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Cannabis use during alcohol treatment is associated with alcohol-related problems one-year post-treatment

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Abstract

Background: Prior research shows that cannabis use during treatment for Alcohol Use Disorders (AUD) is related to fewer abstinent days from alcohol, although only among those who use cannabis 1–2x/month. Here we extend prior research by assessing the relationship between the frequency of cannabis use during AUD treatment and post-treatment alcohol-related consequences.

Methods: Data come from the Combined Pharmacotherapies and Behavioral Interventions (COMBINE) Study, a large US randomized control trial of treatments for AUD. The current analyses include 206 cannabis users and 999 cannabis abstainers and compare longitudinal drinking data between those who used cannabis versus those who abstained during COMBINE treatment. The primary exposure was quartiles of cannabis use (Q1: less than 1x/month during treatment, Q2: 1–2x/month, Q3: 4–8x/month, Q4: 12x/month or more), with cannabis abstainers as the reference group. Outcomes were alcohol-related problems at the end of treatment and one-year post-treatment as measured by the Drinker Inventory Consequences.

Results: Compared to cannabis abstinence, the most frequent use during treatment was related to 1.44 times as many physical consequences one-year post-treatment. Cannabis use was not related

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Contributors

Meenakshi Sabina Subbaraman was the PI of the grant, did the statistical analyses, managed the literature search, and wrote the first draft of the manuscript. Deidre Patterson assisted with data preparation and preliminary analyses. Jane Metrik and Bob Stout helped with writing the final draft. All authors have approved the final manuscript.

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to physical consequences immediately after treatment, or to intrapersonal, interpersonal, social responsibility or impulse control problems at either post-treatment time point.

Conclusions: In a sample of individuals in treatment for AUD, using cannabis 12x/month or more during treatment is associated with increased rates of physical consequences attributed to alcohol use. Individuals in treatment for AUD who also use cannabis might benefit from reducing or stopping cannabis use to avoid alcohol-related physical problems.

Keywords

Alcohol; Cannabis; Marijuana; Alcohol Use Disorder; Alcohol-Related Problems; Drinker Inventory of Consequences

1. Introduction

Alcohol and cannabis co-use is prevalent, with cannabis being the most commonly used drug among drinkers (Falk et al., 2008). Results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC, N = 43,093) show that approximately 22.5% of individuals with AUD use cannabis, less than 10% use other drugs (Falk et al., 2008), and 60% or more use tobacco (Chen et al., 2006). NESARC findings also indicate that cannabis use can exacerbate alcohol effects, subsequently increasing the risk of alcohol-related problems and alcohol use disorder (AUD) (Blanco et al., 2016). Using two waves (2001–2002 and 2004–2005) of NESARC data, multiple regression analyses showed that any cannabis use at Wave 1 was significantly related to 2.5 times the odds of a DSM-IV AUD at Wave 2, three years later (Blanco et al., 2016). A similar study also using NESARC data found that compared to no cannabis use, any cannabis use at Wave 1 was associated with twice the odds of incident AUD and 30% increased odds of persistent AUD three years later (Weinberger et al., 2016). The authors recommended further research on the relationship between cannabis and AUD, as well as their associations with specific alcohol-related problems (Weinberger et al., 2016). Prior results were also limited by the use of a dichotomous past-year cannabis use exposure, as the relationship between cannabis and alcohol use is more nuanced (Subbaraman, 2014, 2016).

To better understand these nuances, a recent secondary analysis of the Combined Pharmacotherapies and Behavioral Interventions (COMBINE) Study, a randomized control trial of AUD treatments, used longitudinal data to examine how cannabis use during a 16-week treatment period affected end-of-treatment and one-year post-treatment outcomes. As compared to no cannabis use, any cannabis use during treatment was related to a significantly lower percentage of days abstinent from alcohol as far as one year post-treatment, although only among the second quartile of cannabis users, i.e., those who used cannabis once or twice per month (Subbaraman et al., 2017). This suggests that the relationship between cannabis and alcohol use is probably not linear, and might be driven by individuals who substitute cannabis for alcohol by using cannabis more frequently and alcohol less frequently (Subbaraman et al., 2017). Cannabis use was not related to drinks per drinking day or heavy drinking days, which raises questions regarding both whether these individuals are still at increased risk for alcohol-related problems, as well as how these individuals are using cannabis and alcohol together vs. separately.

While some individuals use cannabis and alcohol synergistically, or as complements, subsequently increasing their frequency and/or quantity of drinking, others substitute cannabis for alcohol, subsequently reducing their drinking and related problems. In the general population, cannabis can act as both a substitute and a complement, and co-use patterns may depend on demographic and subgroup differences, such as the history of substance use disorders (SUD) (Guttmannova et al., 2016; Subbaraman, 2014). A cost study of the relationship between cannabis comorbidity and alcohol, mood and thought disorders in hospitals found that cannabis comorbidity was significantly related to the longer length of stays and higher charges for patients whose primary diagnosis was AUD, suggesting that cannabis use can exacerbate symptoms and factors related to AUD (12). Similarly, a secondary analysis of a chronic disease management study found that among individuals who met criteria for drug or alcohol dependence and reported recent drug use (i.e., opioid or stimulant) or heavy drinking, cannabis use was associated with 27% lower odds of abstinence from drug use and heavy drinking (13). On the other hand, a review of cannabis substitution among individuals with AUD showed that cannabis does satisfy or partially satisfy all seven criteria for being a substitute medication for alcohol use, though more research is crucial before considering recommending cannabis to individuals in AUD treatment (Subbaraman, 2014). Specifically, the review called for longitudinal research of how cannabis use affects alcohol use and related problems among individuals with AUD who want to quit or reduce drinking (Subbaraman, 2014). To our knowledge, associations between cannabis use and alcohol-related problems post-treatment have not been examined before.

The goal of this study was to assess the relationship between cannabis use frequency during treatment and alcohol-related problems post-AUD treatment using longitudinal data. Examining cannabis use in relation to specific alcohol-related problems beyond alcohol use itself is important because problems highlight key areas for intervention, affect a larger proportion of the population than AUD, often might be a precursor to an AUD, and can serve as a proxy for examining milder forms of AUD. Furthermore, secondary measures such as alcohol-related problems and psychosocial functioning are also considered important long-term outcomes among individuals with AUD.

2. Materials and Methods

2.1. Sample

Data were obtained from the Combined Pharmacotherapies and Behavioral Interventions (COMBINE) study. An overview of the study design, methodology and primary findings have been described previously (Anton et al., 2006; COMBINE Study Research Group, 2003). Briefly, the COMBINE study is a National Institute on Alcohol Abuse and Alcoholism (NIAAA) sponsored multi-site randomized clinical trial designed to examine the efficacy of combined pharmacotherapies (naltrexone, Acamprosate) and a behavioral intervention for alcohol dependence. Participants attended outpatient treatment over 16 weeks at 11 national COMBINE Study sites, and all had a primary diagnosis of alcohol dependence (Anton et al., 2006; COMBINE Study Research Group, 2003). The current analyses include 206 cannabis users and 999 cannabis abstainers and compare longitudinal

drinking data between those who used cannabis versus those who abstained during COMBINE treatment (N = 1,205). This study was approved by the Public Health Institute's Institutional Review Board.

2.2. Measures

Cannabis use data were collected using Form-90 in the original COMBINE study. Cannabis use was first dichotomously coded to indicate if an individual had used cannabis on any day between baseline and the last day of treatment (coded as 1; at least one day) or had not used cannabis during this specified time (coded as 0; none). The primary exposure was cannabis use during treatment, defined by quartiles among users (n = 206) with cannabis abstainers as the referent (n = 999). Following previously published analyses that showed differential effects of cannabis according to frequency of use (Subbaraman et al., 2017), cannabis users were grouped into quartiles based on the distribution of the percentage of days of cannabis use during the 16week treatment period: Quartile 1 (Q1; approximately 1–4% of days, or less than 1x/month), Quartile 2 (Q2; approximately 5–8% of days, or 1–2x/month), Quartile 3 (Q3; approximately 9 – 39% of days, or 4–8x/month), and Quartile 4 (Q4; approximately 40–100% of days, or 12x/month or more).

Alcohol problems both at the end of treatment (16 weeks) and one-year post-treatment (68 weeks) were measured by the Drinker Inventory of Consequences (DrInC). The DrInC is a wellvalidated, self-administered questionnaire that measures adverse consequences of drinking in five domains: *Impulse Control* (12 items, e.g., drinking has caused other drug use, taken foolish risks while drinking), *Physical* (8 items, e.g., had a hangover after drinking, sex life has suffered because of drinking), *Interpersonal* (10 items, e.g., said or done something embarrassing while drinking, lost a friend because of my drinking), *Intrapersonal* (8 items, e.g., felt guilty or ashamed because of my drinking, lost interest in hobbies and activities because of drinking), and *Social Responsibility* (7 items, e.g., missed days of school or work because of drinking, have had money problems because of drinking) (Miller et al., 1995). For each item, participants were asked, “Since your last interview, how often has this happened to you?” with possible response categories scored as Never = 0, Once or a few times = 1, 2 = Once or twice a week = 2, Daily or almost daily = 3. We examined the association between cannabis use quartiles and each of the five domain subscales, as well as the association between cannabis use quartiles and the total DrInC score.

2.3. Statistical Analyses

First, we compared total and subscale DrInC scores at baseline, end of treatment (16 weeks), and one-year post-treatment (68 weeks) across cannabis frequency groups using bivariate negative binomial regressions. We then used multivariable negative binomial regressions to estimate adjusted incident rate ratios (IRR) for the total and subscale DrInC scores; negative binomial regression was used because DrInC scores are over-dispersed count data for which the conditional variances exceed the conditional means. All multivariable regressions controlled for the baseline DrInC total score as well as age, gender (F/M), education (high school or less vs. some college or more), employment (full- or part-time employed vs. other), income (< \$15,000, \$15,000–29,999, \$30,000–59,999, \$60,000–89,999, \$90,000+),

marital status (married or cohabiting vs. other) and self-reported race/ethnicity (Non-Hispanic White, Non-Hispanic Black, Hispanic, Other), nicotine use (Y vs. N), and other drug use (Y vs. N use of any of the following: sedatives/tranquilizers, hypnotics, steroids, amphetamines, cocaine, hallucinogens, inhalants, opiates or other unspecified drug). For 16-week outcomes, regressions controlled for 16-week percent days abstinent, drinks per drinking day, and percent heavy drinking days; for 68-week outcomes, regressions controlled for 68-week percent days abstinent, drinks per drinking day, and percent heavy drinking days. All analyses were performed in Stata 14.2 (StataCorp., 2015).

3. Results

3.1. Bivariate Results

Table 1 describes demographic and substance use characteristics of the sample overall, cannabis abstainers, and each of the four cannabis frequency groups. Table 1 also shows significant bivariate differences between cannabis abstainers and cannabis users; abstainers were older, more likely female, more likely in higher income groups, more likely married and less likely to use nicotine at baseline. Table 2 displays bivariate comparisons of DRINC subscale and total scores across cannabis use frequency groups with abstainers as the referent. At baseline, all cannabis users had significantly higher (worse) impulse control scores than cannabis abstainers, regardless of cannabis use frequency. At baseline, Q3 (4–8x/month) also had significantly higher social responsibility scores. At the end of treatment, Q3 and Q4 (12x/month or more) had significantly higher impulse control and social responsibility scores than abstainers, while Q4 also had higher physical and total DrInC scores. By one-year post-treatment, Q2 (1–2x/month), Q3 and Q4 all had significantly higher impulse control and social responsibility scores than abstainers, while Q2 and Q4 also had higher physical scores.

3.2. Multivariable Regression Results

Table 3 displays results from multivariable negative binomial regression. After adjusting for demographics and baseline alcohol use and problems, the heaviest cannabis users (Q4) - participants who used cannabis 12x/month or more - had significantly higher rates of physical consequences related to alcohol use one-year post-treatment compared to cannabis abstainers. Specifically, heaviest use during treatment was related to 1.44 times as many physical consequences one-year post-treatment. Cannabis use quartiles were not significantly related to any of the five consequence domains at the end of treatment, or to intrapersonal, interpersonal, impulse control or social responsibility alcohol-attributable consequences one-year post-treatment (not shown). Cannabis use quartiles were not related to the total DrInC score at either time point.

Those reporting higher income levels generally had lower rates of physical consequences compared to those reporting < \$15,000. As expected, total DrInC score at baseline and percent heavy drinking days through one-year post-treatment were both positively related to the rate of physical consequences, while percent days abstinent through one-year post-treatment was inversely related.

3.3. Post Hoc Analyses

Post hoc, we used logistic regressions to examine each DrInC item within the physical consequences subscale (measured one-year post-treatment) to identify which specific problems were driving the significant results. These regressions controlled for the same covariates as those described above. Within physical consequences, Q4 users had significantly higher odds of hangover after drinking (OR = 25.67, 95% CI: 3.26 – 202.05), feeling sick and vomiting after drinking (OR = 3.71, 95% CI: 1.57 – 8.76), not eating properly because of drinking (OR = 2.59, 95% CI: 1.03 – 6.48), and injuring/hurting/burning self while drinking (OR = 3.94, 95% CI: 1.38 – 8.84) compared to cannabis abstainers.

4. Discussion

4.1. Summary of Results

Our primary aim was to examine the relationship between cannabis use frequency during AUD treatment and alcohol-related problems post-treatment. We found that compared to cannabis abstainers, the heaviest cannabis users, or those who used approximately 12x/month or more during treatment, had higher rates of physical problems attributed to their drinking one full year post-treatment, adjusting for drinking levels and baseline alcohol problems. This relationship was not evident immediately post-treatment, or among individuals who used cannabis less frequently. The lack of a significant association between cannabis use and alcohol-related problems immediately post-treatment could be due to a significant overall reduction in drinking observed during treatment in the original COMBINE Study (Anton et al., 2006). During treatment, participants averaged at approximately 75% days abstinent from alcohol with 7.1 drinks/drinking day, while at the one-year follow-up, they averaged approximately 63% days abstinent with 8.5 drinks/drinking day. The increases in drinking in the post-treatment period could help explain the significant association between cannabis use and alcohol-related physical problems at the one-year follow-up, as discussed below (Section 4.2.). Few other variables were related to alcohol consequences, and all in the expected directions: those with higher incomes had lower rates of problems and those with more baseline problems had higher rates. Not surprisingly, longer length of abstinence from alcohol was associated with lower rates of alcohol-related physical consequences.

The lack of significant associations between cannabis use and alcohol-related problems across most domains is interesting and consistent with previous findings of a lack of association between heavy drinking and cannabis frequency in the COMBINE sample (Subbaraman et al., 2017). Taken together, the results from the current and previous studies signal that more work is needed to understand whether there are safe levels of cannabis use for individuals in AUD treatment. It is also unclear why only physical alcohol-related problems were related to using cannabis 12x/month or more, while other problems were not. Both clinical and epidemiological studies have consistently shown that co-use of alcohol and cannabis leads to more physiological, cognitive and behavioral impairment than the use of either substance alone (Chait and Perry, 1994; Downey et al., 2013; Ramaekers et al., 2001; Ronen et al., 2008; Subbaraman, 2016; Subbaraman and Kerr, 2015), which supports the findings that the heaviest cannabis users had more physical problems and injuries

attributable to alcohol. However, cannabis use specifically has been linked to depression and/or anxiety, diminished lifetime achievement, and abnormal brain development as well (Guttmannova et al., 2017), which suggests that cannabis use would exacerbate alcohol-related inter- and intrapersonal problems, as well as impulse control and social responsibility. Although we did see that higher frequencies of cannabis use were related to problems with impulse control and social responsibility at both end of treatment and one-year post-treatment in bivariate tests, these results were not robust to multivariable model specifications in the current study.

4.2. Potential Mechanisms

Previously, we found no differences in heavy drinking across cannabis use frequency groups, either at end of treatment or one year post-treatment, and that the only group of cannabis users that differed from abstainers on the frequency of alcohol use were “mid-level” users or those who use cannabis only 1–2x/month (Subbaraman et al., 2017). Given our prior results, we speculate that higher rates of physical consequences among the heaviest cannabis users are actually due to increased blood levels of Δ^9 -tetrahydrocannabinol (THC) and not increased quantity or frequency of alcohol consumption. Even if the quantity of alcohol consumed remains low, experimental studies have shown that alcohol potentiates subjective intoxication from cannabis as levels of THC in blood are higher when THC is consumed with alcohol, particularly at the lower doses of alcohol (Lukas and Orozco, 2001). Cannabis and alcohol co-administration subsequently results in increased impairment (Downey et al., 2013) and stronger physiological effects compared to using either substance alone (Ronen et al., 2010). However, our speculation assumes that individuals who used cannabis at high levels during treatment continued to use heavily, and more research is needed in this area.

4.3. Cannabis Use and Alcohol-Related Problems in Other Populations

A study of university undergraduates found that cannabis use was associated with increased likelihood of other substance use and alcohol-related negative physical consequences, such as injury, unprotected sex, and blacking out (Keith et al., 2015). Furthermore, those with more than 10-days of cannabis use in the past 30-days appeared to have more problems than less frequent cannabis users (Keith et al., 2015). Similarly, a study of weekly cannabis users found that heavy drinking and cannabis use synergistically increased the likelihood of unprotected sex (Metrik et al., 2016). A study of female cannabis users not seeking treatment found that alcohol use potentiated cannabis problem severity, which includes having problems with sleep (another physical consequence) or with low self-esteem attributed to cannabis use (Stein et al., 2014).

We know of no other studies that have examined the relationship between cannabis use among individuals with AUD during AUD treatment and post-treatment alcohol-related problems. The current findings corroborate those from a previous study that found that cannabis comorbidity was significantly associated with longer hospital stays and higher costs for patients with primary AUD, suggesting that cannabis can aggravate problems related to AUD (Pacula et al., 2008). Still, further replication of these findings is warranted.

4.4. Limitations and Future Directions

We rely on self-report of alcohol and cannabis use, as well as DrInC outcomes; these measurements may be affected by recall and/or social desirability biases. Another important limitation is the potential presence of unmeasured confounding in that individuals who use cannabis at a high-level during treatment may differ from abstainers and lighter cannabis users in some way that could manifest as a spurious relationship. For example, individuals who are willing to admit to high levels of cannabis use during treatment might also be more willing to admit to certain consequences. We also do not know how much cannabis individuals were using, the potency of the cannabis, the method of ingestion, the prevalence of cannabis use disorder in this sample, or whether participants were using cannabis on the actual days that they experienced alcohol-related problems, let alone when those problems occurred relative to last cannabis use episode. Currently, event-level literature regarding alcohol-related problems is concentrated on substance use and sexual risk behaviors (Hensel et al., 2011; Kerr et al., 2015; Metrik et al., 2016; Rendina et al., 2015; Walsh et al., 2014). One event-level study examined daily associations between marijuana and alcohol use and the extent to which the associations differed as a function of cannabis use disorder (CUD) and/or AUD diagnosis. Heavy drinking was more likely to occur on days when cannabis was also used among individuals with AUD and those with comorbid AUD and CUD, but not among those with only CUD (Metrik et al., 2018).

Detailed, event-level data are needed to establish the temporal proximity between cannabis use and the range of alcohol-related problems, and ongoing projects will be collecting these data. Forthcoming research will also assess whether particular subgroups are more prone to alcohol-related problems when using cannabis (e.g., those with mental health comorbidities), and what mechanisms (e.g., cognitive impairment) might explain this relationship.

Although these results are novel, they require replication. Clinically, the results do suggest that heavy cannabis use should be avoided during AUD treatment to avoid potential exacerbation of physical consequences; however, more research is needed to recommend a specific threshold at which alcohol treatment outcomes are not exacerbated by cannabis use. Furthermore, the co-use of cannabis and alcohol may hinder intervention on both substances, yet few studies have explored how to treat or reduce co-use as opposed to treating each substance alone (Yurasek et al., 2017). Clinical studies of alcohol and tobacco co-use show that interventions can reduce the use of both effectively (Cooney et al., 2015; Kahler et al., 2008; O'Malley et al., 2009) and that cannabis users benefit from interventions targeting smoking cessation and drinking outcomes (Hendricks et al., 2012; Metrik et al., 2011). Clinical trials are needed to fully test the efficacy of an intervention that specifically addresses co-use of cannabis and alcohol in alcohol treatment outcomes.

5. Conclusion

To our knowledge, this is the first study to examine the relationship between cannabis use during treatment for AUD and alcohol-related problems post-treatment. We also extend our prior work, which had utilized the same cannabis use frequency measure; we had previously found that the use of quartiles as opposed to a dichotomous measure of use revealed more details regarding the relationship between cannabis and alcohol use. We find that in a sample

of individuals in treatment for AUD, using cannabis 12x/month or more during treatment is associated with increased rates of physical problems related to drinking. These results have concrete clinical implications; for example, clinicians treating individuals who use both cannabis and alcohol might consider intervening on both substances, while individuals in treatment for AUD who also use cannabis might consider cutting down their cannabis use to avoid alcohol-related problems. The current findings are particularly timely given the increased liberalization of cannabis laws in the US and around the world.

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Highlights

- Frequent cannabis use in alcohol use disorder (AUD) treatment is related to physical problems 1 yr. later
- Cannabis use during treatment is not related to other problems, e.g. impulse control
- The relationship between cannabis use and alcohol-related problems is not linear

Table 1.
Descriptive statistics of demographics and baseline drinking across cannabis frequency groups

	Cannabis Abstainers				
	Sample Overall n = 999	Quartile 1 ^a n = 58	Quartile 2 n = 45	Quartile 3 n = 52	Quartile 4 n = 51
Age (mean, SD) *	44.43 (10.20)	45.81 (10.19)	41.64 (8.75)	41.44 (9.41)	38.85 (7.11)
Female (%) **	30.92	33.03	25.86	17.78	9.62
Education (%)					
High School or Less	24.53	24.27	29.63	26.83	28.00
Some College	75.47	75.73	70.37	73.17	72
Employment (%)					
Full or part-time	71.35	70.35	67.24	75.56	84.62
Unemployed/retired/other	28.65	29.65	32.76	24.44	15.38
Income (%) *					
< \$15 000	10.15	9.85	17.24	8.89	7.84
\$15 000–29 999	16.10	13.71	18.97	17.78	33.33
\$30 000–59 999	29.93	31.57	24.14	28.89	31.37
\$60 000–89 999	19.56	20.00	20.69	15.56	11.76
> \$90 000	24.26	24.87	18.97	28.89	15.69
Marital Status (%) *					
Married/cohabitating	46.23	48.55	37.93	44.44	26.92
Single/divorced/widowed/separated	53.77	51.45	62.07	55.56	73.08
Race/Ethnicity (%)					
White	76.90	77.48	72.41	84.44	78.85
Black	7.89	8.11	13.79	2.22	9.62
Hispanic	11.08	10.41	8.62	8.89	11.54
Other	4.13	4.00	5.17	4.44	0.00
Other Drug Use (%) **	6.06	4.00	6.90	13.64	17.31
Nicotine Use (%) **	51.04	47.15	63.79	71.11	76.92
% Days Abstinent (mean, SD)	25.08 (25.07)	24.88 (24.67)	25.4 (25.2)	24.81 (25.74)	26.00 (27.08)
					23.14 (21.82)

	Cannabis Abstainers		Quartile 1 ^a	Quartile 2	Quartile 3	Quartile 4
	Sample Overall	n = 999	n = 58	n = 45	n = 52	n = 51
Drinks/Drinking Day (mean, SD)	12.44 (7.91)	12.2 (7.97)	12.4 (6.59)	11.63 (6.7)	14.65 (7.18)	12.55 (6.92)
% Heavy Drink Days (mean, SD)	65.49 (29.57)	65.54 (28.17)	65.86 (28.67)	59.04 (31.01)	67.52 (30.51)	67.65 (26.69)

^aQuartiles are based on cannabis use frequency during treatment

(Q1: less than 1x/month during treatment, Q2: 1–2x/month, Q3: 4–8x/month, Q4: 12x/month or more)

* $P<0.01$

** $P<0.001$

Bivariate comparisons of Drinker Inventory of Consequences domain subscales across cannabis frequency groups^{a, b}

Table 2.

	Cannabis Abstainers				
	Quartile 1 ^a	Quartile 2	Quartile 3	Quartile 4	
n = 999 (REF)	n = 58	n = 45	n = 52	n = 51	
<i>Baseline</i>					
Impulse Control (mean, SD)	7.21 (4.14)	8.38 (4.49) *	8.64 (4.58) *	9.23 (4.09) **	8.96 (4.30) **
Physical	9.14 (4.37)	8.91 (4.00)	10.11 (4.40)	9.62 (3.91)	9.75 (4.84)
Interpersonal	14.33 (5.70)	14.09 (5.04)	14.20 (5.43)	14.79 (5.24)	14.55 (6.09)
Intrapersonal	9.82 (6.00)	9.88 (5.77)	9.75 (6.54)	11.15 (6.07)	10.37 (5.47)
Social Responsibility	6.00 (4.14)	6.72 (3.91)	6.77 (4.73)	7.35 (4.09) *	7.22 (3.97)
Total DRINC	46.50 (20.35)	47.98 (19.34)	49.48 (21.64)	52.13 (19.37)	51.02 (20.76)
<i>End of treatment/16-week outcomes</i>					
Impulse Control	1.88 (3.06)	2.91 (3.69)	2.57 (3.42)	3.08 (3.78) *	4.30 (5.18) **
Physical	2.40 (3.72)	2.96 (3.97)	3.57 (4.63)	3.75 (4.66)	4.14 (4.92) *
Interpersonal	4.18 (5.62)	5.64 (6.26)	5.40 (6.56)	5.77 (6.78)	6.09 (6.40)
Intrapersonal	2.41 (4.36)	3.09 (4.10)	3.40 (5.13)	3.67 (5.39)	4.02 (4.82)
Social Responsibility	1.40 (2.84)	2.29 (3.62)	1.81 (3.07)	2.81 (4.01) *	3.23 (4.05) *
Total DRINC	12.28 (18.07)	16.89 (20.22)	16.76 (21.23)	19.08 (23.36)	21.77 (23.32) *
<i>One-year post-treatment/68-week outcomes</i>					
Impulse Control	2.88 (3.38)	3.83 (4.19)	4.68 (4.17) *	5.68 (6.39) **	4.67 (5.58) *
Physical	3.60 (4.34)	4.04 (4.20)	5.97 (4.71) *	5.34 (5.21)	5.98 (5.76) *
Interpersonal	5.90 (6.50)	6.89 (6.62)	7.49 (6.50)	8.13 (7.55)	8.18 (7.54)
Intrapersonal	3.71 (5.01)	4.04 (5.08)	5.86 (5.23)	5.76 (6.66)	5.33 (5.44)
Social Responsibility	2.06 (3.14)	2.83 (3.57)	3.62 (3.89) *	4.34 (5.01) **	3.69 (4.25) *
Total DRINC	18.15 (20.45)	21.63 (21.93)	27.62 (22.60)	29.24 (28.98)	27.84 (25.63)

^aQuartiles are based on cannabis use frequency during treatment

(Q1: less than 1x/month during treatment, Q2: 1–2x/month, Q3: 4–8x/month, Q4: 12x/month or more)

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b P -values come from bivariate negative binomial regressions with cannabis abstiners as the referent

* $P<0.05$

** $P<0.01$

*** $P<0.001$

Table 3.

Adjusted Incident Rate Ratios from multivariable negative binomial regressions of cannabis use on alcohol-related problems as measured by Drinker Inventory of Consequences (DrInC) “Physical Consequences” subscale one-year post-treatment

Physical Consequences	
	IRR (95% CI)
Cannabis use (vs. None)	
Quartile 1 ^a	0.99 (0.74, 1.33)
Quartile 2	1.31 (0.95, 1.81)
Quartile 3	1.10 (0.77, 1.56)
Quartile 4	1.44 (1.02, 2.04)*
Age	1.00 (0.99, 1.01)
Male (vs. Female)	0.88 (0.76, 1.03)
Some college or more (vs. less)	1.14 (0.97, 1.35)
Full- or part-time employed (vs. not)	0.97 (0.83, 1.15)
Income (vs. < \$15,000)	
\$15 000–29 999	0.87 (0.67, 1.14)
\$30 000–59 999	0.72 (0.56, 0.93)*
\$60 000–89 999	0.77 (0.57, 1.03)
> \$90 000	0.67 (0.49, 0.90)**
Married/cohabitating (vs. not)	1.06 (0.90, 1.25)
Race/Ethnicity (%) (vs. Non-Hisp White)	
Non-Hispanic Black	0.92 (0.70, 1.21)
Hispanic	0.92 (0.73, 1.17)
Other	1.00 (0.70, 1.44)
Baseline DrInC score	1.01 (1.01, 1.02)***
Nicotine use (vs. none)	1.05 (0.90, 1.21)
Other drug use (vs. none)	1.00 (0.77, 1.31)
Percent Days Abstinent	0.99 (0.98, 0.99)***
Drinks per Drinking Days	1.01 (0.99, 1.03)

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Physical Consequences	
IRR (95% CI)	
Percent Heavy Drink Days ^b	1.01 (1.00, 1.01) ^{***}

^aQuartiles are based on cannabis use frequency during treatment

^b(Q1: less than 1x/month during treatment, Q2: 1–2x/month, Q3: 4–8x/month, Q4: 12x/month or more)Heavy drinking defined as four or more drinks for women, five or more drinks for men

* $P < 0.05$

** $P < 0.01$

*** $P < 0.001$