who used both marijuana and alcohol versus alcohol alone [12]. A few studies have examined the possible moderating effects of alcohol and other drugs on risky sexual behavior, but with mixed results [29, 30]. A study of high-risk youth found no significant interaction between marijuana and alcohol on risky sexual behavior, but another study with low-income black youth found significant interactions between marijuana and alcohol on using a condom at last sexual intercourse and sex while high in the past 90 days, but no significant interactions between marijuana and cocaine on risky sexual behaviors [30]. To our knowledge, the individual contribution of marijuana compared to both alcohol and other drugs, as well as the potential interaction of marijuana with alcohol and other drugs, on risky sexual behavior among YBMSM has not been studied.

This analysis uses data from a behavioral intervention pilot study to examine the contribution of problem marijuana use to the overall sexual risk profile of YBMSM in a diverse urban setting in Southern California. As noted previously, this is a relevant inquiry given that BMSM are over-represented among new and overall HIV cases in the USA, and YBMSM ages 13–34 are at highest risk for new HIV infections compared to any group. Additionally, marijuana use over time is not without other health risks that may contribute to other health disparities for black Americans. For example,

evidence suggests that marijuana use precedes and increases the likelihood of future use of other substances [31–37], heightens risk for escalating consumption to hazardous levels, and results in poor cessation outcomes for both substances [38–42]. Additionally, a significant proportion of people who smoke marijuana recreationally experience symptoms of dependence [43, 44], and prolonged marijuana use can lead to adverse physical and mental health outcomes [45–53]. These negative effects on health have been found to persist into later adulthood and to affect black men more than white men [54].

Methods

Baseline data used for these analyses were collected at the time of participant enrollment in the Peer Promotion of Wellness and Enhanced Linkage to Resources (PPOWER) Project, a 3-year pilot study funded by the Substance Abuse and Mental Health Services Administration (SAMHSA). PPOWER was a multi-sectoral collaboration between a university-based research center and local community-based partners with expertise in behavioral health/substance abuse treatment, HIV/STI counseling and testing, and comprehensive HIV medical care. All study procedures were approved by the California State University, Long Beach Institutional Review Board (IRB00000815). PPOWER aimed to (a) engage YBMSM ages 18 to 24; (b) conduct screening and provide a brief intervention on reduction of alcohol and marijuana use; (c) provide motivation and support to YBMSM through individualized support and role model stories; (d) increase access to HIV and hepatitis C (HCV) testing; and (e) establish a continuum of care for those who tested positive for HIV and/or HCV, or were at risk for other STIs, engaged in substance abuse, or experienced other challenges.

Sample Characteristics, Engagement, and Enrollment Procedures

Participants included in this analysis were young men who (a) self-identified as black/African American males, (b) were between the ages of 18 and 24 years, (c) engaged in any voluntary sexual activity with another man at least once, and (d) resided in Long Beach or its surrounding communities in Los Angeles County, California. Using convenience sampling, the PPOWER Project staff and volunteer peer advocates engaged gay- and non-gay identified YBMSM in Long Beach, California, from November 2016 to June 2018, at health-related events, gay-friendly bars and clubs, and college campus events and venues. Outreach and enrollment were facilitated by word of mouth from within the peer advocates' social networks. Upon providing informed consent, participants completed a questionnaire (tablet or paper format). Staff were available to answer questions during the survey process.

Study Measures The measures for the PPOWER pilot study included demographic characteristics, attitudes, self-efficacy, and behaviors related to substance use, sexual health, and HIV/STI risk.

Included in the substance use measures were measures of problem marijuana, alcohol, and other drug use. Two sub-scales of the Alcohol, Smoking, and Substance Involvement Screening Test version 3 (ASSIST V3.0) [55] were employed to measure problem marijuana use (ASSIST-M), and problem use of other drugs (ASSIST-O). Each ASSIST scale is composed of an 8-item questionnaire measuring substance use frequency and context to evaluate problem use. Scores between 4 and 26 indicate a moderate health risk [56]. Problem alcohol use was assessed using the Alcohol Use Disorder Identification Test (AUDIT) [57], a 10-item questionnaire designed to detect problems based on alcohol consumption, symptoms of dependence, and alcohol-related physical or social harm in the past year. A score higher than 7 is indicative of harmful drinking [58].

Self-efficacy for safer sexual behaviors was measured with six questions that assessed participants' confidence in engaging in safe sex practices with their main or other partner. A main partner was defined as the main sexual partner or last person with whom the participant had sex. Other partner was defined as the last person the participant had sex with in the past 3 months that was not their main partner. Questions included (a) verbalizing preferences for particular behaviors, (b) refusing undesirable sexual practices, (c) refusing sex if not in the mood, (d) asking one's partner to wait for a barrier, (e) asking one's partner to use a barrier, and (f) refusing sex without barrier. Responses were coded on a 4-point Likert scale (1—Not at all, 2—A little, 3—Somewhat, 4—Very much). The scale showed good reliability, with a Cronbach's alpha of .81 for main partner and .87 for other partner.

Sexual health measures included the use of safe sex behaviors with a main partner or other partner, barrier or prevention method (i.e., male condoms, female condoms, pre-exposure prophylaxis (PrEP) or post-exposure prophylaxis (PEP), avoiding vaginal or anal sex, mutual monogamy, interviewing or asking partners about test results, and inspecting partners' genitals/mouth/anus) at last sexual encounter, and ever using a condom or ever using PrEP/PEP. Sexual health was also measured by asking for self-reported history of HIV testing and HIV status.

Measures of HIV/STI risk were gathered as part of the funder-required National Minority AIDS Initiative (MAI) Substance Abuse/HIV Prevention Initiative Adult Questionnaire. These included types of sex (i.e., oral sex, anal sex, and/or vaginal sex), and types of sex partners (i.e., main/primary partner and/or other sex partner(s)). Behaviors associated with HIV/STI risk were also collected with 4 items that asked about risky sexual behaviors within the past 3 months. The four items were (a) unprotected sex for money, drugs, or other things;

(b) unprotected sex with someone you knew or suspected had HIV/or an STI; (c) unprotected sex with a partner you knew or suspected of being an injector; and (d) unprotected sex while under the influence of alcohol or drugs.

Demographic variables included sexual orientation, age, highest education level completed, household income categories, employment status, living situation categories, homelessness (dichotomized), and past incarceration history.

Study Procedures Upon completing a short eligibility screening questionnaire and providing informed consent, PPOWER participants were scheduled at a time and confidential setting of their choice to complete the baseline questionnaire, which included coffee shops, fast food restaurants, interview rooms in community-based partner organizations, and open spaces on college campuses or at parks. In some cases, the baseline questionnaire was completed at the time of enrollment. PPOWER staff remained available to answer questions and provide assistance while participants completed the questionnaire. Completion time for 247 participants ranged from 7 to 66 min with a mean completion time of 22 min. Research staff reviewed questionnaire data for completion, and descriptive statistics were reviewed periodically to evaluate study reach and progress.

Analyses Analyses were conducted using SPSS 26. Demographic and behavioral characteristics of marijuana users were compared to those of non-users using independent samples t tests and chi-square analysis. Further analyses of marijuana users were done using Pearson's correlation coefficients to assess the relationships between problem marijuana use (ASSIST-M scores) and (a) problem alcohol and other drug use (AUDIT and ASSIST-O scores), (b) self-efficacy for safer sexual behaviors, (c) sexual health, (d) perception of risk and past sexual behaviors, and (e) risky sexual behavior in the past 3 months. Hierarchical logistic analysis was conducted to examine the individual contributions of problem marijuana, alcohol, and other drug use on risky sexual behavior and the interaction effects of problem marijuana with problem alcohol and other drug use.

Results

Descriptive Characteristics A total of 250 YBMSM ranging from 18 to 25 ($M = 22.0$ years) were included in PPOWER. Slightly over half (50.8%) identified as gay, 24.0% considered themselves to be bisexual, and 17.2% identified as straight or heterosexual. Most of the participants (95.6%) reported having completed high school or the equivalent, which is a higher proportion than that reported by the 2010 U.S. Census for Long Beach-Lakewood men ages 18 to 24 (81.2%) [59]. A sizeable proportion at 41.6% were unemployed, 15.6%

reported being homeless or living in a shelter, and 30.4% had an annual household income of less than $10,000. Thirty-two percent of participants reported incarceration for three or more days in their lifetime, while 18.4% of the participants experienced incarceration within the past 2 years.

YBMSM reported sexual and substance use behaviors. The most frequently reported behavior was oral sex (94.0%), followed by anal sex (89.2%), and vaginal sex (48.8%). Most of the participants reported recent sexual activity; 76.0% engaged in either oral, anal, or vaginal sex during the past 30 days. Among the participants, 67.4% reported having recent sex with someone other than their primary sex partner in the past 3 months. A majority (62.4%) reported ever having sex under the influence of drugs and/or alcohol, and 60.9% of those had done so within the past three months. Exchange of unprotected sex for money, drugs, or shelter was reported by 40.0% of the YBMSM, and 20.8% did so in the past 3 months.

Among the YBMSM participants, 12.4% never used a condom and 55.2% did not use a condom or other barrier during their most recent sexual encounter. About a third (29.6%) had unprotected sex with someone they knew or suspected had HIV/STI. The majority (87.3%) did not report any prior use of either PrEP or PEP. In terms of HIV testing, 26.4% had never been tested for HIV. At the time of enrollment, 73.2% of respondents reported at least one previous test for HIV and of these, 22 (8.8%) self-reported a positive HIV test.

Among the 250 YBMSM included in the study, 80.0% reported prior use of marijuana at least once in their lifetime. A majority of the sample (59.2%) reported using marijuana in the past 30 days. Among those who reported marijuana use in the past 30 days, the largest group were those who also drank alcohol (32.4%), followed by those who used alcohol and other drugs in conjunction with marijuana (19.6%). A small percentage of the sample (6.4%) reported using only marijuana in the past 30 days. About a third (36.8%) reported using tobacco. Fifteen distinct other drugs were reported, with methamphetamines and other stimulants mentioned most often, followed by heroin and other opiates, several "club drugs," and hallucinogens, including LSD and hallucinogenic mushrooms. "Pills" of unknown content were also reported.

Comparison of Marijuana Users and Non-users YBMSM who reported prior use of marijuana at least once in their lifetime ($n = 200$) and those who did not ($n = 48$) were not significantly different in terms of demographic characteristics including age, sexual orientation, highest education level completed, employment status, living situation, homelessness, or household income category (Table 1). The two groups were significantly different on incarceration, with marijuana users more likely to have been incarcerated for 3 days or more within the past 2 years (X^2 (1, 248) = 8.15, $p < 0.001$). Table 2 shows the differences between those who had ever used marijuana and those who had not on sexual risk and protective behaviors.

Those who had ever used marijuana were more likely to have engaged in sexual behaviors than those who had never used marijuana (oral sex: X^2 (1, 245) = 18.35, $p < 0.001$; anal sex: X^2 (1, 235) = 19.99, $p < 0.001$; and vaginal sex: X^2 (1, 244) = 8.32, $p < 0.01$). The two groups were not significantly different on use of barriers or protection, HIV testing and status, types of sex partners, and risky sex behaviors, such as exchanging unprotected sex for money, drugs, or shelter within the last 3 months, having unprotected sex within the past 3 months with a person known/suspected to have HIV/STD, and having unprotected sex within the past 3 months with a person known/suspected of injecting. Marijuana users were, however, more likely to report having unprotected sex while under the influence of alcohol or drugs within the past three months than non-users (X^2 (2, 239) = 13.88, $p < .001$).

These initial findings suggested an increase in certain sexual risk behaviors for those who had used marijuana, but the relationship between alcohol and other drugs with risky sexual behavior is also well documented. To understand the relationship between marijuana use and the other variables of interest, such as alcohol and other drugs, perceived self-efficacy for safer sexual behaviors, sexual health, perceived risk of past sexual behaviors, and current sexual risk, further analyses were limited to the sample of YBMSM who reported previous marijuana use in their lifetime. Those who reported no marijuana use in their lifetime ($n = 48$) were removed from the rest of the analyses.

Results of Bivariate Correlations Bivariate correlations between problem marijuana, alcohol, and other drug use and the other variables of interests among marijuana users are presented in Table 3. Problem marijuana use was highly correlated with both problem alcohol ($r = 0.51$, $p < 0.001$) and other drug use ($r = 0.29$, $p < 0.001$). Problem alcohol and other drug use were highly correlated with each other ($r = 0.47$, $p < 0.001$). All three substances were negatively correlated with household income (marijuana: $r = -0.22$, $p < 0.001$; alcohol: $r = -0.16$, $p < 0.05$l and other drugs: $r = -0.23$, $p < 0.01$), positively correlated with being homeless or in a shelter (marijuana: $r = 0.15$, $p < 0.05$; alcohol: $r = 0.19$, $p < 0.01$; and other drugs: $r = 0.35$, $p < 0.001$), and associated with being incarcerated for at least 3 days within the past 2 years (marijuana: $r = 0.16$, $p < 0.05$; alcohol: $r = 0.21$, $p < 0.01$; and other drugs: $r = 0.24$, $p < 0.001$).

Problem marijuana use was not associated with perceived self-efficacy toward using safe sex behaviors with a main partner or other partner, barrier or prevention method used at last sexual encounter, ever using a condom or ever using PrEP/PEP, having been tested for HIV or a positive test for HIV, or number of sexual partners in the past 3 months.

Marijuana, alcohol, and other drugs were correlated with 4 items that measured risky sexual behaviors in the past 3 months: (a) unprotected sex for money, drugs, or other

Table 1 Participant demographics by self-reported lifetime substance use (n = 248)

Demographic characteristics	Marijuana nonusers (n = 48)	Reported marijuana use (n = 200)	X^2 or t	df	Significance
Age	22.5 (18–25)	21.9 (18–25)	1.65	236	$p = 0.11$
Sexual orientation			1.44	3	$p = 0.70$
Gay	55.3% (26)	51.0% (99)			
Bisexual	19.1% (9)	26.3% (51)			
Straight or heterosexual	21.3% (10)	17.0% (33)			
Questioning	4.3% (2)	5.7% (11)			
Highest education level completed			6.92	4	$p = 0.14$
Middle school	2.1% (1)	5.0% (10)			
High school	70.8% (34)	61.8% (123)			
Community college/technical school	14.6% (7)	27.6% (55)			
Four-year college	10.4% (5)	5.0% (10)			
Beyond 4-year college	2.1% (1)	0.5% (1)			
Employment status			2.08	3	$p = 0.56$
Employed full-time	18.8% (9)	12.7% (25)			
Employed part-time	37.5% (18)	33.0% (65)			
Unemployed (full-time student)	8.3% (4)	10.2% (20)			
Unemployed (other reasons)	35.4% (17)	44.2% (87)			
Living situation			4.31	5	$p = 0.51$
Alone	10.6% (5)	12.1% (24)			
With partner or spouse	23.4% (11)	15.7% (31)			
With parents	34.0% (16)	26.3% (52)			
With other relatives	4.3% (2)	7.6% (15)			
With friends or roommates	7.0% (8)	26.8% (53)			
Other	10.6% (5)	11.6% (23)			
Homeless or in a shelter	8.0% (4)	17.5% (35)	2.45	1	$p = 0.12$
Incarcerated in past 2 years	4.2% (2)	22.0% (44)	8.15	1	$p < 0.01$
Household income			1.61	4	$p = 0.81$
$0–$10,000	23.4% (11)	32.3% (64)			
$10,001–$30,000	31.9% (15)	29.3% (58)			
$30,001–$50,000	31.9% (15)	26.8% (53)			
$50,001–$70,000	8.5% (4)	8.6% (17)			
More than $70,000	4.3% (2)	3.0% (6)			

No significant differences in terms of demographics were observed between those who reported and those who did not report marijuana use

things within the past 3 months (r's ranged from 0.18 to 0.27); (b) unprotected sex with someone you knew or suspected had HIV or/and an STD within the past 3 months (r's ranged from 0.19 to 0.23); (c) unprotected sex with a partner you knew or suspected of being an injector within the past 3 months (r's ranged from 0.24 to 0.44); and (d) unprotected sex while under the influence of alcohol or drugs within the past 3 months (r's ranged from 0.32 to 0.41). The four items were combined into a composite score called the Sexual Risk Index (SRI). The four individual items were first coded as yes or no for each item, and then initially summed for the total SRI score. Total scores, however, were not normally distributed, so for the following analyses the SRI was dichotomized into 2 groups, participants with a 0 for all items vs. participants with a score above 0. Marijuana, alcohol, and other drugs were all correlated with the SRI (r's ranged from 0.33 to 0.42).

Hierarchical Logistic Regression Hierarchical logistic regression analyses were conducted to examine the individual contributions of problem marijuana, alcohol, and other drug use on risky sexual behavior (SRI), and to test whether alcohol and other drugs may moderate the relationship between marijuana and risky sexual behavior. Z-scores for marijuana, alcohol, and other drugs were used to reduce multicollinearity

Table 2 Sexual health and sexual risk by self-reported lifetime substance use ($n = 248$)

Sexual health and sexual risk	Marijuana nonusers ($n = 48$)	Marijuana users ($n = 200$)	χ^2	df	Significance
Use of barrier or protection					
Did not use a barrier or other prevention method at last sexual encounter	52.2% (24)	56.8% (113)	0.32	1	$p = 0.57$
Never used a condom	10.9% (5)	13.0% (26)	0.15	1	$p = 0.70$
Did not report any PrEP or PEP use ever	88.6% (39)	88.0% (168)	0.02	1	$p = 0.90$
HIV testing					
Had never been tested for HIV	21.3% (10)	27.5% (55)	0.76	1	$p = 0.38$
Had not tested within the last 6 months	52.1% (25)	46.0% (92)	0.58	1	$p = 0.45$
Reported a positive HIV test	8.3% (4)	9.0% (18)	0.02	1	$p = 0.89$
Types of sex					
Ever had oral sex	83.0% (39)	98.0% (194)	18.35	1	$p < 0.001$
Ever had anal sex	73.9% (34)	94.9% (187)	19.99	1	$p < 0.001$
Ever had vaginal sex	30.4% (14)	54.0% (107)	8.32	1	$p < 0.01$
Had either oral/anal/vaginal sex in the past 30 days	70.7% (29)	80.7% (159)	2.04	1	$p = 0.15$
Types of sex partners					
Had a main/primary sex partner	40.4% (19)	33.8% (67)	0.72	1	$p = 0.40$
Had other sex partners who were not their main sex partner in the last 3 months	68.1% (32)	67.5% (131)	0.01	1	$p = 0.94$
Had other sex partners but did not have a main sex partner	44.7% (21)	51.3% (99)	0.66	1	$p = 0.42$
Had both main sex partner and other sex partners	23.4% (11)	15.7% (31)	1.61	1	$p = 0.21$
Other related HIV risk behaviors					
Exchanged unprotected sex for money, drugs or shelter within the last 3 months	13.3 (6)	13.5% (24)	0.00	1	$p = 0.98$
Had unprotected sex within the past 3 months with a person known/suspected to have HIV/STI	17.0% (8)	15.5% (30)	0.06	1	$p = 0.80$
Had unprotected sex within the past 3 months with a person known/suspected of injecting	13.0% (6)	13.9% (27)	0.02	1	$p = 0.88$
Had sex under the influence of drugs and/or alcohol within the past 3 months	15.2% (7)	45.1% (87)	13.88	1	$p < 0.001$

among the predictor variables and to facilitate comparisons between the disparate instruments used to assess problem marijuana, alcohol, and other drugs.

In step 1, risky sexual behavior was regressed on problem marijuana use along with two control variables, household income, and incarceration for at least 3 days within the past 2 years. Household income was entered into the model as a control term because of income's strong association with problem marijuana use and to control for the association between low income and sex in exchange for risky sex behaviors among MSM, such as unprotected sex, transactional sex, and sex with risky partners. Incarceration was also entered into the model as a control variable because of its association with problem marijuana use, and also because of the well-documented risk of HIV/STI-related risk behaviors, such as unprotected anal sex and needle sharing, among MSM within prisons and jails [60, 61]. Although homelessness was associated with problem marijuana use, it was not entered into the model because of its high linear association with household income. The results are shown in Table 4. Consistent with previous studies that have examined the relationship between

marijuana and risky sexual behavior, problem marijuana use significantly predicted greater levels of risky sexual behavior ($OR = 2.08$, $p < 0.001$). The two control variables, income and incarceration, were not significant predictors of risky sexual behavior in any of the models.

In step 2, problem alcohol use and problem use of other drugs were entered into the model. Problem marijuana remained a significant predictor of risky sexual behavior after entering alcohol and other drugs into the model ($OR = 1.51$, $p < 0.05$). Both alcohol and other drugs had a significant effect on risky sexual behavior (alcohol: $OR = 1.88$, $p < 0.01$, other drugs: $OR = 1.80$, $p < 0.01$).

In step 3, the interaction term of problem marijuana and alcohol use (step 3a), or of problem marijuana and other drug use (step 3b), was entered into the regression equation in two separate models. In step 3a, with the interaction term for marijuana use and alcohol, the interaction term was not significant. Marijuana, alcohol, and other drug use made significant contributions to risky sexual behavior with the interaction term in the model (marijuana: $OR = 1.57$, $p < 0.05$; alcohol: $OR = 1.93$, $p < 0.01$; and other drugs: $OR = 1.76$, $p < 0.01$).

Table 3 Bivariate correlations of problem marijuana, alcohol, and other drug use with other variables among marijuana users ($n = 192$)

Measure	Problem marijuana use	Problem alcohol use	Problem other drug use
Problem marijuana use	1	0.508***	0.288***
Problem alcohol use	0.508***	1	0.465***
Problem other drug use	0.288***	0.465***	1
Household income	− 0.224**	− 0.164*	− 0.228**
Homeless or in a shelter	0.147*	0.190**	0.347***
Incarcerated in past 2 years	0.163*	0.209**	0.243***
Sexual self-efficacy (main partner)	− 0.097	− 0.002	0.076
Sexual self-efficacy (other partner)	− 0.144	− 0.264**	− 0.183*
Barrier or prevention method used at last sexual encounter	− 0.086	− 0.147*	− 0.097
Ever used a condom	− 0.027	− 0.191**	−0.216**
Ever used PrEP/PEP	0.113	0.012	0.057
Ever tested for HIV	0.018	− 0.010	0.065
Positive for HIV result	0.076	0.077	0.200**
Number of partners in past 3 months	0.119	0.191**	0.273***
Sexual Risk Index	0.332***	0.419***	0.376***
Unprotected sex for money, drugs, or other things within the past 3 months	0.176*	0.255**	0.273***
Unprotected sex with someone you knew or suspected had HIV or/and an STD within the past 3 months	0.203**	0.194**	0.228**
Unprotected sex with a partner you knew or suspected of being an injector within the past 3 months	0.237**	0.304***	0.441***
Unprotected sex while under the influence of alcohol or drugs within the past 3 months	0.318***	0.413***	0.337***

Problem marijuana use was measured with the ASSIST-M, problem alcohol use was measured with the AUDIT, problem other drug use was measured with the ASSIST-O

* Significant at $\alpha < 0.05$

** Significant at $\alpha < 0.01$

*** Significant at $\alpha < 0.001$

In step 3b, when the interaction term for problem marijuana use and other drugs was entered into the model, the interaction term was significant ($OR = 0.59$, $p < 0.01$). Further analysis found that for low and mean levels of other drug use, marijuana use predicts risky sexual behavior, but for high levels of other drug use, the relationship between marijuana use and risky sexual behavior is no longer significant. Marijuana, alcohol, and other drug use made significant contributions to risky sexual behavior with the interaction term in the model (marijuana: $OR = 1.57$, $p < 0.05$, alcohol: $OR = 1.76$, $p < 0.05$, and other drugs: $OR = 2.04$, $p < 0.01$).

Discussion

Our findings corroborate those of other researchers who have suggested that YBMSM are more likely to use marijuana compared to other drugs [5, 62]. Additionally, our findings highlight the frequency of marijuana use within this YBMSM sample and build on the limited research available on the relationship between marijuana use and sexual risk

behaviors. Our finding that marijuana use is correlated with sexual risk behaviors is consistent with research on other drugs that has documented the association between substance use such as ecstasy, cocaine and methamphetamine, and sexual risk-taking behaviors [63]. While marijuana use was found to predict sexual risk behaviors, our study found a complicated relationship between marijuana and other markers for HIV risk, as marijuana use was not associated with perceived self-efficacy toward using safe sex behaviors with a main partner or other partner, using a preventative method/barrier at the last sexual encounter, using a condom, using PrEP/PEP, having testing for HIV, and having more sexual partners.

A unique contribution of this study is the approach to evaluate both the independent relationship between problem marijuana use and sexual risk behaviors and the interaction effects of problem marijuana use and both alcohol and other substance use. The current study found that when problem alcohol and other drugs were included in the model, problem marijuana use still predicted risky sexual behavior. Our results are inconsistent with previous studies that found that when risky sex was regressed on both marijuana and alcohol,

Table 4 Sexual Risk Index regressed on problem marijuana, alcohol, and other drug use

Step	Variables	Odds Ratio	Sig
1	Marijuana	2.08	< 0.001
	Household income	0.84	0.24
	Incarcerated in past 2 years	0.86	0.70
2	Marijuana	1.51	< 0.05
	Household income	0.89	0.50
	Incarcerated in past 2 years	0.51	0.14
	Alcohol	1.88	< 0.01
	Other drugs	1.80	< 0.01
3a	Marijuana	1.57	0.04
	Household income	0.89	0.47
	Incarcerated in past 2 years	0.49	0.13
	Alcohol	1.93	< 0.01
	Other drugs	1.76	< 0.01
	Marijuana X Alcohol	0.77	0.19
3b	Marijuana	1.57	0.04
	Household income	0.93	0.68
	Incarcerated in past 2 years	0.56	0.21
	Alcohol	1.76	< 0.01
	Other drugs	2.04	< 0.01
	Marijuana X other drugs	0.59	< 0.01

SRI measured sexual behavior associated with HIV/STI risk within the past 3 months

Problem marijuana use was measured with the ASSIST-M, problem alcohol use was measured with the AUDIT, problem other drug use was measured with the ASSIST-O

marijuana did not significant predict risky sex [28, 29]. We should note that the current study also adjusted for the individual effects of other drugs and our sample was exclusively YBMSM, while the above-mentioned studies only measured the effects of marijuana and alcohol and was comprised of primarily male and female adolescents. Our study is consistent with another study among a low-income sample of black adolescents that analyzed the impact of marijuana, alcohol, and cocaine on risky sexual behavior [30]. They found that marijuana and cocaine were the best predictors of risky sexual behavior, in contrast to other studies that found marijuana had less impact on risky sexual behavior than other drugs [29]. These findings are consistent with previous research that report high rates of marijuana use during sex among BMSM [17, 62], and suggest that there is a preference for using marijuana as a sex drug within the YBMSM population, a finding that deserves further exploration.

In addition, the current study found that problem other drugs moderated the relationship between marijuana and risky sexual behavior. Further analysis found that at low levels of problem other drugs, the positive association between marijuana and risky sexual behavior was significant, but at high levels of other drugs, the relationship between problem marijuana use and risky sexual behavior was no longer significant. These findings are inconsistent with another study that did not find a significant interaction between cocaine use and marijuana on risky sexual behavior among black adolescents [30]. The authors of that study found support for an additive effects model for marijuana and cocaine, in which the effect of marijuana and cocaine on risky sexual behavior can be calculated by summing the individual effects of each drug. In contrast, the current study found support for the redundant effects of problem marijuana and other drugs on risky sexual behavior, in which at high levels of other drugs, the addition of marijuana has no effect on risky sexual behavior. Taken together, our findings suggest that interventions that target risky sexual behavior among YBMSM should not neglect the importance of other drugs when addressing problem marijuana use, and might even consider addressing problem other drug usage before marijuana use among multi-drug users [28, 64–68].

Another strength of this study was the involvement of YBMSM who are low-income, disenfranchised from healthcare and social service systems, and who experience the fallout from a legacy of institutional and interpersonal racism, marginalization, and discrimination. YBMSM continue to be an understudied and underserved group who are disproportionately affected by HIV/AIDS. By using a community-based network of partners to reach and engage YBMSM, a population that would normally be difficult to find and engage, we aimed to inform future HIV prevention efforts by including those who are most affected by the epidemic.

There are a few limitations noted in this study. First, this descriptive study focused on associations between substance use and sexual behaviors. Given that a single data point is used for this analysis, neither causality nor sequencing or patterns of substance use can be inferred between the factors examined in this study. Rather, we use standardized scales to estimate problem use for each substance at the time of study enrollment. Finally, the present study relies on self-reported data, which may be subject to recall and interviewer biases. These limitations point to opportunities for strengthening future research in this area such as including biomarkers for marijuana use and dairy methods for data collection.

Conclusion

For many, marijuana is valued as a benign or even medicinal substance; perceptions that are likely to be reinforced with the widespread legalization, social acceptance, and even glamorization of adult recreational marijuana use. Yet, our findings suggest that marijuana use may be a risk factor for poor sexual health among YBMSM. It appears that there may be value in adopting prevention-focused messaging that highlights sexual

risk as one of the potential health risks associated with regular marijuana use, at least for YBMSM. Likewise, interventions designed to promote safe and healthy sexual behavior among YBMSM should tailor messaging related to substance use depending on whether marijuana is used by itself or with other drugs. Finally, future research should explore patterns of substance use among YBMSM and whether problem drug usage typically occurs in a stepped progression beginning with marijuana use as a sexual enhancer.

In conclusion, YBMSM have unique needs deserving of increased attention and resources, and ameliorating the public health injustices evidenced by HIV inequalities requires concerted efforts to address contextual environments. Future efforts should identify opportunities for developing holistic wellness intervention approaches that support YBMSM and take into account the role of context, which includes marijuana and other substance use, in facilitating high-risk sexual behaviors.

Data Availability Not applicable.

Compliance with Ethical Standards

Conflict of Interest The 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 California State University, Long Beach (16-376, 17-391, and 18-437) 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.

Code Availability Not applicable.

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