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EVALUATION OF A ROLLING MINDFULNESS-BASED RELAPSE PREVENTION GROUP IN A RESIDENTIAL SUBSTANCE ABUSE TREATMENT SETTING: SHORT-TERM EFFECTIVENESS AND PROCESSES OF CHANGE

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BY

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DISSERTATION

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Ph.D. in Psychology

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ABSTRACT

Background: Relapse following treatment is common among individuals with substance use disorder (SUD) and effective treatments that support long-term recovery are needed. Mindfulness-based relapse prevention (MBRP; Bowen, Chawla, & Marlatt, 2011) is a promising intervention, yet there is a lack of evidence on how MBRP can be effectively disseminated and adapted for different real-world treatment settings. MBRP has most commonly been delivered as a closed-cohort group among individuals receiving aftercare treatment. It is unclear whether MBRP can be effectively delivered as a rolling admission group and among individuals at earlier stages in the recovery process. Additionally, there is a need to better understand how and why MBRP works, which can inform the

refinement of MBRP. **Study Aims:** This study was a non-randomized, open trial to evaluate the feasibility, acceptability, and mechanisms of behavior change (MOBC) related to a manualized rolling admission version of MBRP that was offered to individuals with substance use disorder (SUD) who had just completed medical detoxification and who were starting a 21-day inpatient treatment program. **Methods:** The rolling MBRP treatment was developed over several years through an iterative process and the final version used in this study consisted of eight one-hour modules. Study participants included 109 adults (46% female, 74.3% racial/ethnic minorities, mean age = 36.40) enrolled in an inpatient SUD treatment program. The rolling MBRP group was offered to all patients in the inpatient program. Patients who enrolled in the study completed a baseline assessment at admission and a post-assessment right before discharge from the inpatient treatment program. Attendance at each MBRP session was tracked. **Results:** Individuals attended an average of 3.69 sessions (SD=2.12), out of three to six possible sessions (depending on length of stay), indicating feasibility. Regarding acceptability, participants reported high satisfaction ratings. Total number of sessions attended did not predict MOBC. However, attending two or more sessions (versus one or none) predicted better mental health and higher mindfulness at post-assessment, and these effects were mediated by informal and formal mindfulness practice. Also, total number of sessions attended had numerous indirect effects, via frequency of informal and formal mindfulness practice, on post-assessment MOBC (craving, confidence in achieving valued goals, mental health, regulatory flexibility, self-compassion, and mindfulness). **Conclusions:** Findings provide preliminary evidence that MBRP can be effectively delivered as a rolling admission group among individuals who

have just completed medical detoxification and are starting an inpatient treatment program. Rolling MBRP may be particularly effective in improving mental health and dispositional mindfulness. Findings also suggest that both informal and formal mindfulness practice may be key in facilitating changes in MOBC. Regulatory flexibility and self-compassion were both significantly predicted by mindfulness practice, suggesting that these constructs are worthy of further investigation as MOBC in MBRP. Future research on rolling MBRP is warranted and has the potential to make MBRP more accessible and available in a diverse range of treatment settings.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Introduction

Background

Substance use disorders (SUD) remain prevalent and account for a considerable proportion of global disease burden (Whiteford et al., 2014). Return to problematic substance use following treatment and repeated admissions to treatment programs are common among individuals with SUD (Brownell et al., 1986; McLellan, Lewis, O'Brien, Kleber, 2000; McLellan, McKay, Forman, Cacciola, & Kemp, 2005). Hence, there is a need for effective treatments for SUD that support long-term recovery and reduce the rates of relapse following treatment.

One recently developed behavioral treatment that holds promise in supporting long-term recovery from SUD is mindfulness-based relapse prevention (MBRP; Bowen, Chawla, & Marlatt, 2011). MBRP is a group-based behavioral treatment for SUD that integrates mindfulness training with cognitive-behavioral relapse prevention components. The evidence base for MBRP is still relatively small but highly promising (Bowen et al., 2009; Bowen et al., 2014; Brewer et al., 2009; Brewer et al., 2011; Glasner et al., 2016; Witkiewitz et al., 2014; Zemestani & Ottaviani, 2016). Notably, two randomized controlled trials of MBRP have demonstrated that MBRP outperformed standard cognitive-behavioral relapse prevention (RP) in supporting long-term outcomes (Bowen et al., 2014; Witkiewitz et al., 2014). In the largest trial of MBRP conducted to date (N= 286), Bowen et al. (2014) compared MBRP to treatment-as-usual (TAU) and RP and found that MBRP resulted in the best outcomes among these treatments, with individuals receiving MBRP showing the lowest rates of substance use and heavy drinking one year following treatment. Witkiewitz et al. (2014) evaluated the efficacy of MBRP delivered

1

in a residential setting among a diverse group of women involved in the criminal justice system. Results from this study revealed that individuals who received MBRP reported significantly less substance use and fewer legal and medical problems 15-weeks post-treatment.

It is important to note that there are several mindfulness-based interventions for addictive disorders that are similar to MBRP, including mindfulness training for smokers (MTS; Davis, Manley, Goldberg, Smith, & Jorenby, 2014), mindfulness-based substance abuse treatment for adolescents (MBSAT; Himelstein, Saul, & Garcia-Romeu, 2015), and mindfulness-oriented recovery enhancement (MORE; Garland, 2013). These other interventions share with MBRP a core focus on formal mindfulness meditation practice. A recent meta-analysis of mindfulness-based interventions for substance misuse, including MBRP and the interventions noted above, found that these interventions had significant small-to-large effects in reducing substance misuse, craving, and stress (Li, Howard, Garland, McGovern, & Lazar, 2017).

Unresolved Issues Related to Mindfulness-Based Relapse Prevention

Although MBRP is an effective treatment for SUD, one important unresolved issue is the need to determine whether and how MBRP can be effectively disseminated and adapted for different real-world treatment settings (Witkiewitz & Black, 2014). Further investigation of dissemination strategies for delivering MBRP is essential for expanding the reach of MBRP and ultimately benefiting a greater proportion of individuals suffering from SUD. In the two largest trials of MBRP (Bowen et al., 2009; Bowen et al., 2014), treatment was delivered in the form of an 8-week closed cohort group. Additionally, in the larger literature on mindfulness-based interventions for

substance misuse, the majority of randomized trials have involved closed-cohort groups (Li et al., 2017). Hence, there is a lack of evidence regarding whether MBRP is effective when delivered as a rolling admission treatment. Closed cohort groups may not be feasible in many treatment settings because patients may not be able to wait for treatment and treatment agencies may not have the resources to coordinate closed cohort groups (McHugh & Barlow, 2010). Open or rolling MBRP groups, in which new patients may be present at each group, are highly appealing because they can be more easily implemented and may be more suitable for a wider range of different treatment agencies. To date, research on the feasibility, acceptability, and effectiveness of rolling MBRP is limited to only two studies. For the abovementioned Witkiewitz et al. (2014) study, in which MBRP outperformed RP, the MBRP group was delivered as a rolling group. This study provides the strongest evidence to date that MBRP can be effectively delivered as a rolling group. Additionally, Brewer et al. (2009) conducted a trial of MBRP in which the treatment was delivered as a partially rolling group. Participants could enter the group either at module 1 or module 4 out of 8 weekly modules. In this study, there were no differences in outcomes between individuals who received cognitive-behavioral therapy or MBRP. Hence, the Brewer et al. (2009) study provides some further support that MBRP can be effectively delivered as a rolling group. Although the Witkiewitz et al. (2014) and Brewer et al. (2009) studies provide preliminary evidence that MBRP is effective as a rolling group, these studies have notable limitations. The Witkiewitz et al. (2014) study was only conducted among women and the Brewer et al. (2009) study had a very small sample size (14 individuals completed MBRP) and treatment retention was

low (43% completed MBRP). Thus, further research is needed in order to determine if rolling MBRP can be effectively delivered in various real-world treatment settings.

There is also a lack of evidence about whether MBRP is effective among individuals who are at relatively early stages in the recovery process, such as individuals who have just completed medical detoxification treatment and are entering inpatient treatment. The two largest trials of MBRP (Bowen et al., 2009; Bowen et al., 2014) have delivered MBRP among individuals receiving aftercare treatment. Moreover, among existing studies on mindfulness-based interventions for substance misuse, the majority of randomized trials for alcohol and drug use disorders have delivered the mindfulness-based intervention among individuals in aftercare treatment or who have completed an extended stabilization phase before starting mindfulness treatment (Li et al., 2017). Research on MBRP delivered earlier in the recovery process would provide important information about when MBRP is appropriate and effective to provide for individuals at different stages of treatment.

A second important unresolved issue regarding MBRP is the need to better understand MBRP processes or mechanisms of behavior change (MOBC); that is, how and why MBRP works and for whom MBRP is most effective. In the past two decades, researchers have argued that gaining a better understanding of MOBC in behavioral treatments is critical for advancing the field of psychological science and ultimately enhancing the efficacy of treatments (Kazdin, 2007; Longabaugh & Magill, 2011; Nock, 2007). A better understanding of MOBC that are operating in MBRP is critical for several reasons. First, by knowing key client behaviors or MOBC that change from receiving MBRP and that drive therapeutic benefit from MBRP, we can optimize the

effectiveness of MBRP by better targeting these intermediary processes in treatment. As an example, suppose we find that MBRP clients who show the greatest increases in "behavior x" have the best outcomes following MBRP. We could then design MBRP treatments to more efficiently and effectively enhance clients' engagement "behavior x" in order to maximize therapeutic benefit. Knowing the most important targets to focus on in MBRP may be particularly important for clinicians in various real-world treatment settings in which it may be necessary to deliver modified or shortened versions of MBRP because the standard delivery of eight 2-hour sessions of MBRP is simply not feasible. Second, knowing key processes that change from receiving MBRP can help clinicians identify which types of clients might benefit the most from receiving MBRP. For example, if MBRP was shown to be particularly effective in enhancing "behavior x," clients who show very low levels of "behavior x" at a baseline assessment may benefit the most from receiving MBRP rather than other treatments that target different intermediary processes.

Empirical studies are just beginning to understand MOBC that may be operating in MBRP. Witkiewitz and Bowen (2010) demonstrated that MBRP appears to reduce reactivity to depressive symptoms. Compared to individuals who received treatment-as-usual (12-step oriented treatment and psychoeducation), individuals who received MBRP did not exhibit an association between depressive symptoms and craving, which in turn predicted less post-treatment substance use. Elwafi, Witkiewitz, Mallik, Thornhill, and Brewer (2013) demonstrated that engaging in informal mindfuless practice (e.g., using mindfulness in daily life or to manage momentary craving) may be essential in enhancing one's ability to resist cigarette use in response to craving. Among cigarette smokers

participating in MBRP, those who more frequently engaged in informal mindfulness practice demontrated a weaker association between craving and cigarette use at the end of treatment. Grow, Collins, Harrop, and Marlatt (2015) found that time spent engaging in out-of-session mindfulness practice (both formal and informal combined) predicted less craving and substance use following treatment. Witkiewitz et al. (2013) demonstrated that the mindfulness abilities of awareness, acceptance, and non-judgment may explain how MBRP reduces substance craving. They found that MBRP significantly increased these mindfulness abilities, which in turn predicted greater reductions in substance craving from baseline to 4-months post-treatment. Finally, Brewer et al. (2009) demonstrated that MBRP may reduce stress responses to a greater extent than cognitive-behavioral therapy (CBT) for substance use disorders. Compared to individuals who received CBT, individuals who received MBRP exhibited significantly lower physiological and psychological indices of stress during a stress provocation task. Altogether, these studies suggest that MBRP may reduce reactivity to depressive symptoms, craving experiences, and stressful situations, and that frequency of mindfulness practice and increases in mindfulness abilities may explain these reductions in reactivity. Importantly, these findings are consistent with the theorized mechanisms of MBRP.

Despite promising preliminary findings on MOBC in MBRP, the number of studies examining MOBC in MBRP to date is still very small and it is therefore difficult to make firm conclusions about MOBC in MBRP. Future work is needed to further understand how and why MBRP works, which can inform efforts to ultimately optimize the efficacy of MBRP. There are several other plausible processes that may be operating

as MOBC in MBRP that have not been thoroughly examined. One potentially promising MOBC to examine in MBRP is increases in self-compassion. The construct of self-compassion has been defined as being kind and understanding towards oneself in moments of suffering, recognizing that one's experience part of the larger experience of human suffering, and approaching one's own pain with a balanced perpective that does not involve over-identifying with one's suffering (Neff & Dahm, 2015). Researchers have posited that self-compassion may be a key MOBC across different mindfuless-based interventions (Baer, 2010; Hölzel et al., 2011; Neff & Dahm, 2015). In fact, Kuyken et al. (2010) found that self-compassion significantly mediated the effects of mindfulness-based cognitive therapy (MBCT) for recurrent depression, a treatment that is similar to MBRP. Increases in self-compassion are plausible in MBRP because MBRP explicitly targets self-compassion through loving-kindness meditations, and MBRP faciliators aim to model a compassionate attitude as they relate to participant experiences.

Another potentially promising MOBC to examine in MBRP is improvement in regulatory flexibility. Researchers have operationalized the multi-dimensional construct of regulatory flexibility in different ways. Among the various operationalizations, there appears to be several components of regulatory flexibility:1) the ability to flexibly match one's regulatory approach to the unique challenges and opportunities across different situations, 2) the ability to implement a diverse and flexible range of regulatory strategies, 3) the ability to flexibly adjust one's regulatory approach as needed as a situation changes over time (Aldao, Sheppes, & Gross, 2015; Bonanno & Burton, 2013; Cheng, Lau, & Chan, 2014; Kashdan & Rottenberg, 2010; Kato, 2012). Researchers have proposed that mindfulness-based interventions may be particularly effective in targeting

regulatory flexibility (Brown, Ryan, & Creswell, 2007; Hayes et al., 2011; Shapiro, Carlson, Astin, Freedman, 2006). Mindfulness-based interventions aim to teach individuals how to non-judgmentally observe the various aspects of one's ongoing momentary situational context, which in turn may facilitate flexible and contextually-appropriate responses that are consistent with one's needs, goals, or values. In other words, greater non-judgmental awareness of the present moment may facilitate enhanced ability to accurately perceive what is actually happening and enhanced ability to consciously choose regulatory strategies that provide the best match to the situation. Relatedly, by teaching individuals how to bring greater awareness to their own behavioral responses, mindfulness-based interventions may reduce inflexible and automatic regulatory responses that may be rule-governed and insensitive to the unique aspects across situations or how the same situation is changing over time. Several studies on acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 2011) for cigarette smoking have examined regulatory flexibility as a MOBC of change. Specifically, these studies have utilized the Avoidance and Inflexibility Scale (AIS; Gifford et al., 2004), which assesses substance-specific inflexibility, or the degree to which individuals have inflexible responses to internal smoking triggers without relying on avoidance-based strategies to prevent smoking (e.g., strategies aimed at reducing or eliminating internal triggers). Among these ACT studies using the AIS, three studies have shown that regulatory flexibility mediates ACT treatment outcomes (Bricker, Wyszynski, Comstock, & Heffner, 2013; Gifford et al., 2004; 2012) and two studies have shown that individuals low in baseline regulatory flexibility have better outcomes from receiving ACT compared to standard cognitive-behavioral smoking cessation interventions

(Bricker et al., 2014a; 2014b). MBRP is similar to ACT with respect to treating SUD in that both treatments teach mindfulness skills aimed to enhance an individual's ability to respond flexibly to substance use triggers. Although regulatory flexibility may be a MOBC in MBRP, no studies to date have empirically examined regulatory flexibility as a MOBC in MBRP.

The Current Study

The current study was a non-randomized, open trial of a rolling admission version of MBRP ("rolling MBRP") that was delivered in a residential treatment center for individuals with SUD. The primary aims were to: 1) examine the feasibility and acceptability of rolling MBRP, 2) examine the effect of rolling MBRP on the MOBC variables of craving, abstinence self-efficacy, and confidence to achieve valued goals, and 3) examine self-compassion and regulatory flexibility as novel MOBC in MBRP. A series of secondary aims were also examined. Secondary Aim 1 was to examine whether the results from the primary aim analyses could be replicated by using an alternative analytic approach in which a binary attendance variable (i.e., attended a certain number of sessions, yes or no), instead of a continuous attendance variable, was used as the predictor of MOBC variables. Secondary Aims 2-4 were focused on replicating preliminary findings in the literature regarding MOBC in MBRP. Details regarding the primary aims, secondary aims, and hypotheses are provided below:

Primary Aim 1: To evaluate the feasibility and acceptability of rolling MBRP.

Hypothesis 1a: On average, participants will attend at least 3 group sessions during their stay, and participant ratings on the perceived helpfulness of rolling

MBRP will be in the high range (mean score at or above 3 on a Likert-type scale ranging from 0 to 4).

Primary Aim 2: To evaluate the short-term effectiveness of rolling MBRP by examining the association between rolling MBRP attendance and the MOBC of craving, abstinence self-efficacy, and confidence in achieving valued goals after treatment. Craving and abstinence self-efficacy were selected as MOBC given participants were still residing at the treatment center at the time of the post-assessment (which was conducted immediately before each participant was formally discharged) and thus had limited opportunities to engage in substance use between the baseline and post-assessment. End-of-treatment craving and abstinence self-efficacy are both prognostic of post-treatment substance use (Kadden & Litt, 2011; Witkiewitz, Bowen, Douglas, & Hsu, 2013).Given the recent call to examine a broader range of constructs that more adequately capture post-assessment functioning among individuals with SUD (Tiffany, Friedman, Greenfield, Hasin, & Jackson, 2012), we also examined confidence in achieving valued goals as an MOBC variable. We focused on *confidence* in achieving values-consistent goals, rather than ratings of current success in achieving goals, because individuals were still residing at the treatment center at the post assessment and were not yet fully engaged in their typical daily activities. Additionally, research has found that both ratings of confidence and success in regards to values-consistent goals are similarly predictive of relevant clinical outcomes such as depressive symptoms (Jensen, Vowles, Johnson, & Gertz, 2015).

Hypothesis 2a: Attending a higher number of rolling MBRP sessions will be

associated with significantly lower substance craving, higher abstinence self-

efficacy, and higher confidence in achieving valued goals at the post-assessment.

Primary Aim 3: To evaluate self-compassion and regulatory flexibility as novel

MOBC in MBRP.

Hypothesis 3a: Attending a higher number of rolling MBRP sessions will be

associated with significantly higher scores on self-compassion at the post-

assessment.

Hypothesis 3b: Attending a higher number of rolling MBRP sessions will be

associated with significantly better scores on measure of both general and

substance-specific regulatory flexibility at the post-assessment.

Secondary Aim 1: To evaluate Primary Aims 1 and 2 using an alternative analytic

method (i.e., use a binary attendance variable)

Hypothesis for Secondary Aim 1: The substantive pattern of findings from the

primary analyses will be replicated when conducting analyses with a binary

attendance variable (1 = attended $\geq$ 2 sessions of MBRP, an "adequate dose"; 0 =

attended one or no sessions of MBRP, "a minimal dose or no dose." We chose at

least two sessions at a cut-off primarily because of the distribution of values for

the number of sessions variable. That is, for the variable "number of sessions

attended" the distribution of values across participants (see Table 1) indicated that

2 or more sessions was a reasonable cut off point to transform number of sessions

into a binary attendance variable. Additionally, we were interested in evaluating

the lowest number of sessions that might produce therapeutic benefit. We

reasoned that 2 sessions might confer benefit given prior studies that have

demonstrated that brief mindfulness interventions consisting of two sessions have

resulted in positive treatment effects among individuals using substances (de Dios

et al., 2012; Mermelstein & Garske, 2015).

Secondary Aim 2: To evaluate mental health and mindfulness following

participation in MBRP. Research has shown that mindfulness-based interventions for

SUD improve stress and mental health-related outcomes (Garland, Roberts-Lewis,

Tronnier, Graves, & Kelly, 2016; Glasner et al., 2016; Li et al., 2017; Zemestani &

Ottaviani, 2016). Additionally, some studies have found that mindfulness-based

interventions for SUD may differentially impact dispositional mindfulness compared to

other treatments. Bowen et al. (2009) found that MBRP resulted in greater increases in

the mindfulness compared to TAU. Garland et al. (2016) found that mindfulness

mediated treatments effects of mindfulness-oriented recovery enhancement (MORE) for

individuals with co-occurring SUD and psychiatric disorders.

> *Hypothesis for Secondary Aim 2a:* Attending a higher number of rolling MBRP
>
> sessions will be associated with significantly better mental health at the post-
>
> assessment.
>
> *Hypothesis for Secondary Aim 2b:* Attending a higher number of rolling MBRP
>
> sessions will be associated with significantly higher scores on mindfulness at the
>
> post-assessment.

Secondary Aim 3: To evaluate whether participation in rolling MBRP moderates

the association between mental health and craving.

Hypothesis for Secondary Aim 3: Attending a higher number of rolling MBRP

sessions will moderate the association between post-assessment mental health and

craving, such that participants who attend more sessions will exhibit a weaker

association between mental health and craving at the post-assessment.

Secondary Aim 4: To evaluate whether informal and formal mindfulness practice

predict MOBC variables.

Hypothesis for Secondary Aim 4: Greater self-reported engagement in informal

and formal mindfulness practice during treatment will be predict more favorable

scores on MOBC variables at the post-assessment.

Method

Participants and Study Setting

Participants in the current study were 109 individuals receiving inpatient

treatment (approximately 21 to 28 days) at Turquoise Lodge Hospital, a residential

substance use disorder treatment program. Turquoise Lodge Hospital is a structured, New

Mexico State Department of Health operated facility that offers a variety of substance use

disorder services, including medical detoxification and rehabilitation services in a

hospital-based, intensive inpatient setting. At Turquoise Lodge, all patients who are

admitted to the inpatient treatment program receive medical detoxification treatment

immediately before being admitted to the inpatient program. Inpatient treatment at

Turquoise Lodge consists mostly of group sessions, including Alcoholics Anonymous

and Narcotics Anonymous groups and other group sessions focused on key themes (i.e.,

anger management, nutrition, relapse prevention). Patients also receive individual

counseling during their treatment stay. Eligibility criteria for the current study were: 1)

13

admitted to the inpatient treatment program at Turquoise Lodge Hospital, and 2) able to read and write English. Table 1 provides a summary of the descriptive statistics for the study sample.

Study Design and Procedures

The current study was a non-randomized, open trial of a rolling MBRP treatment. The study was approved by the University of New Mexico Institutional Review Board. The rolling MBRP group was offered to all patients in the inpatient program, including patients who enrolled in the study and those who did not enroll in the study. For patients who were enrolled in the study, their attendance at each session was tracked. Study participants were not required to attend the rolling MBRP groups and had the choice of attending other groups (e.g., Alcoholics Anonymous or Narcotics Anonymous groups) that were offered at the same time as the rolling MBRP groups.

Patients who were admitted to the inpatient treatment program at Turquoise Lodge were informed about the study through the posting and distribution of study flyers. Patients interested in participating in the study had the opportunity to meet individually with Corey Roos, who provided a consent form for the participant to review and answered any questions regarding the consent form and study participation. Informed consent was obtained for all participants enrolled in the study. At the baseline assessment, participants completed a paper-based survey. At the post-assessment, participants completed a second paper-based survey immediately before they were formally discharged from the program. Participants received a $5 gift card for completion of the baseline assessment and a $10 gift card for completion of the post-assessment.

Development of Rolling Mindfulness-Based Relapse Prevention

Rolling MBRP is an adaption of the manualized MBRP therapist manual (Bowen et al., 2010). The manual for rolling MBRP was developed by Corey Roos with input from Drs. Katie Witkiewitz and Sarah Bowen. The design of the rolling MBRP program has been significantly informed by Corey Roos' ongoing experience delivering rolling MBRP at Turquoise Lodge, starting in 2014. Because a closed-cohort MBRP group was not feasible at Turquoise Lodge, Corey Roos developed an initial version of rolling MBRP in 2014 that he could deliver as a clinical practicum student at Turquoise Lodge. This initial version of the rolling MBRP program involved seven 90-minute sessions. Over the course of three years, the manual has been updated through an iterative process, which has involved making changes based on: a) clinical observations made by Corey Roos, Dr. Katie Witkiewitz, and other graduate student MBRP therapists at Turquoise Lodge, b) consultation with Dr. Sarah Bowen, and c) discussion among Dr. Katie Witkiewitz (the clinical supervisor of all MBRP therapists), Corey Roos, and the team of graduate student MBRP therapists that have volunteered at Turquoise Lodge since 2015. Of note, Corey Roos established Turquoise Lodge as a practicum site for clinical graduate students at University of New Mexico and he recruited a team of clinical graduate students to lead rolling MBRP groups. From 2015 to present, Corey Roos and a total of six other graduate students have led rolling MBRP groups at Turquoise Lodge. Corey Roos has assisted Dr. Katie Witkiewitz in training and supervising the graduate student therapists in rolling MBRP. The final version of rolling MBRP that was implemented in the current study consisted of eight unique 60-minute modules. The length of the sessions was changed from 90 minutes to 60 minutes in order to facilitate better in-session engagement and to promote higher attendance rates. At Turquoise

Lodge, all other therapy groups offered were 60 minutes. Hence, patients at Turquoise

Lodge were generally more accustomed to 60-minute groups and several patients

explicitly noted their preference for 60 minute groups.

Table 2 provides an overview of the key intentions and treatment components of

each module for the final version of rolling MBRP that was implemented in this study.

The rolling MBRP group includes several specific adaptions that were intended to

balance the needs of newcomers and regular attendees who may be present at any

session. First, at every session, a brief introduction of the group is provided and the group

rules (e.g., confidentiality, respect for others, etc.) are reviewed to orient newcomers.

Second, at the start of every session therapists guide participants through the same

mindfulness practice, a brief mindful check-in practice (5-10 minutes) that involves first

checking in with one's internal experience (body sensations, thoughts, and emotions) and

then anchoring one's awareness on the breath for several minutes. Beginning with the

same practice at every session is intended to create a sense of consistency and structure

across the different sessions. The mindful check-in also serves to introduce newcomers to

two key processes that are emphasized throughout the group: observing one's own

internal experience and redirecting one's attention to the breath. Third, at every session,

therapists also inquire about participants' experience following the mindful check-in.

Engaging in this inquiry process towards the beginning of every session also serves to

orient newcomers to inquiry, which is a common element of the group. During the

inquiry process regular attendees can model the process of sharing their direct experience

during the practice. Fourth, in order to orient newcomers to each rolling group therapists

engage in a brief review of key concepts and learning points that have been discussed in

16

prior sessions. For example, following the mindful check-in and inquiry, therapists typically pose one or two questions to prior attendees aimed at reviewing basic points from prior sessions. Fifth, in the rolling MBRP group, the "SOBER Breathing Space" is a core skill that that is thoroughly reviewed and practiced every other session. Additionally, mentioning the SOBER during practice review and discussion of outside practice is common at most sessions. Similar to the mindful check-in, the repetition of the SOBER also serves to create a sense of structure and consistency across the groups.

During data collection for the current study, the rolling MBRP group was offered to all patients at Turquoise Lodge two or three times per week, depending on the week (i.e., the group was offered on three days every other week, and was offered on two days the other weeks). To facilitate practice of formal meditation outside of the sessions, a set of mp3 players with guided meditation recordings was made available to all patients at Turquoise Lodge. Specifically, mp3 players were provided to each individual counselor at Turquoise Lodge and it patients were interested they could sign out a mp3 player from their counselor. All patients were provided with access to the mp3 players, regardless of their participation in the study.

Each rolling MBRP group was typically facilitated by one MBRP therapist, with some groups occasionally co-facilitated by two MBRP therapists. During data collection for the current study, there were a total of five graduate students, including Corey Roos, who led the rolling MBRP groups at Turquoise Lodge. All of the MBRP therapists were graduate students in a Ph.D. clinical psychology program who were trained in MBRP and received ongoing clinical supervision by Dr. Katie Witkiewitz, a licensed clinical psychologist who has extensive experience with MBRP. Three MBRP therapists had

Master's degrees in clinical psychology and two MBRP therapists had Bachelor's degrees in psychology with substantial prior experience in running treatment groups in residential treatment settings. All therapists had personal mindfulness practices.

Therapist Fidelity

Therapist fidelity to the rolling MBRP treatment was assessed using the MBRP Adherence and Competence Scale (MBRP-AC; Chawla et al., 2010), a validated fidelity rating tool for MBRP. The Adherence section includes items assessing adherence to MBRP treatment components (e.g., leading a particular mindfulness practice) and adherence to discussion of key concepts (e.g., acceptance of current experience). The Competence section includes items assessing therapist competence in delivering specific components (e.g., therapist competence during inquiry MOBC), and items assessing overall therapist competence during the session (e.g., rating of overall quality of session). The items in the competence section were measured on a Likert-type scale (0 = low ability/not satisfactory and 4 = high ability/excellent).

Two trained raters simultaneously observed one session (in-person) for each MBRP therapist and completed independent fidelity ratings using the MBRP-AC. There were three raters total; one licensed clinical psychologist and two Master's level clinical psychology graduate students.

Measures

Table 3 provides a summary of the assessment schedule for this study. The internal consistency reliabilities (Cronbach alphas) for all multi-item measures exceed 0.7 at baseline and post-assessment.

Demographic questionnaire. Four items were used to assess gender, age, race/ethnicity, and marital status.

Treatment history items. A single item was used to assess the total number of times participants had completed inpatient or intensive outpatient treatment for alcohol/drug or other mental health problems. Another single item was used to assess the total number of times participants had completed medical detoxification.

Days abstinent prior to treatment. A single self-report item was used to assess days abstinent from substances prior to admission to the residential treatment center.

Severity of dependence scale (SDS). The SDS is a 5-item self-report questionnaire that was used to assess substance use disorder severity (Gossop et al., 1995). The SDS includes Likert-type items (e.g., Do you think you use of drugs was out of control?) rated on various scales (e.g., 0 = almost never to 3 = nearly always). The SDS has demonstrated good psychometric properties among individuals with SUD (Gossop et al., 1995). Scores on the SDS can range from 0 to 15 (current sample range: 2 to 15).

Self-compassion Scale-Short Form (SCS-SF). The SCS-SF is a 12-item self-report questionnaire that was used to assess self-compassion (Raes, Pommier, Neff, & Van Gucht, 2011). The SCS-SF includes items (e.g., I tried to see my failing as part of the human condition) rated on a scale from 0 (almost never) to 4 (almost always). The SCS-SF has demonstrated good psychometric properties among community samples and is highly correlated with the long form of the SCS (Raes et al., 2011). Additionally, the SCS has been utilized among individuals with SUD (Brooks, Kay-Lambkin, Bowman, & Childs, 2012). Scores on the SCS can range from 0 to 48 (current sample range: 3 to 48).

Cognitive and affective mindfulness scale-revised (CAMS-R). The CAMS-R is a 10-item self-report questionnaire of dispositional mindfulness. The CAMS-R has four subscales that can be used to assess four components of mindfulness: *attention* (the ability to regulate attention), *present-moment focus* (an orientation to present or immediate experience), *awareness* (awareness of experience), and *acceptance* (an attitude of acceptance or non-judgment towards experience) (Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007). The CAMS-R includes items (e.g., I tried to notice my thoughts without judging them) rated on a scale from 0 (rarely) to 3 (almost always). The CAM-R has demonstrated good psychometric properties among community samples (Feldman et al., 2007). Total scores on the CAM can range from 0 to 30 (current sample range: 2 to 30).

Short form health survey (SF-12). Two items from the SF-12 (Ware, Kosinski, & Keller, 1996) were used to assess mental health. The two items are Likert-type items ("How much of the time during the past week have you felt calm and peaceful?" and "How much of the time in the past week have you felt down-hearted and blue") rated from 0 (none of the time) to 5 (all of the time). The SF-12 is a widely utilized measure of mental health that has demonstrated good psychometric properties (Ware, Kosinski, Dewey, & Gandek, 2000) and has been used among individuals with SUD (Grant et al., 2004). Scores on the mental health subscale of the SF-12 can range from 0 to 10 (current sample range: 0 to 10).

Penn alcohol craving scale (PACS). An adapted version of the PACS, a 5-item self-report questionnaire, was used to assess alcohol/drug craving (Flannery, Volpicelli, & Pettinati, 1999). Item content was re-worded so that the items applied to both alcohol

and other drug craving. The PACS includes Likert-type items (e.g., During the past week past week how often have thought about drinking/using and how good it would make you feel?) rated on various scales (e.g., 0 = never to 6 = nearly all the time). The adapted version of the PACS has been used in several studies among individuals with SUD receiving mindfulness-based treatment and has demonstrated good psychometric properties in these studies (Bowen et al., 2009; 2014). Scores on the PACS can range from 0 to 30 (current sample range: 0 to 30).

Self-efficacy item. A single item was used to measure abstinence self-efficacy, or self-rated confidence to abstain from alcohol/drugs after treatment (Hoeppner, Kelly, Urbanoski, & Slaymaker, 2011). The single item is "How confident are you that you will be able to stay clean and sober in the next 90 days, or 3 months?" rated on a scale from 1 (not at all confident) to 10 (very confident). This single item has been used among individuals in residential treatment for SUD and scores from this item predicted substance use 6 months after discharge (Hoeppner et al., 2011). The current sample range for self-efficacy scores was 1 to 10.

Avoidance and inflexibility scale (AIS). The AIS is a 15-item self-report questionnaire that was used to measure substance-specific inflexibility when responding to internal substance-related triggers (Gifford et al., 2004). Higher scores on the AIS indicate greater inflexibility, whereas lower scores indicate greater flexibility. The AIS has been used in several studies among individuals with tobacco use disorder and has demonstrated good psychometric properties (Bricker et al., 2013; Gifford et al., 2004; 2012). The AIS includes Likert-type items (e.g., Item 1: How likely is it that these thoughts will lead you to drink/use" and Item 2: "How much are you struggling to control

these thoughts") rated on a Likert-type scales (e.g., 1 = not at all to 5 = very likely). For

the current study, an abbreviated 6-item version of the AIS was used in analyses (items 1,

2, 6, 7, 11, and 12) because numerous participants in the study commented on how they

were confused by the same subset of items that began with "How important is it to get rid

of…?" How important is it for you to reduce how often…?" and How important is it to

reduce the intensity of…?" For example, several participants commented that they were

unsure whether the items meant reducing substance-related feeling in the short-term or

long-term. Scores on the 6-item version of the AIS can range from 0 to 24 (current

sample range: 0 to 22).

    Regulatory flexibility scale (RFS). The RFS is a 24-item self-report questionnaire

that was designed for this study to measure general regulatory flexibility. The items for

the RFS were created based on several theories about the construct of regulatory

flexibility (Aldao, Sheppes & Gross, 2015; Bonanno & Burton, 2013; Cheng, Lau &

Chan, 2014; Kashdan & Rottenberg, 2010; Kato, 2012). All items of the RFS are based

on the following stem: "When handling difficult/bothersome thoughts, feelings, and

situations…" Items were included to assess several aspects of regulatory flexibility:

context sensitivity (e.g., "…I carefully considered whether my response was best for each

challenge that came up"), perceived repertoire (e.g., "…I felt I had limited options for

handling situations and emotions"), monitoring (e.g., "…I checked in with myself

throughout each situation to make sure what I was doing was actually helping me"),

adjustment (e.g., "…I was able to change my approach for handling things when I

realized things were not going well"), and sensitivity to values (e.g., "…I was able to get

perspective on the situation by thinking about my core values). Scores on the RFS can range from 0 to 96 (current sample range: 11 to 95).

Valued living scale (VLS). An adapted 9-item version of the VLS was used to assess importance of life goals, confidence to achieve these goals, and success in achieving these goals (Jensen et al., 2015). The original VLS includes 32 Likert-type items (e.g., 0 = not important, 10 = very important) regarding goals in a variety of life domains. The VLS has demonstrated good psychometric properties among individuals with chronic pain (Jensen et al., 2015). The adapted 9-item version of the VLS used in this study will focus on assessing goals related to physical health, social relations, and productivity. Out of the 9 items, 3 items assessed importance (e.g., "How important is this goal to you?"), 3 items assessed confidence (e.g., "How confident are you that you can achieve or maintain this goal after you leave Turquoise Lodge?") and success (e.g., "How successful have you been at maintaining this goal in the past week?"). Scores on the confidence subscale of the VLS can range from 0 to 30 (current sample range: 13 to 30).

Treatment length item. A single item was used to measure length of stay at Turquoise Lodge (current sample range 2 to 5 weeks).

Mindfulness group follow-up questionnaire. A questionnaire was administered as part of the post-assessment to assess perceived helpfulness of the MBRP group and self-reported informal and formal mindfulness practice during one's treatment stay. This measure was based on a questionnaire that has been used in prior studies of MBRP (Bowen et al., 2009; 2014). Perceived helpfulness of the MBRP group was assessed with a single item ("Overall, how helpful has the mindfulness class been for you") on a scale

from 0 = not at all helpful to 4 = very helpful. Frequency of informal mindfulness practice was computed as a total score from five items, each rated on a scale with 0 = almost never, 1 = two to three times total, 2 = one to two days per week, 3 = three to four days per week, 4 = five or more days per week. These items included: 1) "During your stay, how often have you been practicing the SOBER technique?", 2) "During your stay how often have you been using mindfulness to check-in with yourself?", 3) "During your stay how often have you been using mindfulness to cope with stress and difficult emotions?", 4) "During your stay how often have you been using mindfulness to stay focused on your environment or the activity you were doing?", 5) "During your stay how often have you been using breathing to handle a difficult moment? Total scores for informal practice can range from 0 to 20 (current sample range: 4 to 20).

Frequency of formal practice was assessed with a single item: "During your stay, how often have you been setting aside time when you are alone to practice mindfulness exercises?" The response options for this item were: 0 = almost never, 1 = two to three times total, 2 = one to two days per week, 3 = three to four days per week, 4 = five or more days per week. The current sample range for scores on the single frequency of formal practice item was: 0 to 4. Typical duration of formal practice was assessed with the following single item : "On days you set aside time to practice mindfulness exercises on your own, about how many total minutes do you typically practice?" The response options for this item ranged were: 0 = I don't set aside time, 1= two to five minutes, 2 = six to ten minutes, 3 = eleven to twenty minutes, to 4 = twenty-one or more minutes.

Statistical Analyses

Descriptive analyses, t-tests, chi-square tests, bivariate correlations, and reliability analyses were conducted in SPSS. All other analyses, including multiple regression models and mediation analyses, were conducted using Mplus version 8 (Muthén & Muthén, 1998).

Missing data. When feasible, maximum likelihood estimation was used for all analyses, which provides the variance-covariance matrix for all available data and is the preferred method for estimation when some data are missing.

Therapist fidelity analyses. Inter-rater reliability was tested using mean competence ratings across the two raters. Two-way mixed model intraclass correlation coefficients (ICCs) were examined.

Covariates. For all multiple regression models reported in this manuscript (including models in the primary, secondary, and supplementary analyses), the following covariates were included as predictors of the dependent variable in order to control for potential confounding effects of other relevant client factors: the baseline score of the particular post-assessment dependent variable included in each model, baseline substance use disorder severity (total score on SDS), gender, age, race (0 = white, 1 = racial/ethnic minority), length of treatment at Turquoise Lodge (number of weeks), and days abstinent prior to baseline.

Primary Aim 1-3 Analyses. To examine the acceptability of rolling MBRP (primary aim 1), descriptive analyses were conducted to calculate the mean score on the perceived helpfulness item. To examine the effect of rolling MBRP (primary aim 2) on MOBC variables, multiple regression analyses were conducted with mindfulness group attendance as the predictor and post-assessment self-efficacy (score on the single self-

efficacy item), craving (total scores from the PACS), and confidence in achieving valued

goals (total scores for the 3 confidence items of the VLS) as the dependent variables.

To examine self-compassion and regulatory flexibility as novel mechanisms of

behavior change (MOBC) following participation in rolling MBRP (primary aim 3),

multiple regression analyses were conducted with mindfulness group attendance as a

predictor of post-assessment self-compassion and regulatory flexibility. Two indices of

regulatory flexibility were examined: total scores from the Avoidance and Inflexibility

Scale (AIS), a measure of substance-specific regulatory inflexibility, and total scores

from the Regulatory Flexibility Scale (RFS), a measure of general regulatory flexibility.

Secondary aim 1 data analyses. To evaluate primary aims 2 and 3 using an

alternative analytic method, we conducted a multiple regression with a binary attendance

variable (1 = attended > 2 sessions of rolling MBRP, an "adequate dose"; 0 = attended 1

or no sessions of rolling MBRP, "a minimal dose or no dose"). The dependent variables

in the regression models were post-assessment craving, abstinence self-efficacy,

confidence in achieving valued goals, self-compassion, and regulatory flexibility. As

noted previously, we chose at least two sessions as a cut-off because primarily because

for the variable "number of sessions attended" the distribution of values across

participants (see Table 1) indicated that 2 or more sessions was a reasonable cut off point

to transform number of sessions into a binary attendance variable. Additionally, we

sought to evaluate the lowest number of sessions that might produce therapeutic benefit

and prior studies have demonstrated that brief mindfulness interventions consisting of

two sessions have resulted in positive treatment effects among individuals using

substances (de Dios et al., 2012; Mermelstein & Garske, 2015).

Secondary aim 2 data analyses. To evaluate mental health and mindfulness following participation in rolling MBRP, multiple regression analyses were conducted with mindfulness group attendance as a predictor of post-assessment mental health (total score on mental health subscale of SF-12) and mindfulness (total scores from the CAMS-R). Additionally, the same regression models were conducted with the binary attendance variable.

Secondary aim 3 data analyses. To evaluate whether participation in rolling MBRP attenuated the association between mental health and craving, moderated regression analysis was conducted with post-assessment mental health, rolling MBRP attendance, and the interaction of mental health and rolling MBRP attendance as predictors of post-assessment craving. Additionally, the same moderated regression models were conducted with the binary attendance variable.

Secondary aim 4 data analyses. To evaluate whether informal and formal mindfulness practice were associated with MOBC variables, multiple regression analyses were conducted with frequency of informal practice, frequency of formal practice, and typical duration of formal practice as predictors of the MOBC variables.

Supplementary data analyses. The following supplementary analyses were not among the primary and secondary aims originally proposed. Yet, these analyses were conducted given questions of interest that arose later in the data collection and analysis process.

Supplementary analysis 1. Paired samples t-tests were conducted to evaluate baseline to post-assessment changes in MOBC variables among the "minimal or no dose group" (1 or no sessions) and among the "adequate dose group" ($\geq$ 2 sessions).

27

Supplementary analysis 2. To evaluate the role of informal and formal

mindfulness practice in mediating the relations between mindfulness group attendance

and the MOBC variables, we conducted mediation analyses using the distribution of

products of coefficients approach (MacKinnon, 2008). Specifically, we tested the

statistical significance of mediated effects using the RMediation program (Tofighi &

MacKinnon, 2011). First, a series of mediation analyses were conducted to test whether

frequency of informal practice mediated the effect of mindfulness group attendance on

the MOBC variables. Then, additional mediation analyses were conducted with

frequency of formal practice and typical duration of formal practice as the mediator

variables. All mediation models included the following covariates as predictors of

mindfulness group attendance, mindfulness practice, and the dependent variable: baseline

value of the dependent variable, substance dependence severity, gender, age, race, length

of stay, and days abstinent prior to baseline.

Supplementary analysis 3. To evaluate whether gender, race, and substance use

disorder severity moderated the effect of rolling MBRP attendance on MOBC variables,

we conducted a series of moderated regression analyses.

Supplementary analysis 4. To evaluate whether frequency of formal practice

moderated the effect of typical duration of formal practice on MOBC variables, we

conducted a series of moderated regression analyses.

Results

Descriptive Results

Client characteristics for the study sample (N =109) are presented in Table 1. Of

note, the sample included only slightly more males (n = 59) than females (n = 50), was

racially/ethnically diverse (74.3% of the sample were racial or ethnic minorities), and reported relatively high rates of prior inpatient or intensive outpatient mental health/substance use disorder treatment (56% of the sample had at least 1 prior treatment episode). Table 4 presents the bivariate correlations and internal consistency reliabilities for key study variables. As shown in Table 4, substance dependence severity, age, gender, race, length of treatment, and days abstinent prior to randomization were not significantly correlated with number of rolling MBRP sessions attended. We also tested for differences on baseline covariates between the adequate dose group (attended two or more sessions) and the minimal dose group (attended one or no sessions). As shown in Table 5, there were no significant differences between these two groups on baseline covariates.

Missing Data

A total of 21 participants (19.3% of the full sample) did not complete the post-assessment and thus had missing data on all measures administered at the post-assessment. The primary reason for missing data at the post-assessment was because participants were discharged from the residential center earlier than expected and we were not able to contact the participant to complete the post-assessment over the phone. Attrition analyses revealed that gender, age, dependence severity, race, marital status, prior treatment episodes, polysubstance use, and baseline values for all MOBC variables were not significantly related to having missing data at post-assessment. For regression models and mediation models, parameters were estimated using maximum likelihood estimation and thus all available data from the full sample of 109 were used.

Therapist Fidelity Ratings

On average, therapists adhered to 99% of intervention components. Inter-rater reliability for mean competence ratings was good (ICC = .857). The mean competence score across therapists was 3.8 (*SD* = 0.26); this score falls between 3 = good and 4 = excellent.

Testing of Primary Aims

Descriptive analyses of rolling MBRP session attendance (see Table 1) showed that the mean number of rolling MBRP sessions attended was 3.69 (*SD* = 2.12). The median number of sessions attended was 4. There were 24 participants (22% of the sample) who attended 1 group or less and 85 participants (78% of the sample) who attended 2 groups or more. Also, 71% of the sample attended 3 groups or more and 38% attended 5 groups or more. Descriptive analyses demonstrated that the mean score on the perceived helpfulness item (which ranged from 0 = "not at all helpful" to 4 = "very helpful") was 3.38 (*SD* = 0.77), indicating high satisfaction. The response anchor of 3 corresponded with "considerably helpful" and 88% of participants who completed the post-assessment rated the rolling MBRP group as either considerably helpful or very helpful. Furthermore, mean scores among the full sample for self-reported out-of-session mindfulness practice were as follows: frequency of informal practice (mean = 2.72, SD = 0.89, corresponding most closely with response anchor 3= three to four days a week); frequency of formal practice (mean = 2.53, SD = 1.17, in-between response anchors 2 = one to two days a week and 3 = three to four days a week); and typical length of time spent engaging in formal practice (mean = 2.06, SD = 1.03, corresponding most closely with response anchor 2 = six to ten minutes).

Multiple regression analyses demonstrated that number of rolling MBRP sessions attended was not significantly associated with the post-assessment MOBC variables of abstinence self-efficacy, craving, or confidence to achieve values-consistent goals (see Table 6). Number of rolling MBRP sessions attended was not significantly associated with the post-assessment MOBC variables of regulatory flexibility, substance-specific inflexibility, or self-compassion (see Table 6).

Testing of Secondary Aims

Because there were considerably more individuals in the subgroup who attended two or more sessions (85 individuals total; 68 with both baseline and post-assessment data) as compared to the subgroup who attended one or no sessions (24 individuals total; 15 with both baseline and post-assessment data), we conducted Levene's tests of equality of variance between the two subgroups for all the MOBC variables. These tests revealed that the homogeneity of variance assumption for the two subgroups was not violated for any MOBC variables.

Attending two or more rolling MBRP sessions (versus one or less) was not significantly associated with post-assessment abstinence self-efficacy, craving, confidence to achieve values-consistent goals, regulatory flexibility, substance-specific inflexibility, or self-compassion (see Table 7). However, attending two or more rolling MBRP sessions (versus one or less) significantly predicted higher post-assessment mindfulness scores ($\beta = 0.351$; between-group Cohen's $d = 0.95$ at post-assessment) and better mental health ($\beta = 0.277$; between-group Cohen's $d = 0.51$ at post-assessment) (see Table 7 and Figures 1 and 2).

Moderated multiple regression analyses demonstrated that number of rolling MBRP sessions attended did not significantly moderate the association between post-assessment mental health and craving (B = 0.035, *SE* = 0.128, *p* = 0.784). Attending two or more rolling MBRP sessions (versus one or less) also did not significantly moderate the association between post-assessment mental health and craving (B = 0.864, *SE* = 1.13, *p* = 0.443).

Analyses examining mindfulness practice as a predictor of MOBC variables demonstrated several significant results. Frequency of *informal* practice significantly predicted lower post-assessment craving (*β* = -0.377), higher confidence in achieving values-based goals (*β* = 0.235), better mental health (*β* = 0.441), higher regulatory flexibility (*β* = 0.369), higher self-compassion (*β* = 0.319), and higher mindfulness (*β* = 0.443) (see Table 8). However, frequency of informal practice was not significantly associated with post-assessment abstinence self-efficacy or substance-specific inflexibility.

Frequency of *formal* practice significantly predicted lower post-assessment craving (*β* = -0.257), higher confidence in achieving valued goals (*β* = 0.279), better mental health (*β* = 0.362), higher regulatory flexibility (*β* = 0.270), higher self-compassion (*β* = 0.261), and higher mindfulness (*β* = 0.449) (see Table 9). Frequency of formal practice was not significantly associated with post-assessment abstinence self-efficacy or substance-specific inflexibility.

Quantity of formal practice significantly predicted lower post-assessment craving (*β* = -0.246), higher confidence in achieving valued goals (*β* = 0.271), better mental health (*β* = 0.354), higher regulatory flexibility (*β* = 0.256), higher self-compassion (*β* =

0.311), and higher mindfulness ($\beta = 0.470$) (see Table 10). Quantity of formal practice was not significantly associated with post-assessment abstinence self-efficacy or substance-specific inflexibility.

Testing of Supplementary Analyses

As shown in Table 11, paired samples t-tests revealed that among participants who attended two or more rolling MBRP sessions, there were significant changes from baseline to post-assessment for craving (decrease; Cohen's $d = 0.65$), mental health (increase; Cohen's $d = 0.70$), regulatory flexibility (increase; Cohen's $d = 0.88$), substance-specific inflexibility (decrease; Cohen's $d = 0.72$), self-compassion (increase; Cohen's $d = 1.12$), and mindfulness (increase; Cohen's $d = 1.02$). Among participants who attended one or no sessions, the only significant change from baseline to post-assessment among MOBC variables was for substance-specific inflexibility (increase; Cohen's $d = 0.90$).

As shown in Table 12, there was a significant indirect effect (i.e., mediation) of number of rolling MBRP sessions, via frequency of informal practice, on post-assessment craving, mental health, regulatory flexibility, self-compassion, and mindfulness. We did not find a significant indirect effect of number of sessions, via frequency of informal practice, on post-assessment abstinence self-efficacy, confidence in achieving valued goals, or substance-specific inflexibility.

As shown in Table 13, there was a significant indirect effect of number of rolling MBRP sessions, via frequency of formal practice, on post-assessment craving, confidence in achieving valued goals, mental health, regulatory flexibility, self-compassion, and mindfulness. We did not find a significant indirect effect of number of

sessions, via frequency of formal practice, on post-assessment abstinence self-efficacy or substance-specific inflexibility. As shown in Table 14, we did not find a significant indirect effect of number of sessions, via *typical duration of* formal practice, for any of the post-assessment MOBC variables.

Because we found that attending two or more rolling MBRP sessions predicted better post-assessment mental health and higher mindfulness (secondary aim 1), we were interested in testing whether these effects (with the binary attendance variable) were mediated by mindfulness practice. Results indicated that there was a significant indirect effect of attending two or more rolling MBRP sessions, via frequency of informal practice, on post-assessment mental health (B = 0.562, *SE* = 0.255, 95% *CI*: 0.141, 1.131) and post-assessment mindfulness (B = 1.524, *SE* = 0.756, 95% *CI*: 0.301, 3.227). Also, there was a significant indirect effect of attending two or more rolling MBRP sessions, via frequency of formal practice, on post-assessment mental health (B = 0.473, *SE* = 0.246; 95% *CI*: 0.072, 1.025) and post-assessment mindfulness (B = 1.642, *SE* = 0.765, 95% *CI*: 0.389, 3.355). Furthermore, there was a significant indirect effect of attending two or more rolling MBRP session, via *typical duration of* formal practice, on post-assessment mental health (B = 0.418, *SE* = 0.249, 95% *CI*: 0.026, 0.988) and post-assessment mindfulness (B = 1.193 , *SE* = 0.892, 95% *CI*: 0.428, 3.894).

Gender, race, and baseline substance use disorder severity did not significantly moderate the effect of rolling MBRP attendance on any MOBC variables (all *p*'s > .05).

With the exception of post-assessment mindfulness, no MOBC variables were significantly predicted by the interaction between frequency of formal practice and typical duration of formal practice (all *p*'s > .05). The interaction between frequency of

formal practice and typical duration of formal practice significantly predicted post-assessment mindfulness (B = -0.883, *SE* = 0.436, *p* = 0.043). Among participants reporting low frequency of formal practice (below the median score of 3, corresponding with 3 to 4 days per week), typical duration of practice did not predict post-assessment mindfulness (B = 1.549, *SE* = 1.183, *p* = 0.190). However, among participants reporting high frequency of formal practice (above the median score), typical duration of practice significantly predicted post-assessment mindfulness (B = 2.431, *SE* = 1.01, *p* = 0. 016).

Discussion

The current study sought to empirically investigate the feasibility, acceptability, and mechanisms of behavior change (MOBC) related to a manualized rolling admission version of mindfulness-based relapse prevention (MBRP) that was offered to adults (N = 109) with substance use disorders receiving inpatient treatment at a residential treatment program. This study was a non-randomized, open trial of rolling MBRP in which study participants had the option of attending rolling MBRP groups that were offered to all patients at the treatment center. The rolling MBRP intervention evaluated in this study was developed over the course of several years through an iterative process, and the final version consists of eight one-hour modules. Participants completed study questionnaires upon admission to the inpatient treatment program (a "baseline assessment") and again immediately before discharge (a "post-assessment"), which was typically 21 to 28 days following admission to the inpatient program. Five trained therapists (three master's level and two bachelor's level) delivered the treatment; ratings of therapist fidelity indicated excellent adherence (overall adherence to 99% of components) and competence (mean competence ratings of 3.8 on 0 to 4 scale).

Feasibility and Acceptability of Rolling MBRP

Individuals attended an average of over 3 sessions, out of three to six possible sessions (depending on length of stay), indicating feasibility. Acceptability of rolling MBRP was demonstrated by high satisfaction ratings. The mean satisfaction rating of 3.38 fell between the response anchors of 3 = considerably helpful and 4 = very helpful. Acceptability was also demonstrated by high attendance rates. On average participants attended about 4 groups, with 78% of the sample attending 2 sessions or more and 38% attending 5 sessions or more. These attendance rates were deemed as high especially in light of the fact that the rolling MBRP group was typically offered as an *additional* group option during the evening groups (with Alcoholics/Narcotics Anonymous being the other group offered at the same time), and thus participants were not required to attend the rolling MBRP groups and had a viable alternative option. Engagement in out-of-session mindfulness practice was also relatively frequent. On average, participants reported engaging in informal practice about 3-4 days per week, engaging in formal practice about 2-3 days per week, and typically spending about six to ten minutes when engaging in formal practice. Altogether, results suggest that a rolling admission version of MBRP is acceptable to clients, that clients will attend this type of group in an inpatient setting, and that clients will practice mindfulness out of session.

The Effect of Rolling MBRP on Mechanisms of Behavior Change

The total number of rolling MBRP sessions each participant attended was not related to self-reported craving, abstinence self-efficacy, confidence in achieving valued goals following treatment, or mental health. However, attending at least two or more sessions (versus one or none) was significantly associated with better post-assessment

mental health, as measured by the mental health subscale of the Short Form Health Survey-12 (Ware et al., 1996). That is, those who attended two or more sessions had better post-assessment mental health than those who attended one or no sessions (medium between-group effect size). Furthermore, individuals who attended two or more sessions exhibited a significant improvement in mental health from baseline to post-assessment (medium-to-large within-group baseline-to-post effect size). Given the similarities between MBRP and mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990) and mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002), which have strong evidence for improving mental health outcomes (Khoury et al., 2013), it is not surprising that MBRP may also improve mental health. The current findings regarding mental health are also consistent with several studies that have found that mindfulness-based treatments for addictive disorders are related to significant improvements in stress and mental-health related outcomes (Garland et al., 2016; Glasner et al., 2016; Li et al., 2017; Zemestani & Ottaviani, 2016). Altogether, the current study provides some preliminary evidence that a rolling admission version of MBRP may be effective, particularly in improving mental health among individuals receiving inpatient SUD treatment.

The lack of a significant association between rolling MBRP attendance and the other MOBC variables (i.e., craving, abstinence self-efficacy, confidence in achieving valued goals) may have been influenced by the timing of the post-assessment. The post-assessment was administered at the very end of each participant's treatment stay while the participant was still residing at the treatment center. Importantly, participants had not yet returned to the typical contexts of their daily lives. It is possible that additional effects

of rolling MBRP could have been detected if another assessment was administered several months following the intensive inpatient treatment program and at a time in which participants were fully immersed in their daily lives and more fully exposed to life stressors. Of note, although number of rolling MBRP sessions attended did not significantly predict post-assessment craving, individuals who attended at least two sessions still exhibited statistically significant reductions in craving from baseline to post-assessment (medium within-group baseline-to-post effect size).

The number of rolling MBRP sessions attended was not related to the MOBC variables of self-compassion, mindfulness, regulatory flexibility, or substance-specific inflexibility. However, attending two or more sessions was significantly associated with higher post-assessment mindfulness, as measured by the Cognitive and Affective Mindfulness Scale-Revised (Feldman et al., 2007). In other words, those who attended two or more sessions had higher post-assessment mindfulness than those who attended one or no sessions (large between-group effect size). Further, individuals who attended two or more sessions exhibited a significant improvement in mindfulness from baseline to post-assessment (large within-group baseline-to-post effect size). The significant relation between rolling MBRP attendance and mindfulness makes sense given that MBRP explicitly targets mindfulness abilities, such as focusing attention on present moment experience and bringing an open and curious stance towards distressing thoughts and feelings. To date, however, the evidence regarding whether mindfulness is a MOBC in mindfulness-based interventions for addictive disorders is still mixed (see meta-analysis by Li et al., 2017). Hence, the current study findings add to this body of

literature and provide evidence that a rolling admission version of MBRP appears to be successful in mobilizing the putative MOBC of mindfulness, at least in the short-term.

Counter to expectations, rolling MBRP attendance did not moderate the association between mental health and craving at post-assessment. Hence, we were not able to replicate the substantive results from Witkiewitz and Bowen (2010), in which receiving MBRP moderated the relation between depressive symptoms at the end of treatment and substance craving 2-months following treatment. As noted above, it is possible that our ability to detect effects related to craving were limited because at the time of the post-assessment, participants were still at the residential treatment center and were not yet re-immersed in their typical daily lives.

We also investigated the roles of both informal (i.e., on-the-go mindfulness practice during daily situations) and formal mindfulness practice (i.e., setting aside time to practice mindfulness meditation) as MOBC in rolling MBRP. Overall, both informal and formal practice predicted a wide range of MOBC variables at post-assessment. For example, frequency of informal practice during one's treatment stay predicted better mental health, higher regulatory flexibility, higher self-compassion, and higher mindfulness at post-assessment. Frequency of formal practice predicted lower craving, higher confidence in achieving valued goals, better mental health, higher regulatory flexibility, higher self-compassion, and higher mindfulness at post-assessment. Furthermore, typical duration of formal practice significantly predicted lower craving, higher confidence in achieving valued goals, better mental health, higher regulatory flexibility, higher self-compassion, and higher mindfulness at post-assessment.

To further explore the role of mindfulness practice as a MOBC following rolling

MBRP, we evaluated whether mindfulness practice mediated the effect of rolling MBRP

attendance on MOBC variables at post-assessment. Given that we found significant main

effects of attending two or more sessions on post-assessment mental health and

mindfulness, we evaluated whether these effects were mediated by mindfulness practice.

Results indicated that frequency of informal practice, frequency formal practice, and

typical duration of formal practice significantly mediated the effect of attending two or

more rolling MBRP sessions on post-assessment mental health and mindfulness.

Although total number of rolling MBRP sessions attended did not have a main effect on

MOBC variables, number of sessions attended had numerous indirect effects on MOBC

variables via mindfulness practice. First, frequency of informal practice significantly

mediated the effect of number of rolling MBRP sessions attended and the following

variables at post-assessment: craving, mental health, regulatory flexibility, self-

compassion, and mindfulness. Second, frequency of formal practice significantly

mediated the effect of number of rolling MBRP sessions attended on the following

variables at post-assessment: craving, confidence in achieving valued goals, mental

health, regulatory flexibility, self-compassion, and mindfulness. Third, typical duration of

formal practice was not a significant mediator in any of the MOBC models.

The collective findings regarding mindfulness practice in the current study

indicate that the degree to which individuals engage in out-of-session mindfulness

practice may be a key mechanism that mobilizes change in a variety of domains. Notably,

mindfulness practice mediated the effects of six out of the eight MOBC variables

examined. The findings also suggest that *both* informal and formal practice are important

for individuals to engage in as a means to optimize benefits from rolling MBRP. Providing opportunities for practice (e.g., mp3 players) and encouraging mindfulness practice among clients in between sessions—both formally and informally—is a key focus of MBRP. Therefore, our findings regarding the importance of practice in the change process indicate that it may be crucial for therapists to actively facilitate and reinforce outside practice, rather than disregard whether or not clients are practicing. Our findings are consistent with two prior studies of MBRP that found evidence for both formal and informal mindfulness practice as MOBC (Elwafi et al., 2013; Grow et al., 2015). To date, however, there are generally few empirical studies on mindfulness practice as a MOBC in MBRP and other mindfulness-based interventions for addictive disorders. Our findings suggest that future work on the role of mindfulness practice as a MOBC is warranted.

Interestingly, in this study we found more consistent evidence that *frequency* (e.g., how often) of practice, rather than *typical duration* of practice, was a significant mediator in models that tested the following mediational pathway: number of sessions → mindfulness practice → MOBC variable. Specifically, there appeared to be a significant dose-response relation between number of sessions attended and frequency of practice, but not typical duration of practice. Hence, these findings suggest that treatment providers may have greater ability to strategically target the frequency in which clients practice (by offering or recommending more sessions) in order to optimize benefit from MBRP. However, it is important to note that the findings regarding frequency versus typical duration of practice are preliminary and require replication.

41

We found a significant interaction effect between frequency of formal practice and typical duration of formal practice in the prediction of post-assessment mindfulness. Typical duration of formal practice predicted post-assessment mindfulness only among participants with high frequency of formal practice, but not participants with low frequency of formal practice. This finding suggests that duration of formal practice may only be important if participants are also practicing informal practice frequently. Future work can examine frequency and typical duration of formal practice, and their interaction, as predictors of MOBC and outcomes.

The current study also investigated MOBC in MBRP that have received relatively little attention to date, including self-compassion, regulatory flexibility, and substance-specific inflexibility. Results from the current study provide preliminary evidence that self-compassion and regulatory flexibility may function as MOBC following MBRP. As noted above, frequency of informal and formal mindfulness practice mediated the effect of rolling MBRP attendance on self-compassion and regulatory flexibility. These specific results suggest that frequent engagement in mindfulness practice outside of session may play a key role in facilitating greater self-compassion and regulatory flexibility. Future work is warranted to explore the extent to which mindfulness practice is important in mobilizing self-compassion and regulatory flexibility, as well as whether these constructs may be unique MOBC to mindfulness-based interventions for addictive disorders.

The current study also provided an initial test of regulatory flexibility assessed via a self-report measure that we developed, the Regulatory Flexibility Scale (RFS). Preliminary examination of the RFS in this study showed that it had excellent internal consistency reliability. Further empirical investigation of the RFS is needed to determine

whether the RFS may be a valid and reliable tool for measuring regulatory flexibility in future studies. Interestingly, substance-specific inflexibility, as measured by an abbreviated form of the Avoidance and Inflexibility Scale (AIS; Gifford et al., 2004), was not related to mindfulness attendance or practice. The AIS has been primarily studied among smokers (Bricker et al., 2013; Gifford et al., 2004; 2012) and thus it is possible that the AIS may not be a useful measure among individuals with substance use disorders in an inpatient setting. Further, numerous participants shared that they were confused by some items of the AIS.

Our study is unique from prior studies of MBRP in that our findings shed light on the dose-response relationship between number of MBRP sessions attended and MOBC variables. Our findings indicate that a relatively small dose of rolling MBRP (e.g., two or more 1-hour sessions) may be beneficial for clients, particularly in targeting mindfulness and mental health. However, it is important to note that the sample size for the subgroup attending less than two sessions was relatively small and it is possible that parameter estimates within this subgroup may have been unreliable. Additionally, we only examined short-term MOBC and did not examine the effect of attending two or more sessions on long-term MOBC or substance use outcomes. Hence, results that suggest that two or more sessions may be beneficial should be viewed with caution and further work is needed. Other studies among young adult substance users have found positive effects of just two brief mindfulness training sessions (de Dios et al., 2012; Mermelstein & Garske, 2015). Our study provides preliminary evidence that just two sessions could also be beneficial for adults with severe substance use disorders who are receiving inpatient treatment.

In regards to the dose-response relationship between number of MBRP sessions attended and MOBC variables, we also demonstrated a gradient effect by which attending a greater number of session predicted more frequent engagement in informal and formal practice. Kazdin (2007) notes that providing evidence of a gradient effect offers additional support for a putative MOBC. To our knowledge, our study is the first to demonstrate a gradient effect that lends support to the notion that mindfulness practice may be a proximal mechanism of change that drives additional MOBC, such as craving, in mindfulness-based interventions for addictive disorders.

Study Limitations

The primary limitation of this study was that it was a non-randomized, open trial and therefore causal conclusions regarding rolling MBRP cannot be drawn from our design. Although we statistically controlled for several potentially confounding factors (e.g., dependence severity), it is possible that there were other important confounding factors that we did not account for in the analyses. Another key limitation is that study participants were only assessed before and immediately after treatment. A follow-up assessment was not administered, and actual substance use behavior was not examined in our study because individuals were still residing at the treatment center at the post-assessment. Hence, it is still not known whether rolling MBRP impacts long-term outcomes, including risk and severity of substance use relapse following treatment. The current study relied exclusively on retrospective self-report questionnaires, which have many limitations, such as recall biases and response biases. Most assessments in this study were relatively brief, which could have resulted in measurement error and affected the results. In this study, the sample size was relatively small. The study was conducted

in an inpatient setting and may not generalize to other treatment settings. We did not control for other treatment options that participants engaged in while residing at the residential treatment center. In addition to a rolling treatment, the study also had "rolling" therapists, which could have affected the results. For therapist fidelity, we only coded one session and did not code every session. Finally, about 19% of the sample had missing data for the post-assessment. Although this level of attrition is moderate, missing data still could have biased study results.

Summary and Conclusions

We conducted a non-randomized, open trial to evaluate the feasibility acceptability, mechanisms of behavior change (MOBC) related to a manualized rolling admission version of MBRP. Key results from our study were: 1) feasibility was demonstrated by good attendance rates and acceptability was demonstrated satisfaction ratings were high, 2) attending two or more sessions (versus one or none) predicted better mental health and higher mindfulness at post-assessment, 3) frequency of informal practice, frequency formal practice, and typical duration of formal practice significantly mediated the effect of attending two or more rolling MBRP sessions on post-assessment mental health and mindfulness, and 4) total number of sessions attended did not have main effects on MOBC variables, yet number of sessions had numerous indirect effects, via frequency of informal and formal mindfulness, on a variety of MOBC variables at post-assessment, including craving, confidence in achieving valued goals, mental health, regulatory flexibility, self-compassion, and mindfulness.

One key conclusion from this study is that delivering MBRP as an open, rolling admission group may be a viable and effective alternative to delivering MBRP as a

closed-cohort group. The option of delivering MBRP as a rolling treatment, as opposed to closed-cohort MBRP, may be particularly valuable for treatment settings where a closed-cohort group is not a feasible or suitable mode of delivery. However, further empirical evidence to establish the efficacy of rolling MBRP is needed. For example, evaluation of rolling MBRP with a randomized controlled trial design and longer-term follow-ups would be valuable in providing stronger evidence for the efficacy of rolling MBRP.

Our study also contributes to the literature on MOBC related to mindfulness-based interventions for addictive disorders. In particular, our findings suggest that both informal and formal mindfulness practice outside of session may be key MOBC in MBRP. To date, there are still few empirical studies of mindfulness-based interventions for addictive disorders that have specifically examined the importance of informal and formal mindfulness practice. For instance, it is still unclear how important it is for individuals to continue practicing mindfulness in the long-term in order to maintain benefits from receiving MBRP. Our findings indicate that further research on mindfulness practice as a MOBC is worthwhile. Also, in this study we examined regulatory flexibility and self-compassion, two constructs that have not been examined as MOBC in MBRP. These constructs were significantly predicted by mindfulness practice, suggesting that that further investigation of these constructs as MOBC may be valuable.

A final noteworthy aspect of the current study is that the rolling MBRP treatment was delivered to individuals with relatively severe substance use disorders who had just completed medical detoxification treatment. To our knowledge, there is just one other empirical study of mindfulness-based interventions for alcohol and drug use disorders that has delivered the intervention immediately following medical detoxification among

individuals beginning inpatient treatment. In this study by Witkiewitz et al. (2014), participants completed a four-week detoxification and stabilization phase before starting MBRP groups as part of inpatient treatment. Therefore, our study provides additional preliminary evidence that MBRP can be safely and effectively delivered to individuals who have just completed medical detoxification treatment and are beginning inpatient treatment.

In sum, this study demonstrated that MBRP can be effectively delivered as a rolling group as part of an inpatient treatment program for substance use disorders. Future work on rolling admission versions of MBRP and similar treatments has the potential to ultimately make mindfulness-based treatments for addictive disorders more accessible and available in a diverse range of treatment settings.

References

Aldao, A., Sheppes, G., & Gross, J. J. (2015). Emotion regulation flexibility. *Cognitive Therapy Research*, 39(3), 263-278.

Baer, R. A. (2010). Self-compassion as a mechanism of change in mindfulness- and acceptance based treatments. In R. A. Baer (Ed.) *Assessing mindfulness & acceptance processes in clients* (pp.135-154). Oakland, CA: New Harbinger.

Bowen, S., Chawla, N., & Marlatt, G. A. (2010). *Mindfulness-based relapse prevention for addictive behaviors: A clinician's guide*. Guilford Press.

Bowen, S., Chawla, N., Collins, S. E., Witkiewitz, K., Hsu, S., Grow, J., ... & Marlatt, A. (2009). Mindfulness-based relapse prevention for substance use disorders: a pilot efficacy trial. *Substance Abuse*, 30(4), 295-305.

Bowen, S., Witkiewitz, K., Clifasefi, S. L., Grow, J., Chawla, N., Hsu, S. H., … Larimer, M. E. (2014). Relative efficacy of mindfulness-based relapse prevention, standard relapse prevention, and treatment as usual for substance use disorders. *JAMA Psychiatry, 71*(5), 547-556.

Brewer, J. A., Mallik, S., Babuscio, T. A., Nich, C., Johnson, H. E., Deleone, C. M., ... & Carroll, K. M. (2011). Mindfulness training for smoking cessation: results from a randomized controlled trial. *Drug and Alcohol Dependence*, *119*(1), 72-80.

Brewer, J. A., Sinha, R., Chen, J. A., Michalsen, R. N., Babuscio, T. A., Nich, C., ... & Rounsaville, B. J. (2009). Mindfulness training and stress reactivity in substance abuse: Results from a randomized, controlled stage I pilot study. *Substance Abuse*, *30*(4), 306-317.

Bricker, J. B., Bush, T., Zbikowski, S. M., Mercer, L. D., & Heffner, J. L. (2014a). Randomized trial of telephone-delivered acceptance and commitment therapy versus cognitive behavioral therapy for smoking cessation: a pilot study. *Nicotine & Tobacco Research*, *16*(11), 1446-1454.

Bricker, J. B., Mull, K. E., Kientz, J. A., Vilardaga, R., Mercer, L. D., Akioka, K. J., & Heffner, J. L. (2014b). Randomized, controlled pilot trial of a smartphone app for smoking cessation using acceptance and commitment therapy. *Drug and Alcohol Dependence, 143*, 87–94.

Bricker, J., Wyszynski, C., Comstock, B., & Heffner, J. L. (2013). Pilot randomized controlled trial of web-based acceptance and commitment therapy for smoking cessation. *Nicotine & Tobacco Research, 15*(10), 1756–1764.

Brooks, M., Kay-Lambkin, F., Bowman, J., & Childs, S. (2012). Self-compassion amongst clients with problematic alcohol use. *Mindfulness*, *3*(4), 308-317.

Brown, K. W., Ryan, R. M., & Creswell, J. D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*(4), 211-237.

Chawla, N., Collins, S., Bowen, S., Hsu, S., Grow, J., Douglas, A., & Marlatt, G. A. (2010). The mindfulness-based relapse prevention adherence and competence scale: development, interrater reliability, and validity. *Psychotherapy Research*, *20*(4), 388-397.

Cheng, C., Lau, H. P. B., & Chan, M. P. S. (2014). Coping flexibility and psychological adjustment to stressful life changes: A meta-analytic review. *Psychological Bulletin, 140*(6), 1582-1607.

Davis, J. M., Manley, A. R., Goldberg, S. B., Smith, S. S., & Jorenby, D. E. (2014).
Randomized trial comparing mindfulness training for smokers to a matched
control. *Journal of Substance Abuse Treatment*, *47*(3), 213-221.

de Dios, M. A., Herman, D. S., Britton, W. B., Hagerty, C. E., Anderson, B. J., & Stein,
M. D. (2012). Motivational and mindfulness intervention for young adult female
marijuana users. *Journal of Substance Abuse Treatment*, *42*(1), 56-64.

Elwafi, H. M., Witkiewitz, K., Mallik, S., Thornhill IV, T. A., & Brewer, J. A. (2013).
Mindfulness training for smoking cessation: Moderation of the relationship
between craving and cigarette use. *Drug and Alcohol Dependence*, *130*(1), 222-
229.

Feldman, G., Hayes, A., Kumar, S., Greeson, J., & Laurenceau, J. P. (2007). Mindfulness
and emotion regulation: The development and initial validation of the Cognitive
and Affective Mindfulness Scale-Revised (CAMS-R). *Journal of
Psychopathology and Behavioral Assessment*, *29*(3), 177-190.

Flannery, B. A., Volpicelli, J. R., & Pettinati, H. M. (1999). Psychometric properties of
the Penn alcohol craving scale. *Alcoholism: Clinical and Experimental
Research*, *23*(8), 1289-1295.

Garland, E. L. (2013). *Mindfulness-oriented recovery enhancement for addiction, stress,
and pain*. Washington, DC: NASW Press.

Garland, E. L., Roberts-Lewis, A., Tronnier, C. D., Graves, R., & Kelley, K. (2016).
Mindfulness-Oriented Recovery Enhancement versus CBT for co-occurring
substance dependence, traumatic stress, and psychiatric disorders: Proximal

outcomes from a pragmatic randomized trial. *Behaviour Research and Therapy*, *77*, 7-16.

Gifford, E. V., Kohlenberg, B. S., Hayes, S. C., Antonuccio, D. O., Piasecki, M. M., Rasmussen-Hall, M. L., & Palm, K. M. (2004). Acceptance-based treatment for smoking cessation. *Behavior Therapy*, *35*(4), 689-705.

Gifford, E. V., Kohlenberg, B. S., Hayes, S. C., Pierson, H. M., Piasecki, M. P., Antonuccio, D. O., & Palm, K. M. (2011). Does acceptance and relationship focused behavior therapy contribute to bupropion outcomes? A randomized controlled trial of functional analytic psychotherapy and acceptance and commitment therapy for smoking cessation. *Behavior Therapy*, *42*(4), 700-715.

Glasner, S., Mooney, L. J., Ang, A., Garneau, H. C., Hartwell, E., Brecht, M. L., & Rawson, R. A. (2016). Mindfulness-based relapse prevention for stimulant dependent adults: A pilot randomized clinical trial. *Mindfulness*, 1-10.

Gossop, M., Darke, S., Griffiths, P., Hando, J., Powis, B., Hall, W., & Strang, J. (1995). The Severity of Dependence Scale (SDS): psychometric properties of the SDS in English and Australian samples of heroin, cocaine and amphetamine users. *Addiction*, *90*(5), 607-614.

Grant, B. F., Stinson, F. S., Dawson, D. A., Chou, S. P., Dufour, M. C., Compton, W., ... & Kaplan, K. (2004). Prevalence and co-occurrence of substance use disorders and independent mood and anxiety disorders: Results from the national epidemiologic survey on alcohol and related conditions. *Archives of General Psychiatry*, *61*(8), 807-816.

Grow, J. C., Collins, S. E., Harrop, E. N., & Marlatt, G. A. (2015). Enactment of home

    practice following mindfulness-based relapse prevention and its association with

    substance-use outcomes. *Addictive Behaviors*, *40*, 16-20.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2011). *Acceptance and commitment*

    therapy: The MOBC and practice of mindful change. Guilford Press.

Himelstein, S., & Saul, S. (2015). Mindfulness-based substance abuse treatment for

    adolescents: a 12-session curriculum. New York: Routledge.

Hoeppner, B. B., Kelly, J. F., Urbanoski, K. A., & Slaymaker, V. (2011). Comparative

    utility of a single-item versus multiple-item measure of self-efficacy in predicting

    relapse among young adults. *Journal of Substance Abuse Treatment*, *41*(3), 305-

    312.

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U.

    (2011). How does mindfulness meditation work? Proposing mechanisms of action

    from a conceptual and neural perspective. *Perspectives on Psychological*

    Science, *6*(6), 537-559.

Jensen, M. P., Vowles, K. E., Johnson, L. E., & Gertz, K. J. (2015). Living well with

    pain: development and preliminary evaluation of the valued living scale. *Pain*

    Medicine, *16*(11), 2109-2120.

Kabat-Zinn J. (1990). *Full catastrophe living: Using the wisdom of your body and mind*

    to face stress, pain, and illness. New York, NY: Delacorte Press.

Kadden, R. M., & Litt, M. D. (2011). The role of self-efficacy in the treatment of

    substance use disorders. *Addictive Behaviors*, *36*(12), 1120-1126.

Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental

aspect of health. *Clinical Psychology Review*, *30*(7), 865-878.

Kato, T. (2012). Development of the coping flexibility scale: evidence for the coping

flexibility hypothesis. *Journal of Counseling Psychology*, *59*(2), 262–273.

Kazdin, A. E. (2007). Mediators and mechanisms of change in psychotherapy

research. *Annual Review of Clinical Psychology, 3*, 1-27.

Khoury, B., Lecomte, T., Fortin, G., Masse, M., Therien, P., Bouchard, V., ... &

Hofmann, S. G. (2013). Mindfulness-based therapy: a comprehensive meta-

analysis. *Clinical psychology Review*, *33*(6), 763-771.

Kuyken, W., Watkins, E., Holden, E., White, K., Taylor, R. S., Byford, S., ... &

Dalgleish, T. (2010). How does mindfulness-based cognitive therapy

work?. *Behaviour Research and Therapy*, *48*(11), 1105-1112.

Li, W., Howard, M. O., Garland, E. L., McGovern, P., & Lazar, M. (2017). Mindfulness

treatment for substance misuse: A systematic review and meta-analysis. *Journal

of Substance Abuse Treatment*, *75*, 62-96.

Longabaugh, R., & Magill, M. (2011). Recent advances in behavioral addiction

treatments: focusing on mechanisms of change. *Current Psychiatry

Reports*, *13*(5), 382-389.

MacKinnon, D. P. (2008). *Introduction to statistical mediation analysis*. Routledge.

McHugh, R. K., & Barlow, D. H. (2010). The dissemination and implementation of

evidence-based psychological treatments: a review of current efforts. *American

Psychologist*, *65*(2), 73-84.

McKay, J. R. (2009). *Treating substance use disorders with adaptive continuing care*. American Psychological Association.

McLellan, A. T., Lewis, D. C., O'Brien, C. P., & Kleber, H. D. (2000). Drug dependence, a chronic medical illness. *JAMA*, *284*(13), 1689-1695.

McLellan, A. T., McKay, J. R., Forman, R., Cacciola, J., & Kemp, J. (2005). Reconsidering the evaluation of addiction treatment: from retrospective follow-up to concurrent recovery monitoring. *Addiction*, *100*(4), 447–458.

Mermelstein, L. C., & Garske, J. P. (2015). A brief mindfulness intervention for college student binge drinkers: A pilot study. *Psychology of Addictive Behaviors*, *29*(2), 259-269.

Muthén, L. K., & Muthén, B. O. (1998). Mplus User's Guide, 8th Edn. *Los Angeles:* Muthén & Muthén.

Neff, K. D., & Dahm, K. A. (2015). Self-compassion: What it is, what it does, and how it relates to mindfulness. In *Handbook of Mindfulness and Self-Regulation* (pp. 121-137). Springer New York.

Nock, M. K. (2007). Conceptual and design essentials for evaluating mechanisms of change. *Alcoholism: Clinical and Experimental Research*, *31*(s3), 4s-12s.

Raes, F., Pommier, E., Neff, K. D., & Van Gucht, D. (2011). Construction and factorial validation of a short form of the self-compassion scale. *Clinical Psychology & Psychotherapy*, *18*(3), 250-255.

Segal Z.V., Williams J.M.G., Teasdale J.D. (2002). *Mindfulness-Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse.* New York, NY: Guilford Press.

Shapiro, S. L., Carlson, L. E., Astin, J. A., & Freedman, B. (2006). Mechanisms of mindfulness. *Journal of Clinical Psychology*, *62*(3), 373-386.

Tiffany, S. T., Friedman, L., Greenfield, S. F., Hasin, D. S., & Jackson, R. (2012). Beyond drug use: a systematic consideration of other outcomes in evaluations of treatments for substance use disorders. *Addiction*, *107*(4), 709-718.

Tofighi, D., & MacKinnon, D. P. (2011). RMediation: An R package for mediation analysis confidence intervals. *Behavior Research Methods*, *43*(3), 692-700.

Ware, J. E., Kosinski, M., Dewey, J. E., & Gandek, B. (2000). *SF-36 health survey: manual and interpretation guide*. Quality Metric Inc..

Ware, J., Jr., Kosinski, M., & Keller, S. D. (1996). A 12-Item Short-Form Health Survey: Construction of scales and preliminary tests of reliability and validity. *Medical Care, 34*, 220-233.

Whiteford, H. A., Degenhardt, L., Rehm, J., Baxter, A. J., Ferrari, A. J., Erskine, H. E., ... & Burstein, R. (2013). Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *The Lancet*, *382*(9904), 1575-1586.

Witkiewitz, K., & Black, D. S. (2014). Unresolved issues in the application of mindfulness-based interventions for substance use disorders. *Substance Use & Misuse*, *49*(5), 601-604.

Witkiewitz, K., & Bowen, S. (2010). Depression, craving, and substance use following a randomized trial of mindfulness-based relapse prevention. *Journal of Consulting and Clinical Psychology*, *78*(3), 362–74.

Witkiewitz, K., Bowen, S., Douglas, H., & Hsu, S. H. (2013). Mindfulness-based relapse

    prevention for substance craving. *Addictive Behaviors*, *38*(2), 1563–71.

Witkiewitz, K., Bowen, S., Harrop, E. N., Douglas, H., Enkema, M., & Sedgwick, C.

    (2014). Mindfulness-based treatment to prevent addictive behavior relapse:

    theoretical models and hypothesized mechanisms of change. *Substance Use &*

    Misuse, *49*(5), 513-524.

Witkiewitz, K., Warner, K., Sully, B., Barricks, A., Stauffer, C., Thompson, B. L., &

    Luoma, J. B. (2014). Randomized trial comparing mindfulness-based relapse

    prevention with relapse prevention for women offenders at a residential addiction

    treatment center. *Substance Use & Misuse*, *49*(5), 536-546.

Zemestani, M., & Ottaviani, C. (2016). Effectiveness of mindfulness-based relapse

    prevention for co-occurring substance use and depression

    disorders. *Mindfulness*, *7*(6), 1347-1355.

Table 1

Descriptive Statistics for the Study Sample, n (%) or mean (standard deviation (SD))

Variable	N (%) or Mean (SD)
Gender	
Male	59 (54.1%)
Female	50 (45.9%)
Race/Ethnicity	
African-American/Black	7 (6.4%)
Non-Hispanic White	28 (25.7%)
American Indian/Alaskan Native	9 (8.3%)
Hispanic/Latino	57 (52.3%)
Asian/Pacific Islander	0 (0%)
Mixed	5 (4.6%)
Other	2 (1.8%)
Missing	1 (0.9%)
Age	36.40 (9.4)
Married or in Committed Relationship	18 (16.7%)
Lifetime Inpatient or Intensive Outpatient Treatment Episodes	1.27 (1.58)
Detoxification Treatment Episodes	1.77 (1.44)
Primary Drug of Choice	
Alcohol	54 (49.5%)
Cocaine/Crack	7 (6.4%)
Methamphetamine	13 (11.9%)
Marijuana	1 (0.9%)
Heroin	14 (12.8%)
Opioid Pills	3 (2.8%)
Anti-anxiety Pills	1 (0.9%)
Missing	16 (14.7%)
Polysubstance Use	56 (52.8%)

Baseline Substance Dependence Severity	10.82 (3.01)
Treatment Length of Stay (in weeks)	3.52 (0.71)
Days Abstinent Before Baseline	12.21 (7.05)
Number of Rolling MBRP Sessions Attended	3.69 (2.12)
Distribution of MBRP Sessions Attendance	
Attended 0 Rolling MBRP Sessions	5 (4.6%)
Attended 1 Rolling MBRP Session	19 (17.4%)
Attended 2 Rolling MBRP Sessions	8 (7.3)
Attended 3 Rolling MBRP Sessions	20 (18.3%)
Attended 4 Rolling MBRP Sessions	16 (14.7%)
Attended 5 Rolling MBRP Sessions	17 (15.6%)
Attended 6 Rolling MBRP Sessions	13 (11.9%)
Attended 7 Rolling MBRP Sessions	9 (8.3%)
Attended 8 Rolling MBRP Sessions	1 (0.9%)
Attended 9 Rolling MBRP Sessions	1 (0.9%)

Table 2

Overview of Modules in Rolling MBRP

	Module	Learning Objectives	Mindfulness Practices and Other Content *Note: The Mindful Check-in is practiced every module
1.	Stepping Out of Autopilot	• To develop an understanding of the difference between "autopilot" and mindfulness • To learn about the role of autopilot in substance use • To learn that mindfulness can involve noticing certain details of the present moment, often pleasurable aspects, that we may miss out on when we are on autopilot (e.g., taste of food)	• Mindful Eating • Discussion of autopilot vs. mindfulness • SOBER space
2.	Mindfulness and Thoughts	• To practice stepping back and observing thoughts as words or images that arise in the mind, rather than facts about reality • To practice the process of noticing when the mind gets carried away by thoughts and then returning one's attention to a focal point (e.g., the breath) • To develop an understanding of how mindful awareness of thoughts in challenging situations can create perspective and improve our ability to respond skillfully	• Mindfulness of Thoughts • Discussion about the nature of thoughts and types of thoughts • Mindful Breathing Meditation
3.	Mindfulness and Valued Living	• To develop greater clarity about valued directions in different life domains • To develop greater clarity about how one's values may play a role in the recovery process • To understand that mindfulness skills, particularly the SOBER space, are not just skills for avoiding substances but can be used to make conscious choices that are consistent with values in many life domains	• SOBER space • Values Worksheet

4.	Developing a Mindfulness Practice	• To practice paying attention to body sensations as a way to connect to present moment experience • To understand how mindfulness is practiced and how individuals develop a personal mindfulness practice	• Body Scan • Discuss the process of developing a personal mindfulness practice
5.	Self-compassion	• To develop an understanding of how kindness towards oneself may be helpful in the process of mindfully checking-in with oneself during difficult moments • To explore the benefits of cultivating compassion toward oneself and others more generally during the recovery process	• Kindness Meditation • Discussion about compassion and self-compassion
6.	Mindfulness in Challenging Situations	• To learn how the SOBER space can be used in high-risk situations, including substance-related situations • To understand how mindfulness in general applies to a range of different challenging or stressful situations	• SOBER Space in a Challenging Situation Exercise • Discussion of using the SOBER space in challenging situations
7.	Mindfulness and Emotions	• To learn different ways of relating to emotions, such as labeling emotions or intentionally making room for difficult emotions. • To develop an understanding of how acceptance and change go together in the recovery process	• Mindfulness of Emotions Practice • Guest House Poem • Discussion about bringing mindfulness to emotions
8.	Checking in During Difficult Moments	• To practice pausing and bringing gentle curiosity towards internal experiences as they occur, including urges or bothersome internal experience • To practice approaching difficult experiences staying with and observing clearly what is actually happening, in order to ultimately facilitate conscious and adaptive responses instead of reflective or unhelpful reactions.	• Discussion about body sensations, emotions, thoughts, actions, and their differences and interconnections • Checking-In During a Difficult Moment Exercise (a variant of urge surfing)

Table 3

Assessment Schedule

Measure	Description/Purpose	Baseline	Post
Demographic Questionnaire	Gender, age, race/ethnicity, marital status	X	
Treatment History Item	Prior inpatient or intensive outpatient treatment	X	
Severity of Dependence Scale (SDS)	Substance Use Disorder Severity	X	
Self-compassion Scale-Short Form (SCS)	Self-reported self-compassion	X	X
Cognitive and Affective Mindfulness Scale (CAMS)	Self-reported mindfulness	X	X
Short Form Health Survey (SF-12)	Self-reported mental health	X	X
Penn Alcohol Craving Scale (PACS)	Self-reported craving for alcohol/drugs	X	X
Self-efficacy item	Self-reported confidence to stay abstinent	X	X
Avoidance and Inflexibility Scale (AIS)	Self-reported regulatory inflexibility for internal substance-related triggers	X	X
Regulatory Flexibility Scale (RFS)	Self-reported general regulatory flexibility	X	X
Valued Living Scale (VLS)	Self-reported life goal importance, success, and confidence	X	X
Treatment Length Item	Length of treatment stay at Turquoise Lodge		X
Mindfulness Group Follow-up Questionnaire	Self-reported mindfulness practice and satisfaction ratings of rolling MBRP		X

Table 4

*Bivariate Correlations (Significant Correlations in **Bold**) and Internal Consistency Reliabilities (Underlined) for Key Study Variables*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Number of Sessions Attended	--	**.235**	**.294**	.183	-.132	.071	.189	**-.281**	-.009	-.069	.070	**.264**	-.048	-.021	-.051	-.161	.190	.037
2. Informal Practice-Frequency		.891	**.778**	**.665**	-.190	.090	**.336**	**.353**	**.422**	-.146	**.300**	**.400**	.104	-.049	-.213	-.003	.021	-.123
3. Formal Practice-Frequency			--	**.812**	-.122	.071	**.332**	**.260**	**.308**	-.177	.247	**.381**	.086	-.165	**-.222**	-.032	-.011	-.074
4. Formal Practice Typical duration				.760	-.105	.129	**.28**	**.258**	**.347**	-.084	**.294**	**.385**	.186	-.193	-.160	.036	.003	.013
5. Craving-P					.875	**-.565**	**-.508**	**-.562**	**-.290**	**.582**	**-.412**	**-.419**	**.212**	-.025	-.128	.034	**-.312**	-.082
6. Abstinence Self Efficacy-P						--	**.522**	**.338**	**.239**	**-.50**	**.476**	**.432**	-.033	.054	-.049	-.185	.134	.152
7. Confidence to Achieve Valued Goals-P							.748	**.387**	**.371**	**-.293**	**.302**	**.263**	-.083	-.050	-.099	-.086	.157	-.145
8. Mental Health-P								.721	**.36**	**-.350**	**.453**	**.480**	-.143	.017	-.038	**.024**	.224	.002
9. Regulatory Flexibility-P									.910	**-.245**	**.514**	**.457**	.173	.029	-.108	-.011	-.113	-.035
10. Substance-Specific Inflexibility-P										--	**-.313**	**-.304**	.186	-.018	.216	.144	-.092	.004
11. Self-compassion-P											.803	**.572**	.090	-.066	-.023	-.046	.005	.179
12. Mindfulness-P												.868	-.064	-.119	-.090	-.132	.036	.140
13. Substance Dependence Severity													.755	.073	-.052	.046	**-.266**	-.053
14. Gender														--	-.085	-.013	-.006	-.046
15. Age															--	-.045	.156	.079
16. Race																--	-.140	.079
17. Length of Treatment																	--	-.030
18. Days Abstinent Prior to Baseline																		--

Note. Bolded font = $p < .05$. P = measured at the Post assessment; Underlined values on the diagonal are the Cronbach's alphas for multi-item measures.

Table 5

Comparison Between Adequate Dose Group and Minimal Dose Group on Baseline Demographic and Treatment-Related Variables

| | Means (*SD*) or *n* (%) | | |
	Adequate Dose Group (attended ≥2 sessions)	Minimal Dose Group (attended one or no sessions)	*P*-Value
Craving-B	10.21 (7.94)	9.41 (8.52)	.680
Abstinence Self Efficacy-B	8.53 (1.88)	8.35 (1.96)	.685
Confidence to Achieve Valued Goals-B	26.82 (3.73)	24.91 (5.59)	.059
Mental Health-B	5.67 (2.14)	6.08 (2.30)	.416
Regulatory Flexibility-B	58.29 (16.96)	57.65 (17.07)	.874
Substance-Specific inflexibility-B	9.43 (5.87)	8.26 (6.62)	.114
Self-compassion-B	20.49 (8.32)	22.14 (9.06)	.421
Mindfulness-B	15.24 (6.25)	15.00 (7.40)	.872
Substance Dependence Severity	10.67 (3.10)	11.37 (2.67)	.312
Female Gender	38 (44.7%)	12 (50.0%)	.646
Age	36.10 (9.39)	37.42 (9.56)	.548
Racial/Ethnic Minority	61 (71.8%)	19 (82.6%)	.292
Days Abstinent Prior to Baseline	12.28 (7.39)	11.96 (5.82)	.843

Note. $* p < 0.05 ** p < 0.01$. B = measured at baseline.

Table 6

Continuous Attendance Variable (Number of Sessions) as a Predictor of MOBC Variables

	MOBC Variables							
	Craving	Abstinence Self-efficacy	Confidence to Achieve Valued Goals	Mental Health	Regulatory flexibility	Substance-specific inflexibility	Self-Compassion	Mindfulness
Number of Sessions Attended	B = - 0.275 SE = 0.257 β = - 0.114	B = - 0.060 SE= 0.077 β = - 0.081	B = 0.187 SE = 0.166 β = 0.123	B = 0.154 SE = 0.087 β = 0.198	B = 0.544 SE = 0.779 β = 0.079	B = 0.010 SE = 0.241 β = 0.004	B = 0.185 SE = 0.402 β = 0.055	B = 0.504 SE = 0.278 β = 0.222
Baseline Score Dependent Variable	B = 0.227 SE = 0.068** β = 0.350	B = 0.338 SE = 0.087** β = 0.428	B = 0.346 SE = 0.097** β = 0.436	B = - 0.031 SE = 0.09 β = - 0.039	B = 0.393 SE = 0.101 ** β = 0.443	B = 0.324 SE = 0.088** β = 0.401	B = 0.025 SE = 0.105 β = 0.030	B = 0.164 SE = 0.090 β = 0.216
Substance Dependence Severity	B = 0.307 SE = 0.191 β = 0.170	B = 0.030 SE= 0.058 β = 0.054	B = - 0.180 SE= 0.121 β = - 0.156	B= - 0.010 SE= 0.067 β = - 0.016	B = 0.318 SE = 0.578 β = 0.064	B = 0.219 SE = 0.192 β = 0.120	B = 0.293 SE = 0.297 β = 0.118	B = - 0.111 SE = 0.209 β = - 0.062
Gender (0 = male, 1 = female)	B = - 1.100 SE = 1.040 β = - 0.108	B = 0.298 SE = 0.31 β = 0.096	B = - 1.333 SE = 0.674* β = - 0.203	B = 0.237 SE = 0.373 β =0.071	B = 2.764 SE = 3.243 β = 0.097	B = - 0.294 SE = 0.983 β = - 0.031	B = - 0.498 SE= 1.674 β = - 0.035	B = - 0.779 SE = 1.143 β = - 0.079
Age	B = - 0.058 SE = 0.054 β = - 0.112	B = -0.001 SE = 0.017 β = - 0.007	B = 0.000 SE = 0.039 β = - 0.001	B = 0.016 SE = 0.019 β = 0.094	B = - 0.012 SE = 0.188 β = - 0.008	B = 0.094 SE = 0.053 β = 0.191	B = - 0.036 SE =0.087 β = - 0.049	B = - 0.016 SE = 0.059 β = - 0.031
Race (0 = white, 1 = racial/ethnic minority)	B = - 0.230 SE = 1.182 β = - 0.020	B = -0.412 SE = 0.359 β = - 0.120	B = -0.343 SE= 0.740 β = - 0.048	B = - 0.019 SE= 0.410 β = - 0.005	B = 0.612 SE= 3.453 β = 0.020	B = 1.565 SE= 1.071 β = 0.152	B = -1.006 SE = 1.828 β = - 0.065	B = - 1.002 SE = 1.267 β = - 0.093
Length of Treatment	B = - 1.151 SE = 0.811 β = - 0.158	0.132 SE = 0.244 β = 0.059	B = - 0.523 SE = 0.565 β = - 0.111	B = 0.367 SE = 0.272 β = 0.156	B = - 4.494 SE= 2.429 β = - 0.215	B = 0.084 SE= 0.753 β =0.012	B = 0.559 SE= 1.221 β = 0.0057	B = - 0.230 SE = 0.921 β = - 0.031
Days Abstinent Prior to Baseline	B = 0.018 SE = 0.077 β = 0.025	B = 0.025 SE = 0.023 β = 0.112	B = - 0.081 SE = 0.048 β = - 0.173	B = 0.004 SE = 0.027 β = 0.018	B = - 0.341 SE = 0.250 β = - 0.154	B = 0.028 SE = 0.071 β =0.042	B = 0.128 SE= 0.124 β = 0.124	B = 0.058 SE = 0.084 β = 0.082

Note. * = $p < .05$; ** = $p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error.

Table 7

Binary Attendance Variable (At Least 2 Sessions) as a Predictor of MOBC Variables

	MOBC Variables							
	Craving	Abstinence Self-efficacy	Confidence to Achieve Valued Goals	Mental Health	Regulatory flexibility	Substance-specific inflexibility	Self-Compassion	Mindfulness
Attended at Least Two Sessions (0 = No, 1 = Yes)	B = - 0.673 SE = 1.478 β = -0.048	B = - 0.237 SE = 0.438 β = -0.055	B = 1.161 SE = 1.011 β = 0.125	B = 1.214 SE = 0.479* β = 0.277	B = 2.574 SE = 4.464 β = 0.062	B = 1.254 SE = 1.425 β = 0.090	B = 0.461 SE = 0.323 β = 0.163	B = 4.391 SE = 1.461** β = 0.351

Note. $* = p < .05$; $** = p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error.

Table 8

Frequency of Informal Mindfulness Practice as a Predictor of MOBC Variables

	MOBC Variables							
	Craving	Abstinence Self-efficacy	Confidence to Achieve Valued Goals	Mental Health	Regulatory flexibility	Substance-specific inflexibility	Self-Compassion	Mindfulness
Frequency of Informal Practice	B = -0.451 SE = 0.117 ** β = -0.377	B = -0.003 SE = 0.040 β = -0.008	B = 0.193 SE = 0.086* β = 0.235	B = 0.169 SE = 0.041** β = 0.441	B = 1.232 SE = 0.356** β = 0.369	B = - 0.190 SE = 0.116 β = -0.175	B = 0.526 SE = 0.186** β = 0.319	B = 0.534 SE = 0.133** β = 0.433

Note. * = $p < .05$; ** = $p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error.

Table 9

Frequency of Formal Mindfulness Practice as a Predictor of MOBC Variables

	MOBC Variables							
	Craving	Abstinence Self-efficacy	Confidence to Achieve Valued Goals	Mental Health	Regulatory flexibility	Substance-specific inflexibility	Self-Compassion	Mindfulness
Frequency of Formal Practice	B = -1.166 SE = 0.474* β = -0.257	B = -0.076 SE = 0.157 β = -0.052	B = 0.849 SE = 0.317** β = 0.279	B = 0.527 SE = 0.163** β = 0.362	B = 3.561 SE = 1.50* β = 0.270	B = -0.651 SE = 0.460 β = -0.153	B = 1.640 SE = 0.727* β = 0.261	B = 1.943 SE = 0.491** β = 0.449

Note. * = $p < .05$; ** = $p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error.

Table 10

Typical Duration of Formal Mindfulness Practice as a Predictor of MOBC Variables

	MOBC Variables							
	Craving	Abstinence Self-efficacy	Confidence to Achieve Valued Goals	Mental Health	Regulatory flexibility	Substance-specific inflexibility	Self-Compassion	Mindfulness
Typical duration of formal mindfulness practice	B = - 1.074 SE =0.485* β = -0.240	B = 0.192 SE = 0.159 β = 0.134	B = 0.838 SE = 0.317* β = 0.285	B = 0.526 SE = 0.170** β = 0.358	B = 3.22 SE = 1.598* β = 0.238	B = - 0.296 SE = 0.474 β = -0.072	B = 2.521 SE = 0.740 ** β =0.396	B = 2.512 SE = 0.552** β = 0.533

Note. * = p < .05; ** = p < .01. B = unstandardized coefficient; β = standardized coefficient; SE = standard error.

Table 11

Baseline to Post Changes in MOBC Variables

	MOBC Variables							
	Craving	Abstinence Self-efficacy	Confidence to Achieve Valued Goals	Mental Health	Regulatory flexibility	Substance-specific inflexibility	Self-Compassion	Mindfulness
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
"Minimal Dose Group" Attended Less than 2 sessions (*n* = 15, with both baseline and post data)	Baseline: 8.31 (7.64)	Baseline: 7.77 (2.09)	Baseline: 21.91 (6.06)	Baseline: 6.47 (2.23)	Baseline: 58.30 (15.32)	Baseline: 10.20 (7.16)	Baseline: 22.33 (9.74)	Baseline: 14.57 (8.14)
	Post: 6.07 (5.36)	Post: 8.69 (1.97)	Post: 25.55 (5.08)	Post: 6.13 (2.17)	Post: 73.90 (15.99)	Post: 4.80 (4.13)	Post: 28.66 (8.18)	Post: 16.76 (6.36)
	Change: -2.23 (8.61)	Change: 0.92 (2.06)	Change: 3.64 (7.05)	Change: 0.33 (3.33)	Change: 15.60 (22.08)	Change: -5.40 (5.97)*	Change: 6.33 (14.03)	Change: 2.21 (9.24)
	Cohen's *d*: 0.25	Cohen's *d*: 0.44	Cohen's *d*: 0.52	Cohen's *d*: 0.09	Cohen's *d*: 0.71	Cohen's *d*: 0.90	Cohen's *d*: 0.45	Cohen's *d*: 0.24
"Adequate Dose Group" Attended 2 or more sessions (*n* = 68, with both baseline and post data)	Baseline: 10.50 (7.92)	Baseline: 8.52 (1.91)	Baseline: 27.00 (3.46)	Baseline: 5.67 (2.17)	Baseline: 59.27 (16.37)	Baseline: 9.66 (5.78)	Baseline: 20.78 (8.24)	Baseline: 15.41 (6.26
	Post: 5.58 (5.02)	Post: 8.81 (1.47)	Post: 27.76 (2.68)	Post: 7.46 (1.50)	Post: 73.64 (13.92)	Post: 5.75 (4.77)	Post: 31.83 (6.74)	Post: 22.10 (4.17)
	Change: -4.91 (7.51)*	Change: 0.29 (1.80)	Change: 0.76 (3.61)	Change: 1.79 (2.55)*	Change: 14.37 (16.40)*	Change: -3.91 (5.46)*	Change: 11.08 (9.85)*	Change: 6.69 (6.55)*
	Cohen's *d*: 0.65	Cohen's *d*: 0.16	Cohen's *d*: 0.21	Cohen's *d*: 0.70	Cohen's *d*: 0.88	Cohen's *d*: 0.72	Cohen's *d*: 1.12	Cohen's *d*: 1.02

Note. * = mean difference is significant at $p < .05$ from paired samples t-test; M = Mean; SD = Standard Deviation.

Table 12

Indirect Effects of Number of Sessions on MOBC Variables Via Frequency of Informal Mindfulness Practice

MOBC Variables							
Craving Model	Abstinence Self-efficacy Model	Confidence to Achieve Valued Goals Model	Mental Health Model	Regulatory flexibility Model	Substance-specific inflexibility Model	Self-Compassion Model	Mindfulness Model
B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Effect of Number of Sessions on Informal Practice: 0.495 (0.238)*	Effect of Number of Sessions on Informal Practice: 0.509 (0.234)*	Effect of Number of Sessions on Informal Practice: 0.528 (0.234)*	Effect of Number of Sessions on Informal Practice: 0.472 (0.224)*	Effect of Number of Sessions on Informal Practice: 0.585 (0.235)*	Effect of Number of Sessions on Informal Practice: 0.555 (0.070)*	Effect of Number of Sessions on Informal Practice: 0.496 (0.231)*	Effect of Number of Sessions on Informal Practice: 0.500 (0.235)*
Effect of Informal Practice on MOBC: -0.442 (0.122)**	Effect of Informal Practice on MOBC: - 0.003 (0.041)	Effect of Informal Practice on MOBC: 0.171(0.089)	Effect of Informal Practice on MOBC: 0.163 (0.042)**	Effect of Informal Practice on MOBC: 1.238 (0.383)**	Effect of Informal Practice on MOBC: -0.202 (0.118)	Effect of Informal Practice on MOBC: 0.520 (0.190)**	Effect of Informal Practice on MOBC: 0.486 (0.134)**
Indirect Effect of Number of Sessions on MOBC Via Informal Practice: -0.219 (0.125)* 95% CI [-0.496, -0.011]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: -0.002 (0.023) 95% CI [-0.05, 0.046]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: 0.073 (0.06) 95% CI [-0.02, 0.214]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: 0.077 (0.043)* 95% CI [0.005, 0.171]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: 0.724 (0.378)* 95% CI [0.112, 1.576]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: -0.112 (0.068) 95% CI [-0.25, 0.016]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: 0.258 (0.159)* 95% CI [0.01, 0.622]	Indirect Effect of Number of Sessions on MOBC Via Informal Practice: 0.243 (0.136)* 95% CI [0.016, 0.546]

Note. * = $p < .05$; ** = $p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error; CI = Confidence Interval. All models included the following covariates as predictors of number of sessions, informal practice, and the dependent variable: baseline value of the dependent variable, substance dependence severity, gender, age, race, length of stay, and days abstinent prior to baseline.

Table 13

Indirect Effects of Number of Sessions on MOBC Variables Via Frequency of Formal Mindfulness Practice

MOBC Variables							
Craving Model	Abstinence Self-efficacy Model	Confidence to Achieve Valued Goals Model	Mental Health Model	Regulatory flexibility Model	Substance-specific inflexibility Model	Self-Compassion Model	Mindfulness Model
B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Effect of Number of Sessions on Formal-F: 0.185 (0.060)**	Effect of Number of Sessions on Formal-F: 0.178 (0.059)**	Effect of Number of Sessions on Formal-F: 0.173 (0.060)**	Effect of Number of Sessions on Formal-F: 0.148 (0.018)**	Effect of Number of Sessions on Formal-F: 0.192 (0.060)**	Effect of Number of Sessions on Formal-F: 0.188 (0.060)**	Effect of Number of Sessions on Formal-F: 0.173 (0.058)*	Effect of Number of Sessions on Formal-F: 0.146 (0.060)*
Effect of Formal-F on MOBC: -1.035 (0.517)*	Effect of Formal-F on MOBC: -0.081 (0.168)	Effect of Formal-F on MOBC: 0.780 (0.341)*	Effect of Formal-F on MOBC: 0.495 (0.172)**	Effect of Formal-F on MOBC: 3.386 (1.675)*	Effect of Formal-F on MOBC: -0.756 (0.491)	Effect of Formal-F on MOBC: 1.662 (0.771)*	Effect of Formal-F on MOBC: 1.780 (0.501)**
Indirect Effect of Number of Sessions on MOBC Via Formal-F: -0.191 (0.118)* 95% CI [-0.459, -0.002]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: -0.014 (0.032) 95% CI [-0.083, 0.047]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: 0.135 (0.078)* 95% CI [0.012, 0.313]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: 0.073 (0.027)** 95% CI [0.023, 0.129]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: 0.659 (0.393)* 95% CI [0.013, 1.538]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: -0.142 (0.107) 95% CI [-0.383, 0.037]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: 0.288 (0.171)* 95% CI [0.016, 0.675]	Indirect Effect of Number of Sessions on MOBC Via Formal-F: 0.260 (0.133)* 95% CI [0.041, 0.557]

Note. $* = p < .05$; $** = p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error; CI = Confidence Interval; Formal-F = Frequency of Formal Mindfulness Practice; All models included the following covariates as predictors of number of sessions, formal practice, and the dependent variable: baseline value of the dependent variable, substance dependence severity, gender, age, race, length of stay, and days abstinent prior to baseline.

Table 14

Indirect Effects of Number of Sessions on MOBC Variables Via Typical Duration of Formal Practice (Formal-D)

MOBC Variables							
Craving Model	Abstinence Self-efficacy Model	Confidence to Achieve Valued Goals Model	Mental Health Model	Regulatory flexibility Model	Substance-specific inflexibility Model	Self-Compassion Model	Mindfulness Model
B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Effect of Number of Sessions on Formal-D: 0.076(0.059)	Effect of Number of Sessions on Formal-D: 0.097(0.057)	Effect of Number of Sessions on Formal-D: 0.092(0.059)	Effect of Number of Sessions on Formal-D: 0.086 (0.055)	Effect of Number of Sessions on Formal-D: 0.105 (0.058)	Effect of Number of Sessions on Formal-D: 0.114 (0.058)*	Effect of Number of Sessions on Formal-D: 0.085 (0.056)	Effect of Number of Sessions on Formal-D: 0.056 (0.060)
Effect of Formal-D on MOBC: -1.127(0.546)*	Effect of Formal-D on MOBC: 0.223 (0.173)	Effect of Formal-D on MOBC: 0.858 (0.342)*	Effect of Formal-D on MOBC: 0.538 (0.184)**	Effect of Formal-D on MOBC: 2.958 (1.648)	Effect of Formal-D on MOBC: -0.397 (0.542)	Effect of Formal-D that on MOBC: 2.628(0.770)**	Effect of Formal-D on MOBC: 2.370 (0.540)**
Indirect Effect of Number of Sessions on MOBC Via Formal-D: -0.086 (0.085) 95% CI [-0.286, 0.046]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: 0.022 (0.023) 95% CI [-0.013, 0.078]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: 0.079 (0.063) 95% CI [-0.02, 0.214]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: 0.041 (0.035) 95% CI [-0.017, 0.12]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: 0.335 (0.263) 95% CI [-0.05, 0.957]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: -0.067 (0.077) 95% CI [-0.248, 0.058]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: 0.194 (0.145) 95% CI [-0.033, 0.53]	Indirect Effect of Number of Sessions on MOBC Via Formal-D: 0.142 (0.132) 95% CI [-0.096, 0.429]

Note. * = $p < .05$; ** = $p < .01$. B = unstandardized coefficient; β = standardized coefficient; SE = standard error; CI = Confidence Interval; Formal-D = Typical duration of Formal Mindfulness Practice; All models included the following covariates as predictors of number of sessions, informal practice, and the dependent variable: baseline value of the dependent variable, substance dependence severity, gender, age, race, length of stay, and days abstinent prior to baseline.
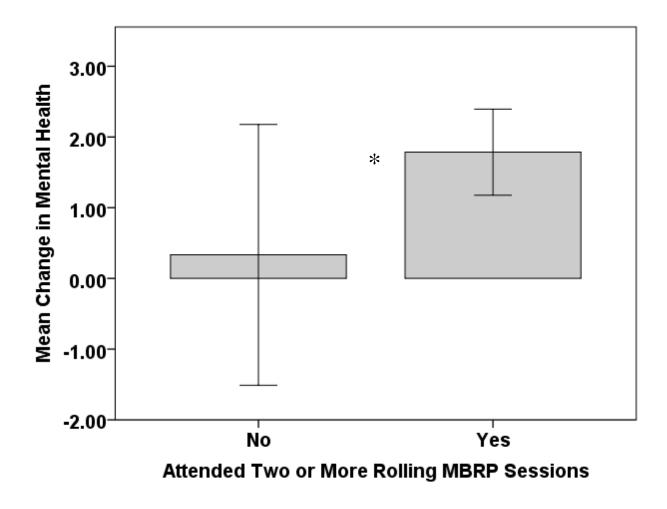
Figure 1. Mean change in mental health from baseline to post-assessment by rolling MBRP attendance. Error bars are 95% confidence interval. Scores on the mental health subscale can range from 0 to 10; higher scores indicate better mental health. * = mean difference is significant at $p < .05$
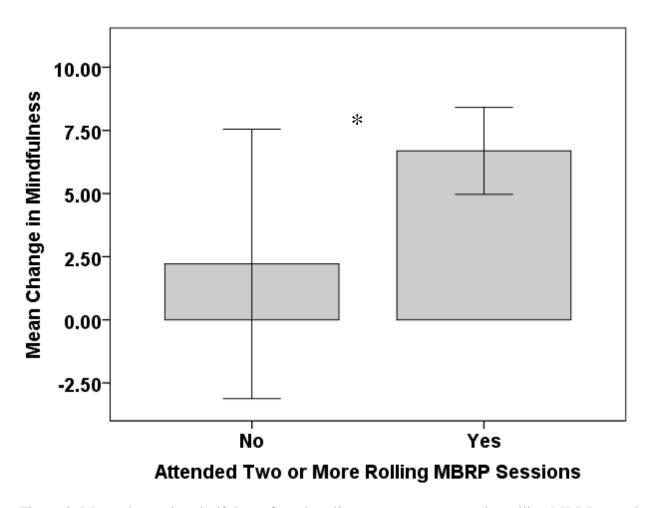
Figure 2. Mean change in mindfulness from baseline to post-assessment by rolling MBRP attendance. Error bars are 95% confidence interval. Total mindfulness scores can range from 0 to 30. * = mean difference is significant at $p < .05$