Contingency management for college student smokers: The role of drinking as a moderator and mediator of smoking abstinence during treatment

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HIGHLIGHTS

- Improving smoking cessation rates in young adults is important for the future health of young people.
- We found that early sustained abstinence improved later sustained abstinence in contingency management (CM).
- Heavy drinking both before and during CM treatment undermined sustained abstinence.
- CM holds promise for young smokers, but drinking needs to be addressed concurrently.

ARTICLE INFO

ABSTRACT

Introduction: Contingency management (CM) is effective for promoting smoking abstinence; however, moderators and mediators of CM treatment efficacy in young adult populations are under-explored. We leveraged fine-grained data from a large randomized controlled trial: 1) to determine whether early attainment of sustained abstinence mediated the effect of treatment on abstinence; 2) to test whether heavy drinking moderated the effect of treatment on abstinence; and 3) to test a serial mediation model of the effects of drinking during early treatment on sustained smoking abstinence.

Methods: College student smokers (N = 110) were randomized to receive either CM treatment or noncontingent reinforcement (NR) over a 21-day treatment period. All participants received $5 for providing twice-daily breath carbon monoxide (CO) samples. In CM, additional money was provided for samples that indicated smoking reduction (Initial Phase; first 7 days), and for samples ≤ 5 ppm (Abstinence Phase; following 14 days).

Results: CM treatment led to greater sustained abstinence relative to NR. Longer sustained abstinence in the Initial Phase partially mediated the effect of treatment on sustained abstinence in the Abstinence Phase. Heavier pretreatment drinkers had shorter periods of sustained abstinence in the Abstinence Phase; this effect was greater in CM. A serial mediation model determined that increased drinking during the Initial Phase led to decreased sustained abstinence, which then led to decreased sustained abstinence in the Abstinence Phase.

Conclusions: These data provide a greater understanding of how heavy drinking and early sustained abstinence may affect success during treatment in young adults undergoing contingency management treatment for smoking.

1. Introduction

Smoking remains the leading cause of preventable death, and young adults (age 18–24) smoke at the highest rates of any age group in the United States (ASPA, 2014). Tobacco companies specifically target young adult and college populations (Ling & Glantz, 2002), and recent data indicate that the most common period of smoking uptake is now between the ages of 19–20, when many young adults are in college (Bernat, Klein, & Forster, 2012; Terry-McElrath & O'Malley, 2015). Despite the relatively short history of smoking, by the end of college, smokers are more likely than their peers to experience adverse health effects such as increased sick days (Caldeira et al., 2012). As smoking at this stage may be more malleable than later in life (Caldeira et al., 2012), and because many of these young smokers will continue to smoke into adulthood (Kenford et al., 2005), targeted intervention in this population is key to reduce the burden of disease across the life

course (Ling, Neilands, & Glantz, 2009).

One of the most effective interventions for reducing smoking in adults is contingency management (CM; Halpern, French, Small, et al., 2015; Lussier, Heil, Mongeon, Badger, & Higgins, 2006; Sigmon & Patrick, 2012). CM directly reinforces abstinence from smoking by providing monetary or other incentives contingent on evidence of abstaining from smoking (Higgins, Heil, & Lussier, 2004). Although CM is known to be successful for reducing smoking in adults, it has rarely been studied in young adults or college students (Cahill, Hartmann-Boyce, & Perera, 2015). The neuroplasticity of young adulthood, combined with a heightened focus on immediate rewards, suggests that this developmental period may be particularly well-suited for CM intervention (Krishnan-Sarin, Balodis, Kober, et al., 2013; Stanger, Budney, & Bickel, 2013). CM for smoking in college students was shown to be efficacious at reducing smoking while contingencies were in place in a single prior study (Correia & Benson, 2006). Overall, however, young adults are vastly under-studied in reference to contingency management protocols for smoking, and very little is known about how to optimize CM interventions for the unique environment of college.

Tevyaw, Colby, Tidey, et al. (2009) tested the efficacy of CM in a large, randomized controlled trial in a college student sample (CM versus a noncontingent reinforcement control group, NR). During the first week of the 3-week study, participants in the CM group were asked to reduce their smoking and were differentially reinforced for samples which showed a reduction in smoking (Initial Phase). During the second two weeks, participants in the CM group were reinforced for samples indicating abstinence (Abstinence Phase). Participants in the NR group were paid a set amount for providing samples, independent of the sample value. In that study, CM was significantly favored over NR for longest consecutive abstinence period, percent of abstinent readings, and lower average carbon monoxide (CO). Findings thus indicated that CM can be efficacious for abstinence from smoking in this population. However, within-person patterns of abstinence achievement and mediators of treatment success have not been explored.

The current study aims to provide a fine-grained analysis of patterns of abstinence achievement and explore mediators of treatment success during the Abstinence Phase of the intervention in the clinical trial reported by Tevyaw et al. (2009). Long-term abstinence from smoking is achieved through attaining short-term smoking milestones: initiation of abstinence, and short-term abstinence (Shiffman, Scharf, Shadel, et al., 2006). Abstinence early in smoking treatment has also been associated with a greater likelihood of later, long-term abstinence among substance-dependent smokers (Frosch, Nahom, & Shoptaw, 2002). In these analyses, we aim to capitalize on a study with an ideal design for examining within-person processes of change as we have data across 3 weeks, including abstinence initiation and maintenance during treatment.

One behavior that may undermine the initiation of abstinence and short-term maintenance of early abstinence is heavy alcohol use. In older adults, heavy alcohol use has proximal effects on treatment: higher pretreatment drinking levels are predictive of lower rates of abstinence among smokers enrolled in cessation trials (Hays, Schroeder, Offord, et al., 1999; Leeman, McKee, Toll, et al., 2008). Alcohol may also directly undermine smoking cessation, as laboratory data show that drinking acutely increases smoking (Verplaetse & McKee, 2017); thus, our fine-grained data gave us an opportunity to explore this possibility. In young adults in particular, drinking is closely associated with smoking, and college students often drink conjointly with smoking (Hoeppner, Bidwell, Colby, & Barnett, 2014; Jackson, Colby, & Sher, 2010; Sutfin, Reboussin, McCoy, & Wolfson, 2009). Drinking can increase the likelihood of smoking on a particular occasion in this population, as well as the number of cigarettes smoked (Dierker, Lloyd-Richardson, Stolar, et al., 2006), and heavier drinking students may find it harder to be successful in smoking treatment (Cook, Fucito, Piasecki, et al., 2012). Binge drinking in particular is related to higher rates of smoking and dependence in this population (Jiang, Lee, & Ling,

2014a), and problematic alcohol use is associated with greater nicotine dependence (Dierker & Donny, 2008; Hughes & Kalman, 2006).

However, the extent to which degree of alcohol involvement may interact with contingency management treatment for smoking in college students has not been examined. Given the close links between smoking and drinking, it is likely that alcohol involvement may negatively affect treatment success, as adult alcohol-dependent individuals have more trouble quitting in CM trials relative to non-alcohol dependent smokers and lower quit rates overall relative to non-alcoholic smokers in contingency management treatment (Cooney, Cooper, Grant, et al., 2017; Rohsenow, Tidey, Martin, et al., 2015). This may be due to alcohol's negative effect on abstinence initiation and early maintenance of sustained abstinence. We tested this directly in this sample first by testing a simple mediation model in which treatment effect was hypothesized to be mediated by attainment of longer periods of abstinence in the Initial Phase. Then, we examined whether heavy pretreatment alcohol use at baseline moderated the effect of treatment (CM or NR) on sustained abstinence in the Abstinence Phase. Finally, we explored whether drinking during the Initial Phase directly mediated the effect of treatment condition on sustained abstinence during the Initial Phase and thus affected sustained abstinence in the Abstinence Phase in a serial mediation model.

2. Methods

As the study methods have been described previously (Correia & Benson, 2006), they are only briefly described here, but with greater detail for the relevant measures and procedures for the present study.

2.1. Participants

110 college students (38.2% female, 77.3% white) were randomized to treatment. To be included, participants had to be daily smokers and have an expired alveolar CO level at baseline of 10 parts per million (ppm) or greater, and be currently enrolled in college. Participants were on average 19.7 years old (SD = 1.3), had an average CO of 18.8 ppm (SD = 8.7), and smoked on average 11.6 cigarettes per day (SD = 4.9).

2.2. Study design

The parent study used a 2 × 2 factorial design to investigate the effects of contingency management (CM) versus a non-contingent reinforcement (NR) control, crossed with a counseling component comparing three one-hour sessions of motivational interviewing versus a time-matched relaxation control across 3 weeks. Further details on the counseling interventions can be found in Tevyaw et al. (2009). In this study, because there was no effect of Motivational Enhancement Therapy during CM treatment, we collapsed across intervention conditions and focused on the CM and NR group interventions. Across all three weeks of the intervention, participants in both groups submitted breath CO samples twice daily.

2.3. Procedures

After completing informed consent procedures, participants completed baseline measures of individual differences and submitted a breath CO sample to determine eligibility. Eligible participants were randomized to either a CM or NR group. The participants were informed that a study staff member would meet with them twice each day for the duration of the study to test their CO, with a minimum of 6 h between sample readings.

2.4. Study interventions

The study took place across three weeks: A one-week Initial Phase, followed immediately by a two-week Abstinence Phase.