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ORIGINAL RESEARCH

The association of therapeutic versus recreational marijuana use and antiretroviral adherence among adults living with HIV in Florida

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Purpose: Marijuana use is common among people living with HIV (PLWH), but its association with antiretroviral therapy (ART) adherence is unclear. This study examined the association between reason for marijuana use and ART adherence in a sample of adults living with HIV.

Patients and methods: Participants (N=703) recruited from seven community health centers in Florida completed a 45-minute questionnaire assessing demographics, symptoms of anxiety and depression, ART adherence, and substance use, including reasons for marijuana use. ART adherence was defined as the proportion of days in the last 30 days participants did not miss any medication and dichotomized as optimal (≥95%) and suboptimal (<95%). Multivariate logistic regression analysis assessed the association between therapeutic marijuana use to manage HIV symptoms (ie, improve appetite/gain weight, induce sleep, relieve nausea/vomiting, relieve pain, relieve anxiety/depression/stress) versus recreational marijuana use and ART adherence.

Results: Approximately one third (33.2%) of the participants reported using marijuana in the past 3 months. Of marijuana users, 21.8% reported using marijuana only for therapeutic purposes to manage HIV-associated medical symptoms, while 78.2% reported recreational use. After controlling for covariates, therapeutic use of marijuana was not associated with ART adherence (AOR =1.19, 95% CI =0.60–2.38, p=0.602) while recreational marijuana users showed significantly greater odds of suboptimal ART adherence compared to nonusers (AOR =1.80, 95% CI =1.18–2.72, p=0.005).

Conclusion: Our results suggest differences in ART adherence between individuals who report recreational versus therapeutic marijuana use. Continued research examining the health implications of marijuana use among adults living with HIV is important as legalization of recreational and medical marijuana proliferates in the United States.

Keywords: HIV/AIDS, marijuana use, antiretroviral therapy, antiretroviral adherence

Introduction

Adherence to an antiretroviral therapy (ART) regimen has significantly improved HIV-related morbidity and mortality, making it perhaps the most salient behavior to optimize health among people living with HIV (PLWH).[1–3] Optimal adherence is linked to viral suppression, improved immune functioning, and decreased disease transmission.[2,4] Despite these benefits, suboptimal medication adherence is a problem that persists in HIV treatment. Factors such as demographic characteristics (eg, age, female sex, and African–American race), depression, and illicit drug use have all been associated with suboptimal adherence in HIV treatment.[5–8] While psychoactive drug use has been associated with suboptimal adherence among PLWH, marijuana use may have potential medicinal benefits in this population.[9–12]

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Marijuana use is prevalent among PLWH, with up to 60% of adults in this population reporting current use.[13–17] Although up to 75% of PLWH who use marijuana report recreational motives, several studies have also shown that many adults in this population report using marijuana to manage HIV-associated symptoms, such as pain, nausea, lack of appetite, insomnia, anxiety, and depression.[9–12,18,19] D'Souza et al showed that the most prevalent rationales for marijuana use among PLWH were to relax or reduce stress (86%), to increase appetite (58%), and to reduce HIV symptoms such as nausea (38%).[19] Marijuana may be associated with improved HIV symptom management, as Woolridge et al noted that 27% of PLWH reported managing HIV-associated symptomatology with marijuana and that 80% of those participants endorsed improvements in nausea, pain, anxiety, and depression.[12]

Conversely, smoked marijuana is associated with deleterious effects on the cardiopulmonary system.[20] In addition, marijuana use is associated with impairments in memory and attention.[21] Research also suggests that marijuana use exacerbates HIV-associated neurocognitive deficits.[22] Moreover, marijuana use is associated with the exacerbation of psychopathology, decreased engagement in social roles, and increased use of other illicit substances; all of which negatively affect treatment adherence.[23]

Studies examining marijuana use and ART adherence suggest mixed results. De Jong et al noted that marijuana use was not associated with adherence, although alcohol use and other illicit substances reduced the likelihood of achieving optimal ART adherence.[5] Slawson et al drew similar findings, as at least daily use of marijuana was not associated with ART adherence.[24] In contrast, other studies have found that marijuana use is associated with suboptimal medication adherence.[8,19,25–28] To date, previous studies have exclusively examined the presence or absence of use as well as the frequency of marijuana use in relation to ART adherence, thereby negating potential important distinctions in motives (ie, recreational use versus use to manage HIV-associated medical symptoms) for marijuana use.

Florida is a salient locale to examine the association between motive for use and ART adherence, as the state currently has the third highest prevalence of PLWH in the United States and has experienced an increasing incidence of HIV since 2013.[29] Due to the legalization of medical marijuana in Florida in 2017, physician prescribed medical marijuana was not assessed as data for this study was collected prior to legalization. Many consider medical marijuana to represent that which is prescribed or recommended by a physician, but PLWH often report using it to self-manage medical conditions, as it is one of the most common types of complementary and alternative medicine used by PLWH in Florida.[30] We therefore sought to compare ART adherence among PLWH who used marijuana to self-manage specific symptoms or health conditions (therapeutic use), compared to those who used it recreationally.

Thus, the present study aimed to examine the association between therapeutic versus recreational marijuana use and ART adherence among adults living with HIV in Florida. We hypothesized that individuals reporting recreational marijuana use would be significantly more likely than non-marijuana users and therapeutic users to exhibit suboptimal ART adherence.

Patients and methods

Participants and procedures

The sample (N=703) included participants recruited from October 2014 to March 2017 from the Florida Cohort, an ongoing National Institute on Alcohol Abuse and Alcoholism (NIAAA)-funded study examining health outcomes among PLWH receiving care within Florida. Participants were recruited at multiple county health departments, community clinics, and settings throughout Florida (ie, Gainesville, Ft Lauderdale, Lake City, Miami, Orlando, Sanford, and Tampa). Persons with HIV were informed about the study by clinic or facility staff, or by brochures. All adults living with HIV were eligible to participate. After providing written informed consent, participants completed a self-administered 45-minute questionnaire on paper or via a secured laptop assessing information regarding demographics, symptoms of anxiety and depression, ART adherence, and substance use and misuse. Participants received $25.00 for completing the study. The Institutional Review Boards of the University of Florida, Florida International University, and Florida Department of Health approved this study.

Measures

ART adherence

Participants answered the question, "In the last 30 days, how many days did you miss at least one dose of your HIV medication?"[31] ART adherence was defined as the proportion of days in the last 30 days they did not miss any medication and dichotomized as optimal (≥95%) and suboptimal (<95%) adherence. Previous studies demonstrate that ≥95% ART adherence is strongly associated with HIV-1 RNA viral suppression and increased CD4+ count.[24,32,33]

Marijuana use

Participants who endorsed marijuana use within the past 3 months answered questions pertaining to frequency (on average, how often have you used marijuana in the past 3 months?), frequency on days of use (in the past 3 months, on days when you used marijuana, how many times did you use on average?), and duration of at least weekly use (how many years have you used marijuana at least once per week?). Marijuana users reported their preferred route of administration (ROA; ie, joints, blunts, pipes, vaporizing devices, and ingestion/edibles). Participants were dichotomized as yes or no based on whether or not they endorsed any use by those means.

Participants reporting using marijuana in the past 3 months were asked to report how often they used marijuana for several specific reasons. In line with Schauer et al classification of reasons for marijuana use developed in collaboration with the Centers for Disease Control and Prevention, we defined recreational marijuana users as those who endorsed use often or sometimes for the purpose of getting high or stoned, increasing libido/improving sexual performance, or fitting into social situations.[34] Participants using to manage HIV-associated medical symptoms reported using marijuana often or sometimes for any of the following five reasons: improving appetite/gaining weight, inducing sleep, relieving nausea/vomiting, relieving pain, and relieving anxiety/depression/stress. Participants endorsing marijuana use for both recreational and therapeutic purposes were classified as recreational users. Participants reporting any marijuana use were thus classified into two groups based on their reasons of use: any recreational use and therapeutic users only.

Other substance use

Participants self-reported substance use in the last 12 months including alcohol, tobacco, and illicit drug use other than marijuana. Hazardous drinking was defined as consuming more than 14 drinks per week or ≥5 drinks per occasion at least monthly in the past 12 months for males and >7 drinks per week or ≥4 drinks per occasion at least monthly for females, which has been shown to place PLWH at increased risk for adverse health events.[35,36] Tobacco use and any other illicit drug use within the past 12 months were dichotomized as yes or no, respectively.

Depression

The eight-item Patient Health Questionnaire (PHQ-8) was used to assess current depressive symptoms. A cutoff of ≥10 has been previously established to define current depression.[37] The PHQ-8 has demonstrated high reliability and validity among PLWH.[37,38] The eight items comprising the PHQ-8 demonstrated good (α=0.88) internal consistency in this sample.

Anxiety

The 7-item Generalized Anxiety Disorder (GAD-7) Scale was utilized to assess current anxiety symptoms. Scores ranging from 0 to 9 were categorized as no/mild symptoms of anxiety and scores ≥10 were categorized as moderate/severe. The GAD-7 has shown good validity and adequate internal consistency (α=0.79–0.91) as a screener for generalized anxiety disorder in previous studies and demonstrated excellent (α=0.92) internal consistency in this sample.[39,40]

Sociodemographics

Age, race, sex, homelessness, level of education, and marital status were collected. Participants were categorized into four age groups: 18–34, 35–44, 45–54, and ≥55 years. Race/ethnicity was categorized into Hispanic, White, Black, and others. Sex was based on participant's sex at birth (ie, male or female). Level of education was classified into three groups: less than high school, high school, and more than high school. Homelessness was defined as living in a homeless shelter, emergency shelter, car, street, or abandoned building in the last 12 months. Marital status was dichotomized as married or living with a long-term partner versus being single, divorced, widowed, or separated.

Statistical analyses

Participants were categorized into those reporting recreational use, therapeutic use to manage HIV-associated medical symptoms, or as nonusers. Bivariate analyses were conducted using chi-square tests to assess the differences in frequency, frequency on days of use, duration of at least weekly use, and ROA among the two marijuana use groups, as well as to assess differences in demographics, mental health variables, substance use, and ART adherence among the two marijuana use groups and nonusers. To further assess the association between the primary independent variable, reason for marijuana use, and the dichotomous ART adherence variable (≥95% = coded as 1, and <95% = coded as 2), we utilized multivariate logistic regression analysis controlling for potential confounding variables associated with marijuana use in bivariate analysis ($p<0.05$; ie, homelessness, cigarette smoking, hazardous drinking, and other drug use), as well as demographic variables (ie, sex, age, and race) commonly associated with ART adherence. Multivariate analysis investigating the association between recreational versus therapeutic marijuana use and

ART adherence utilized "nonusers" as the designated referent group. Crude and adjusted odds ratios (AORs) with 95% CIs were presented. All statistical analyses were conducted using SPSS Version 24.[41]

Results

Sample characteristics

The sample (N=703) had a mean age of 47.08 years (SD =11.27). The racial/ethnic breakdown was 53.7% Black, 22.4% White, 20.4% Hispanic, and 3.5% others. The majority of participants (68.7%) were males. Most (62.2%) had a high school diploma or less, while 37.9% reported obtaining a degree beyond high school. The majority of participants (81.0%) reported being unmarried. Mean years since HIV diagnosis was 11.52 (SD =7.61). Approximately one third (32.0%) of the sample reported <95% ART adherence.

Recreational and therapeutic marijuana use

Marijuana use in the past 3 months was reported by 33.2% of participants. Over one-fourth (26.0%) of all participants reported using marijuana for recreational purposes, of which 88.5% reported using recreationally to get high or stoned. Regarding therapeutic use to manage HIV-associated symptoms, 26.5% of the sample reported use to relieve anxiety, depression, or stress; the most prevalent rationale reported among all therapeutic marijuana users. In addition, 22.3% reported use to induce sleep, 22.2% reported pain relief, 21.3% reported use to improve appetite/gain weight, and 14.9% reported use to relieve nausea/vomiting. Most (70.3%) marijuana users reported using for both recreational and therapeutic purposes, with only 7.7% reporting exclusive recreational use (Table 1).

After categorization, 51 (7.2%) of all participants reported only therapeutic use to manage HIV-associated medical symptoms, 183 (26.0%) were recreational users, and 66.8% were nonusers. Of marijuana users, 21.8% were therapeutic users, while 78.2% were recreational users. Approximately one third (33.3%) of all marijuana users were daily users, while an additional 23.9% reported using marijuana at least weekly. There were no significant differences in marijuana use frequency between therapeutic users and recreational users (χ^2 =1.10, p=0.776), although frequency on days of reported use between groups was significant (χ^2 =9.14, p=0.010) with 74.6% of recreational users reporting using at least twice per day versus 52.9% of therapeutic users reporting using at least twice. Table 2 provides additional information related to differences in use characteristics between the two marijuana use groups.

The most prevalent reported ROAs were joints (82.7%), followed by blunts (75.6%), pipes (54.5%), edibles (20.7%), and vaporizing devices (19.2%). Recreational users were more likely than therapeutic users to smoke joints (χ^2 =5.96, p=0.015) and consume edibles (χ^2 =7.84, p=0.005).

Demographics, substance use, and ART adherence among therapeutic users, recreational users, and nonusers

The 45–54 years age group had the highest prevalence of therapeutic use and recreational use (χ^2 =17.95, p=0.006). Males were more likely to report recreational use while therapeutic use was more prevalent among females (χ^2 =9.20, p=0.010). Homeless individuals were most likely to report recreational use (χ^2 =9.03, p=0.011). There were no significant differences in the type of marijuana use related to education, race, or marital status.

Regarding substance misuse and type of marijuana use, hazardous drinkers were most likely to engage in recreational use, while those reporting less than hazardous levels of alcohol consumption were most likely to report therapeutic marijuana use (χ^2 =18.28, p=0.001). Among individuals using other illicit substances, current drug users were most likely to report

Table 1 Prevalence of reported recreational and therapeutic reasons for marijuana use (N=703)

Recreational or therapeutic use	Reason	Frequency	Percentage
Recreational use	To get high/stoned	162	23.0
	To improve sexual performance	76	10.8
	To fit into social situations	77	11.0
Therapeutic use	To improve appetite/gain weight	150	21.3
	To induce sleep	157	22.3
	To relieve nausea/vomiting	105	14.9
	To relieve pain	156	22.2
	To relieve anxiety, depression, or stress	186	26.5

Note: Participants could select more than one option.

Table 2 Frequency, quantity, and duration of use among marijuana users (n=234)

Marijuana use variables	Category	Therapeutic users (n=51)	Recreational users (n=183)	Total (n=234)	Chi-square value	*p*-value
Frequency	Daily	14 (27.5)	64 (35.0)	78 (33.3)	1.10	0.776
	Weekly	13 (25.5)	43 (23.5)	56 (23.9)		
	Monthly	10 (19.6)	34 (18.5)	44 (18.9)		
	< monthly	14 (27.5)	42 (23.0)	56 (23.9)		
Frequency of use on days of use	4+	7 (13.7)	43 (23.8)	50 (21.6)	**9.14**	**0.010**
	2–3	20 (39.2)	92 (50.8)	112 (48.3)		
	1	24 (47.0)	46 (25.4)	70 (30.2)		
Duration of at least weekly use	>15 years	15 (29.4)	65 (36.1)	80 (34.6)	2.63	0.620
	11–15 years	4 (7.8)	22 (12.2)	26 (11.3)		
	6–10 years	9 (17.6)	30 (16.7)	39 (16.9)		
	1–5 years	11 (21.6)	26 (14.4)	37 (20.6)		
	<1 year	12 (23.5)	37 (20.6)	49 (21.2)		

Notes: "n" may vary slightly according to missing data. Bold values indicate significance at $p<0.05$.

recreational marijuana use (χ^2 =15.01, p=0.001) compared with therapeutic users and nonusers. There were no significant differences between groups regarding symptoms of anxiety or depression. Recreational marijuana users showed significantly less optimal ART adherence compared to therapeutic marijuana users and nonusers (χ^2 =14.28, p=0.001). Table 3 provides information related to differences in study variables between recreational and therapeutic users, and nonusers.

Predictors of ART adherence

Unadjusted results show that therapeutic use to manage HIV-associated medical symptoms was not significantly associated with suboptimal ART adherence (odds ratio [OR] =1.44, 95% CI =0.78–2.66, p=0.234), while recreational use (OR =1.97, 95% CI =1.37–2.82, $p<0.0001$) was associated with greater odds of suboptimal ART adherence in comparison with nonuse. These associations remained consistent in adjusted models, as therapeutic use of marijuana was not associated with ART adherence (AOR =1.19, 95% CI =0.60–2.38, p=0.602) while recreational marijuana users showed significantly greater odds of suboptimal ART adherence as compared with nonusers (AOR =1.80, 95% CI =1.18–2.72, p=0.005). Table 4 summarizes other factors associated with suboptimal adherence.

Discussion

Of the 30 states with legislation legalizing marijuana, nine states and the District of Colombia have legalized marijuana for recreational use. Our results suggest differences in adherence behavior between individuals who report using marijuana recreationally versus those who report using to manage HIV-associated symptoms. Specifically, we found recreational use to be associated with lower ART adherence, supporting our hypothesis. There were no significant differences between recreational and therapeutic marijuana users regarding frequency of marijuana use. However, there was a significant difference in the average number of times marijuana was used on a typical day when participants reported use, such that nearly 75% of recreational users reported using marijuana at least twice on days of reported use, while only 53% of therapeutic users reported using at least twice. Thus, recreational users may have been more likely to evidence suboptimal adherence not as a result of the number of days they used, but rather the number of times used on those days.

The mechanism behind lower ART adherence among recreational marijuana users may also be related to the use of other substances. The literature supports an association between non-marijuana substance use and suboptimal ART adherence.[8,42–44] Bivariate analyses revealed a statistically significant negative association between hazardous drinking and other illicit drug use and ART adherence in our sample, and recreational marijuana users in our sample showed a higher prevalence of use of such substances compared to therapeutic users. To this point, Lake et al recently found that marijuana use was associated with suboptimal ART adherence only during reported periods of binge alcohol use.[45] As such, the higher prevalence of hazardous drinking among recreational marijuana users compared with therapeutic users and nonusers may explain the significant association between recreational marijuana use and suboptimal ART adherence. Another explanation for our findings may be that those who use primarily for therapeutic reasons may be more generally focused on their health and thus more adherent to ART. In line with previous findings, De Jong et al found that adults living with HIV with moderate to

Table 3 Demographics, substance use, mental health, and health status differences among recreational and therapeutic marijuana users and nonusers (N=703)

Variables	Category	Nonusers (n=469)	Therapeutic users (n=51)	Recreational users (n=183)	Total (N=703)	Chi-square value	*p*-value
Demographics							
Age (years)	18–34	59 (12.9)	10 (19.6)	43 (23.4)	112 (16.2)	**17.95**	**0.006**
	35–44	80 (17.5)	11 (21.6)	33 (18.0)	124 (17.9)		
	45–54	184 (40.3)	22 (43.1)	73 (40.0)	279 (40.4)		
	≥55	134 (29.3)	8 (15.7)	34 (18.6)	176 (25.5)		
Sex	Male	301 (65.9)	32 (62.8)	142 (77.6)	475 (68.7)	**9.29**	**0.010**
	Female	156 (34.1)	19 (37.2)	41 (22.4)	216 (31.3)		
Race	Hispanic	102 (22.3)	10 (19.6)	29 (15.8)	141 (20.4)	9.12	0.167
	Not Hispanic, White	99 (21.7)	9 (17.6)	47 (25.7)	155 (22.4)		
	Not Hispanic, Black	242 (53.0)	32 (62.8)	97 (53.0)	371 (53.7)		
	Not Hispanic, others	14 (3.0)	0 (0.0)	10 (5.5)	24 (3.5)		
Education	< high school	142 (31.2)	18 (35.3)	60 (32.8)	220 (31.9)	6.29	0.178
	High school diploma or equivalent	127 (27.9)	19 (37.3)	62 (33.9)	208 (30.2)		
	> high school	186 (40.9)	14 (27.4)	61 (33.3)	261 (37.9)		
Homelessness	No	391 (86.5)	46 (90.1)	139 (76.0)	576 (84.5)	**9.03**	**0.011**
	Yes	61 (13.5)	5 (9.9)	40 (24.0)	106 (15.5)		
Marital status	Married/living with a long-term partner	81 (17.8)	14 (27.4)	36 (19.6)	131 (19.0)	2.84	0.241
	Divorced/widowed/separated/single	374 (82.2)	37 (72.6)	147 (80.4)	558 (81.0)		
Substance use							
Other drug use	No	291 (67.8)	32 (66.7)	93 (51.3)	416 (63.2)	**15.01**	**0.001**
	Yes	138 (32.2)	16 (33.3)	88 (48.7)	242 (36.8)		
Cigarettes	No	249 (56.7)	15 (30.0)	62 (34.9)	326 (48.9)	**31.99**	**<0.001**
	Yes	190 (43.3)	35 (70.0)	116 (65.1)	341 (51.1)		
Hazardous drinking	No	292 (67.6)	38 (76.0)	87 (50.9)	417 (63.9)	**18.28**	**0.001**
	Yes	140 (32.4)	12 (24.0)	84 (49.1)	236 (36.1)		
Mental health							
Depression	<10, no depression	312 (69.2)	31 (62.0)	122 (67.8)	465 (68.2)	1.10	0.577
	≥10, current depression	139 (30.8)	19 (38.0)	58 (32.2)	216 (31.8)		
Anxiety	<10, no, mild anxiety	313 (70.3)	33 (66.0)	120 (68.9)	466 (69.7)	0.453	0.797
	≥10, moderate or severe anxiety	132 (29.7)	17 (34.0)	54 (31.1)	203 (30.3)		
ART adherence	<95%	125 (27.3)	18 (35.3)	78 (42.6)	221 (32.0)	**14.28**	**0.001**
	≥95%	332 (72.7)	33 (64.7)	105 (57.4)	470 (68.0)		

Notes: "n" may vary slightly according to missing data. Bold values indicate significance at $p<0.05$.
Abbreviation: ART, antiretroviral therapy.

severe nausea who smoked marijuana showed improved ART adherence.[5]

Reports of marijuana use to manage anxiety, depression, or stress were made by 79.4% of marijuana users, while 64.0% reported use to improve sleep and manage pain. Although previous evidence indicates that marijuana may be useful in treating such symptoms, use can also escalate toward dependence, as marijuana use disorder is prevalent in ~30% of marijuana users.[46] Previous research has shown cognitive behavioral therapies (CBTs) to be effective for treating chronic pain and insomnia, as well as psychological and substance use disorders associated with these conditions.[47–49] Therefore, CBTs may offer an effective treatment for medical comorbidities commonly associated with HIV. Identifying psychological distress and providing appropriate referrals for intervention may improve the quality of life of PLWH, especially given findings from previous studies of improved ART adherence with psychotherapeutic interventions.[50–53]

Limitations and strengths

Our study has limitations and strengths of note. Although the majority of marijuana users reported using for both therapeutic and recreational reasons, only 18 participants reported recreational use exclusively, leading authors to classify recreational marijuana users as those who reported both therapeutic use and recreational use. In addition, individuals reporting using marijuana to "fit into a social situation" were categorized as recreational users, based on Schauer et al definition of recreational use.[34] Although this statement may have therapeutic connotations (ie, symptoms

Table 4 Logistic regression examining the association between type of marijuana use and ART adherence (<95%) (N=703)

Variables	Unadjusted OR (CI)[a]	*p*-value	Adjusted OR (CI)[b]	*p*-value
Marijuana use				
No marijuana use	Referent		Referent	
Therapeutic use	1.44 (0.78–2.66)	0.234	1.19 (0.60–2.38)	0.602
Recreational use	**1.97 (1.37–2.82)**	**<0.0001**	**1.80 (1.18–2.72)**	**0.005**
Sex				
Male	Referent		Referent	
Female	1.19 (0.85–1.67)	0.301	1.39 (0.93–2.07)	0.104
Age (years)				
18–34	Referent		Referent	
35–44	1.30 (0.77–2.21)	0.317	1.56 (0.87–2.81)	0.120
45–54	0.86 (0.54–1.38)	0.549	0.97 (0.57–1.63)	0.965
≥55	0.81 (0.49–1.35)	0.439	0.98 (0.54–1.77)	0.961
Race				
Hispanic	Referent		Referent	
Not Hispanic, White	0.70 (0.42–1.16)	0.169	**0.52 (0.30–0.93)**	**0.028**
Not Hispanic, Black	1.23 (0.81–1.86)	0.316	0.83 (0.51–1.33)	0.441
Not Hispanic, others	0.72 (0.27–1.95)	0.526	0.57 (0.19–1.65)	0.306
Homelessness				
No	Referent		Referent	
Yes	**2.21 (1.46–3.36)**	**<0.0001**	**1.76 (1.09–2.84)**	**0.020**
Cigarette smoking				
No	Referent		Referent	
Yes	**1.84 (1.33–2.56)**	**<0.0001**	1.30 (0.88–1.91)	0.175
Hazardous drinking				
No	Referent		Referent	
Yes	**1.84 (1.32–2.57)**	**<0.0001**	1.38 (0.94–2.03)	0.100
Other drug use				
No	Referent		Referent	
Yes	**1.59 (1.13–2.22)**	**0.006**	1.27 (0.86–1.88)	0.213

Notes: [a]Unadjusted odds ratio; [b]adjusted odds ratio. Bold values indicate significance at $p<0.05$.
Abbreviations: ART, antiretroviral therapy; OR, odds ratio.

related to anxiety), only three participants reported marijuana use exclusively for this purpose, and thus, categorizing these participants as therapeutic users as opposed to recreational users would likely not significantly affect our results. In addition, our study used a cross-sectional design, thus we cannot determine the temporality of the observed associations. Furthermore, it is possible that financial compensation could have introduced bias such as social desirability in responding. However, previous research studies suggest that compensation is critical for participation, particularly for vulnerable populations, and further that payment does not encourage drug use or additional risk-taking behaviors.[54,55] Despite these limitations, this study delineated differences between recreational users and therapeutic users of marijuana while controlling for significant confounding variables. Our sample comprised high levels of racial and ethnic diversity; therefore, we believe our findings constitute a substantial and relevant contribution to the literature regarding the influence of different reasons for use and ART adherence.

Future directions

Future studies should examine the association between biologically confirmed (ie, urine toxicology assays for tetrahydrocannabinol [THC] metabolites) marijuana use and viral suppression as well as examine the association between physician prescribed marijuana with ART adherence and viral suppression. Studies examining the influence of marijuana use frequency on days of use may elucidate potential reasons for lower ART adherence among recreational marijuana users. Larger samples would also help elucidate group differences between participants reporting exclusively therapeutic/medicinal, recreational, or combined marijuana use. In addition, investigations examining dronabinol versus whole-leaf marijuana as well as other forms of marijuana consumption (eg, edibles), and ART adherence would also be helpful in determining the most effective clinical interventions for PLWH. Qualitative interviews involving marijuana users would advance our understanding of the association of marijuana use and ART adherence, complementing

quantitative data and allowing users to provide perspective for their own experiences.

Conclusion

To our knowledge, this is the first study assessing the association between motive for use of marijuana and ART adherence. Recreational marijuana users showed significantly greater odds of suboptimal ART adherence as compared with nonusers, while therapeutic marijuana use was not associated with ART adherence in the Florida Cohort sample. Previous studies suggest that the prevalence of marijuana use among PLWH is high and that motives for use differ (ie, some consume marijuana for recreational reasons while others consume for therapeutic reasons that help manage HIV-associated medical symptoms).[12,17,19] Our findings contribute to the literature by examining relevant distinctions among marijuana users that impact ART adherence by underscoring the importance of discerning motivation for marijuana use when considering the effect of marijuana on ART adherence among PLWH. Our findings also speak to a potential need to consider recreational versus therapeutic/medical marijuana users as two separate groups, rather than one homogenous group of marijuana users. Given the differences in adherence observed in this study based on motive for use, classification of marijuana users into distinct groups may prove beneficial for future research to gain a more nuanced understanding of the health-related consequences of marijuana use among PLWH.

Medical marijuana is currently legal in 30 states and the District of Columbia. In these territories, HIV/AIDS is recognized as one of the most common ailments for which physicians prescribe medical marijuana.[56] Moreover, legalization of recreational marijuana use continues to expand in the United States and Canada. As these trends continue, studies examining the health effects of medical and recreational marijuana use will be helpful in informing PLWH and those responsible for their care about potential health effects of marijuana use.

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Disclosure

The authors report no conflicts of interest in this work.

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