



Published in final edited form as:

Psychol Addict Behav. 2017 December ; 31(8): 888–896. doi:10.1037/adb0000319.

Mindfulness-Based Interventions for Addictive Behaviors: Implementation Issues on the Road Ahead

Adam D. Wilson¹, Corey R. Roos¹, Charles S. Robinson¹, Elena R. Stein¹, Jacob A. Manuel², Matthew C. Enkema³, Sarah Bowen², and Katie Witkiewitz¹

¹Department of Psychology, University of New Mexico

²Department of Psychology, Pacific University

³Department of Psychology, University of Washington

Abstract

Over the past 35 years, mindfulness meditation practices have increasingly been integrated into Western medical settings. Research into the benefits of mindfulness-based interventions (MBIs) continues to expand, such that there are currently more than a dozen different protocolled MBIs for patients suffering from a variety of physical and psychological disorders. In the last decade, a number of MBIs specifically designed to treat addictive behaviors have been developed and tested. This review first provides a brief overview of the current state of the science with respect to the efficacy of MBIs for addictive behaviors, and some of the proposed mechanisms underlying the efficacy of MBIs. Second, the review highlights unresolved implementation issues and provides suggestions for how future research can address the implementation challenges in order to advance the delivery of MBIs. Specifically, this review focuses on the lack of clear empirical guidelines in the following areas: 1) effective training for MBI treatment providers; 2) adaptations of the traditional two-hour closed-cohort group format; 3) delivery of MBIs in one-on-one treatment contexts; 4) delivery of MBIs at different points in the change process; 5) delivery of MBIs via technology-based platforms; and 6) facilitation of precision medicine in the delivery of MBIs. Specific research directions are suggested with an eye towards a meaningful increase in access to MBIs for front-line clinicians and clients.

Keywords

mindfulness; mindfulness-based interventions; addictive behaviors; implementation; mechanism of change

Introduction

In the 35 years since Kabat-Zinn (1982) integrated secularized mindfulness-based practices into traditional Western medical settings, there has been a steady growth in interest and investigation of such interventions for a variety of medical and psychological disorders.

Kabat-Zinn's Mindfulness-Based Stress Reduction program (MBSR; Kabat-Zinn, 1990), developed as a treatment for chronic pain and other chronic medical conditions, provided a format for an integrated, secularized intervention protocol consisting of 8 weekly group sessions. This format has since been expanded and modified for a number of different clinical populations and settings, such as Mindfulness Based Cognitive Therapy for depression (MBCT; Segal, Williams, & Teasdale, 2002), Mindfulness-Based Childbirth and Parenting (MBCP; Duncan & Bardacke, 2010), Mindfulness-Based Elder Care (MBEC; McBee 2008), Mindfulness-Based Therapy for Insomnia (MBT-I; Ong & Sholtes, 2010), and Mindfulness Based Eating Awareness Training (MB-EAT; Kristeller, Wolever, & Sheets, 2014).

Interventions specific to addictive behaviors include Mindfulness-Based Relapse Prevention (MBRP; Bowen, Chawla, & Marlatt, 2010; Witkiewitz, Marlatt, & Walker, 2005), MBRP for Women (MBRP-W; Amaro, Spear, Vallejo, Conron, & Black, 2014), Mindfulness-Based Substance Abuse Treatment for Adolescents (MBSAT; Himmelstein, Saul, & Garcia-Romeu, 2015), Mindfulness Training for Smokers (MTS; Davis et al., 2014a; Davis, Manley, Goldberg, Smith, & Jorenby, 2014b), Mindfulness-Based Addiction Treatment (MBAT; Vidrine et al., 2016), and Mindfulness-Oriented Recovery Enhancement (MORE; Garland et al., 2014). In addition, certain "third-wave" behavioral treatments that have been applied to addictive behaviors include modules designed to increase mindfulness. For example, both Acceptance and Commitment Therapy (ACT; Hayes, Strosahl & Wilson, 1999) and Dialectical Behavior Therapy (DBT; Linehan et al., 2006) include mindfulness practices as part of treatment.

Despite the growing presence of MBIs, there continues to be a lack of consensus regarding how mindfulness should best be operationalized and measured (Davidson, 2010; Chiesa, 2013). A working conceptualization might characterize mindfulness as non-judgmental awareness and acceptance of present moment experience (Bishop et al., 2004; Kabat-Zinn, 1994). Arising from the contemplative traditions and Buddhist philosophy, mindfulness in its current 21st century incarnation in medical and psychological contexts can be understood as a secular approach to developing a more adaptive intrapersonal relationship with physical and psychological experience (Kabat-Zinn, 2011). Mindfulness-based interventions (MBIs) for addictive behaviors specifically target awareness of and reactions to craving and other aversive cognitive, affective, or physical states (Witkiewitz et al., 2014).

With the amount of research into MBIs increasing, efforts to translate research into practice naturally come up against implementation issues, challenges, and impediments. The purpose of this paper is two-fold. First, we provide a critical overview of the current state of collective scientific literature on MBIs for addictive behaviors. This includes a brief review of the evidence for efficacy, the proposed mechanisms of change, and the nature of the studies which constitute this evidence base. Second, we address key implementation issues brought to light by gaps in the science, and provide suggestions for how future research can address these issues to improve implementation efforts. These key limitations to implementation fall, broadly, into six categories for which guidelines and/or evidence are still lacking: 1) effective training for MBI treatment providers; 2) adaptations of the traditional two-hour closed-cohort group format; 3) delivering MBIs in one-on-one

treatment contexts; 4) delivering MBIs at different points in the change process; 5) delivery of MBIs via technology-based platforms; and 6) promotion of precision medicine in the delivery of MBIs.

The State of the Science: Efficacy of MBI's for Addictive Behaviors

A number of reviews and meta-analyses have examined the evidence supporting MBIs in the treatment of addictive behaviors. In a systematic review, Zgierska and colleagues (2009) reviewed 25 studies and found evidence of preliminary efficacy and safety. In a second systematic review, Chiesa and Serretti (2014) reviewed 24 studies and found evidence to suggest that MBIs support reduction in use of, and craving for, a variety of substances, including alcohol, amphetamines, cigarettes, cocaine, marijuana, and opioids. As shown in Table 1, there have been four meta-analyses of MBIs for addictive behaviors, all of which have provided support for MBIs in targeting addictive behaviors, consequences, and related outcomes (e.g., craving). With respect to behavioral addiction, Maynard and colleagues (2015) found moderate to large effect sizes in seven studies of MBIs for gambling behaviors/symptoms and financial outcomes. More recently, a meta-analysis of 33 studies by Li and colleagues (2017) found significant effects of MBIs in the reduction of substance misuse, craving, and stress.

Not surprisingly, however, given the relatively recent adaptation of MBIs for addictive behaviors, there are several mixed findings. For example, the Li and colleagues (2017) meta-analysis concluded there was evidence for the effectiveness of MBIs with respect to post-treatment smoking cessation abstinence rates when compared to alternative treatments; however, another recent meta-analysis of 10 RCTs by Maglione and colleagues (2017) found no statistically significant effects of mindfulness meditation treatments on cigarettes per day or abstinence rates when compared to active control conditions. Similarly, a recent meta-analysis by Grant and colleagues (in press) found no differences in abstinence rates or frequency/quantity of alcohol and drug use, but did find small effect sizes for the effect of MBRP on craving and negative consequences of alcohol/drug use. Recent meta-analyses shed light on the need for more large well designed RCTs in this area, as the low quality of evidence supporting efficacy in these studies was to some degree attributable to the small number of studies, heterogeneity of interventions and control conditions, lack of precision in reporting results, and statistically significant findings for publication bias. For example, the Grant et al (in press) meta-analysis included studies that ranged in size from 24 subjects to 286 subjects. Many of the smaller studies had very wide confidence intervals and low quality of evidence, which likely contributed to the mixed findings.

The State of the Science: Mechanisms of Change

In addition to remaining questions around the generalizability and adaptability of MBIs across treatment contexts, more studies are needed to better understand how, why, and for whom MBIs for addictive behaviors are effective. Mechanisms proposed by Garland and Black (2014) and Witkiewitz and Black (2014) continue to generate empirical inquiry. Briefly, we review findings to date, as a foundation for our discussion of implementation issues in the second half of this paper.

Reductions in Reactivity—Several studies suggest that MBIs for substance use disorders (SUD) may reduce reactivity to various challenging experiences that can trigger substance use. Witkiewitz and Bowen (2010) found that MBRP attenuated the association between post-treatment negative affect and self-reported craving 2-months following treatment, which in turn predicted less post-treatment substance use at 4-months following treatment. Brewer and colleagues (2009) found that individuals with SUDs showed less physiological reactivity and subjective distress during a stress provocation task among those who received mindfulness training as compared to CBT. Garland, Gaylord, Boettiger, and Howard (2010) found that individuals with SUD exhibited increased physiological recovery from alcohol-related cues (e.g., pictures of alcohol) if they received mindfulness training as compared to treatment as usual. Finally, Garland, Froeliger, and Howard (2014) found that individuals with chronic pain and opioid use problems exhibited increased physiological recovery from opioid-related cues (e.g., pictures of opioids) and decreased subjective craving following the cue exposure task if they received MORE as compared to a social support control group.

Mindfulness Practice—MBIs typically include assignments to practice mindfulness both formally and informally between the weekly sessions. However, research to date provides only some support for practice as a mechanism of change. Elwafi and colleagues (2013) found frequency of informal mindfulness practice (e.g., using mindfulness in daily life or to manage craving) moderated the association between post-treatment craving and smoking. Specifically, among cigarette smokers participating in mindfules training, those who more frequently engaged in informal mindfulness practice demonstrated a weaker association between craving and cigarette use at post-treatment. Another study by Grow and colleagues (2015) found greater time spent engaging in home practice was associated with subsequent reductions in substance use and craving at follow-up. Finally, a recent study by Enkema and Bowen (under review) found that following MBRP, formal mindfulness practice moderated the relationship between craving at post-course and number of substance use days at 6-month follow up.

Neurobiological mechanisms—There is extensive literature on the neurobiology of addiction and a growing body of literature on the neurobiological correlates of mindfulness, however very few studies have examined the neurobiological mechanisms of MBIs specifically for addictive behaviors. While there is preliminary evidence to suggest that MBIs may act on neurobiological systems in a corrective manner that restores more normal functioning in the disordered systems underlying addiction (Garland, Froeliger, & Howard., 2013), future investigations in this area are needed to ascertain whether mindfulness practices indeed have measurable effects on areas of the brain thought to be implicated in the neurocircuitry of addiction.

Witkiewitz and colleagues (2013) hypothesized that neuroimaging studies may identify functional alterations in the insula, anterior cingulate cortex (ACC), and amygdala indicative of reductions in bottom-up stress/cue-reactivity following MBIs for addictive behaviors. However, there is also evidence of improved functional connectivity of the dorsomedial prefrontal cortex (PFC) with the insula (Farb et al., 2007) and increased ACC/PFC coupling (Xue, Tang, & Posner, 2011) following mindfulness interventions, which may be indicative

of improved top-down control. Li and Sinha (2008) outlined the role of the ACC and mPFC in inhibitory control and emotion/stress regulation. Experienced meditators show greater processing in the ACC and mPFC, indicative of top-down control (Hölzel et al., 2007). However, further research, specifically with populations suffering from addictive disorders, is necessary to determine whether any improvements in functional connectivity related to top down control systems have a meaningful impact with respect to substance use behavior.

A number of reviews highlight the potential impact of mindfulness practices on the neural circuitry supporting attention, emotion regulation, interoception, and conflict monitoring. Specific brain regions implicated in these functions include the insula, ACC, temporoparietal junction (TPJ), inferior frontal cortex, hippocampus, amygdala, dorsolateral PFC, and medial PFC (mPFC; Hölzel et al., 2011; Garland et al., 2013). It has been proposed that these regions work together to support present-moment awareness, allowing an individual to notice, attend to, and better cope with the craving and stress-related cues that may trigger addictive behavior relapse. Rather than automatically engaging in learned substance use behaviors, the individual may develop the ability to notice the experience of craving and non-judgmentally respond (cf. Witkiewitz et al., 2013; Garland et al., 2013; McConnell & Froeliger, 2015).

We have briefly reviewed the current evidence on the efficacy of MBIs for addictive behaviors, and also provided examples of research beginning to investigate the proposed cognitive, behavioral, and neurobiological mechanisms of change that may play a role in the impact of these interventions. We argue, however, that any attempt to bridge the gap between efficacy and effectiveness must include a critical look at the challenges associated with delivering these treatments in real world settings, and attention to future research efforts that would resolve some of these issues. For example, of the 36 non-lab studies included in the Li et al., (2017) meta-analysis, 22 used some variation of the 90-to-180 minute closed-cohort group intervention format. Though there are notable exceptions (cf. Price et al., 2012; Himmelstein et al., 2015), many of the treatment studies to date have examined a relatively narrow range of delivery methods. Relatedly, there is currently little consensus around effective training for those delivering MBIs for substance use disorders, what adaptations may be necessary for delivery in a one-on-one settings, and whether MBI's for addictive disorders may appropriately and effectively be delivered via technology-based platforms. Addressing these implementation challenges would result not only in stronger research design and protocols for future investigations around efficacy and mechanisms of change, but also, importantly, greater real world adoption of the treatments determined to have a strong evidence base.

Key Implementation Issues and Future Directions to Address these Issues

1. Limited Guidelines around Effective Training for Treatment Providers—There are, at present, relatively few front-line clinicians trained to deliver MBIs for addictive behaviors. Part of this is likely due to natural dissemination challenges that all newer treatments endure. It is also possible, however, that many providers may view the necessity of having a personal mediation practice as an obstacle to their adoption and delivery of MBIs. While there is a strong and well-articulated rationale for clinicians having a personal

mediation practice (cf. Kabat-Zinn, 2003), and while MBIs generally require, or at least strongly advocate for, providers having an active practice of their own prior to and during delivery of these treatments, there are no empirical studies to support (or contradict) this requirement. More broadly, there is a general lack of empirical inquiry into best practices for training clinicians to effectively deliver MBIs.

To our knowledge, there are only two empirical studies specifically investigating the association between clinician competence and treatment outcome in the delivery of an MBI. Chawla and colleagues (2010) assessed the relationship between ratings on the Adherence and Competence scale, designed to assess MBRP therapist fidelity, and study outcomes in a positive trial of MBRP (Bowen et al., 2009). Analyses of 10 study therapists and 12 group-based MBRP cohorts (total of 93 MBRP participants) found that overall therapist adherence to protocol was positively related to increases in mindfulness over the 8-week course, but not to therapeutic alliance. No significant relationships were found, however, between ratings of therapist competence and either mindfulness or therapeutic alliance. Another study by Huijbers and colleagues (2017) used the Mindfulness-Based Interventions Teaching Assessment Criteria (MBI:TAC; Crane et al., 2013) to evaluate 15 providers of MBCT to 241 patients with recurrent depression. Results indicated that clinician competence had no statistically significant association with any of the outcomes (patient attendance, depressive symptoms post-treatment and at 15th month follow-up) or proposed mechanisms (mindfulness, cognitive reactivity, rumination, self-compassion) of interest. While these failures to detect a difference does not indicate that training is entirely inconsequential, it does speak to a clear need for more and better science in this area.

In addition to the MBI:TAC and MBRP Adherence and Competence Scale, researchers currently have at their disposal the MBCT Adherence Scale (Segal, Teasdale, Williams, & Gemar, 2002). While all of these scales have been consistently used to measure therapist fidelity to the treatment protocol (cf. Kuyken et al., 2008; Bowen & Kurz, 2012), the utility of these measures as outcomes of interest in a training paradigm, or as predictors of patient outcome in a treatment paradigm, remains largely uninvestigated. Moreover, no studies have investigated the relationship between clinicians' personal mindfulness practice and either competence ratings or participant outcomes.

In short, any progress toward a clinical science of MBIs for addictive behaviors must address what Dimidjian and Segal (2015) refer to as “the thorny question of clinician training” (p. 605). Recommendations differ widely across MBIs with respect to frequency and duration of both personal practice and formal training for providers. Empirical investigation will serve not only to answer questions from skeptics and non-adopters in the ranks of front-line clinicians, but also ensure that patients receive the best care possible from the providers who are, eventually, trained in these treatments.

2. Limited Guidelines around Adaptations of the Traditional Two-Hour Closed-Cohort Group Format—To date, most methodologically rigorous randomized controlled trials (RCTs) of MBIs for SUDs have delivered the MBI as a closed-cohort group treatment with 2-hour or 2.5-hour long treatment sessions (Li et al., 2017). In these closed-cohort groups, a cohort of individuals completes the treatment together over the course of 8 weeks,

without any new individuals joining the group. Unfortunately, closed-cohort groups may present logistical challenges. Many treatment settings may not have the staff resources to organize and successfully implement closed-cohort treatment groups (McHugh & Barlow, 2010). Additionally, in some cases, it may not be beneficial for a client to wait several weeks or months for the next closed-cohort group to begin. Treatment sessions that are 2 or 2.5 hours in length may present further logistical issues with regards to scheduling. Some clients may also find it difficult to stay fully engaged for 2 or 2.5 hours and shorter sessions might promote better engagement and learning (Didonna, 2009).

Accordingly, a key future direction is to develop and empirically evaluate MBIs for SUDs that are delivered in more flexible and accessible formats (Kazdin, 2017). An open or rolling admission group, in which newcomers and prior attendees can attend any treatment session, may be more feasible to implement in many treatment settings. However, there is still limited empirical evidence that rolling MBIs for SUDs are effective. Of note, there are a few existing studies using rolling (Witkiewitz et al., 2014) or partially rolling (Brewer et al., 2009) MBIs for SUDs, but by in large the evidence base for MBIs for SUDs is based on closed-cohort group treatments. Importantly, to date there are no published treatment manuals for rolling MBIs for SUD. Our research group has developed and is currently evaluating a manualized rolling admission version of MBRP for both an inpatient and outpatient setting (Roos, Witkiewitz, & Bowen, 2016). We are testing the rolling MBRP program with both 1-hour (in an inpatient setting) and 2-hour (in an outpatient setting) sessions. Results from these preliminary studies will provide further information on whether rolling admission group-based MBIs for SUDs are feasible, acceptable, and effective. Rolling admission MBIs for SUD, with the option of shorter treatment sessions, may ultimately expand the reach of MBIs for SUDs by facilitating the successful implementation of MBIs for SUDs in a diverse range of real-world treatment settings.

3. Limited Guidelines around Delivering MBIs in One-on-One and Brief

Treatment Contexts—The majority of empirical studies on MBIs for SUDs have delivered the MBI in an 8-week group format (Li et al., 2017), with only a limited number evaluating one-on-one treatment contexts. For example, there are several RCTs of MBRP and MORE, but all of these studies examine these group-based treatment formats (cf. Li et al., 2017). To date, there are no published treatment manuals of empirically supported MBIs for SUD delivered as one-on-one treatments. Hence, another key direction for future research is to conduct further work on *individually-delivered* MBIs for SUDs.

Research on *brief* individually-delivered versions of MBIs for SUDs would also expand the reach of MBIs for SUDs. Preliminary results are promising among studies of brief versions of MBIs for SUDs among young adults and college students. For instance, de Dios and colleagues (2013) found positive effects of a brief MBI (two 45-minute sessions) among female young adult marijuana users. Similarly, Mermelstein and Garske (2015) found positive treatment effects of a brief MBI (two 30-minute sessions) among college student heavy drinkers. However, the literature on brief MBIs for SUDs is still in its infancy and no studies have examined the extension of brief MBIs to primary care settings, an area of great potential for intervention.

Clinicians may draw from a variety of treatment approaches and techniques when conducting individual psychotherapy with a client. Therefore, clinicians may be interested in empirically-based guidelines for how to integrate mindfulness-based treatment components with other treatment methods when treating individuals with SUDs in one-on-one treatment contexts. A recently developed behavioral treatment for alcohol use disorder (AUD), called affect regulation treatment (ART; Stasiewicz et al., 2013) is one example of how mindfulness can be integrated with other treatment methods. ART is an individually-delivered treatment supplement to CBT for AUD and has preliminary empirical support as an effective treatment for negative affect drinkers (Stasiewicz et al., 2013). Mindfulness training is provided during the initial stages of the treatment to prepare clients for subsequent sessions of prolonged imaginal exposure to negative affect-related drinking situations. Further research could focus on whether mindfulness training may be particularly useful in helping clients tolerate and benefit from prolonged imaginal exposure or other exposure-based treatment methods (Brake et al., 2016). Overall, further research is needed to provide empirical guidelines on how mindfulness training can be integrated with other SUD treatment approaches.

4. Limited Guidelines around Delivering MBIs at Different Points in the Change Process—The majority of methodologically rigorous RCTs of MBIs for alcohol and drug use disorders (not including tobacco use disorders) have been conducted among individuals who have already reached some level of stabilization. For example, two out of the three RCTs of MORE were conducted among individuals living in therapeutic communities and who were not actively using substances (Garland, Gaylord, Boettiger, & Howard, 2010; Garland, Roberts-Lewis, Tronnier, Graves, & Kelley, 2016), and the primary RCTs of MBRP have been among individuals currently in outpatient-based aftercare treatment following the completion of inpatient treatment or intensive outpatient treatment (Bowen et al., 2009; Bowen et al., 2014), or among individuals who completed a four week inpatient detoxification and stabilization phase prior to starting MBRP groups (Witkiewitz et al., 2014).

A key future direction is to assess MBIs among individuals with alcohol and drug use disorders who are at a variety of stages in the change or recovery process, different levels of stabilization, and who may have different treatment (e.g., non-abstinence) goals. This will be critical for providing empirical guidelines about when MBIs are appropriate and effective in the recovery process. Given prior studies have primarily focused on MBIs in the context of abstinence-based programs and cessation studies, it is critical to study whether MBIs can also be useful for active users who may have harm reduction goals (e.g., reduced drinking, as opposed to abstinence).

5. Limited Evidence Addressing Delivery of MBIs via Technology-Based Platforms—Delivering MBIs for SUDs via technology-based platforms, such as web-based or smartphone-based interventions, is another area of research that could greatly expand the reach of these interventions. Technology-based interventions in general can improve access to empirically-supported treatments by circumventing barriers to effective

treatment delivery such as scheduling or transportation issues, lack of trained providers, and lack of general resources (Carroll & Rounsaville, 2010).

To date there are still a relatively small number of studies that have evaluated technology-based MBI for SUDs. However, preliminary studies on web-based and mobile-based MBIs for SUD interventions show promising results. For example, there are two studies on technology-based versions of acceptance and commitment therapy (ACT) for smoking cessation, an intervention that includes mindfulness training as one component (Bricker, Wyszynski, Comstock, & Heffner, 2013; Bricker et al., 2014). These studies demonstrated ACT for smoking cessation was effective when delivered as a web-based intervention (Bricker et al., 2013) or as a smartphone-based application (Bricker et al., 2014). Ruscio and colleagues (2016) evaluated the momentary effects of brief mindfulness training delivered via a personal digital assistant among adult smokers. Results indicated brief mindfulness training was effective in reducing both momentary craving and smoking over time. Furthermore, it is important to note that there is solid evidence that technology-based MBIs can be successfully delivered for other conditions like depression and anxiety (Cavanagh, Strauss, Forder, & Jones, 2014). Additional studies examining smartphone-based MBIs for SUD are underway. Garrison and colleagues (2015) are currently conducting a randomized controlled trial of a smartphone application-based mindfulness training program for smoking cessation.

Technology-based MBIs for SUD could be especially suitable and appealing for adolescents and young adults, who may be hesitant to seek out treatment in specialty SUD treatment settings. Given that MBIs for SUD may be particularly effective in promoting long-term recovery (Bowen et al., 2014), MBI components could be implemented into existing multifaceted technology-based continuing care interventions for SUDs, such as the smartphone-based intervention called Addiction-Comprehensive Health Enhancement Support System (A-CHESS; Gustafson et al., 2014), or the web-based program called the therapeutic education system (TES; Marsch et al., 2014).

6. Limited Promotion of Precision Medicine in the Delivery of MBIs—In line with the current ‘precision medicine’ movement in healthcare toward delivering customized, individually tailored treatments to patients, we argue that a better understanding of mechanisms of change and treatment moderators of MBIs for SUDs may facilitate precision medicine and improve treatment outcomes in the implementation of MBIs for SUDs. An ability to tailor treatment based on individual patient characteristics (moderators) or individual patient progress with respect to craving, reactivity, home practice or other proposed mechanisms, may improve retention and results. Investigations in this area may lead to more informed decisions about when and how to implement MBIs for SUDs to produce the maximum therapeutic benefit for clients in various settings (Kazdin, 2007; Longabaugh & Magill, 2011).

Recent studies have assessed client characteristics that may moderate the efficacy of MBIs. Witkiewitz and colleagues (2013) found MBRP was more effective in reducing post-treatment substance use than CBT among racial and ethnic minority women, but there were no differences in outcomes between these treatments among non-Hispanic white women.

Glasner and colleagues (2016) found MBRP reduced post-treatment substance use to a greater extent than a health education control among individuals with co-occurring diagnoses of major depression or generalized anxiety disorder, but there were no differences in outcomes between the treatment groups among those without these diagnoses. Similarly, Roos and colleagues (in press) found that MBRP was more effective than relapse prevention or treatment as usual for individuals with more severe substance use disorder severity and greater depression and anxiety symptoms at baseline

Although studies are beginning to shed light on mechanisms of change and treatment moderators of MBIs for SUDs, as reviewed above, there is still much work to be done in this area, and replication of preliminary findings are warranted. Future empirical investigations of mechanisms of change and treatment moderators across multiple levels of analysis (e.g., psychological, neurobiological, physiological), may begin to provide converging evidence for how, why, and when MBIs for SUDs exert their therapeutic effects.

7. Conclusion—It is a fertile and exciting time for research on MBIs for addictive behaviors. We are encouraged by the preponderance of evidence suggesting these treatments are efficacious across a number of disorders, populations, and treatment contexts. However, in an effort to ensure that these treatments are adopted, and prove effective in real world settings, we have suggested a number of areas in which future research could fill gaps in the science, and improve implementation efforts. Unresolved issues include training of treatment providers, adaptability of group formats, delivery in individual therapy contexts, delivery earlier in the change process, the role of technology, and the potential for precision medicine. While we believe that our distillation of these issues and suggestions for future research represent a strength of this paper, we also acknowledge limitations. There may, of course, be unresolved implementation issues outside our purview that should be added to the six we included here. This is not a systematic review, nor were we able to meta-analyze preliminary work in the six areas we addressed. Additionally, we were not able to incorporate studies currently in progress that may in fact be designed to address some of these issues.

We hope that in our presentation of these issues, we have fostered a spirit of inquiry that spurs innovative research in these areas, and engenders efficient translation from research into front-line practice. Forward progress should ultimately produce more accessible, flexible, and effective treatments for clinicians treating those suffering from addictive disorders, in a wider variety of contexts and settings.

Acknowledgments

This research was supported by grants funded by the National Institute on Alcohol Abuse and Alcoholism [T32 AA018108 (McCrary, PI), R21 AA024926 (Witkiewitz, PI)].

References

Amaro H, Spear S, Vallejo Z, Conron K, Black D. Feasibility, acceptability, and preliminary outcomes of a mindfulness-based relapse prevention intervention for culturally-diverse, low-income women in substance use disorder treatment. *Substance Use & Misuse*. 2014; 49(5):547–59. [PubMed: 24611850]

- Bishop SR, Lau M, Shapiro S, Carlson L, Anderson ND, Carmody J, Devins G. Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*. 2004; 11:230–241. DOI: 10.1093/clipsy.bph077
- Bowen S, Chawla N, Collins SE, Witkiewitz K, Hsu S, Grow J, Marlatt A. Mindfulness-based relapse prevention for substance use disorders: A pilot efficacy trial. *Substance Abuse*. 2009; 30(4):295–305. DOI: 10.1080/08897070903250084 [PubMed: 19904665]
- Bowen, S., Chawla, N., Marlatt, GA. *Mindfulness-based relapse prevention for substance use disorders: A clinician's guide*. New York, NY: Guilford Press; 2010.
- Bowen S, Kurz AS. Between-session practice and therapeutic alliance as predictors of mindfulness after mindfulness-based relapse prevention. *Journal of clinical psychology*. 2012; 68(3):236–245. [PubMed: 22135221]
- Bowen S, Witkiewitz K, Clifasefi SL, Grow J, Chawla N, Hsu SH, Larimer ME. Relative efficacy of mindfulness-based relapse prevention, standard relapse prevention, and treatment as usual for substance use disorders: A randomized clinical trial. *JAMA Psychiatry*. 2014; 71(5):547. [PubMed: 24647726]
- Brake CA, Sauer-Zavala S, Boswell JF, Gallagher MW, Farchione TJ, Barlow DH. Mindfulness-based exposure strategies as a transdiagnostic mechanism of change: an exploratory alternating treatment design. *Behavior therapy*. 2016; 47(2):225–238. [PubMed: 26956654]
- Brewer JA, Sinha R, Chen JA, Michalsen RN, Babuscio TA, Nich C, Rounsaville BJ. Mindfulness Training and Stress Reactivity in Substance Abuse: Results from a Randomized, Controlled Stage I Pilot Study. *Substance Abuse*. 2009; 30(4):306–317. DOI: 10.1080/08897070903250241 [PubMed: 19904666]
- Bricker J, Wyszynski C, Comstock B, Heffner JL. Pilot randomized controlled trial of web-based acceptance and commitment therapy for smoking cessation. *Nicotine & Tobacco Research*. 2013; 15(10):1756–1764. [PubMed: 23703730]
- Bricker JB, Mull KE, Kientz JA, Vilardaga R, Mercer LD, Akioka KJ, Heffner JL. Randomized, controlled pilot trial of a smartphone app for smoking cessation using acceptance and commitment therapy. *Drug and alcohol dependence*. 2014; 143:87–94. [PubMed: 25085225]
- Carroll KM, Rounsaville BJ. Computer-assisted Therapy in Psychiatry: Be Brave—It's a New World. *Current Psychiatry Reports*. 2010; 12(5):426–432. [PubMed: 20683681]
- Cavanagh K, Strauss C, Forder L, Jones F. Can mindfulness and acceptance be learnt by self-help?: A systematic review and meta-analysis of mindfulness and acceptance-based self-help interventions. *Clinical psychology review*. 2014; 34(2):118–129. [PubMed: 24487343]
- Chiesa A. The difficulty of defining mindfulness: Current thought and critical issues. *Mindfulness*. 2013; 4:255–268. DOI: 10.1007/s12671-012-0123-4
- Chiesa A, Serretti A. Are mindfulness-based interventions effective for substance use disorders? A systematic review of the evidence. *Substance Use & Misuse*. 2014; 49(5):492–512. DOI: 10.3109/10826084.2013.770027 [PubMed: 23461667]
- Crane RS, Eames C, Kuyken W, Hastings RP, Williams JMG, Bartley T, Surawy C. Development and validation of the mindfulness-based interventions-teaching assessment criteria (MBI: TAC). *Assessment*. 2013; 20(6):681–688. [PubMed: 23794181]
- Davis J, Goldberg S, Anderson M, Manley A, Smith S, Baker T. Randomized trial on mindfulness training for smokers targeted to a disadvantaged population. *Substance Use & Misuse*. 2014a; 49(5):571–85. [PubMed: 24611852]
- Davis JM, Manley AR, Goldberg SB, Smith SS, Jorenby DE. Randomized trial comparing mindfulness training for smokers to a matched control. *Journal of substance abuse treatment*. 2014b; 47(3):213–221. [PubMed: 24957302]
- Davidson RJ. Empirical explorations of mindfulness: conceptual and methodological conundrums. *Emotion*. 2010; 10:8–11. DOI: 10.1037/a0018480 [PubMed: 20141297]
- de Dios MA, Herman DS, Britton WB, Hagerty CE, Anderson BJ, Stein MD. Motivational and mindfulness intervention for young adult female marijuana users. *Journal of substance abuse treatment*. 2012; 42(1):56–64. [PubMed: 21940136]
- Didonna, F. *Clinical handbook of mindfulness*. Springer; New York: 2009. Mindfulness-based interventions in an inpatient setting; p. 447-462.

- Dimidjian S, Segal ZV. Prospects for a clinical science of mindfulness-based intervention. *American Psychologist*. 2015; 70(7):593. [PubMed: 26436311]
- Duncan LG, Bardacke N. Mindfulness-based childbirth and parenting education: promoting family mindfulness during the perinatal period. *Journal of Child and Family Studies*. 2010; 19(2):190–202. [PubMed: 20339571]
- Elwafi HM, Witkiewitz K, Mallik S, Iv TA, Brewer JA. Mindfulness training for smoking cessation: Moderation of the relationship between craving and cigarette use. *Drug and Alcohol Dependence*. 2013; 130(1–3):222–229. DOI: 10.1016/j.drugalcdep.2012.11.015 [PubMed: 23265088]
- Enkema MC, Bowen S. Mindfulness practice moderates the relationship between craving and substance use in a clinical sample. under review.
- Farb NA, Segal ZV, Mayberg H, Bean J, McKeon D, Fatima Z, Anderson AK. Attending to the present: mindfulness meditation reveals distinct neural modes of self-reference. *Social cognitive and affective neuroscience*. 2007; 2(4):313–322. [PubMed: 18985137]
- Garrison KA, Pal P, Rojiani R, Dallery J, O'Malley SS, & Brewer JA. A randomized controlled trial of smartphone-based mindfulness training for smoking cessation: A study protocol. *BMC Psychiatry*. 2015; 15(1)doi: 10.1186/s12888-015-0468-z
- Garland EL, Gaylord SA, Boettiger CA, Howard MO. Mindfulness training modifies cognitive, affective, and physiological mechanisms implicated in alcohol dependence: Results from a randomized controlled pilot trial. *Journal of Psychoactive Drugs*. 2010; 42(2):177–192. [PubMed: 20648913]
- Garland E, Froeliger B, Howard M. Mindfulness training targets neurocognitive mechanisms of addiction at the attention-appraisal-emotion interface. *Frontiers in psychiatry*. 2013; 4:173.
- Garland EL, Black DS. Mindfulness for Chronic Pain and Prescription Opioid Misuse: Novel Mechanisms and Unresolved Issues. *Substance use & misuse*. 2014; 49(5):608–611. [PubMed: 24611857]
- Garland EL, Manusov EG, Froeliger B, Kelly A, Williams JM, Howard MO. Mindfulness-oriented recovery enhancement for chronic pain and prescription opioid misuse: Results from an early-stage randomized controlled trial. *Journal of Consulting and Clinical Psychology*. 2014; 82(3):448. [PubMed: 24491075]
- Garland E, Froeliger B, Howard M. Effects of mindfulness-oriented recovery enhancement on reward responsiveness and opioid cue-reactivity. *Psychopharmacology*. 2014; 231(16):3229–3238. [PubMed: 24595503]
- Glasner S, Mooney LJ, Ang A, Garneau HC, Hartwell E, Brecht ML, Rawson RA. Mindfulness-Based Relapse Prevention for Stimulant Dependent Adults: A Pilot Randomized Clinical Trial. *Mindfulness*. 2016:1–10.
- Grant SP, Colaiaco B, Motala A, Shanman R, Booth M, Sorbero M, Hempel S. Mindfulness-based relapse prevention for substance use disorders: A systematic review and meta-analysis. *Journal of Addictive Medicine*. in press.
- Grow JC, Collins SE, Harrop EN, Marlatt GA. Enactment of home practice following mindfulness-based relapse prevention and its association with substance-use outcomes. *Addictive behaviors*. 2015; 40:16–20. [PubMed: 25218066]
- Gustafson DH, McTavish FM, Chih M-Y, Atwood AK, Johnson RA, Boyle MG, Shah D. A smartphone application to support recovery from alcoholism. *JAMA Psychiatry*. 2014; 71(5):566–572. [PubMed: 24671165]
- Hayes, SC., Strosahl, KD., Wilson, KG. *Acceptance and commitment therapy: An experiential approach to behavior change*. Guilford Press; 1999.
- Himelstein S, Saul S, Garcia-Romeu A. Does Mindfulness Meditation Increase Effectiveness of Substance Abuse Treatment with Incarcerated Youth? A Pilot Randomized Controlled Trial. *Mindfulness*. 2015; 6(6):1472–1480. DOI: 10.1007/s12671-015-0431-6
- Hölzel BK, Ott U, Hempel H, Hackl A, Wolf K, Stark R, Vaitl D. Differential engagement of anterior cingulate and adjacent medial frontal cortex in adept meditators and non-meditators. *Neuroscience letters*. 2007; 421(1):16–21. [PubMed: 17548160]

- Hölzel BK, Carmody J, Vangel M, Congleton C, Yerramsetti SM, Gard T, Lazar SW. Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Research: Neuroimaging*. 2011; 191(1):36–43. [PubMed: 21071182]
- Huijbers MJ, Crane RS, Kuyken W, Heijke L, van den Hout I, Donders ART, Speckens AE. Teacher Competence in Mindfulness-Based Cognitive Therapy for Depression and Its Relation to Treatment Outcome. *Mindfulness*. 2017:1–13.
- Kabat-Zinn J. An outpatient program in behavioral medicine for chronic pain patients based on the practice of mindfulness meditation: Theoretical considerations and preliminary results. *General hospital psychiatry*. 1982; 4(1):33–47. [PubMed: 7042457]
- Kabat-Zinn, J. Full catastrophe living: Using the wisdom of your body and mind to face stress, pain, and illness. New York, NY: Delacorte Press; 1990.
- Kabat-Zinn, J. Wherever you go, there you are: Mindfulness meditation in everyday life. New York, NY: Hyperion Books; 1994.
- Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clinical psychology: Science and practice*. 2003; 10(2):144–156.
- Kabat-Zinn J. Some reflections on the origins of MBSR, skillful means, and the trouble with maps. *Contemporary Buddhism*. 2011; 12(01):281–306.
- Kazdin AE. Mediators and mechanisms of change in psychotherapy research. *Annual Review of Clinical Psychology*. 2007; 3:1–27.
- Kazdin AE. Addressing the treatment gap: A key challenge for extending evidence-based psychosocial interventions. *Behaviour Research and Therapy*. 2017; 88:7–18. [PubMed: 28110678]
- Kristeller J, Wolever R, Sheets Q. Mindfulness-based eating awareness training (MB-EAT) for binge eating: A randomized clinical trial. *Mindfulness*. 2014; 5(3):282–297.
- Kuyken W, Byford S, Taylor RS, Watkins E, Holden E, White K, Teasdale JD. Mindfulness-based cognitive therapy to prevent relapse in recurrent depression. *Journal of consulting and clinical psychology*. 2008; 76(6):966. [PubMed: 19045965]
- Li CSR, Sinha R. Inhibitory control and emotional stress regulation: Neuroimaging evidence for frontal-limbic dysfunction in psycho-stimulant addiction. *Neuroscience & Biobehavioral Reviews*. 2008; 32(3):581–597. [PubMed: 18164058]
- Li W, Howard MO, Garland EL, McGovern P, Lazar M. Mindfulness treatment for substance misuse: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment*. 2017; 75:62–96. [PubMed: 28153483]
- Linehan MM, Comtois KA, Murray AM, Brown MZ, Gallop RJ, Heard HL, Lindenboim N. Two-year randomized controlled trial and follow-up of dialectical behavior therapy vs. therapy by experts for suicidal behaviors and borderline personality disorder. *Archives of general psychiatry*. 2006; 63(7):757–766. [PubMed: 16818865]
- Longabaugh R, Magill M. Recent advances in behavioral addiction treatments: focusing on mechanisms of change. *Current Psychiatry Reports*. 2011; 13(5):382–389. [PubMed: 21750958]
- Marsch LA, Guarino H, Acosta M, Aponte-Melendez Y, Cleland C, Grabinski M, Edwards J. Web-based behavioral treatment for substance use disorders as a partial replacement of standard methadone maintenance treatment. 2014
- Maynard BR, Wilson AN, Labuzienski E, Whiting SW. Mindfulness-Based Approaches in the Treatment of Disordered Gambling: A Systematic Review and Meta-Analysis. *Research on Social Work Practice*. 2015; doi: 10.1177/1049731515606977
- Maglione MA, Maher AR, Ewing B, Colaiaco B, Newberry S, Kandrack R, Hempel S. Efficacy of mindfulness meditation for smoking cessation: A systematic review and meta-analysis. *Addictive Behaviors*. 2017
- McBee, L. Mindfulness-based elder care: A CAM model for frail elders and their caregivers. Springer Publishing Co; 2008.
- McConnell PA, Froeliger B. Mindfulness, mechanisms and meaning: perspectives from the cognitive neuroscience of addiction. *Psychological inquiry*. 2015; 26(4):349–357. [PubMed: 26924915]
- McHugh RK, Barlow DH. The dissemination and implementation of evidence-based psychological treatments: a review of current efforts. *American Psychologist*. 2010; 65(2):73. [PubMed: 20141263]

- Mermelstein LC, Garske JP. A brief mindfulness intervention for college student binge drinkers: A pilot study. *Psychology of addictive behaviors*. 2015; 29(2):259. [PubMed: 25402833]
- Ong J, Sholtes D. A mindfulness-based approach to the treatment of insomnia. *Journal of clinical psychology*. 2010; 66(11):1175–1184. [PubMed: 20853441]
- Price CJ, Wells EA, Donovan DM, Rue T. Mindful awareness in body-oriented therapy as an adjunct to women's substance use disorder treatment: A pilot feasibility study. *Journal of substance abuse treatment*. 2012; 43(1):94–107. [PubMed: 22119181]
- Roos CR, Bowen S, Witkiewitz K. Baseline patterns of substance use disorder severity and depression and anxiety symptoms moderate the efficacy of mindfulness-based relapse prevention. *Journal of Consulting and Clinical Psychology*. in press.
- Roos CR, Witkiewitz K, Bowen S. Mindfulness-Based Relapse Prevention: An Adaptation for an Open, Rolling Group. 2016 Unpublished treatment manual.
- Ruscio AC, Muench C, Brede E, Waters AJ. Effect of brief mindfulness practice on self-reported affect, craving, and smoking: a pilot randomized controlled trial using ecological momentary assessment. *Nicotine & Tobacco Research*. 2016; 18(1):64–73. [PubMed: 25863520]
- Segal ZV, Teasdale JD, Williams JM, Gemar MC. The mindfulness-based cognitive therapy adherence scale: Inter-rater reliability, adherence to protocol and treatment distinctiveness. *Clinical Psychology & Psychotherapy*. 2002; 9(2):131–138.
- Segal, ZV., Williams, JMG., Teasdale, JD. Mindfulness-Based Cognitive Therapy for Depression: A New Approach to Preventing Relapse. New York, NY: Guilford Press; 2002.
- Stasiewicz PR, Bradizza CM, Schlauch RC, Coffey SF, Gulliver SB, Gudleski GD, Bole CW. Affect regulation training (ART) for alcohol use disorders: Development of a novel intervention for negative affect drinkers. *Journal of substance abuse treatment*. 2013; 45(5):433–443. [PubMed: 23876455]
- Vidrine JI, Spears CA, Heppner WL, Reitzel LR, Marcus MT, Cinciripini PM, Tindle HA. Efficacy of Mindfulness-Based Addiction Treatment (MBAT) for Smoking Cessation and Lapse Recovery: A Randomized Clinical Trial. *Journal of Consulting and Clinical Psychology*. 2016; 84(9):824–838. [PubMed: 27213492]
- Witkiewitz K, Marlatt GA, Walker D. Mindfulness-based relapse prevention for alcohol and substance use disorders. *Journal of Cognitive Psychotherapy*. 2005; 19(3):211–228.
- Witkiewitz K, Bowen S. Depression, craving, and substance use following a randomized trial of mindfulness-based relapse prevention. *Journal of consulting and clinical psychology*. 2010; 78(3): 362. [PubMed: 20515211]
- Witkiewitz, Bowen, Douglas, Hsu. Mindfulness-based relapse prevention for substance craving. *Addictive Behaviors*. 2013; 38(2):1563–1571. [PubMed: 22534451]
- Witkiewitz Greenfield, Bowen. Mindfulness-based relapse prevention with racial and ethnic minority women. *Addictive Behaviors*. 2013; 38(12):2821–2824. [PubMed: 24018224]
- Witkiewitz K, Lustyk MKB, Bowen S. Retraining the addicted brain: A review of hypothesized neurobiological mechanisms of mindfulness-based relapse prevention. *Psychology of Addictive Behaviors*. 2013; 27(2):351. [PubMed: 22775773]
- Witkiewitz K, Black DS. Unresolved Issues in the Application of Mindfulness-Based Interventions for Substance Use Disorders. *Substance Use & Misuse*. 2014; 49(5):601–604. DOI: 10.3109/10826084.2014.852797 [PubMed: 24611855]
- Witkiewitz K, Bowen S, Harrop EN, Douglas H, Enkema M, Sedgwick C. Mindfulness-Based Treatment to Prevent Addictive Behavior Relapse: Theoretical Models and Hypothesized Mechanisms of Change. *Substance Use & Misuse*. 2014; 49:513–524. [PubMed: 24611847]
- Witkiewitz K, Warner K, Sully B, Barricks A, Stauffer C, Thompson BL, Luoma JB. Randomized trial comparing mindfulness-based relapse prevention with relapse prevention for women offenders at a residential addiction treatment center. *Substance Use & Misuse*. 2014; 49(5):536–546. [PubMed: 24611849]
- Xue S, Tang YY, Posner MI. Short-term meditation increases network efficiency of the anterior cingulate cortex. *Neuroreport*. 2011; 22(12):570–574. [PubMed: 21691234]

Zgierska A, Rabago D, Chawla N, Kushner K, Koehler R, Marlatt A. Mindfulness meditation for substance use disorders: A systematic review. *Substance Abuse*. 2009; 30(4):266–294. [PubMed: 19904664]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 1

Meta-Analyses Examining Effectiveness of MBIs for Addictive Behaviors

Citation	Number of Studies	Target Addictive Behavior	Effect Sizes (95% CI) Addictive Behavior	Effect Sizes (95% CI) Additional Outcomes
Maynard et al (2015)	7	Gambling	Hedges' $g=0.68$ (0.39, 0.98)	Financial outcomes: Hedges' $g=0.75$ (0.24, 1.26)
Li et al (2017)	33	Substance misuse	Cohen's $d=-0.33$ (-0.49, -0.17)	Craving: Cohen's $d=-0.68$ (-1.11, -0.25)
		Smoking cessation	OR=1.76 (0.99, 3.15)	Stress: Cohen's $d=-1.12$ (-2.24, -0.01)
Maglione et al (2017)	10	Cigarettes per day	Mean difference = 1.52 (-1.03, 4.07)	
		Abstinence rates	OR = 2.52 (0.76, 8.29)	
Grant et al (in press)	9	Any substance use	OR = 0.72 (0.46, 1.13)	Craving: mean difference = -0.13 (-0.19, -0.08)
		Substance use consequences	Mean difference = -0.23 (-.39, -0.07)	

Note. 95% CI = 95% confidence intervals of the effect size.