Addictive Behaviors 104 (2020) 106259

Contents lists available at ScienceDirect

Addictive Behaviors

journal homepage: www.elsevier.com/locate/addictbeh

Depressive symptoms moderate cannabis use for young adults in a Text-Delivered randomized clinical trial for cannabis use disorder

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HIGHLIGHTS

- Cannabis use and depression disorders often co-occur in young adulthood.
- Text-delivered treatment for CUD effectiveness varied by depression level.
- Results support simultaneous treatment of CUD and depression with young adults.

ARTICLE INFO

Keywords:
Young adults
Cannabis use
Depression
Cannabis use disorder treatment

ABSTRACT

Background: The importance and complexity of addressing both substance use and mood disorders such as depression within traditional treatment settings is well established. However, little is known about this issue within the context of mHealth treatment. Research is needed to determine if depression interacts with mHealth delivered cannabis use disorder treatment similarly compared traditional treatments.
Objective: We examined the moderating effect of depressive symptoms on cannabis use with 96 young adults (ages 18 to 25) enrolled in a text-delivered randomized clinical trial for cannabis use disorder. Participants were followed for three months.
Method: We used a repeated measures general linear model to test if depressive symptoms moderated the treatment's effect on cannabis use. Self-report of past 30-day use and urinalysis of THC metabolites were the outcome measures. Depressive symptoms were measured using the PHQ-2, with scores > 3 serving as the clinical cut-point, indicating likely depression disorder.
Results: Participants with sub-threshold depression scores significantly reduced the number of days they used cannabis across all three months of the study. For participants with scores above the clinical cut-point, treatment had no effect on cannabis use. Similarly, participants with sub-threshold depression scores reduced the number of positive urinalysis results at three months. Effect sizes ranged from small to medium.
Conclusion: Results support the importance of simultaneously addressing depressive symptoms and cannabis use when treating young adults using text-delivered counseling. As mHealth interventions continue to demonstrate efficacy in addressing substance use disorders, the integration of mood disorder treatments appears warranted.

1. Introduction

Young adults (ages 18 to 25) have the highest rate (5%) of cannabis use disorder (CUD) compared to other age groups (SAMHSA, 2018) and are the least likely to seek treatment for this disorder (Wu, Zhu, Mannelli, & Swartz, 2017). Developing and testing effective treatments to engage this hard to reach population is an important public health challenge. A promising development to address this challenge is the utilization of digital treatments that can augment traditional face-to-face treatments or can be stand-alone interventions. Two issues make this approach particularly useful for young adults. First, digital treatments such as text-delivered programs increase the sense of privacy by allowing the young adult to access treatment without the stigma of entering a physical treatment program or therapist's office (Hoch, Preuss, Ferri, & Simon, 2016). Second, young adults are extremely comfortable with texting, sending and receiving approximately 128 texts per day (Burke, 2016). Thus, text-delivered treatments for CUD are an appropriate modality for this population.

Young adults also experience more major depressive episodes (13.1%) compared to other age groups (SAMHSA, 2018). Research on

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https://doi.org/10.1016/j.addbeh.2019.106259
Received 3 November 2019; Received in revised form 6 December 2019; Accepted 15 December 2019
Available online 31 December 2019

the causal pathways of this disorder has found a bi-directional relationship, with research suggesting a causal link from depression to cannabis use (Feingold, Weiser, Rehm, & Lev-Ran, 2015), and other research suggesting that cannabis increases the risk for depression (Hanna, Perez, & Ghose, 2017). Both are serious disorders and both peak in young adulthood, underscoring the need to test mHealth interventions that address both cannabis use and depression.

The purpose of the current study was to understand the influence of depressive symptoms on the effectiveness of a text-delivered CUD treatment with young adults. We posed the question, "would treatment effectiveness of a text-delivered intervention be dependent upon severity of depressive symptoms, where more symptoms would be associated with worse outcomes?" To answer this question, we tested the moderating effect of depressive symptoms on cannabis use in a randomized clinical trial with 96 young adults. We hypothesized that participants with fewer depressive symptoms would reduce their cannabis use (the number of days used cannabis and positive THC urine results) compared to participants with more depressive symptoms.

2. Material and methods

2.1. Participants

Data used in the current study were from a parent randomized clinical trial for the treatment of cannabis use disorder with an automated texting program called Peer Network Counseling-txt (PNC-txt). PNC-txt is a 4-week, automated, and personalized text-delivered cannabis treatment that focuses on close peer relations. PNC-txt applies motivational interviewing (Miller & Rollnick, 2013) principles, but uses a relational framework in addressing risk behaviors, focusing on the interpersonal and environmental interactions that the participant encounters. Details of the parent study are in Mason et al. (2018), therefore a brief summary is provided here. One hundred and one young adults, ages 18 to 25 who met CUD criteria, were randomized into either PNC-txt or control conditions, and were followed for 3-months. The vast majority of participants were college students. The control condition was an assessment only condition. Participants were recruited through flyers, electronic signage, and campus radio spots and were compensated $150 in Amazon e-gift cards for their participation. At 3-months, the PNC-txt group reduced number of heavy cannabis-use days, relationship problems due to cannabis use, and memory problems compared with controls. Study procedures were approved by the Institutional Review Board at the first author's university and a Certificate of Confidentiality was obtained from the National Institutes of Health. Recruitment began November 2017 and data collection was completed by March 2018.

2.2. Measures

2.2.1. Demographics

Participants reported their age, sex (female = 0, male = 1), and race/ethnicity.

2.2.2. Past 30-day cannabis use

Past-30-day cannabis use was measured using an item from the Youth Risk Behavior Survey, "During the past 30-days, on how many days did you use marijuana?" (YRBS; CDC, 2013). Responses were coded as the number of days used marijuana.

2.2.3. Urine drug test

The CLIA Waived Integrated E-Z Split Key Cup II was used to determine whether cannabis metabolites (THC) were present in the participant's urine sample. The test was administered in-person at screening and within 1 week after the 3-month follow-up assessment was completed. A positive result for cannabis metabolites was required for inclusion in the study. THC is detected based on an immunoassay using cutoff level of 50 ng/mL. This device has high levels of sensitivity, specificity, and diagnostic efficiency, making it appropriate for use as a screening tool for recent substance use (Greene, Lehman, & McMillin, 2011). Results were encoded as: no presence of cannabis metabolites = 0, presence of cannabis metabolites = 1.

2.2.4. Depressive symptoms

We assessed depressive symptoms using the Patient Health Questionnaire (PHQ-2) (Kroenke, Spitzer, & Williams, 2002). Participants rate the frequency of depression symptoms within the past two weeks. The two items that form the depression scale are, 1) "Feeling down, depressed, or hopeless" and 2), "Little interest or pleasure in doing things". Responses were encoded as "not at all" = 0, "several" =1, "more than half the days" = 2, and "nearly every day" = 3. The responses were then summed to produce a total score with a range of 0 to 6. We then created a dichotomous variable where scores > 3 served as the clinical cut-point, per the PHQ-2 scoring procedures. Values were encoded as unlikely depressive disorder (screen negative) = 0, and likely depressive disorder (screen positive) = 1. We followed recommendations when using a two-item scale and conducted a Spearman-Brown reliability test producing a reliability estimate of 0.830 (Eisinga, Te Grotenhuis, & Pelzer, 2013).

2.3. Analytic plan

We calculated descriptive statistics on all variables used in our models. To test our hypothesis we conducted a repeated measures analysis of covariance, to examine Time X Condition X Depressive Symptoms interactions, controlling for race, gender, and age. Our first model included past 30-day cannabis use at baseline (Time 1) and at three follow-up intervals (1-month, 2-month, and 3-month post-baseline). The second model included the results of the urinalysis, which was measured at baseline and at 3-month post-baseline follow-up. We obtained effect sizes using the Cohen's *d* statistic to determine the magnitude of the intervention's effectiveness. We examined alcohol and other substance use between those who screened positive for depression and those who did not. We found no difference and thus did not include these in the analysis. We conducted all analyses using IBM SPSS (2012, V21).

3. Results

3.1. Sample characteristics

Fifty-five male participants (57.3%) and 41 female participants (42.7%) enrolled in the study. Participant ages ranged from 18 to 25 (M = 20.33, SD = 1.76). Participants were 77.1% white, 8.9% Black/African American, 6.9% mixed race, and 5% other, and 92.7% were enrolled as college students. At baseline, the sample reported using cannabis 24 days in the past 30 days (SD = 6.2), and 32% screened positive for likely depression disorder. Chi-square and *t*-tests revealed no significant differences between experimental conditions.

3.2. Past 30-Day cannabis use

Significant Time X Condition X Depressive Symptoms effects were found on past 30-day cannabis use at one, two, and three months post enrollment. Beginning with one month depressive symptom scores, for participants who screened negative for depression, treatment produced a small effect F (1, 89) = 3.44, p = 0.017; d = 0.39, reducing cannabis use by 4.3 days compared to 2.8 days for those who screened positive. At two months, for the screen negative participants, the treatment produced a medium effect F (1, 89) = 6.51, p = 0.012; d = 0.54, reducing cannabis use by 4.6 days compared to 1.1 days for those who screened positive for depression. At the three month follow up for screen negative participants, the treatment produced a small effect F (1,

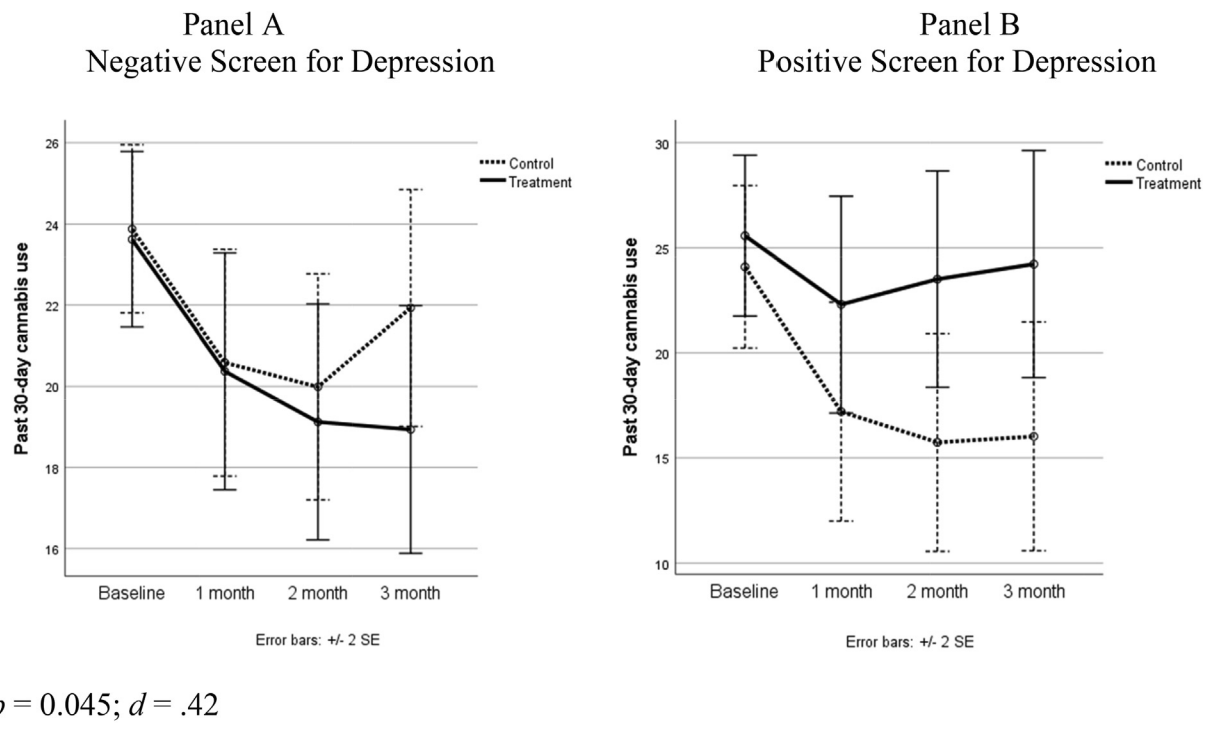

Fig. 1. *Past 30-Day Cannabis Use by Depression Level at Three Months.* $p = 0.045$; $d = 0.42$.

89) = 4.13, $p = 0.045$; $d = 0.42$, reducing cannabis use by 4.5 days compared to 2.2 days for those who screened positive for depression. Fig. 1, Panel A, shows the three-month follow-up results where the screen negative participants have a continuous reduction of days used cannabis over the period of the study. In contrast, panel B shows that for participants who screened positive, they reduced the days they used cannabis but then returned close to their baseline level of use. Panel B also shows that the control group who screened positive for depression appear to have reduced their cannabis use, although this is not significant compared to the treatment group.

3.3. Urinalysis of THC metabolites

Significant interaction effects of depressive symptoms on treatment condition were also found for the results of the urinalyses, producing a medium effect size F (1, 86) = 6.47, $p = 0.013$; $d = 0.55$. Fig. 2, Panel A, shows that participants who screened negative produced significantly more urines negative for cannabis metabolites compared to the control group (12% vs. 3%). Similar to the past 30-day cannabis use results, Panel B shows no treatment effect for those in the treatment condition who screened positive for depression, producing no negative urine results.

4. Discussion

The purpose of this study was to advance the literature on mHealth treatment of cannabis use disorder with young adults by examining the role of depressive symptomatology in treatment response. The results supported our hypothesis that depressive symptoms would moderate treatment effects, where lower levels of depressive symptoms would be associated with better outcomes. Reductions in self-reported past 30-day cannabis use coupled with the urinalyses results, provide confidence in these findings.

The findings reveal a marked contrast in cannabis use by depression level for participants in the treatment condition. For both outcomes, the comparison between depression level groups illustrates the lack of treatment effect with young adults who likely have a depressive disorder. The screen positive group would typically make initial reductions in their cannabis use, but would return close to their baseline level of use.

Regarding the urinalysis results, these findings are in contrast to the results when the entire sample was analyzed. In the original parent study, we found no significant difference in negative urine results between treatment and control conditions (Mason et al., 2018). As stated, the intervention was based upon Motivational Interviewing approaches, which emphasize choice and personal decision making regarding participants' cannabis use. As such, abstinence was not seen as a condition for success and not emphasized in the treatment. Thus, while 12% may appear like a small percent, it was enough to produce a clinically meaning treatment effect, supporting the need to address depression with young adults in treatment for CUD. It may be that these participants had more cannabis related problems and were more motivated to stop all cannabis use, which would be consistent with other research (Stea, Yakovenko, & Hodgins, 2015). It is not unreasonable to speculate that because these participants had fewer depressive symptoms, they were more engaged and motivated in the treatment compared to those with likely depression disorders.

The findings from this study should be interpreted in light of the following limitations. First, the sample consisted of young adults with CUD, who were primarily White, college students. Second, we used a screening measure to assess depressive symptoms. While the PHQ-2 is well-regarded as an appropriate screening measure for likely depression, using another measure with more items may have provided more confidence in the findings. Third, our sample was fairly small and the follow-up time was three months, rather than the standard minimum of six months.

More research studying the timing of treatment for depressive symptoms will be important and could alter cannabis use outcomes. Consider the person who is 'self-medicating' their depressive symptoms with cannabis. Reducing or stopping cannabis use can activate withdrawal symptoms that are similar to depression: feeling down, irritation, sleep disturbance, and lack of energy or interest (Bolton, Robinson, & Sareen, 2009). In such cases, providing individualized, time sensitive treatment for CUD and depression would likely be

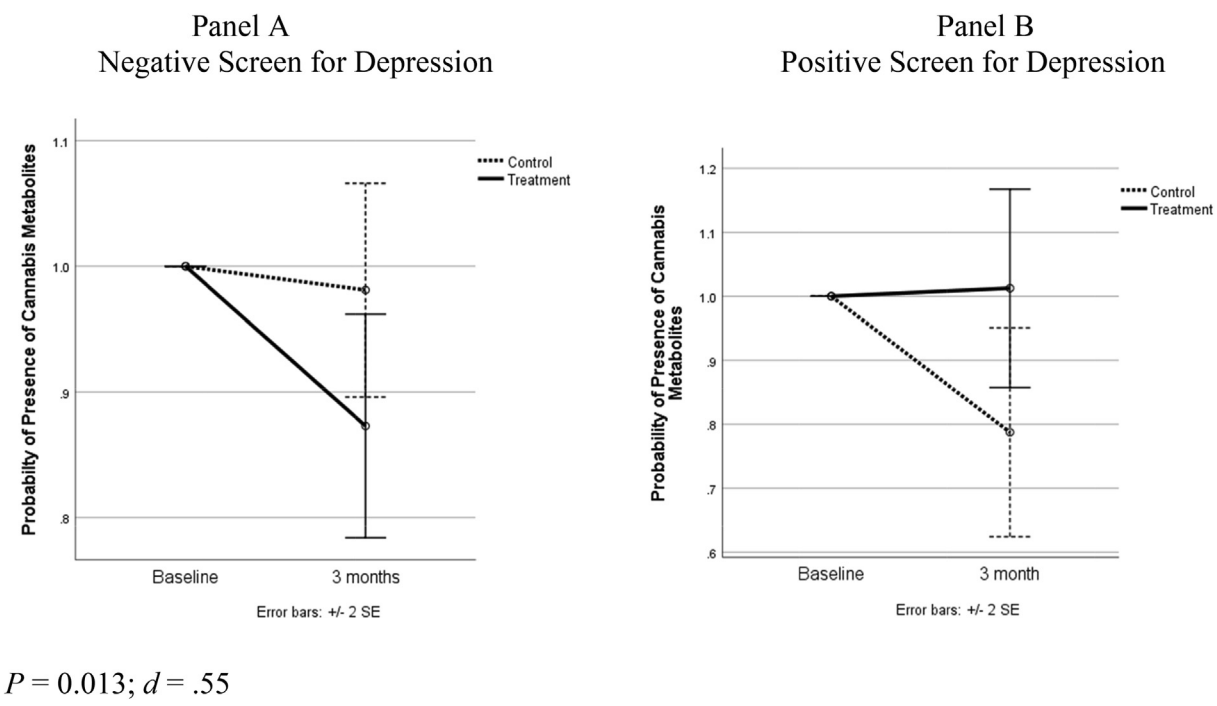

Fig. 2. *Presence of Cannabis Metabolites in Urine Test by Depression Level at Three Months.* $P = 0.013$; $d = 0.55$.

beneficial. Such personalized and nimble treatment approaches are the foundation of mHealth interventions and therefore, research on this topic could provide important clinical guidance in the treatment of young adults struggling with CUD and depression.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

Thanks to the University of Tennessee, College of Social Work, Center for Behavioral Health Research for support of this research.

References

Bolton, J. M., Robinson, J., & Sareen, J. (2009). Self-medication of mood disorders with alcohol and drugs in the National Epidemiologic Survey on Alcohol and Related Conditions. *Journal of Affective Disorders, 115*(3), 367–375. https://doi.org/10.1016/j.jad.2008.10.003.

Burke, K. (2016, May). How many texts do people send every day. Text Request. Retrieved from https://www.textrequest.com/blog/how-manytexts-people-send-per-day/.

Eisinga, R., Te Grotenhuis, M., & Pelzer, B. (2013). The reliability of a two-item scale: Pearson, Cronbach, or Spearman-Brown? *International Journal of Public Health, 58*(4), 637–642.

Feingold, D., Weiser, M., Rehm, J., & Lev-Ran, S. (2015). The association between cannabis use and mood disorders: A longitudinal study. *Journal of Affective Disorders, 172*, 211–218. https://doi.org/10.1016/j.jad.2014.10.006.

Greene, D. N., Lehman, C. M., & McMillin, G. A. (2011). Evaluation of the integrated E-Z split key(®) cup II for rapid detection of twelve drug classes in urine. *Journal of Analytical Toxicology, 35*, 46–53. https://doi.org/10.1093/anatox/35.1.46.

Hanna, R. C., Perez, J. M., & Ghose, S. (2017). Cannabis and development of dual diagnoses: A literature review. *The American Journal of Drug and Alcohol Abuse, 43*(4), 442–455. https://doi.org/10.1080/00952990.2016.1213273.

Hoch, E., Preuss, U. W., Ferri, M., & Simon, R. (2016). Digital interventions for problematic cannabis users in non-clinical settings: Findings from a systematic review and meta-analysis. *European Addiction Research, 22*, 233–242. https://doi.org/10.1159/000445716.

Mason, M. J., Zaharakis, N. M., Moore, M., Brown, A., Garcia, C., Seibers, A., & Stephens, C. (2018). Who responds best to text-delivered cannabis use disorder treatment? A randomized clinical trial with young adults. *Psychology of Addictive Behaviors, 32*(7), 699–709. https://doi.org/10.1037/adb0000403.

Miller, W. R., & Rollnick, S. (2013). *Motivational interviewing: Helping people change* (3rd ed.). New York, NY: Guilford Press.

Stea, J. N., Yakovenko, I., & Hodgins, D. C. (2015). Recovery from cannabis use disorders: Abstinence versus moderation and treatment-assisted recovery versus natural recovery. *Psychology of Addictive Behaviors, 29*(3), 522.

Substance Abuse and Mental Health Services Administration. (2018). Results from the 2017 National Survey on Drug Sse and Health: Detailed tables. Rockville, MD: SAMHSA Center for Behavioral Health Statistics and Quality. Retrieved from https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHDetailedTabs2017/NSDUHDetailedTabs2017.pdf.

Wu, L. T., Zhu, H., Mannelli, P., & Swartz, M. S. (2017). Prevalence and correlates of treatment utilization among adults with cannabis use disorder in the United States. *Drug and Alcohol Dependence, 177*, 153–162. https://doi.org/10.1016/j.drugalcdep.2017.03.037.