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A contingency management method for 30-days abstinence in non-treatment seeking young adult cannabis users

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ABSTRACT

Background: Rates of young adult cannabis use are rising, perceived harm is at its historical nadir, and most users do not want to quit. Most studies evaluating effects of cannabis use in young adults are cross-sectional, limiting causal inference. A method to reliably induce abstinence periods in cannabis users would allow assessment of the effects of abstinence and resumption of use on a variety of outcomes in a within-subjects, repeated measures design.
Methods: We examined the efficacy and feasibility of a voucher-based contingency management procedure for incentivizing one month of continuous cannabis abstinence among young adults who reported at least weekly cannabis use, volunteered to participate in a laboratory study, and did not express a desire to discontinue cannabis use long-term. Continuous cannabis abstinence was reinforced with an escalating incentive schedule, and self-report of abstinence was confirmed by frequent quantitative assays of urine cannabis metabolite (THCCOOH) concentration. New cannabis use during the abstinence period was determined using an established algorithm of change in creatinine-adjusted cannabis metabolite concentrations between study visits.
Results: Thirty-eight young adults, aged 18–25 years, enrolled and 34 (89.5%) attained biochemically confirmed 30-day abstinence. Among those who attained abstinence, 93.9% resumed regular use within two-weeks of incentive discontinuation.
Conclusion: Findings support the feasibility and efficacy of contingency management to elicit short-term, continuous cannabis abstinence among young adult, non-treatment seeking, regular cannabis users. Further work should test the effectiveness of this contingency management procedure for cannabis abstinence in periods longer than one month, which may be required to evaluate some effects of abstinence.

1. Introduction

Cannabis is the most commonly used substance other than alcohol among young adults in the United States (Johnston et al., 2015; SAMHSA, 2014), with nearly 20% of young adults reporting using cannabis currently. Widespread policy changes regarding legal access to medical and non-medical cannabis are expected to increase rates of use further. This is concerning given that ongoing brain maturation occurring well into the third decade of life (Giedd et al., 1999) may increase vulnerability to negative consequences associated with regular cannabis exposure. Indeed, frequent use during this developmental period is the best predictor of persistent use in adulthood (Chen and Kandel, 1995; SAMHSA, 2014) and adverse cognitive (Gruber et al., 2012; Jacobus and Tapert, 2014; Lisdahl and Price, 2012; Lisdahl et al., 2014; Solowij et al., 2011), psychosocial (Chadwick et al., 2013; Degenhardt et al., 2013; Hall, 2014; Marmorstein and Iacono, 2011; Palamar et al., 2014), psychiatric (Di Forti et al., 2015; Volkow et al., 2016), substance use (Agrawal et al., 2004; Fergusson et al., 2006; Hurd et al., 2014; Lynskey et al., 2003; Swift et al., 2012), and academic outcomes (Ellickson et al., 2004; Fergusson and Boden, 2008; Maggs et al., 2015; Meier et al., 2015).

Though strong associations have been reported between frequent young adult cannabis exposure and negative outcomes,

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most studies of the effects of cannabis use are cross sectional, which impedes the ability to draw conclusions about causal effects of cannabis use. Prospective longitudinal trials and experimental manipulations are the gold-standard for determining causality. However, the former is challenging due to cost and time requirements if initial assessments are to occur before exposure and retains biases associated with the decision to initiate cannabis use prior to adulthood or not, and the latter poses ethical concerns for cannabis-naïve participants. A reliable method that would allow examination of change in clinical, cognitive or other measures in response to cannabis abstinence and resumption of use among young adults who regularly use cannabis may represent a viable strategy to study reversible effects of cannabis on outcomes of interest in this important population.

Contingency management (CM) may be an ideally suited approach for studying the potential consequences of cannabis use. Abstinence-based CM was developed according to basic tenets of behavior analysis and operant conditioning (Budney et al., 2001; Higgins and Petry, 1999; Meredith et al., 2014; Petry, 2000; Stanger and Budney, 2010): reinforcing behaviors increases the likelihood that they will recur (Skinner, 1969). From this perspective, addictive substance use is a learned behavior that is reinforced by desirable drug effects. Abstinence-based CM seeks to alter learned substance use behavior with provision of consistent, competing positive reinforcement (e.g., monetary rewards) for verified abstinence (Bigelow et al., 1981).

CM has well-established efficacy for changing substance use behavior (Higgins et al., 1991; Krishnan-Sarin et al., 2013; Petry et al., 2000; Reynolds et al., 2008; Stitzer et al., 1986), specifically cannabis use among treatment seeking adults for total days abstinent (Kadden et al., 2007; Litt et al., 2013) and longer duration of continuous abstinence (Budney et al., 2000, 2006; Cooper et al., 2015; Copeland and Swift, 2009; Litt et al., 2013). CM is also efficacious for treatment seeking adolescent (Kamon et al., 2005; Stanger et al., 2009, 2015; Stewart et al., 2015) and young adult cannabis users (Carroll et al., 2006; Montgomery et al., 2012), particularly when coupled with other psychosocial interventions such as Cognitive Behavior Therapy (CBT), Motivational Enhancement Therapy (MET), and family therapy (Carroll et al., 2006; Kamon et al., 2005; Stanger et al., 2009, 2015; Stewart et al., 2015). However, participants in previous studies were seeking treatment (Kamon et al., 2005; Stanger et al., 2009) and/or met criteria for a cannabis use disorder (Carroll et al., 2006; Stanger et al., 2015). Although participants in prior trials were not necessarily motivated to stop using cannabis (e.g., Stewart et al., 2015), past findings may still only generalize to the most severely impacted young adult cannabis users given that most individuals do no seek treatment for cannabis use until after age 25 (SAMHSA, 2015). It is not known whether CM can be used to effectively induce a period of continuous cannabis abstinence in young adults who do not use cannabis daily, are not seeking treatment, but who nonetheless may be experiencing reversible effects of cannabis. The purpose of this study was to develop a method to reliably attain abstinence in young adult regular cannabis users for one month so that future studies can assess brain, cognitive, behavioral, and mood changes during four consecutive weeks of abstinence and after resumption of use, using a prospective, within-subject design that would allow more definitive conclusions regarding potential effects of abstinence in this important population.

2. Methods

This study was conducted between July and November 2015. All enrolled participants gave written informed consent to a protocol approved by the Partners' Human Subjects Review Committee.

2.1. Participants

Eligible participants were young adults, aged 18–25 years, who reported using cannabis at least weekly. They were recruited via peer referral and advertisements in the community that sought potential participants 'who use marijuana and are between age 18 and 25'. Inclusion criteria included cannabis use in the week prior to the phone screen, English fluency, and willingness to stop using cannabis for 30 days and attend eight study visits over six weeks at the Massachusetts General Hospital (MGH).

2.2. Assessments of participant mood and substance use

At baseline, current and lifetime diagnoses of Axis I disorders were assessed with the Structured Clinical Interview for DSM-IV (SCID-IV), mood was assessed with the Mood and Anxiety Symptoms Questionnaire (MASQ; Watson et al., 1995), and current and lifetime symptoms of Attention Deficit/Hyperactivity Disorder (ADHD) were assessed with a DSM-IV symptom checklist. At baseline, substance use disorders were assessed using the SCID-IV, the Cannabis Use Disorder Identification Test – Revised (CUDIT-R; Adamson and Sellman, 2003) and Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993). Amount and frequency of substance use was assessed at every study visit using a modified Timeline Follow-Back method (Robinson et al., 2014). Cannabis withdrawal was assessed at every visit using the Cannabis Withdrawal Scale (CWS; Allsop et al., 2011).

2.3. Assessment of cannabis metabolites

Participants provided urine specimens at each session. Urine samples were shipped overnight to Dominion Diagnostics (Kingstown, RI, USA) to quantify 11-nor-9-carboxy-Δ9-tetrahydrocannabinol (THCCOOH) levels, a non-psychoactive metabolite of Δ9-tetrahydrocannabinol (THC) and the standard urine biomarker for cannabis use, using liquid chromatography/tandem mass spectrometry (LC–MS/MS). The lower limit of quantification (LOQ) was 5 ng/mL and the maximum value quantified by the LC–MS/MS method was 500 ng/mL. Samples with THCCOOH values ≥500 ng/mL were further analyzed for THC using enzyme immunoassay (EIA), which had an upper LOQ of ≥900 ng/mL.

Urine creatinine concentration was quantified and used to correct THCCOOH concentration for individual differences in hydration (Lafolie et al., 1991). The THCCOOH to creatinine concentrations ratio (CN-THCCOOH) was calculated by dividing the urinary THCCOOH concentration (ng/mL) by urine creatinine concentration (mg/mL), yielding ng THCCOOH/mg creatinine.

2.4. Contingency management (CM) procedure

The CM procedure consisted of a four-week abstinence-based incentive program involving seven study visits over four weeks, and a two-week follow-up visit. The first four visits occurred in the first week of the study, followed by three weekly visits. See Fig. 1 for detailed visit schedule. In order to better ensure initial abstinence requirements were being met, more frequent visits were conducted during Week 1. This allowed for more frequent quantitative assessment of cannabinoid metabolites during early abstinence when CN-THCCOOH reductions are greatest (Budney et al., 2003). More frequent testing initially helps differentiate abstinence from reduction in severity of use and also provides better reinforcement of initial abstinence behavior (Schwilke et al., 2011; Stitzer and Vandrey, 2008). At the baseline visit, all participants completed an abstinence contract with a study staff member that clearly delineated the behavior to be monitored, schedule of moni-