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Are Mindfulness-Based Interventions Effective for Substance Use Disorders? A Systematic Review of the Evidence

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Mindfulness-based interventions (MBIs) are increasingly suggested as therapeutic approaches for effecting substance use and misuse (SUM). The aim of this article is to review current evidence on the therapeutic efficacy of MBIs for SUM. A literature search was undertaken using four electronic databases and references of retrieved articles. The search included articles written in English published up to December 2011. Quality of included trials was assessed. In total, 24 studies were included, three of which were based on secondary analyses of previously investigated samples. Current evidence suggests that MBIs can reduce the consumption of several substances including alcohol, cocaine, amphetamines, marijuana, cigarettes, and opiates to a significantly greater extent than waitlist controls, nonspecific educational support groups, and some specific control groups. Some preliminary evidence also suggests that MBIs are associated with a reduction in craving as well as increased mindfulness. The limited generalizability of the reviewed findings is noted (i.e., small sample size, lack of methodological details, and the lack of consistently replicated findings). More rigorous and larger randomized controlled studies are warranted.

Keywords mindfulness-based stress reduction, mindfulness-based cognitive therapy, dialectical behavioral therapy, acceptance and commitment therapy, mindfulness

INTRODUCTION

In spite of the large availability of treatments for substance use and misuse (SUM), clinical outcomes related to traditional treatments remain far from being satisfactory. As an example, cognitive behavioral therapy (CBT) has proved significant effectiveness for several types of SUM (Irvin, Bowers, Dunn, & Wang, 1999). However, in spite of the short-term success of such an approach, relapse remains a significant problem for 50–70% of patients with SUM addressed to CBT interventions (McHugh, Hearon, & Otto, 2010). As a further example, the 12-step or mutual support groups have likewise received considerable attention (Room, 1998). However, although participation in 12-step programs is usually associated with greater abstinence (Kownacki & Shadish, 1999), these programs may not be clinically indicated for participants adverse to the disease model of addiction (Marlatt & Witkiewitz, 2002) or whose thought and lifestyle is in conflict with the 12-step philosophy.

According to available evidence, if one considers that relapse rates following SUM treatment still remain as high as 60% (Connors, Maisto, & Donovan, 1996; United Nations Office of Drugs and Crime; UNODC, 2007), the need for effective treatments aimed at enhancing the reduction of substance use and the prevention of future relapses becomes evident. As a consequence, the search for newer interventions that could successfully reduce substance use and relapse rates has gained in the last decades increasing attention. In particular, mindfulness-based interventions (MBIs) have been increasingly suggested as potential intervention approaches (Marlatt & Chawla, 2007; Zgierska et al., 2009).

Even though there is not yet complete consensus as to how the concept of mindfulness should be properly operationalized (Chiesa, 2012), mindfulness is currently conceptualized as being a systematic development of attention to present moment experience with an attitude of acceptance and non-judging (Bishop et al., 2004; Kabat-Zinn, 1994). In addition, although the concept of mindfulness has long been best known as a key element of Buddhist spiritual practices (e.g., Gunaratana, 2002; Mizuno, 1972), in the last decades it has also been proven to be a fruitful topic within clinical psychology as a means to reduce the physical and emotional burden related to several

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medical and psychological conditions (Chiesa & Serretti, 2010; Hofmann, Sawyer, Witt, & Oh, 2010).

Recently, an increasing number of studies has pointed to the potential of MBIs to help people manifesting SUM related problems (Zgierska et al., 2009). MBIs include a broad set of interventions and it is currently not completely clear the extent to which they differ from one another (Chiesa & Malinowski, 2011). Indeed, some interventions, such as mindfulness-based stress reduction (MBSR) and mindfulness-based cognitive therapy (MBCT) are almost exclusively based on mindfulness meditation practice. Other interventions such as dialectical behavioral therapy (DBT) and acceptance and commitment therapy (ACT) rely only partially on mindfulness meditation practice and include components of other approaches as well (Chiesa & Malinowski, 2011). It is worth mentioning, however, that all these interventions do not differ with regard to the most fundamental features that include,

- first, the development of a mental state characterized by full attention to internal and external experiences as they occur in any given moment and,
- second, a particular attitude characterized by non-judgment of, and openness to, current experience (Bishop et al., 2004).

The main reasons why MBIs might be helpful for SUM include, among others, the notion that such programs:

1. foster the development of a non-judgmental attitude toward distressing phenomena that would lead to a reduction of the associated distress (Kabat-Zinn, 1982);
2. lead to adaptive changes in one's own thought patterns or in attitudes about one's own thoughts (Teasdale, Segal, & Williams, 1995); and
3. allow for an enhancement of the ability to accept distressful present moment experiences, which, in turn, could reduce substance use behavior as a means to suppress unpleasant emotional experiences (Linehan, 1993b).

In addition, some authors have recently suggested that MBIs might have significant advantages over traditional approaches for the treatments of SUM (e.g., Brewer, Elwafi, & Davis, 2012). Indeed, by fostering an increasing ability to "stay in touch" with whatever is experienced rather than attempting to escape or distance oneself from unpleasant feelings and sensations that frequently lead to craving and relapse[1], mindfulness practice would not lead to any attempt to remove or avoid stimuli that cause relapse, as other approaches suggest (e.g., Room, 1998). Rather, it could help practitioners to become more aware of habit-linked, minimally conscious affective states, and bodily sensations (e.g., low-level craving) that could lead

to relapse over the long-term period, before the intensity of these states is excessively disrupting. Furthermore it could help practitioners observe these states from a more detached and less reactive perspective (Brewer et al., 2012). In line with this view, recent findings from neuro-imaging studies suggest that mindfulness practice might lead to significant changes in brain structure and activation that have been associated with reduced mental ruminations (and, therefore, with a lower likelihood of relapse) (Hölzel et al., 2011). In addition, a recent neuro-imaging study provided preliminary evidence that even a brief mindfulness induction could be associated with an increased ability to dampen one's own reactivity in front of craving -related stimuli (Westbrook et al., 2013).

Taking into account the growing interest in the investigation of MBIs as a therapeutic tool for SUM, the aim of the present work is to review the scientific evidence focusing on the usefulness of MBIs for the reduction of SUM and to identify potential mechanisms linking these interventions to observed outcomes.[2]

METHODS

Literature Search

A literature search was independently undertaken by two reviewers using MEDLINE, ISI web of science, EMBASE, PsychINFO, and references of retrieved articles. The search included articles indexed by the electronic databases mentioned above, published up to December 2011. The search strategy considered only studies published in English. The main search terms were "mindfulness meditation," "mindfulness-based intervention," "mindfulness training," as well as the extended names and the acronyms of each of the main interventions currently subsumed under the rubric of MBIs (Chiesa & Malinowski, 2011; Ivanovski & Malhi, 2007; Zgierska et al., 2009), including "mindfulness-based stress reduction (MBSR)," "mindfulness-based cognitive therapy (MBCT)," "mindfulness-based relapse prevention (MBRP)," "dialectical behavior therapy (DBT)," "acceptance and commitment therapy (ACT)," "spiritual self schema therapy (3S-therapy)," "Vipassana meditation," and "Zen meditation" in combination with the name of each substance (e.g., smoke, alcohol, cocaine; see table 1 for a brief summary of the main characteristics of included interventions).

Selection of Trials

Two reviewers independently searched eligible articles for inclusion. Included studies had to (1) investigate the efficacy of a MBI for adult patients (18 years or older) receiving treatment for SUM, (2) provide quantitative data supported by statistical methodology, and (3) include a control group procedure that was either inactive

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[1]The reader is referred to Hills's criteria for causation, which were developed in order to help assist researchers and clinicians determine if *risk factors* were causes of a particular disease or outcomes or merely associated. (Hill, A. B. (1965). The environment and disease: associations or causation? *Proceedings of the Royal Society of Medicine 58:* 295–300.) Editor's note.

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[2]The reader is asked to consider the implications of the substance user treatment literature rarely exploring when a treatment technique is indicated or contra-indicated based upon theory-driven judgments and/or empirically informed ones. Editor's note.

TABLE 1. Brief overview of the main interventions included in the present review

Main interventions	Main characteristics
Vipassana meditation	Vipassana meditation is considered as the most ancient of the Buddhist meditations (Ahir, 1999). In synthesis, individuals practicing such meditation usually assume a seated position and focus their attention onto the breath. Any time the mind wanders from the breath, the meditator is instructed to bring it back and anchor it to the breath. In addition, participants practicing Vipassana can focus their attention onto four broad categories of objects: body, emotions and feelings, thoughts, and mental processes (Thera, 1973)
Mindfulness-based stress reduction (MBSR)	MBSR is an 8 weeks program, including weekly 2-hours-and-a-half sessions, a 1-day retreat, daily homework, and the request to mindfully attend present moment experiences one or more times daily as a means to generalize formal practice to one's own life (Kabat-Zinn, 1990, 2003). In sum, it is a brief meditation program mainly based on three different techniques: body scan, sitting meditation, and Hatha Yoga practice, which are considered to be a means to help practitioners develop a state of non-judgmental awareness of sensations, emotions, and cognitions in any given moment and to recognize the stream of distractions that continuously flows through the mind.
Mindfulness-based cognitive therapy (MBCT)	Mindfulness-based cognitive therapy (MBCT) is a manualized 8 weeks skills-training group program (Segal, Williams, & Teasdale, 2002) based upon the theoretical framework of information processing theories (Teasdale et al., 1995) and integrating aspects of cognitive behavioral therapy for major depression (Beck, Rush, Shaw, & Emery, 1979) with components of the mindfulness-based stress reduction program developed by Kabat-Zinn (Kabat-Zinn, 1990). Similarly to MBSR, the MBCT program incorporates seated meditation, body scan and, to a littler extent than MBSR, Yoga exercises. Mindfulness practice is mainly aimed at teaching patients "decentering," which is defined as the ability to distance from one's own mental contents.
Mindfulness-based relapse prevention (MBRP)	Mindfulness-based relapse prevention (MBRP) (Witkiewitz, Marlatt, & Walker, 2005) combines Marlatt's cognitive behavioral relapse prevention program (G.A. Marlatt & Gordon, 1985) with mindfulness practice, using a structure similar to that of MBCT (Segal et al., 2002). The mindfulness practices are intended to increase discriminative awareness and acceptance, with a specific focus on affective and physical discomfort
Spiritual self schema therapy (3S-therapy)	Such intervention mixes elements of different approaches including cognitive schema therapy (Young, Klosko, & Weishaar, 2003), which suggests that human behaviors is driven by self-schemas that influence what we attend to by narrowing our focus in accordance with our self-defined preferences and intentions, and a Buddhist theoretical framework, which emphasizes identifying and correcting faulty cognitions that cause harm to self and others such as substance use (Bhikkhu, 2001).
Dialectical behavioral therapy (DBT)	DBT is a 1-year comprehensive manualized treatment program that relies on Linhean's biosocial theory deriving from behavioral science, dialectical philosophy, and Zen practice (M. Linehan, 1993a). According to such perspective, a clients' emotional and behavioral deregulation is seen as deriving from the transaction between an invalidating rearing environment and a biological tendency toward emotional vulnerability. The main dialectic for patients with borderline personality disorder is supposed to be the relationship between acceptance and change. According to the DBT model such dialectic, as well as similar ones, can be resolved by finding a synthesis between two apparently opposed propositions or by looking for what was previously not considered in a given situation.
Acceptance and commitment therapy (ACT)	The main goal of ACT is to discourage experiential avoidance, i.e., the unwillingness to experience negatively evaluated feelings, physical sensations, and thoughts and to foster acceptance of unwanted thoughts and feelings, and to stimulate action tendencies that contribute to an improvement in circumstances of living (Hayes & Spencer, 2005). Several strategies are used to counteract the negative consequences of experiential avoidance such as "cognitive defusion" and "experiencing self as a context," which are suggested to allow patients to choose to more consciously behave in accordance with their values even in the presence of psychological discomfort (Hayes, Luoma, Bond, Masuda, & Lillis, 2006)

(e.g., waitlist) or active (i.e., condition intended to control for non-specific effects of MBIs such as teacher's care, contact time and expectancy effect). Exclusion criteria were the followings: (1) qualitative and speculative reports, (2) brief mindfulness inductions (e.g., 10 minutes' laboratory mindfulness inductions), (3) case reports and case series, and (4) literature reviews and meta-analyses. A flow-diagram of the review process is shown in Figure 1. A summary of excluded studies and reasons for exclusion is shown in Appendix 1. Major details of included studies are noted in Table 2.

Outcome Measures

The primary outcome measure was the difference between MBIs and active or inactive comparators on measures of objective and subjective SUM reduction. Secondary out-

come measures included changes in (1) one's relationship with SUM, (2) self-reported mindfulness levels, (3) miscellaneous outcome measures, (4) drop-out rates, and (5) adverse events. Findings are classified according to the specific substance or class of substances under investigation in each study.

Data Extraction and Synthesis

Data were independently extracted from the published research studies. Similarly to previous systematic reviews on MBIs (Chiesa & Serretti, 2011; Coelho, Canter, & Ernst, 2007), the quality of included studies was assessed using the Jadad Scale (Jadad, Moore, & Carroll, 1996). However this scale was modified by the authors to account for difficulties in blinding patients as to whether they received a given MBI by allocating one point for single

TABLE 2. Main characteristics of included studies

Study	Treatment groups	Number of participants (ITT)	Number of participants (completers)*	Mean age (years)	% Female	Substance category	Treatment length (weeks)	Follow-up measures from endpoint (weeks)	Number of sessions§	Session duration§	Main findings	Main study limitations
(Alfonso et al., 2011)	GMT + MBM TAU	18 16	n.s.	41 ± 7.6 35 ± 10.2	6% 6%	Various drugs and alcohol	7	None	14 n.s.	2 h 30 min n.s.	Participants in the GMT + MBM group achieved significant improvements on several neuropsychological measures including working memory, response inhibition, and decision-making.	Lack of randomization; Small sample size; Lack of follow-up measures
(Alterman et al., 2004)	MM based on MBSR + TAU TAU	18 13	15 (83%) 10 (77%)	36 ± 9.4 37 ± 11.7	61% 44%	Various drugs and alcohol	8	12	8/1 retreat –	2 h/7 h –	Medical problems, as assessed with the medical subscale of the ASI, decreased over time in the group receiving meditation and increased in those assigned to the control group.	Lack of randomization details; Lack of blind assessment; Small sample size; Lack of an active control group
(Altner, 2002)	MBSR + NRT NRT	49 68	49 (100%) 63 (93%)	40 37	74% 54%	Tobacco	8	4, 18, 44	8 –	2 h 30 min –	A significantly higher reduction of tobacco consumption was found in the MBSR group as compared with the control group, which was still maintained at 15-month follow-up.	Lack of randomization; Lack of blind assessment; Lack of an active control group
(Avants et al., 2005)	Group + ind SSST Ind SSST	18 11	16 (89%) 7 (64%)	n.s. n.s.	n.s. n.s.	Cocaine and opiates	8	None	8 8	n.s. n.s.	A significant decrease in substance use, which was confirmed by urine toxicology screens, was observed in both groups. Several further spirituality related features significantly increased as well.	Lack of randomization details; Lack of blind assessment; Small sample size; Lack of follow-up measures

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TABLE 2. Main characteristics of included studies (*Continued*)

Study	Treatment groups	Number of participants (ITT)	Number of participants (completers)*	Mean age (years)	% Female	Substance category	Treatment length (weeks)	Follow-up measures from endpoint (weeks)	Number of sessions§	Session duration§	Main findings	Main study limitations
(Bowen et al., 2006) and (Bowen, Witkiewitz, Dillworth, & Marlatt, 2007)	Vipassana TAU	63 242	57 (90%) 116 (48%)	38 ± 8.67 37.8.67	21% 21%	Various drugs and alcohol	10 days	10, 24	1 n.s.	10 days n.s.	VM participants documented significant decreases in alcohol-related problems and psychiatric symptoms as well as increases in positive psychosocial outcomes that were still significant at the 3-month follow-up. The decrease in avoidance partially mediated effects of the course on post-release alcohol use and consequences.	Lack of randomization; Lack of blind assessment; Lack of information about treatment adherence
(Bowen et al., 2009) and (Witkiewitz & Bowen, 2010)	MBRP TAU (based on a 12SP oriented format)	168 (overall)	102 (61%) (overall)	40 ± 10.3	36%	Various drugs and alcohol	8	8 16	8 n.s.	2 h 1.5 h	Significantly lower rates of substance use and craving were observed in the MBRP group as compared with the TAU over the 4-month post-intervention period. Additionally, MBRP attenuated the relation between post-intervention depressive symptoms and craving.	Lack of blind assessment; Lack of information about treatment drop-outs and reason for drop-out
(Brewer et al., 2009)	MT based on MBRP CBT	18 7	9 (50%) 5 (71%)	35 ± 10.4 45 ± 13.5	28% 29%	Alcohol and/or cocaine	12	None	9 12	1 h 1 h	No significant difference was found between MT and CBT over the treatment period on measures of alcohol and cocaine consumption but a trend favoring ACT was observed at follow-up.	Small sample size; Non-manualized intervention
(Brewer et al., 2011)	MT based on MBRP ALAFST	41 47	29 (70%) 32 (68%)	46 ± 8.7 45 ± 11.4	35% 41%	Tobacco	4	2, 8, 13	8 8	1.5 h 1.5 h	Compared to those randomized to the control group individuals receiving MT documented a greater rate of reduction in cigarette use during treatment that was maintained at the follow-up.	Non-manualized intervention

Study	Group	N	Gender n (%)	Age	%	Substance				Duration	Results	Limitations
(de Dios et al., 2011)	BMI + MM	22	17 (77%)	22 ± 2.6	100%	Marijuana	2	2, 6, 10	2	45	Participants randomized to BMI + MM reported significantly less frequent marijuana use during follow-up, particularly on days when they meditated.	Lack of randomization details; Inclusion of only female participants
	No treat.	12	9 (75%)	23 ± 3.4	100%					–		
(Garland et al., 2010)	MM based on MBCT	27	18 (67%)	40 ± 8.7	19%	Alcohol	10	None	10	n.s.	Mindfulness training significantly reduced stress and thought suppression, increased physiological recovery from alcohol cues, and modulated alcohol attentional bias.	Lack of randomization details; Lack of follow-up measures
	Supp. Group	26	19 (73%)	41 ± 10.2	23%					n.s.		
(E. V. Gifford et al., 2004)	ACT	33	21 (64%)	n.s.	n.s.	Tobacco	7	19	7	2 h 20 min	Although no significant difference was observed between the two groups in terms of tobacco consumption at the end of the treatment period, a significantly lower consumption was observed in the ACT group at the 1-year follow-up.	Lack of randomization details; Lack of information about age and gender of participants
	NRT	43	28 (62%)					45	1	1.5 h		
(S.C. Hayes, K.G. Wilson et al., 2004)	Meth + ACT	42	24 (57%)	n.s.	n.s.	Opiates	16	26	48	1/1.5 h	Both ACT and 12SP groups documented significantly lower objectively assessed opiate and total drug use during follow-up than the group treated only with methadone.	Lack of randomization details; Lack of information about age and gender of participants
	Meth + 12SP	44	26 (59%)						48	1/1.5 h		
	Meth	38	28 (74%)						–	–		
(Hernandez-Lopez et al., 2009)	ACT	43	27 (63%)	42 ± 9.4	64%	Tobacco	7	19, 45	7	1.5 h	The abstinence rates at 12-month follow-up were significantly higher for the ACT group as compared with the CBT group. Furthermore, the ACT group had a 3.78 times higher adjusted odds of 6 months prolonged abstinence.	Lack of randomization; Lack of blind assessment
	CBT	38	29 (76%)	42 ± 9.4	64%				7	1.5 h		

TABLE 2. Main characteristics of included studies (*Continued*)

Study	Treatment groups	Number of participants (ITT)	Number of participants (completers)*	Mean age (years)	% Female	Substance category	Treatment length (weeks)	Follow-up measures from endpoint (weeks)	Number of sessions§	Session duration §	Main findings	Main study limitations
(Linehan et al., 1999)	DBT + TAU TAU	12 15	7 (58%) 11 (73%)	30 ± 6.4 30 ± 7.0	100% 100%	Various drugs and alcohol	52	16	52 + groups –	1/2 h	A significantly higher proportion of drug and alcohol abstinence days was found for participants assigned to DBT vs. controls at all time points aside from the 12-month follow-up when a trend in the same direction was maintained.	Lack of randomization details; Small sample size; Lack of active comparator; Inclusion of only female participants
(Linehan et al., 2002)	DBT 12SP + CVT	11 12	8 (73%) 12 (100%)	n.s.	100% 100%	Heroin	52	16	52 + groups –	1/2 h	A significant reduction in drug use was observed in both groups. However, only participants assigned to DBT maintained reductions in mean opiate use through the whole period of active treatment.	Lack of randomization details; Small sample size; Inclusion of only female participants
(Marcus et al., 2001)	MBSR + TAU TAU	18 18	– –	32 ± 8.95 36 ± 9.45	12% 0%	Various drugs and alcohol	8	None	8 –	2 h 30 min –	None of the clinical variables under investigation differed between the two comparison groups.	Lack of randomization; Lack of blind assessment; Small sample size; Lack of follow-up measures
(Marcus et al., 2009) and (Liehr et al., 2010)	MBSR + TAU TAU	295 164	153 (52%) 81 (49%)	34 36	14% 24%	Various drugs and alcohol	6	None	6 –	3 h –	Although the intervention group documented a greater reduction in total stress during the first 3 months, the overall time trends for two groups were not different. However, the MBSR group documented a significantly higher decrease in cortisol levels as compared with controls.	Lack of randomization; Lack of blind assessment; High drop-out rates

Study	Group	N	Completed	Age	%	Substance					Main findings	Limitations
(Margolin et al., 2006)	SSST + TAU	38	31 (82%)	43 ± 6.1	73%	Heroin	8	None	8	n.s.	A significantly higher reduction of drug use as well as HIV risk behavior was observed in the SSST group as compared with the control group.	Lack of blind assessment; Moderately small sample size; Lack of active comparator; Lack of follow-up measures
	TAU	34	30 (88%)	40 ± 8.0	68%		–		–	–		
(Margolin et al., 2007)	SSST + TAU	21	14 (67%)	43 ± 6	48%	Various drugs and alcohol	12	None	12	n.s.	The time × treatment interaction for use of intoxicants was marginally significant and favored the SSST group. Additionally, the same group reported significantly higher levels of spirituality post-treatment.	Lack of randomization; Lack of blind assessment; Small sample size; Lack of follow-up measures; Lack of active comparator
	TAU	17	11 (65%)	48 ± 5	53%		–		–	–		
(Petersen & Zettle, 2009)	ACT	15	12 (80%)	37 ± 11.5	53%	Alcohol	n.s.	None	n.s.	30/60 min	A significantly higher reduction of depressive levels was found in the ACT group that was mediated by decreases in experiential avoidance.	Lack of randomization details; Lack of follow-up measures; Small sample size
	12SP	13	12 (92%)	39 ± 7.8	62%		n.s.		n.s.	n.s.		
(Smout et al., 2010)	ACT	43	14 (33%)	31 ± 6.5	40%	Metamphet.	12	12	12	1 h	No time × treatment interaction was significant for any primary outcome measure. However, both groups had increased proportions of methamphetamine-free hair samples at endpoint.	Lack of randomization details; High drop-out rates
	CBT	47	17 (36%)	31 ± 6.5	40%		12	12	12	1 h		

Note. Mindfulness/comparison group(s): ACT = Acceptance and commitment therapy, ALAFST = American Lung Associations' freedom from smoking treatment; BMI = Brief motivational intervention; CBT = Cognitive behavioral therapy; CVT = Comprehensive validation therapy; DBT = Dialectical behavioral therapy; GMT = Goal management training; MBM = Mindfulness-based meditation; MBCT = Mindfulness-based cognitive therapy; MBSR = Mindfulness-based stress reduction; MBRP = Mindfulness-based relapse prevention; Meth = Methadone; NRT = Nicotine replacement therapy; SSST = Spiritual self schema therapy; Supp. = Support; TAU = Treatment as usual; 12SP = 12-step program; VM = Vipassana meditation; WL = Waiting list. Substance(s) of abuse: Metamphet. = Methamphetamine.
Duration of meetings: d = days; h = hours; min = minutes.
Main findings: ASI = Addiction Severity Index.
*values are referred to the number of participants who completed the intervention.
§only data about mindfulness-based interventions and active control treatments are reported.
n.s. = not specified.

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blinding of the outcome assessor (maximum Jadad score = 4; Scale range = 0–4). All disagreements (3% of all analyzed parameters) were resolved through discussion. To supplement the Jadad score, we provided further methodological details of included trials that are not included in the original Jadad scale as well (Table 3). A score <3 was considered to be indicative of a low quality study (Jadad et al., 1996).

RESULTS

Characteristic of Included Studies

The original search retrieved 887 articles. In total, 821 articles were excluded because they did not investigate MBIs for SUM. After the first screening, 51 articles remained. Following the application of inclusion and exclusion criteria, 27 studies were excluded (see Appendix 1) and 24 studies—three of which, based on secondary analyses of previously investigated samples, were included in our review (Table 2). Included studies comprised 14 randomized controlled trials (RCTs) and 10 non-randomized controlled trials. Among the 21 original studies, 10 compared MBIs to a waitlist, eight compared MBIs with an active treatment, two compared MBIs with non-specific educational interventions designed to be structurally equivalent to the MBIs in terms of non-specific factors such as benefit expectations and teacher's care, and one study compared a MBI with both an active and a no treatment condition. In terms of substance use category, 12 studies focused on alcohol and/or heterogeneous substance use, four on cigarette smoking, three on opiate use, one on marijuana use, and one on metamphetamine use. In terms of interventions implemented, eight studies focused on MBSR or related mindfulness-based intervention, five on ACT, three on 3S-therapy, two on DBT, one study focused on a Vipassana retreat, one study focused on a goal management training in adjunct to mindfulness meditation, and one study focused on a brief motivational intervention in adjunct to mindfulness meditation (Tables 2 and 3). Although the majority of interventions included in the present review were largely meditation-based MBIs, some interventions such as ACT and DBT included only informal mindfulness practices or brief mindfulness inductions. The possible relevance of these differences has been explored in higher detail in the discussion.

Effects of MBIs on SUM

Fifteen studies provided subjective and/or objective measures of the effects of MBIs on SUM. The majority of such studies focused on alcohol and heterogeneous substance use (Alterman, Koppenhaver, & Mulholland, 2004; Avants, Beitel, & Margolin, 2005; Bowen et al., 2009; Bowen et al., 2006; Brewer et al., 2009; Linehan et al., 1999; Margolin et al., 2007), followed by studies on cigarette smoking (Altner, 2002; Brewer et al., 2011; E. Gifford et al., 2004; Hernandez-Lopez, Luciano, Bricker, Roales-Nieto, & Montesinos, 2009), opiates (Hayes et al., 2004; Linehan et al., 2002), marijuana (de Dios et al., 2011), and methamphetamines (Smout et al., 2010).

Studies focusing on alcohol and a range of types, patterns, and manner of substance use employed diverse study designs. In the largest published randomized controlled study, Bowen et al. (2009) compared MBRP with a TAU largely inspired by the 12-step program. By the end of the treatment period, substance use decreased to a significantly higher extent in the MBRP group as compared with the control group (Wald $\chi^2 = 97.72$, $p < .001$). Two months post-intervention, MBRP participants reported an average of 2.1 days of substance use, whereas TAU participants reported an average of 5.4 days of use; this difference was statistically significant (z $= -2.4$, $p = .02$). However, the effect was curvilinear, and suggested that the treatment gains made by MBRP participants decayed by 4 months post-intervention.

Similarly, in a randomized controlled study performed by Linehan et al. (1999), aimed at comparing DBT + TAU with TAU in a small sample of patients diagnosed with borderline personality disorder and substance misuse, a significantly higher proportion of drug and alcohol abstinence days was found for participants assigned to DBT as compared with controls at almost all time points. The only exception was the 12-month assessment when a trend toward significance favoring DBT was observed. Furthermore, results from the urinalyses data substantially mirrored those from the structured interviews. Positive findings were also observed in the study performed by Avants et al. (2005) aimed at comparing two different versions of 3S-therapy, one including weekly individual sessions and the other including weekly individual and in-group sessions. Self-reported substance use significantly decreased in both groups (F $= 9.51$, $p < .01$), which was confirmed by urine toxicology screens.

A non-randomized controlled trial compared a 10-days Vipassana retreat to an educational condition, including programs such as chemical dependency treatment[3] and substance use intervention-prevention education in

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[3]Treatment can be briefly and usefully defined as a unique, planned, goal directed, temporally structured, multi-dimensional change process, of necessary quality, appropriateness and conditions (endogenous and exogenous), which is *bounded* (culture, place, time, etc.) and can be categorized into professional-based, tradition-based, mutual-help based (AA,NA, etc.) and self-help ("natural recovery") models. There are no unique models or techniques used with substance users- of whatever types and heterogeneities- which aren't also used with non-substance users. Whether or not a treatment technique is indicated or contra-indicated, and its selection underpinnings (theory-based, empirically-based, "principle of faith-based, tradition-based, etc. continues to be a generic and key treatment issue. In the West, with the relatively new ideology of "harm reduction" and the even newer Quality of Life (QOL) and wellbeing treatment-driven models there are now a new set of goals in addition to those derived from/associated with the older tradition of abstinence driven models. Conflict-resolution models may stimulate an additional option for intervention. Each ideological model has its own criteria for success as well as failure. Treatment is implemented in a range of environments; ambulatory as well as within institutions which can include controlled environments Treatment includes a spectrum of clinician-caregiver-patient relationships representing various forms of decision-making traditions/models; (1) the hierarchical model in which the clinician-treatment agent makes the decision(s) and the recipient is compliant and relatively passive, (2) shared decision-making which facilitates the collaboration between clinician and patient(s) in which both

TABLE 3. Quality assessment of included studies

Study	Randomization	Appropriate randomization	Treatment drop outs and withdrawals	Single blinding for the main outcome measure*	Treatment allocation concealment	A-priori power calculation	Similarity in baseline prognostic factors	Therapist experience	Treatment adherence	Concomitant treatments allowed during the study period§	Modified Jadad score*
(Alfonso et al., 2011)	0	0	0	1	n.a.	No	Yes	n.s.	n.s.	n.s.	1
(Alterman et al., 2004)	1	0	0	0	n.s.	No	No	n.s.	n.s.	SoC	0
(Altner, 2002)	0	0	1	0	n.a.	No	Yes	n.s.	n.s.	n.s.	1
(Avants et al., 2005)	1	0	0	0	n.s.	No	Yes	PhD or masters' level therapists who received training and ongoing supervision in the delivery of the intervention.	Therapy adherence rate based on videotapes was 3.66/4	Methad.	1
(Bowen et al., 2006) and (Bowen et al., 2007)	0	0	1	0	n.a.	No	Yes	n.s.	n.s.	n.s.	1
(Bowen et al., 2009) and (Witkiewitz & Bowen, 2010)	1	1	0	0	n.s.	No	No	Master's degrees in psychology or social work and licensed chemical dependency counselors with prior experience in their respective interventions	n.s.	SoC	2
(Brewer et al., 2009)	1	1	1	1	n.s.	No	Yes	PhD-level therapists experienced in CBT or MT (the second one with several years of mindfulness practice and teaching)	n.s.	n.s.	4
(Brewer et al., 2011)	1	1	1	1	n.s.	No	Yes	Single therapist with > 13 years of training in MT and 2 therapists with masters level of training in drug counseling or health psychology	n.s.	Possibility to use nicotine replac. therapy	4
(de Dios et al., 2011)	1	0	0	1	n.s.	No	Yes	Therapists trained in MT by an experienced certified instructor of MBSR	All sessions were audio-recorded but treatment adherence was not reported	n.s.	2
(Garland et al., 2010)	1	0	0	1	n.s.	No	Yes	A master's level social worker with experience in mindfulness meditation and a master's level social worker with experience in the specific intervention under investigation	n.s.	n.s.	2

(Continued on next page)

TABLE 3. Quality assessment of included studies (*Continued*)

Study	Randomization	Appropriate randomization	Treatment drop outs and withdrawals	Single blinding for the main outcome measure*	Treatment allocation concealment	A-priori power calculation	Similarity in baseline prognostic factors	Therapist experience	Treatment adherence	Concomitant treatments allowed during the study period§	Modified Jadad score*
(E. V. Gifford et al., 2004)	1	0	0	1	n.s.	No	No	Psychologists and doctoral students expert of ACT supervised by the founders of the program and certified psychiatrists with extensive training in the medical management of smoking cessation under supervision	Sessions were discussed with the supervisors but a formal assessment was not reported	n.s.	2
(S.C. Hayes, K.G. Wilson et al., 2004)	1	0	0	1	n.s.	No	Yes	Four therapists trained at the master's level or higher in clinical psychology who had at least 2 years of ACT and 3 12-step therapists who had themselves recovered through the 12-step model with at least 5 years of experience	81% adherence for the ACT group and 80% for the active control group	Methad.	2
(Hernandez-Lopez et al., 2009)	0	0	0	0	n.a.	No	No	An ACT-trained clinical psychology doctoral student under the supervision of a senior ACT instructor and a licensed clinical psychologist delivering CBT for smoking cessation treatment for 8 years	95.16% for CBT and 95.79% for ACT	None	0
(Linehan et al., 1999)	1	0	0	1	n.s.	No	Yes	Two psychologists including the developer of DBT, one psychiatrist and two master's level clinicians selected for their experience working with drug addicts	n.s.	Methylphen. max. 20 mg or methad. max. 70 mg	2
(Linehan et al., 2002)	1	0	0	1	n.s.	No	Yes	Two doctoral-level and one master's level behavior therapists with a minimum of 8 months training for DBT and two master's level therapists with chemical dependency certification and 12-step experience for the control group.	All sessions were video-recorded but treatment adherence was not reported	Optional drugs and LAH	2

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Study						Therapist	Adherence	Comparison	Jadad
(Marcus et al., 2001)	0	0	n.a.	No	Yes	A psychotherapist with a long-term meditation practice and advanced training in MBSR	n.s.	n.s.	0
(Marcus et al., 2009) and (Liehr et al., 2010)	0	0	n.a.	No	Yes	Experienced mindfulness practitioners who completed the 7-day intensive training program for health professionals offered by the Centre for Mindfulness	Audio-tapes monitored by expert MBSR teachers but adherence was not reported	n.s.	0
(Margolin et al., 2006)	1	1	n.s.	No	Yes	n.s.	Treatment adherence rates based on video-tapes was 3.54/4	SoC	2
(Margolin et al., 2007)	0	0	n.a.	No	Yes	Therapists who received prior formal training and certification in the delivery of the intervention, as well as ongoing supervision	n.s.	Methad.	0
(Petersen & Zettle, 2009)	1	0	n.s.	No	Yes	n.s.	A random number of ACT sessions was audio-taped. Adherence rate: 8.2/10	ADs	2
(Smout et al., 2010)	1	0	Inapp.	Yes but the expected number of participants was not reached	Yes	A doctoral-level psychologist with 4 years' experience and a master-level psychologist with 1.5 years' experience, providing both CBT and ACT	Audiotapes listened and discussed during supervision but no formal assessment of adherence	ADs	2

Note. ACT = Acceptance and commitment therapy; Ads = antidepressants; CBT = Cognitive behavioral therapy; DBT = Dialectical behavioral therapy; LAH = levomethadyl acetate hydrocloridrate; MBSR = Mindfulness-based stress reduction; Methad. = methadone; Methylphen. = methylphenidate; MT = Mindfulness training; n.a. = Not applicable; n.s. = Not specified; replac. = Replacement; SoC = Standard of care.

*The Jadad score has been calculated by summing the values placed in the 2nd, 3rd, 4th, and 5th columns on the left. Taking into account the impossibility to blind participants as to whether they received the mindfulness or the comparison intervention (fifth criterion of the original Jadad scale), the maximum Jadad score is 4.

§participants could take treatments included in this column in adjunct to the psychological interventions described in table 2 depending on clinician's decision.

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an incarcerated population (Bowen et al., 2006). The study documented that participants who participated in the Vipassana retreat reported significantly less use of co-caine, alcohol, and marijuana at the 3-month follow-up compared to baseline. In another non-randomized con-trolled study, Margolin et al. (2007) compared 3S-therapy + TAU with TAU. Those in the 3S-therapy group re-ported greater reduction in intoxicant use from pre- to post-treatment than did TAU ($p = .08$).

Note, however, that due to several limitations, includ-ing lack of randomization (Bowen et al., 2006; Margolin et al., 2007), lack of objective measures of drug consump-tion (Bowen et al., 2009; Margolin et al., 2007) and small sample sizes (Avants et al., 2005; Margolin et al., 2007), the results from the studies mentioned above should be considered with caution pending further replications in more properly powered randomized controlled studies in-cluding objective measures of SUM.

Contrary to the positive findings observed in studies mentioned above, both Alterman et al (2004) and Brewer et al. (2009) did not find evidence suggesting that a MBSR in adjunct to TAU was better than TAU only and that a mindfulness training based on MBRP was better than group cognitive behavioral therapy (CBT) for the reduc-tion of substance consumption. However, in the second study, a trend favoring CBT was observed. It should be noted, however, that these studies were both limited by a small sample size as well as by several further shortcom-ings including differences in baseline prognostic factors, lack of information about treatment adherence and lack of information about therapist experience in the first study (Alterman et al., 2004).

Four studies focused on MBIs for cigarette smoking cessation. Gifford et al. (2004) compared ACT with nico-tine replacement therapy (NRT) and found that quit rates were comparable at the post-test (ACT = 35% quit rate; NRT = 33% quit rate) and 6-month follow-up. The ACT group had, however, significantly better outcomes at the 1-year follow-up (ACT = 35% quit rate; NRT = 15% quit rate). Expired carbon monoxide assessment showed also a non-significant trend toward higher improvement in the ACT group compared to NRT. A subsequent study compared mindfulness training based on MBRP with the American Lung Associations' freedom from Smok-ing Treatment. During the active treatment, the study documented that those receiving mindfulness training demonstrated a significantly greater reduction in cigarette use than those in the comparison condition ($F = 7.01$, $p = .008$). Differences in abstinence rates reached statis-tical significance at the 17-week follow-up (31% in mind-fulness training group; 6% in control group, $p = .01$; Brewer et al., 2011).

Overall, data from non-randomized controlled trials corroborate results from the studies mentioned above. Indeed, Altner (2002) found that participants receiving MBSR + NRT documented significantly higher smoking

reduction as compared with participants receiving NRT alone, both at the end of the treatment and at 15-month follow-up. Similarly, Hernandez-Lopez et al. (2009) found the participants receiving ACT achieved a signifi-cantly higher reduction in cigarette use than participants receiving CBT. In particular, the abstinence rates at the 12-month follow-up were 30.2% for ACT compared to 13.2% for CBT ($p = .02$). A significant strength of smoking ces-sation studies was that subjective measures were always corroborated by the expired carbon monoxide. However, lack of randomization (Altner, 2002; Hernandez-Lopez et al., 2009), lack of active control groups (Altner, 2002), and the dearth of information about treatment adherence (Altner, 2002; Brewer et al., 2011) indicate that these findings should be interpreted with caution.

Pertaining to studies on opiate dependence, Hayes et al. (2004) found at the 6-month follow-up that completers in the ACT + methadone group produced significantly higher negative urine analyses for opiates than did the methadone only group (61% vs. 28%, $\chi^2 = 4.71$, $p = .03$). Moreover, the ACT + methadone group was less likely to have used any substance at the same time point (ACT + M = 50%; M = 12%, $\chi^2 = 7.51$, $p = .006$). In a differ-ent study, however, no significant difference was observed between DBT + 12-step program versus a comprehen-sive validation therapy + 12-step program on measures of heroine and total drug consumption, although both groups showed significantly lower drug consumption rates from baseline to endpoint ($p < .0001$; Linehan et al., 2002). The small sample size in this study as well as the discrepancy between objective and subjective measures of drug in-take, however, raise concerns about the reliability of these findings.

Also, one study compared a brief mindfulness train-ing + motivational intervention (MT + MI) to an assess-ment only condition in a sample of young female mar-ijuana users (de Dios et al., 2011). The results of this study documented that, compared with controls, partici-pants randomized to MT + MI had significantly less fre-quent marijuana use during follow-up (i.e., 6.15 fewer days at 1 month, 7.81 fewer days at 2 months, and 6.83 fewer days at 3 months) ($\chi^2 = 8.89$, $p = .031$). The de-sign of this study, however, did not allow to ascertain the extent to which such benefits should be attributable to the motivational intervention or to non-specific effects of treatment. Furthermore, few participants achieved com-plete marijuana abstinence and there were no between-group differences in marijuana abstinence at any follow-up time point. Another study aimed at comparing ACT with CBT in a sample of metamphetamine users (Smout et al., 2010), both groups showed increased proportions of methamphetamine-free hair samples et endpoint. How-ever, post-hoc comparisons revealed that this change reached statistical significance for the CBT group only.

In conclusion, aside from a few exceptions, the stud-ies reviewed above show that MBIs can have specific and non-specific beneficial effects on SUM, particularly for smoking cessation and for heterogeneous substance use. However, several limitations including small sample sizes,

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are active, and (3) the 'informed model' in which the patient makes the decision(s). Editor's note.

lack of randomization, and dearth of information about treatment adherence and follow-up measurers suggest that further replications in larger higher quality randomized controlled studies are needed before more definitive conclusions can be drawn.

Secondary Outcome Measures
Changes in One's Relationship with SUM
Several studies investigated the extent to which MBIs altered the relationship with substance use. In the study performed by Bowen and colleagues, the authors reported that, over time, craving decreased to a greater extent among MBRP participants than in TAU participants (Bowen et al., 2009). However, the magnitude of decrease in craving among MBRP participants decreased over the 4-month post-intervention period. Other data show that craving can mediate the relationship between depressive symptoms and substance use among a TAU group but not among a MBRP group (Witkiewitz & Bowen, 2010). In this study, MBRP also attenuated the relation between post- intervention depressive symptoms and craving for 2 months following the intervention: this moderation effect predicted substance use 4 months following the intervention.

Gifford et al. (2004) found that ACT was significantly better than NRT in reducing urges to smoke ($t = 2.02$, $p = .047$), although this was true only when the intent to treat (ITT) sample was considered. On the contrary of these studies, Garland, Gaylord, Boettinger & Howard (2010) did not find significant evidence to suggest that a mindfulness oriented recovery training based on MBCT as well as a non-specific alcohol dependence support group had a significant impact on alcohol craving. Differences in target populations as well as the small sample size and the lack of follow-up measures in Garland et al. (2010)'s study could explain why different results were observed.

Changes in Mindfulness Levels
Although increases in mindfulness levels have been frequently suggested as a mechanism by which MBIs might work, only a few studies investigated if the intervention under investigation increased mindfulness level. All such studies employed the Five Factor Mindfulness Questionnaire (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006), a self-report questionnaire measuring five distinct facets of mindfulness. Overall, the majority of studies converged on suggesting that increases in mindfulness levels did not differ between MBIs and active comparators. In the study performed by Brewer et al. (2009), treatment completers in both the mindfulness training group based on MBRP and in the CBT control group documented significant increases of FFMQ scores over time; although participants in the MT group documented a tendency toward greater increases in FFMQ scores, these differences did not reach statistical significance. A different study comparing a slightly modified version of MBCT to an evidence-based alcohol dependence support group (Garland et al., 2010) did not find evidence to support any main effect of time or time × treatment interaction

on mindfulness levels. An exception was the study performed by Bowen et al. (2009) that compared MBRP with TAU based on the 12-step program. In this study, the "acting with awareness" subscale of the FFMQ increased to a greater extent among MBRP participants than in TAU participants, for whom it decreased; the difference was no longer significant at 4-month follow-up.

Other Outcome Measures
In addition to findings mentioned above, several studies explored the effects of MBIs on psychological stress levels. Employing a non-randomized controlled design aimed at comparing participants addressed to MBSR contrasted with an historical control group, Marcus, Fine, & Kouzekanani (2001) did not find any significant difference between the two treatments on measures of stress. Employing a similar methodological design in a larger cohort of patients, the same authors recently found that although the MBSR group showed a greater reduction in total stress levels during the first 3 months, the overall time effects for the two groups were not significantly different ($p = .14$; Marcus et al., 2009). Similarly, Hayes et al. (2004) failed to find any significant difference between ACT + 12-step program + methadone and methadone only on stress improvement. Smout et al. (2010) did not find evidence to support any significant improvement on stress levels in an ACT group compared with a CBT group. Although the lack of statistical power might account for the lack of significant effects of mindfulness training on stress levels, such an issue deserves further investigation aimed at exploring why, in this particular category of participants, no significant effect on psychological stress was observed.

Other studies focused on the efficacy of MBIs for the reduction of depressive symptoms. Overall, the results suggested that a significant effect of time on the reduction of depressive symptoms was usually observed following the delivery of MBIs (Hayes et al., 2004; Petersen & Zettle, 2009; Smout et al., 2010). However, no significant time × treatment interaction was observed between MBIs and several active comparators. Although these findings could be interpreted as suggestive of a comparable efficacy of MBI as compared with putative treatment for SUM on measures of depression, the small sample size of such studies suggests that these results could simply reflect the lack of statistical power to detect significant differences between groups.

In addition, a number of studies focused on whether MBIs reduced experiential avoidance, a psychological measures of the extent to which individuals tend to avoid unwanted emotional experiences (Hayes, Strosahl et al., 2004; Ruiz, 2010). Bowen et al. (2009) found that, by the end of the treatment period as well as at the 2-month follow-up, experiential avoidance decreased to a significantly higher extent in the MBRP group as compared with the TAU group; however, this difference was no longer significant at 4-month follow-up. Similar findings were reported in the study performed by Petersen and colleagues in which a significantly higher decrease of experiential avoidance was observed in the ACT group as compared

with the traditional CBT group (Petersen & Zettle, 2009). The reduction of experiential avoidance significantly correlated with improvement on depression scores in the ACT group but not in the control group, suggesting a possible mechanism of action specific to ACT.

Studies focusing on 3S-therapy investigated program effects on spirituality. Increases in self-perceived spirituality and a shift from the "addict self" to the "spiritual self" have been hypothesized to be key mediators of change of this approach. Overall, results from these studies supported a significantly higher shift from the "addict self" to the "spiritual self" (Avants et al., 2005; Margolin, Beitel, Schuman-Olivier, & Avants, 2006) and an increase in spiritual practices (Margolin et al., 2007) in 3S-therapy + TAU compared with TAU only, pointing to a non-specific effect of 3S-therapy on spirituality. Furthermore, percentage decreases from baseline to endpoint in HIV risk behavior were significantly correlated with more rapid endorsement of spiritual qualities at post-treatment (Avants et al., 2005). Increased levels of spirituality were associated with higher self-reported motivation for abstinence, HIV prevention and adherence to medications (Margolin et al., 2007) as well as with a reduction of drug use (Avants et al., 2005).

Alfonso, Caracuel, Delgado-Pastor, & Verdejo-Garcia (2011) investigated the effects of a Goal management training + Mindfulness meditation + TAU versus TAU only for the reduction of executive and decision-making deficits in a sample of alcohol misusers and poly-substance users. The study documented that the mindfulness group documented significantly higher improvements on their performance on neuropsychological measures of working memory, response inhibition, and decision-making. Other significant benefits reported following the completion of MBIs included a significant reduction of cortisol levels (Marcus et al., 2009), a reduction of impulsivity (Margolin et al., 2007), a reduction of medical problems (Alterman et al., 2004), and a significant decrease of hostility and paranoid ideation (Marcus et al., 2001). However, on account of the several methodological limitations stated above as well as of the limited or null availability of independent replication, further replications in more rigorous studies are needed before more definitive conclusions can be drawn.

Retention Rates

As dropout rates tend to be very large among samples of participants with SUM, a critical issue is retention rates. Retention rates in samples using alcohol and/or a range of types of drugs ranged between 50% and 90% and rates were relatively independent from the specific MBI employed (Alfonso et al., 2011; Alterman et al., 2004; Avants et al., 2005; Bowen et al., 2009; Bowen et al., 2006; Brewer et al., 2009; Linehan et al., 1999; Marcus et al., 2001; Marcus et al., 2009; Margolin et al., 2007; Petersen & Zettle, 2009). For cigarette smoking, retention rates ranged from 63% to 100% (Altner, 2002; Brewer et al., 2011; Gifford et al., 2004; Hernandez-Lopez et al., 2009). For opiate use, retention rates ranged from 57% to 82% (Hayes et al., 2004; Linehan et al., 2002; Margolin et al., 2006). For heterogeneous substance use disorders, retention rates were 67%, for alcohol misuse (Garland et al., 2010), 77% for marijuana misuse (de Dios et al., 2011), and 33% for metamphetamine misuse (Smout et al., 2010).

Adverse Events

The majority of studies did not include any specific statement about the emergence of adverse events. However, among those studies reporting on the status of adverse events, no side effects that could be specifically associated to treatment were detected or reported over the study period (Bowen et al., 2009; Brewer et al., 2011; Brewer et al., 2009; Smout et al., 2010).

DISCUSSION

The aim of this article was to review current evidence focusing on the usefulness of MBIs for SUM reduction and the potential mechanisms of their therapeutic action. Our review suggests that MBIs can result in reduced consumption of several substances including alcohol, a range of types of drugs, smoke, and opiates to a significantly higher extent than waitlist controls, non-specific educational support group, and some specific control groups. The most extensive findings suggested that MBRP outperforms programs based on the 12-step program (Bowen et al., 2009) that a Vipassana retreat outperformed an educational intervention (Bowen et al., 2006), and that both DBT and 3S-therapy were significantly more effective than no-treatment conditions (Linehan et al., 1999; Margolin et al., 2007) for the reduction of SUM in heterogeneous samples of drug users.

Smoking cessation studies consistently document that different MBIs including ACT (Gifford et al., 2004; Hernandez-Lopez et al., 2009) and MBRP (Brewer et al., 2011) can be as or more effective (i.e., at 4-month or 1-year follow-ups) than some established treatments for smoking cessation (i.e., NRT and CBT) and that MBSR could have at least a non-specific effect on smoking cessation (Altner, 2002). Positive findings were likewise observed in participants with opiate dependence (Hayes et al., 2004; Linehan et al., 2002) and in marijuana misusers (de Dios et al., 2011), though methodological limitations made it difficult to distinguish between the specific and the non-specific effects of these treatments.

Preliminary evidence also suggests that some of included interventions, such as MBSR, did not significantly differ from no treatment conditions (Alterman et al., 2004) or that they could be slightly less efficacious in comparison with established treatments such as CBT (Brewer et al., 2009; Smout et al., 2010). Taking into account the dearth of independent replications as well as the small sample size and the attrition rates observed in some of these studies, it is unclear, however, to what extent these null findings are related to the ineffectiveness of the intervention for the condition under investigation, or simply to methodological shortcomings.

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┌─────────────────────────────────┐
│ Total number of citations       │
│ retrieved from                  │
│ literature searches: N=887      │
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                ├──────│ Articles not directly            │
                │      │ investigating the                │
                │      │ usefulness of a MBI for patients │
                │      │ with SUDs: N=826                 │
                │      └─────────────────────────────────┘
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│ Articles evaluated in full for   │
│ inclusion. N=51                  │
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Included articles: N=24, 3 of which based on secondary analyses of previously investigated samples	Excluded articles: N=27

Reasons for exclusion:

No control group: N=13

Case reports and case series: N=5

Non adult samples: N=4

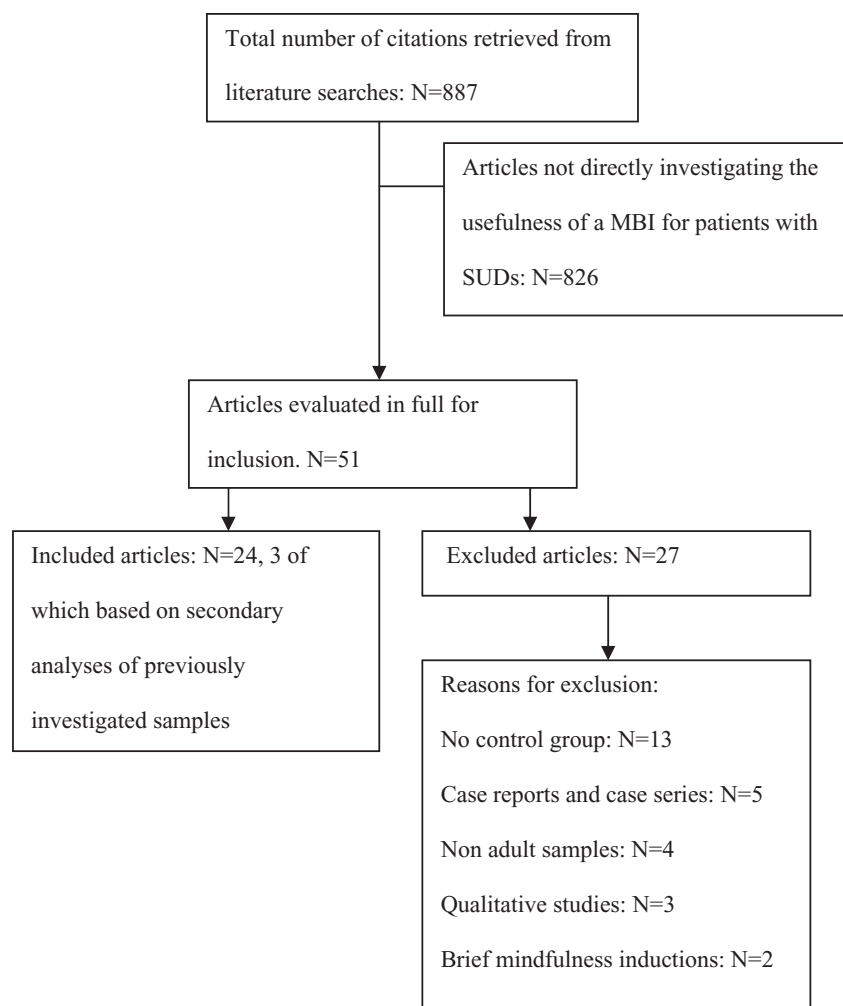Qualitative studies: N=3

Brief mindfulness inductions: N=2

FIGURE 1. Flow diagram of the review process.

Although several studies have consistently reported positive findings, several methodological limitations including, among others, lack of randomization or of randomization details, small sample size, dearth of objective measures of drug use and of information about treatment adherence raise concerns as to whether observed findings are actually due to the delivered interventions or are more properly attributable to methodological biases of included studies (Chiesa, 2011). It is important to consider that non-randomized trials are more likely to show advantages of an innovation over standard treatment (Colditz, Miller, & Mosteller, 1989). Furthermore, the lack of information about treatment adherence limits the understanding as to what extent the interventions actually were delivered as described in the manual. Although the majority of interventions included in the present review were largely based upon specific meditation practices, some interventions such as ACT and DBT included only informal mindfulness practices or brief mindfulness inductions. It is currently unclear the extent to which teaching mindfulness by means of procedures other than traditional meditation practice could influence the efficacy and the mechanisms of action of a given MBI (Chiesa & Malinowski, 2011). Randomized controlled studies investigat-

ing the efficacy and the mechanisms of action of different MBIs within the context of a single experimental design might help understand to which extent interventions currently subsumed under the rubric of MBIs represent a unique rather than an heterogeneous set of psychological approaches.

Several studies investigated the extent to which MBIs altered one's relationship with substances. Overall these studies suggested that MBIs reduce substance craving and smoking urges (Bowen et al., 2009; Gifford et al., 2004) and that mindfulness practice attenuates the relation between depressive symptoms and craving at several time points (Bowen et al., 2009). These findings are compelling given that craving strongly predicts reinstatement is associated with relapse to substance use for all major drugs (e.g., Hartz, Frederick-Osborne, & Galloway, 2001; Hopper et al., 2006; Shiffman et al., 2002). However, contrasting results have also been reported (Garland et al., 2010) and positive effects can decrease over time (Bowen et al., 2009). These findings raise concerns as to which could be the minimal effective "dose" of mindfulness training and the extent to which continuous practice following the intervention is needed in order to maintain short-term benefits over time.

Current evidence preliminary suggests that MBIs were not effective for the reduction of stress levels in the context of SUM (Marcus et al., 2001; Marcus et al., 2009; Smout et al., 2010). This finding was unexpected because mindfulness training has been found to significantly reduce stress levels in heterogeneous samples of healthy participants (Chiesa & Serretti, 2009). Studies are needed that explore whether these null findings are associated with the populations under investigation in the present review or whether they were simply due to methodological shortcomings of included studies. However, several studies found MBIs to significantly reduce depressive symptoms (Hayes et al., 2004; Petersen & Zettle, 2009; Smout et al., 2010). However, these effects did not remain significant when MBIs were compared to active and TAU control conditions.

Although MBIs were generally associated with an increase in self-reported mindfulness levels, no significant difference was observed between MBIs and active control groups (Bowen et al., 2009; Brewer et al., 2009; Garland et al., 2010). Several studies suggested that the reduction of experiential avoidance (Bowen et al., 2009; Petersen & Zettle, 2009) could be one of the mechanisms by which MBIs might actually reduce negative clinical outcomes (Ruiz, 2010). Other mechanisms, such as the increased self-compassion (Van Dam, Shepperd, Forsyth, & Earley-wine, 2010) may be a potential mechanism of MBIs.

Retention rates in reviewed studies were generally moderate to high and that they were significantly superior to those usually observed SUM trials (e.g., De Leon, Hawke, Jainchill, & Melnick, 2000; Wickizer et al., 1994). Moreover, no adverse events were observed that were specifically attributable to MBIs, regardless of the specific method employed and the specific condition under investigation. This points to the feasibility of MBIs among people using and misusing substances.

Study Limitations

Current evidence should be considered with caution on account of the several limitations. The first major limitation is the small sample size of the majority of studies, which raises concerns as to whether similarities between active treatments reflect a non-significant effect rather than the lack of statistical power to detect significant differences between conditions. Second, the studies reviewed represent a range of types of interventions and multiple categories of SUM. This does not allow us to identify a profile for which MBI could be best employed for a given SUM category and/or substance user. However, it is encouraging that significant positive findings have been shown across MBI programs and for various SUM categories. Third, study design limitations, such as the lack of randomization, of randomization details, the lack of measures of treatment adherence, the lack of blind assessment of the main outcome measures, the lack of objective measures of SUM, raise concerns about the reliability of reviewed findings. However, to address this limitation, we assessed the quality of reviewed studies using a standardized scale (Jadad et al., 1996) to better understand of the strengths and limitations of each study. Finally, we included several MBI approaches that might differ from one another in terms of theoretical frameworks, psychological exercises, and specific practices (Chiesa & Malinowski, 2011). However, the interventions included in the present review are consistent with mainstream classifications of mindfulness practices (Baer, 2003; Ivanovski & Malhi, 2007; Zgierska et al., 2009).

CONCLUSIONS

In conclusion, current evidence suggests that MBIs can reduce the consumption of several substances of misuse including alcohol, cocaine, methamphetamines, marijuana, cigarette smoking, and opiates to a significantly higher extent than several types of active and inactive control groups. Moreover, MBIs can improve several psychological outcomes associated with drug consumption. Although the current literature is replete with methodological limitations, MBIs appear to have a promising future as a therapeutic modality in the context of substance use and misuse.

Declaration of Interest

The authors report no conflict of interest. The authors alone are responsible for the content and writing of the article.

THE AUTHORS

Alberto Chiesa, MD, is a psychiatrist, psychotherapist, instructor of mindfulness-based stress reduction and mindfulness-based cognitive therapy (MBCT), and a PhD student in clinical psychopharmacology. He is an author of more than 60 peer-reviewed articles, several of which deal with the topic of mindfulness-based interventions. He is also author of the scientific book "Gli interventi basati sulla mindfulness: *cosa sono, come agiscono, quando utilizzarli*" (English translation: "mindfulness-based interventions: *what are they, how do they work, in which conditions they can be used*"), and he has recently opened a section within the University of Bologna (Italy), which is aimed at investigating the usefulness of MBCT for the treatment of affective and anxiety disorders.

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published in peer-reviewed journals including over 50 systematic reviews and meta-analyses published in leading psychology and psychiatry journals. He recently started a collaboration with Dr. Chiesa aimed at developing thorough cooperation between his experimental and review expertise with the clinical and research expertise of Dr. Chiesa into the field of mindfulness-based interventions.

GLOSSARY

Craving: An intense desire or longing.

Depression: A mood disorder marked especially by sadness, inactivity, difficulty in thinking and concentration, a significant increase or decrease in appetite and time spent sleeping, feelings of dejection and hopelessness, and sometimes suicidal tendencies.

Mindfulness: A particular way of attending to present-moment experience with an attitude of acceptance and nonjudgment.

Relapse: A recurrence of symptoms of a disease after a consistent period of improvement or well-being.

Stress: An organism's response to an environmental condition or stimulus. Stress typically describes a negative condition that can have an impact on an organism's mental and physical well-being.

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