Mindfulness Meditation for Alcohol Relapse Prevention: A Feasibility Pilot Study

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Objectives: Meditation is a promising treatment for alcohol dependence. This 16-week prospective case series was designed to gather preliminary data about the efficacy of meditation for relapse prevention and to evaluate study methods feasibility.

Methods: Nineteen adult alcohol-dependent graduates of an intensive outpatient program were enrolled. Fifteen subjects completed the 8-week meditation course supplemented by at-home meditation and "standard of care" therapy. Outcome measures included surveys and 2 stress-responsive biomarkers.

Results: Subjects (N = 19, 38.4 standard deviation [SD] = 8.6-year-old) were abstinent for 30.9 (SD = 22.2) days at enrollment. Completers (N = 15) attended 82% of meditation course sessions and meditated on average 4.6 (SD = 1.1) days per week; they were abstinent on 94.5% (SD = 7.4) of study days, with 47% reporting complete abstinence and 47% reporting 1 or more heavy drinking days. Their severity of depression, anxiety, stress ($P < 0.05$), and craving ($P < 0.08$), documented relapse triggers, decreased, and the degree of mindfulness increased ($P < 0.05$). The meditation course was rated as a "very important" (8.7/10, SD = 1.8) and "useful relapse prevention tool" (8.5/10, SD = 2.1); participants reported being "very likely" to continue meditating (9.0/10, SD = 1.5). "Gaining skills to reduce stress," "coping with craving," and "good group support" were the most common qualitative comments about the course value. Compared with baseline, at 16 weeks, interleukin-6 levels decreased (N = 12, $P = 0.05$); cortisol levels (N = 10) were reduced but not significantly. There were no adverse events or side effects.

Conclusions: Meditation may be an effective adjunctive therapy for relapse prevention in alcohol dependence, worthy of investigation in a larger trial. The study methods are appropriate for such a trial.

Key Words: meditation, addiction, alcohol dependence, substance use disorders, relapse prevention

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Alcohol dependence is a prevalent, chronic disorder that is associated with a wide variety of negative health outcomes, including significant morbidity, mortality, and disability, all with a significant societal burden.[1,2] Treatment of alcohol dependence increases the probability of abstinence or nonproblematic drinking and can decrease alcohol-related harms.[3,4] However, to date, no treatment has been uniformly effective; approximately 50% of treated alcohol-dependent individuals relapse by 1 year.[3] Given the devastating individual, familial, and societal impact of alcohol dependence, and the results associated with "best practice" therapy, the development of alternative treatments to current modalities is needed.

Meditation, a specific mind-body complementary and alternative medicine technique, may have application to the relapse problem. Meditation, defined as the intentional self-regulation of attention from moment to moment,[5] can be divided into 2 major categories: concentrative, practiced by limiting the attention to a specific object (eg, breath, a sound, an image), and mindfulness. Mindfulness meditation helps practitioners to focus their attention intentionally and non-judgmentally on experience in the present moment.[6] This ancient method of attention control can facilitate an intentional, *mindful* response to a given situation,[7] which may favor more conscious, less habitual behavioral choices. The current study implemented mindfulness meditation.

In the United States, one of the most frequently cited methods of mindfulness meditation training is the Mindfulness Based Stress Reduction program (MBSR).[6] Originally developed for stress and chronic pain management, MBSR as a therapy has shown positive results for a variety of mental health and medical disorders,[8] including anxiety disorders[9] and stress.[10] In a well-designed, randomized, controlled trial, improved relapse prevention in recurrent depression has been reported after Mindfulness-Based Cognitive Therapy, a technique that combines Mindfulness-Based Stress Reduction-based training with cognitive therapy.[11] Similarly, Mindful-

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ness Based Relapse Prevention contains elements of traditional cognitive therapy and has been developed for relapse prevention in substance use disorders (SUDs).[7,12]

Mindfulness meditation ("meditation") as adjunctive therapy for SUDs has met with anecdotal clinical success. Although only 6 pilot studies evaluated effects of meditation for SUDs, they provide encouraging preliminary data. Subjects recovering from SUDs in therapeutic community settings reported improvement in stress, as evaluated by awakening salivary cortisol level and Perceived Stress Scale survey and coping behaviors measures.[13,14] Nicotine-dependent subjects, hospital employees,[15] or individuals from a preexisting smoking study recruitment list[16] reported 41%[15] and 56%[16] smoking-cessation rates compared with 24% among controls at 6 months.[15] A small, pilot, randomized, controlled trial noted positive changes at 5 months in medical symptoms but not in psychopathology or substance use, among SUD-affected residents of a recovery house.[17] A 10-day intensive course in meditation in a low-security prison resulted in a reduction of alcohol, marijuana, and crack cocaine use, an improvement in alcohol-related problems and internal drinking-related locus of control and optimism, and a decrease in psychiatric symptoms, as measured by the Brief Symptom Inventory.[18] There are several ongoing larger clinical trials assessing efficacy of meditation-based approaches, including Mindfulness Based Relapse Prevention, for adults with SUDs.[19]

No studies have assessed meditation as an adjunct for treatment of alcohol-dependence in an outpatient setting. Therefore, we conducted a 16-week long prospective case series to test the hypothesis that a Mindfulness Meditation Relapse Prevention course (modeled on the Mindfulness Based Relapse Prevention, S. Bowen et al, unpublished observations, 2007)[7,12] used as adjunct to "best practice" standard therapy, could be effective for relapse prevention for alcohol-dependent adults in early recovery. Specifically, that subjects will reduce their drinking, experience lessening in the severity of alcohol relapse triggers (anxiety, depression, stress, craving[20]), and improve on 2 biomarker measures of health and stress (interleukin-6 and cortisol). The study also tested the feasibility of the methods for use in a future, randomized, controlled trial.

MATERIALS AND METHODS

Participants

Subjects (N = 19) were recruited between January and February of 2007 from 3 collaborating community-based Intensive Outpatient Treatment Programs (IOPs). These programs provide "best practice" treatment to approximately 500 alcohol-dependent adults at any given time, with 50 new alcohol-dependent adults entering these IOPs monthly. Of the 50 IOP patients, 31 expressed interest in the study and 27 were screened; of those, 4 were ineligible (preexisting bipolar disorder, N = 2; inability to participate in the study activities because of schedule conflict, N = 2). Of the 23 eligible persons, 4 did not complete the baseline interview, citing "not having enough time," resulting in 19 enrolled participants. *Inclusion criteria* included: age 18 years or older; diagnosis of alcohol dependence made by an IOP counselor (Diagnostic Statistical Manual-Fourth Edition [DSM-IV] criteria[21]); and

completion of 2 to 4 weeks of IOP treatment within 1 to 2 weeks before the study start date. *Exclusion criteria* included: current or past regular meditation; active drug abuse or dependence; preexisting bipolar, manic, or delusional disorder; inability to participate in study activities; and self-reported current pregnancy. The study was approved by the institutional review boards of the collaborating institutions. Fifteen subjects completed the study surveys; of those, 12 completed blood and 10 completed saliva collection at baseline and 16 weeks.

Study Intervention

The study intervention consisted of an 8-week course in "Mindfulness Meditation Relapse Prevention" ("meditation"), which began shortly after baseline interviews. Participants as a group attended a 2-hour class weekly for 8 sessions. Classes were manual-guided by a trained instructor (an experienced meditation practitioner and teacher). The course curriculum was patterned after the Mindfulness Based Relapse Prevention (S. Bowen et al, unpublished observations, 2007)[7,12] and was adapted to the specific needs of alcohol-dependent individuals. The main adaptation was to replace illicit-drug-related vocabulary and sections with alcohol-specific equivalents. The curriculum consisted of 2 components: meditation training[6] and Relapse Prevention/Cognitive Behavioral Therapy techniques, designed to prevent relapse in individuals with chronic depression[22] and SUDs.[23] The main themes of the meditation course sessions are summarized in Table 1. In addition to classroom practice, participants were asked to meditate at home (30 minutes/day, 6 days/week) and log practice minutes and days. Subjects received guided-meditation CDs,[25] meditation cushions, and handouts for at-home practice.

Participants were asked to continue their therapy for alcohol dependence with their usual providers. The IOP and continuing care sessions were similar at all treatment centers (Motivational Enhancement Therapy, Relapse Prevention, and 12-Step Facilitation strategies) based on "best-practice" guidelines.[26,27]

Outcome Measures

Participants completed 5 researcher-administered interviews at baseline (in-person) and follow-up (4, 8, 12, 16 weeks postbaseline, over the phone), which included demographic information and all survey-based measures. Two weeks after the meditation course began, biologic measures were added to the protocol: stress-responsive biomarkers (serum interleukin-6, IL-6; salivary cortisol) and liver enzymes (aspartate aminotransferase (AST); alanine aminotransferase (ALT); gamma glutamyl transpeptidase (GGT)). This early sampling served as a "baseline" measure; biomarkers were recollected at 16 weeks. Serum IL-6 concentration was assessed in duplicate determinations by enzyme linked immunoassay using commercial kits with a lower sensitivity of 1 pg/ml (R&D Systems, Minneapolis, MN). The cortisol assessment consisted of 3 (awakening, before lunch, bedtime) saliva samples collected by the participants themselves on 4 consecutive days. Daily cortisol rhythms were determined by

TABLE 1. Session Summary of the Mindfulness Meditation Relapse Prevention 8-week Course

Session	Brief Summary
1. "Automatic pilot" and its relation to craving	Introduction to basic concepts and techniques of meditation; how to be "present in the moment"; acceptance and nonjudgment; awareness of the tendency to make assumptions and judgments of experience; how automatic thoughts can distract from being "present" and lead to alcohol craving
2. Barriers to a mindful, skillful response to situational cues	Sitting meditation, brief "urge surfing" meditation,[20] "noticing triggers and craving" exercise and discussion; use of meditation to interrupt automatic responses and respond mindfully, especially in face of alcohol relapse triggers, craving, and urges
3. Mindfulness in everyday life	Mini-meditation[24] and walking meditation; exercises advancing skills in being "present" and in skillful response to situational cues; ways of integrating meditation into daily life—use of brief meditative techniques to cope with stressors and discomfort (eg, during craving)
4. Staying "present," especially in high-risk situations	Yoga meditation; discussion of high-risk situations for relapse and how meditation can help cope; exercises using yoga and mini-meditation to cope in high-risk situations; use of brief meditation techniques in daily life, including their integration into one's usual response to everyday challenges
5. Balancing acceptance and change	Sitting meditation, mini-meditation, and walking meditation; focus on acceptance, especially of difficult experiences (eg, the discomfort of craving, uncomfortable sensations and emotions, and other people's behavior); ways of coping with problematic relationships and other common causes of relapse
6. Relationship between one's thought patterns and relapse	Sitting meditation, emphasis on thoughts via "thought-labeling" exercise; discussion of lapse and relapse; learning one's own thought patterns; recognition that thoughts often are triggered "automatically" and are not necessarily an accurate reflection of oneself or reality; how certain thought patterns may lead to relapse
7. How can I best take care of myself . . .?	Mini-meditation and sitting meditation; discussion of one's own warning signs of relapse; use of meditation to recognize and cope with warning signs in high-risk situations to reduce relapse risk; creating subject-specific "action plans," including identifying "support network"; practicing mini-meditation in a context of these individual plans
8. Balanced living and what has been learned	Body scan, mini-meditation, and sitting meditation; reflection on what has been learned from the course; ways how subjects can incorporate meditation into daily life; achieving and maintaining "life balance" to better take care of oneself; use of meditation to help maintain life balance and to reduce relapse risk

Adapted with permission from Bowen S, Chawla N, Marlatt G, et al. Mindfulness-based relapse prevention treatment guide. University of Washington, Addictive Behaviors Research Center, Seattle, WA, 2007 (unpublished).

analysis of the free hormone levels in saliva (luminescence immunoassay, IBL, Hamburg, Germany, intra-assay and interassay coefficient of variations <5%).

Self-reported outcomes included: *1. Alcohol consumption* was assessed by using Percent Days Abstinent (PDA, number of abstinent days divided by the number of days at risk for drinking), Heavy Drinking Days (HDD, heavy drinking defined as ≥5 drinks/day for men, ≥4 drinks/day for women), and Total Drinks (total number of standard drinks during a 28-consecutive-days evaluation period). Data on frequency and quantity of alcohol consumption (number of standard drinks per day) for the preenrollment 20 weeks during baseline and for the previous 4 weeks during follow-up interviews were collected using the Timeline Follow-Back method (TLFB),[28] a reliable (test-retest 0.79–0.96) and valid instrument for longitudinal monitoring of self-reported alcohol use.[29] *2. Symptom severity of alcohol relapse triggers* was assessed as follows: severity of depression and anxiety symptoms were measured by using raw scores of the Depression and Anxiety subscales of the Symptom Checklist-90R (SCL-90R).[30] The SCL-90R has good internal consistency (0.77–0.9 range for the subscales) and test-retest reliability (0.8–0.9) and can measure change during treatment.[30] It asks participants to rate (0–4 scale, "not at all" to "extremely") the severity of perceived distress that was generated during the previous week by particular experiences. *Severity of stress symptoms* during the past month was assessed by using the 10-item Perceived Stress Scale (PSS), which has good reliability and validity, with strong test-retest correlation 0.85, and internal consistency 0.88.[31,32] *Craving severity* for past week was measured by using the Obsessive Compulsive Drinking Scale (OCDS).[33,34] Using 14 questions, it characterizes and quantifies drinking-related urges and ability to resist those urges in alcohol-dependent individuals. It has good internal consistency (0.86) and test-retest correlation (0.96).[35,36] *3. Degree of mindfulness* or tendency to be attentive to a present-moment experience in daily life was evaluated by using a mean score of the Mindful Attention Awareness Scale (MAAS),[37] a 15-item instrument. On a 6-point Likert scale (higher scores = greater degree of mindfulness), participants rate how often they currently experience acting on "autopilot"—being preoccupied by thoughts or not paying attention to the present moment. The MAAS is reliable and valid for use in the general population (internal consistency 0.82), responsive to change, and can discriminate between groups expected to differ in degree of mindfulness.[37] *4. Addiction-related Treatment History,* based on the Lifetime Treatment History,[38] included lifetime (baseline interview) and interval treatment history (follow-up interviews). *5. Subject Treatment Satisfaction* was assessed at each follow-up point to determine subjects' treatment experiences and any side effects or adverse events. At 8 weeks, using a 10-point Likert scale (10 = "very important/useful/likely") and qualitative responses, subjects evaluated their experience with the meditation course. In a 16-week exit interview, subjects described their overall treatment satisfaction, perceived change in their alcohol problem,

helpfulness of meditation, and suggestions for improving the intervention.

Statistical Analysis

Study hypotheses were tested by using SPSS statistical software (SPSS, Inc. Chicago, IL). The 2-tailed $P < 0.05$ was considered statistically significant. Baseline characteristics were evaluated for all study subjects (N = 19), and the prepost analyses were conducted for the 15 study completers. Except for the qualitative interview, all outcomes yielded continuous variables and were analyzed as follows. Distributional characteristics of the variables were examined. Alcohol consumption, cortisol and liver enzymes concentrations, and meditation practice duration variables showed nonnormal distributions; nonparametric tests were used for their analyses. Frequencies and means described data at all time points. Comparisons between study completers and "drop-outs" on main baseline characteristics were performed by a visual data inspection. Comparisons between selected subgroups were done by using parametric or nonparametric tests, when appropriate (ANOVA or Wilcoxon tests). Pre- and postdifferences in variables of interest were tested within the group (repeated measures analysis of variance or Friedman test for multiple related measures). The paired Student t test or Mann-Whitney U test compared 2 time-point results. Pearson or Spearman tests evaluated bivariate correlations. Cohen's d ([mean of the difference between pre- and postvalues]/SD of this mean) evaluated the effect size of change in variables of interest at 16 weeks versus baseline within the group. Qualitative data assessing subject treatment experience was reviewed (AZ, MZ) and major themes were identified by a consensus approach.

RESULTS

Baseline characteristics of the sample (N = 19) are presented in Table 2. The sample consisted of middle-aged subjects: 53% women and 84% white. Most had at least a high school diploma (74%) and were employed at least half-time (68%). At enrollment, they reported receiving IOP for 23.7 (SD = 11.2) days and abstinence for 30.9 (SD = 22.2) days. Before IOP (4–20 weeks before enrollment), subjects reported abstinence (PDA) during 48% (SD = 30.2) of days; on drinking days (52% [SD = 9.1] of days), they usually drank heavily (HDD = 12.7 [SD = 8.9] of 28 days), with average consumption of 115 (SD = 89.9) drinks per 28 days. Almost half of the subjects had participated in another outpatient therapy, and more than one-third had undergone at least 1 alcohol detoxification and/or residential treatment in the past. There were no significant gender differences in the prestudy alcohol consumption and baseline clinical characteristics.

Four subjects (2 men) dropped out early in the study, after the first or second meditation session, and were lost to follow-up. Overall, the drop-outs did not substantially differ from the rest of the sample on main baseline clinical and sociodemographic characteristics.

Table 3 describes clinical characteristics of the study completers at baseline and during the study, and Figure 1 shows individual drinking trajectories over time. Baseline values reflect subjects' scores at the end and/or immediately after the IOP therapy; 4- and 8-week values reflect scores

TABLE 2. Baseline Sociodemographic Characteristics, Lifetime Treatment History, and Prestudy Alcohol Consumption Among Study Subjects (N = 19)

Outcome Measure	Study Subjects (N = 19)
Age (yr)	38.4 (8.6)
Ethnicity	
White	16 (84)
African American	1 (5)
Other	2 (11)
Education	
8th grade	2 (11)
High school diploma	3 (16)
Some college	8 (42)
Bachelor's degree (N = 5) or postgraduate education (N = 1)	6 (31)
Employment	
Employed (full-time, N = 1; part-time, N = 13)	14 (73)
Temporary leave	2 (11)
SSI (N = 2) or unemployed (N = 1)	3 (16)
Income, past year	
≤$9999	4 (21)
$10,000–19,999	3 (16)
$20,000–49,999	6 (32)
≥$50,000	5 (26)
No answer	1 (5)
Marital status	
Partnered (married, N = 5; not married, N = 6)	11 (58)
Single (divorced, N = 3; never married, N = 5)	8 (42)
Prestudy (4–20 weeks before enrollment) alcohol consumption	
Mean PDA, percent	47.9 (30.2)
Mean HDD/28 days	12.7 (9.1)
Mean total drinks/28 days	115 (89.9)
Before enrollment	
Length of IOP therapy (days)	23.7 (11.2)
Duration of abstinence (days)	30.9 (22.2)
Lifetime treatment history (alcohol-related)	
Previous outpatient treatment	9 (47)
Previous detoxification services	7 (37)
Previous residential/inpatient treatment	6 (32)

HDD, heavy drinking days (5 drinks for men/day, 4 drinks for women/day); IOP, intensive outpatient program; PDA, percent days abstinent; Total drinks, total number of drinks.

Data are mean (SD) or number (percentage).

during the meditation course; and 12- and 16-week values refer to "postcourse" follow-up. At 16 weeks, a majority of the subjects reported improved or unchanged PDA, HDD, and Total Drinks values (80%, 87%, and 80% of the subjects, respectively) compared with baseline (Fig. 1A–C). Statistical analysis confirmed that some aspects of subjects' alcohol consumption improved (Table 3). PDA showed a tendency to improve during the meditation course (8 weeks: $P = 0.074$, Wilcoxon test), but by 16 weeks PDA values returned to baseline. The number of HDD showed a trend to improve during the study ($P = 0.056$, repeated measures analysis), with the main changes seen during the meditation course

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TABLE 3. Clinical Characteristics of the Sample at Baseline and During the Study (Sample Included 15 Subjects Unless Indicated Otherwise)

Outcome Measures	Baseline	4 Weeks (0–4 wks of meditation course)	8 Weeks (4–8 wks of meditation course)	12 Weeks (0–4 wks after meditation course)	16 Weeks (4–8 wks after meditation course)	Pre-Post[1] p Value	Effect Size[2] Cohen's d
Alcohol consumption during previous 28 days (TLFB)							
Percent days abstinent, %	89.8 (17.4)	97.9 (3.5)	98.1 (3)	92.9 (11.3)	89 (25.5)	0.289	0.03
Heavy drinking days, days	2.3 (4.7)	0.3 (0.6)*	0.3 (0.6)*	0.5 (1.3)*	0.9 (2.1)	0.056	0.3
Total number of drinks	20.8 (34.7)	2.3 (3.9)*	2.8 (5.5)*	4.5 (6.9)	9 (16.8)	0.172	0.3
Stress symptom severity (PSS), total score	21.9 (5.8)	14.3 (7.1)†	14 (6.9)‡	14 (9.6)†	13.7 (8.9)*	0.023	0.7
Mental health symptom severity (SCL-90R)							
Depression, raw score	1.6 (0.8)	0.9 (0.8)†	0.8 (0.7)†	0.9 (1)*	0.9 (0.9)†	0.027	0.9
Anxiety, raw score	1.2 (0.7)	0.7 (0.6)‡	0.6 (0.7)†	0.7 (0.9)†	0.6 (0.7)‡	0.005	1.4
Craving symptom severity (OCDS), total score	10.7 (6.4)	7.5 (4.9)	7.6 (6.6)	8.1 (7.3)	6.7 (6.9)	0.181	0.5
Serum interleukin-6, pg/mL, N = 12 (6 women)	3.9 (1.9)	—	—	—	2.6 (2.4)	0.052	0.6
Salivary cortisol, nM/L, N = 10 (5 women)							
Awakening	13.3 (6.4)	—	—	—	12.6 (6)	0.721	0.1
Midday	9.5 (6.1)	—	—	—	7.1 (3.4)	0.139	0.3
Bedtime	4.2 (2.5)	—	—	—	5.3 (4.3)	0.202	0.3
Liver enzymes, IU/mL, N = 12 (6 women)							
ALT	33.4 (31.6)	—	—	—	35.6 (22.9)	0.367	0.06
AST	28.6 (19.9)	—	—	—	30.8 (17.2)	0.385	0.1
GGT	27 (13.8)	—	—	—	31.7 (22.5)	0.387	0.37
Degree of mindfulness (MAAS), mean score	3.7 (0.8)	4.1 (1)	4.6 (0.8)†	4.9 (0.6)†	4.5 (0.9)*	0.025	0.7
At-home meditation practice (logs)							
No. of "meditating days" per week	—	5.1 (1.1)	4.7 (1.8)	4.7 (2.4)	3.9 (1.7)*	0.339	—
Meditation minutes on "meditating days"	—	36.2 (8.5)	33.4 (18.9)	27.1 (16.9)*	27.4 (19.2)	0.066	—
Meditation minutes per study day	—	27.9 (10.4)	27.1 (19.9)	20.7 (17.5)	15.1 (10.5)†	0.025	—
Treatment history							
Intensive outpatient program or continued care, # (%)	15 (100)	10 (67)	10 (67)	8 (53)	3 (20)	—	—
Attendance of alcoholics anonymous meetings, # (%)	10 (67)	10 (67)	6 (40)	6 (40)	6 (40)	—	—

*$P < 0.05$, †$P < 0.01$, ‡$P < 0.001$ (comparison between baseline and a follow-up value; Wilcoxon paired test or paired t-test).

[1]P value for the difference in an individual outcome from baseline through 16 weeks (for meditation practice variables, 4 week values were considered baseline): repeated measures analysis (Friedman test for related samples or repeated measures ANOVA), except for biomarkers (Wilcoxon paired test or paired t test).

[2]Effect size, Cohen's d, 16-week versus baseline values.

Data are mean (SD) unless otherwise indicated.

MAAS, Mindfulness Attention Awareness Scale; OCDS, Obsessive Compulsive Drinking Scale; PSS, Perceived Stress Scale; SCL-90R, Symptom Checklist-90R; TLFB, Timeline Follow Back method.

(weeks 4, 8: $P < 0.05$, Wilcoxon test). Compared with baseline, Total Drinks decreased significantly at 4 and 8 weeks ($P < 0.05$, Wilcoxon test), but the overall change during the study period did not reach statistical significance (repeated measures analysis; Table 3). During the 16-week study, subjects were abstinent on 94.5% (SD = 7.4) of study days, with 47% (N = 7) reporting complete abstinence, and 47% reporting 1 or more HDD.

Subjects' severity of relapse triggers: depression, anxiety, stress ($P < 0.05$, repeated measures analysis), and craving (4, 8, 16 weeks: $P \leq 0.08$, t test) decreased during the study (repeated measures analysis), with prepost effect sizes ranging from "moderate" to "large" (Table 3).

Compared with baseline, IL-6 level decreased at 16 weeks ($P = 0.052$, t test), which corresponded to a moderate effect size (Table 3). Although cortisol levels (N = 10) also were lower, neither those changes nor changes in liver enzymes (N = 12) were significant ($P > 0.05$, Wilcoxon test, Table 3).

Adherence to the meditation protocol was good. Study completers attended 82% of meditation course sessions and meditated on average 4.6 (SD = 1.1) days per week during the study, with maximum "meditating" time at 4 and 8 weeks (Table 3). Compared with the initial 4-week values, subjects decreased their at-home meditation practice at 12 and 16 weeks ($P < 0.05$, Wilcoxon test); this decrease mostly affected length of daily meditation practice (minutes per day, $P < 0.05$; minutes per meditating day, $P = 0.066$; Friedman test) rather than number of days per week spent on meditation (Table 3). At 16 weeks, all subjects reported meditating at home, with 53% meditating 4 or more days per week. During the study, subjects' degree of mindfulness increased ($P < 0.05$, repeated measures analysis, Table 3).

Participation in "standard of care" sessions for alcohol dependence was reported by 67% of subjects through 8 weeks and by 20% of subjects at 16 weeks. This therapy was
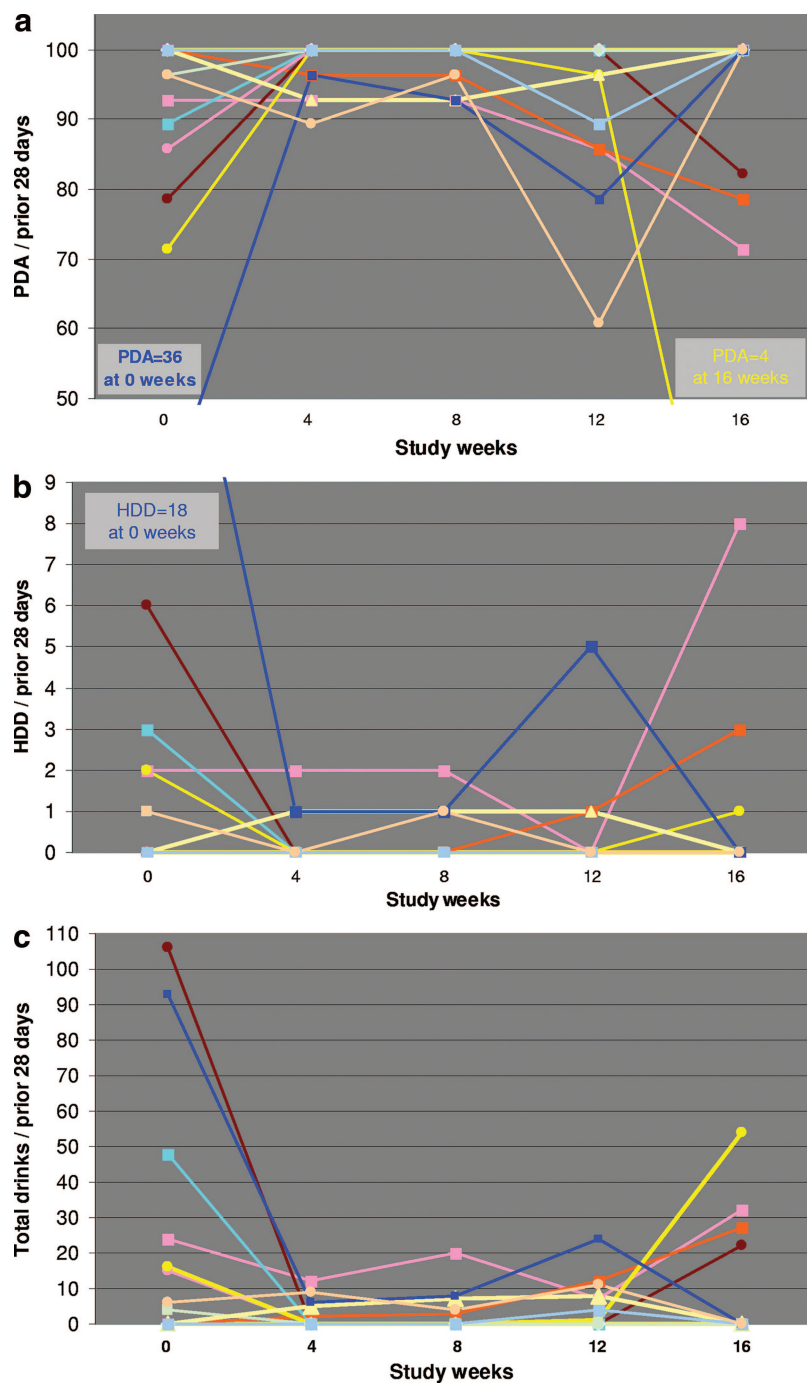
FIGURE 1. Individual drinking trajectories of 15 study subjects from baseline (0 weeks) through 16 weeks of the study, assessed with the Timeline Follow Back method. a) Percent Days Abstinent (PDA) during the previous 28 days: at 16 weeks, 6 subjects reported the same, 6 subjects reported improved, and 3 subjects reported worsened PDA than at baseline. b) Heavy Drinking Days (HDD) during the previous 28 days: at 16 weeks, 6 subjects reported the same, 7 subjects reported fewer, and 2 subjects reported more HDD than at baseline. c) Total Drinks during the previous 28 days: at 16 weeks, 6 subjects reported the same, 6 subjects reported fewer, and 3 subjects reported more Total Drinks than at baseline.

supplemented by Alcoholics Anonymous meetings in approximately half of the subjects (Table 3).

Using the Likert scale, subjects rated the meditation course as very important to them in general (8.7/10, SD =

1.8), useful relapse prevention tool (8.5/10, SD = 2.1), and reported being very likely to continue meditating (9/10, SD = 1.5). "Gaining skills to reduce stress," "real-life skills for coping with craving," and "good group support" were the

most common qualitative themes reported as the most valuable aspects of meditation training. All subjects reported that meditation-related skills were "brand-new" to them and different from those learned during previous addiction treatments. In the 16-week exit survey, subjects continued to report high satisfaction with and usefulness of meditation as a therapy for their alcohol addiction (Table 4). In qualitative exit responses, Mini-Meditation[24] was the most commonly identified form of "the most useful" meditative technique (Table 4). No subject reported dissatisfaction, adverse events, or side effects associated with meditation therapy.

Bivariate correlations between drinking and meditation-related outcomes and variables of interest were assessed. At 16 weeks, PDA, HDD, and Total Drinks correlated to severity of craving ($r = -0.76$, 0.77, 0.76, $P < 0.01$), anxiety ($r = -0.73$, 0.74, 0.74, $P < 0.01$), and depression ($r = -0.47$, 0.46, 0.47, $P = 0.08$). Intensity of daily meditation practice (minutes/day) showed a negative association with severity of craving ($r = -0.49$, $P = 0.06$), anxiety ($r = -0.7$, $P < 0.01$), depression ($r = -0.65$, $P < 0.01$), and stress ($r = -0.62$, $P < 0.05$). Degree of mindfulness negatively correlated to the prelunch cortisol level ($r = -0.78$, $P < 0.01$). Change in outcome measures (16 weeks versus baseline): Change in PDA and Total Drinks correlated to change in craving ($r = -0.55$, $P < 0.05$; and $r = 0.49$, $P = 0.06$) and

stress severity ($r = -0.46$, $P = 0.08$; and $r = 0.47$, $P = 0.08$). Change in degree of mindfulness was associated with change in stress severity ($r = -0.72$, $P < 0.001$). Change in biomarker levels did not correlate to change in drinking or meditation-related outcomes.

Subjects with at least 1 HDD during the study (N = 7), compared with those with no HDD (N = 8), reported more anxiety (all time points, $P < 0.05$), depression (12 and 16 weeks, $P \le 0.05$), craving (16 weeks, $P < 0.01$), lower degree of mindfulness ($P < 0.05$), and fewer meditation minutes per day (12.6 [SD = 12.3] versus 27.8 [SD = 19] minutes per day at 12 weeks, $P < 0.05$).

DISCUSSION

In this study, alcohol-dependent adults in early recovery who used meditation as adjunctive therapy reported 1) continued reduction of some aspects of their drinking, 2) improved mental health and stress-related outcomes during the study, 3) high level of satisfaction with meditation intervention, and 4) meditation intervention was a helpful therapeutic tool during their recovery. This study is the first to assess meditation as an adjunctive treatment for alcohol relapse prevention among alcoholics in a community setting, using both behavioral outcomes and biologic markers. The

TABLE 4. Exit Questionnaire: Quantitative and Qualitative Responses (N = 15)

Exit Survey Questions	Responses (N = 15)
"Please indicate how satisfied you are with the mindfulness meditation therapy you have received." (Likert scale 0–6; 0 = extremely dissatisfied, 3 = neutral, 6 = extremely satisfied)	Mean score (SD): 5.1/6 (0.7) ● Very or extremely satisfied, N = 14 ● Neutral, N = 1
"Compared with before you started the study, please indicate how your alcohol problem has changed overall." (Likert scale 0–6; 0 = very much worse, 3 = no change, 6 = very much improved)	Mean score (SD): 5.3/6 (1.0) ● Much or very much improved, N = 12 ● Minimal improvement, N = 2 ● No change, N = 1
"Please indicate how helpful you think this mindfulness meditation program is for your alcohol problem." (Likert scale 0–4; 0 = not helpful, and has made things worse, 1 = not helpful, but hasn't made things worse, 2 = minimally, 3 = somewhat, 4 = very helpful)	Mean score (SD): 3.5/4 (0.6) ● Very helpful, N = 9 ● Somewhat helpful, N = 5 ● Minimally helpful, N = 1 ● Not helpful, but it hasn't made things worse, N = 1
"Please describe what aspects of the meditation course have been most useful for you." (Most common qualitative themes)	● Mini-meditation, N = 8 ● Different way to approach one's thoughts, N = 4 (thought labeling; it helped with gathering thoughts; tool for getting past negative thoughts; how to reorganize thoughts) ● Walking meditation, N = 2 ● Yoga, N = 2 ● "Time for self" while meditating, N = 2 ● All kinds of meditation, N = 2
"What could make this meditation course better in the future?" (Most common qualitative themes)	● More yoga, N = 5 ● More CDs/DVD with variety of guided meditations, N = 4 ● Follow-up outlets [meetings] after the course completion to meditate, N = 2 ● Longer course duration, N = 2 ● Nothing, N = 2

methods proved to be feasible and would likely be appropriate for use in a larger study. Recruitment, retention, compliance, and subject treatment satisfaction suggest high interest in meditation and feasibility of the intervention protocol in this population. These findings are comparable to those reported by other meditation studies of other types of patients.[8]

Several findings warrant additional comments. Subjects reported clinical improvement. Alcohol consumption decreased during the study, particularly during the meditation course, as assessed by PDA, Total Drinks, and HDD. These positive changes were achieved despite the fact that subjects were largely abstinent at baseline (PDA = 89%) after successful graduation from IOP. Our findings of subjects being abstinent on 94.5% of study days, with 47% reporting complete abstinence or at least 1 HDD, are consistent with those of large randomized trials of behavioral and/or pharmacological therapies for alcohol dependence at 12 or 16 week follow-up.[39,40]

A decrease in severity of alcohol relapse triggers also represents a positive change. The SCL-90R anxiety and depression scores can be predictive of alcohol relapse.[41] Although stress, anxiety, and depression scores were elevated at baseline, they decreased during the study and trended toward normative values.[30,32] A decrease in craving severity is consistent with improved drinking outcomes, suggesting progressive subject recovery; the OCDS have been shown to be responsive to treatment and may reflect subject drinking status and relapse risk.[33,34] This pilot study is the first study to evaluate craving severity among subjects with addiction treated with meditation. The results of our study are consistent with reports of positive meditation effects for stress, anxiety, depression,[8–11] and limited evidence for SUDs,[13–18] and suggest the possibility of efficacy of a meditation intervention as an adjunctive therapy for alcohol dependence. These results, combined with results of bivariate correlations and examination of differences between subjects who reported at least 1 HDD during the study and those who did not, also support the hypothesis that meditation may contribute to positive treatment outcomes in alcohol dependence through positive modification of relapse trigger severities.

This is the first study to examine IL-6 among meditation-treated subjects with SUDs. Interleukin-6, a stress-responsive and illness-sensitive cytokine, decreased during the study ($P = 0.05$), suggesting a positive change, because elevated IL-6 level is a predictor of poor health outcomes and mortality in adults,[42] as well as disease severity and patient mortality in alcoholic hepatitis.[43] The decrease in IL-6 level may represent natural progression of the recovery process; early in the recovery, IL-6 level is elevated, but with abstinence, it decreases.[44] The lack of correlation between the change in drinking outcomes (or mental health outcomes) and change in IL-6 level suggests that decreased IL-6 levels were not a simple effect of a drinking pattern change. Small sample size and/or duration of follow-up may explain the lack of significance in the changes in cortisol and liver enzyme concentrations. Strong links between alcohol dependence and stress, a known relapse trigger,[20] make stress management behavioral therapies particularly attractive. Individuals in recovery can benefit from stress management skills. Meditation has

been associated with stress reduction, improved cortisol regulation (including in subjects with SUDs[14]), and immunomodulation.[10] These findings, along with our pilot results suggest that meditation may have contributed to positive effects on IL-6 in alcohol-dependent adults during recovery.

Degree of mindfulness reflects the extent to which a subject's way of thinking is consistent with "mindfulness." It has been shown to correlate with greater perceived well-being.[37] As expected, the degree of mindfulness, lower at baseline than normative values, increased during the study.[37] Our results suggest that subjects' ways of thinking could have become more mindful as a result of meditation practice. This hypothesis is supported by correlations between the degree of mindfulness and stress-responsive biomarker, lunch cortisol concentration, and between change in the degree of mindfulness and change in stress severity. It also is supported by the observation that subjects with ≥1 HDD had a significantly lower degree of mindfulness and fewer meditation minutes per day at 12 weeks than other subjects.

Our subjects, well familiar with the strategies of "best practice" addiction treatment, appreciated meditation therapy. They reported that skills learned during the meditation course were "brand-new" to them in addition to being "important" and "helpful." Patient satisfaction may contribute to treatment retention, which has been shown to increase likelihood of abstinence.[3,4] Meditation-related skills may expand the existing treatment strategies for alcohol dependence. Training in specific relapse prevention strategies and meditation training and practice can teach subjects to form an association between meditation and relapse prevention skills, and enhance skills acquired through cognitive behavioral therapy,[7,22] ideally improving the outcomes of interest. Meditation therapy has been documented to have long-lasting positive effects that can be maintained.[8] It also seems to be safe; recent studies have not reported side effects or adverse events and a majority of individuals who completed a meditation course reported that the program "had a lasting value" and was highly important,[8] results replicated in this pilot study.

This study is limited by the lack of a control group and its small sample size. Without an appropriate control group, we cannot know to what extent, or whether, meditation, participation in an intervention trial, effects of concomitant "standard of care" therapy and/or "natural course" of recovery over time contributed to subjects' improvement. The strengths of this pilot include verification of the appropriateness of the outcome measures, strong subject involvement in the follow-up measures, and high adherence to the meditation protocol in this study population.

This is the first study to assess meditation as an adjunctive treatment for relapse prevention among alcohol dependent adults and, thus, also the first using behavioral outcomes and biologic markers. Although the results of this pilot study suggest that meditation may be efficacious in reducing drinking and decreasing severity of relapse triggers in recovering alcoholics, a more definitive, randomized trial that compares meditation to "best practice" is needed. The methods used in the current study were demonstrated to be feasible and appropriate for use in that type of a larger trial.

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ACKNOWLEDGMENTS

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