2013

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Journal of Evidence-Based
Complementary & Alternative Medicine

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Journal:	*Journal of Evidence-Based Complementary & Alternative Medicine*
Manuscript ID:	Draft
Manuscript Type:	Original Manuscript
Date Submitted by the Author:	n/a
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Mindfulness-Based Stress Reduction and Change in Health-Related Behaviors

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Word count: 2,258

Abstract

How best to support change in health-related behaviors is an important public health challenge. The role of mindfulness training in this process has received limited attention. We sought to explore whether mindfulness training is associated with changes in health-related behaviors. The Health Behaviors Questionnaire was used to obtain self-reported dietary behaviors, drinking, smoking, physical activity and sleep quality before and after attendance at an eight-week Mindfulness-Based Stress Reduction program. T-test for paired data and chi-square were used to compare pre-post intervention means and proportions of relevant variables with $p = .05$ as level of significance. Participants (n = 174; mean age 47 years, range: 19-68; 61 % female) reported significant improvements in dietary behaviors and sleep quality. Partial changes were seen in drinking and physical activity, and no change in smoking. In conclusion, mindfulness training promotes favorable changes in selected health-related behaviors deserving further study through randomized controlled trials.

Key words: mindfulness; mindfulness-based stress reduction; health behaviors

Introduction

Health-related behaviors such as poor diets, physical inactivity, and smoking are major contributors to a range of disorders including obesity, the metabolic syndrome, type 2 diabetes, and cardiovascular disease.[1, 2] Promoting sustainable change in these behaviors is however a seemingly intractable public health problem.

The capacity for self-regulation is central to making and sustaining behavioral change, and programs that support this capacity represent an opportunity to improve behavioral outcomes.[3] Mindfulness programs, including the widely disseminated Mindfulness-Based Stress Reduction Program,[4] have been shown to enhance emotion self-regulation.[5, 6] However, the possible effect of mindfulness training on health-related behaviors has received limited attention. The aim of this observational study was to examine whether attendance in a Mindfulness-Bases Stress Reduction program would be associated with changes in health-related behaviors (diet, smoking, drinking, physical activity) and sleep quality compared to baseline and whether any changes were associated with the duration of individual practice and improvement in mindfulness skills.

Methods

Population

Study participants belonged to several cohorts of individuals who enrolled in the University of Massachusetts Mindfulness-Based Stress Reduction program in Worcester, MA during 2006. Participants were adults with a wide range of health-related problems including chronic pain, anxiety, depression, and personal or employment-related stress. Each class included approximately 20–25 participants; health-care practitioners referred about half and others were self-referred. Participation in the program was on a self-pay

basis. Prospective participants attend an orientation session prior to the beginning of the program during which they receive detailed information about the program format and requirements. All participants are formally asked for permission to use their de-identified information for research purposes.

The Mindfulness Stress Reduction Program

This program (described in detail elsewhere)[4] consists of seven weekly classes of two and half hours, and an all-day weekend class during the sixth week. Mindfulness is taught through three formal exercises: the body scan, in which attention is moved systematically throughout the body with instructions to notice whatever sensations are present; gentle stretching exercises to support mindfulness during movement; and sitting meditation, during which the arising of cognitions is noticed. During each of these modalities trainees are encouraged to bring a non-judgmental and non-reactive observational stance to whatever is arising in awareness. Up to 45 minutes/day of individual practice of these exercises is also prescribed, using instructions contained in CD recordings. Participants are also encouraged to integrate mindfulness into their everyday activities.

Assessments

Baseline assessments were completed immediately prior to the orientation sessions, while post-program questionnaires were completed during the final program session. Home practice data were collected by means of a mindfulness practice log in which participants recorded the number of minutes of formal and informal mindfulness practice they did each day. Whenever a log was missing, participants were asked to

retrospectively complete a log for the previous week. When data on individual practice were missing we assumed that the minutes of practice for that day were zero.

Primary outcomes

Health behaviors were self-reported through the Health Behaviors Questionnaire,[7] an instrument developed as a pragmatic measure for use in intervention-based research conducted in primary care settings. It consists of 22 items selected from known health behavior scales identified through literature reviews and previous multi-site studies: nine items relate to physical activity and are derived from the Rapid Assessment of Physical Activity (RAPA) questionnaire;[8] three relate to alcohol consumption (from the Behavioral Risk Factor Surveillance System Survey Questionnaire);[9] three to cigarette smoking;[9] and seven (derived from the "Starting the Conversation" questionnaire)[10] to dietary patterns. The Health Behaviors Questionnaire's authors added a final item assessing sleep quality during the previous week (using a six-point Likert response scale ranging from 'very poor' to 'very good').

Demographic characteristics were self-reported and included age, gender, marital status, use of prescription medications and prior psychotherapy. Mindfulness was measured using the Five Facets of Mindfulness questionnaire,[11] an instrument derived from a factor analysis of questionnaires measuring a trait-like general tendency to be mindful in daily life. Items are rated on a Likert scale ranging from 1 (never or very rarely true) to 5 (very often or always true). This instrument has been shown to have good internal consistency and significant relationships in the predicted directions with a variety of constructs related to mindfulness.[12]

Data analysis

For the three drinking questions, a score of 0 was assigned to the second and third questions for anyone who answered 'no' to the first question. A sum variable was created by summing responses across the three questions. For changes in smoking behaviors, the first question "Have you smoked at least 100 cigarettes in your entire life" was excluded because it was not relevant to the assessment of behavioral change. For the second question, a score of 0 was assigned to 'no' responses and a score of 1 to a 'yes' response. The third smoking question was treated as a continuous score. To assess dietary behaviors, responses were re-coded so that the 'none' response was at the beginning of the scale; some of the questions were also reverse-coded such that, for most of the continuous indicators of health behaviors, higher scores would indicate worse (i.e., less healthy) behaviors. For physical activity, responses were computed according to the original scoring method.[8] Participants were assigned to a category of physical activity (sedentary, underactive, underactive-regular, active) based on their responses to questions 1 through 7. Responses for items 8 and 9 were summed to create a single flexibility score, where higher scores reflected greater strength and flexibility. Sleep quality was assessed with a single question that was treated as a continuous variable.

Exploratory analyses aimed at the identification of possible mechanisms of the association between mindfulness training and changes in behaviors. Since mindfulness scores and behaviors were collected at the same time, a formal mediation analysis was not conducted and only associations were considered.

Two-tailed t-test for paired data was used to compare pre-post intervention means of relevant continuous variables and chi-square to compare proportions. Spearman rho was used to examine associations between change in behaviors and change in

mindfulness scores and duration of individual practice, respectively. Results are reported as mean pre-post training change with 95 % confidence intervals (p = 0.05 level of significance). All data analyses were conducted using SPSS statistical software version 20.

Results

Complete baseline and post-training data were available for 174 participants (Figure 1). The mean age was 47 (SD = 10.3 years; range: 19 - 68); 125 participants (61%) were female, and 76% were married or living as married. Most participants reported being in white collar/professional occupations. Over 60% of participants reported current or previous psychotherapy and 70% reported the use of prescription medications. Overall, participants reported engaging in healthy behaviors at baseline, as indicated by the low average number of sweetened beverages, snacks, and dessert servings per week and by the low prevalence of current smokers.

No significant baseline differences were found between the participants who failed to provide post-treatment data (n = 32) and the rest of the sample (n = 174) for demographic variables or for mindfulness scores.

Program attendance

Of the 174 participants with complete data, 168 (97%) attended six or more of the eight weekly sessions, whereas five (4%) participants attended five or fewer sessions.

Home mindfulness practice

About 70% (121/174) of study participants provided some or their entire home practice data. The average number of returned logs was 6.16 (SD = 1.34) out of 7 logs.

Change in health-related behaviors

Drinking

There were no changes in the overall drinking score (Table 1). When examining specific drinking behaviors, participants reported a reduction in the number of days they drank during the previous month, but no changes in the number of drinks they had on those drinking days or in the number of binge drinking episodes.

Smoking

Participation in mindfulness training was neither associated with pre-post intervention changes in the proportion of participants who smoked at least part of a cigarette in the previous week, nor with significant changes in the number of cigarettes participants typically smoked in the previous week.

Dietary behaviors

The overall dietary score significantly improved after completion of the program, indicating an improvement in overall dietary behaviors. When looking at individual responses, participants reported a significant reduction in the number of desserts consumed, as well as an increase in the intake of fruits or vegetables. We also observed marginally significant reductions in the number of sweetened beverages, fast food meals, and in the use of fats.

Physical activity

The proportion of participants in the "sedentary" category decreased after the completion of the program. Participants also reported an increase in strength/flexibility scores by the end of the training.

Sleep quality

Examination of sleep quality scores suggested that the quality of sleep improved across the training (table 1).

Exploratory analyses

Change in mindfulness skills and health-related behaviors

We did not detect correlations between changes in overall mindfulness score or the various facets of mindfulness and changes in health behaviors, with the exception of sleep quality, which was positively associated with change in overall mindfulness scores (rho = 0.30, $p < 0.01$) as well as with changes in three of the subscales: Observe (rho = 0.28, p = 0.01), Acting with Awareness (rho = 0.19, p = 0.01), and React (rho = 0.21, $p < 0.01$).

Associations between individual mindfulness practice and changes in behaviors

Higher smoking scores (indicating worse smoking behavior) were inversely associated with the number of days spent in sitting meditation (rho = - 0.23, p = 0.04), yoga practice (rho = - 0.30, p = 0.01), and informal meditation (rho = - 0.25, p = 0.03). Individual home practice was not associated with changes in dietary behavior, drinking, or physical activity. The improvement in sleep quality was related to the amount of time participants spent in informal practice (rho = 0.23, p = 0.01), but not with the duration of the other individual practices.

Discussion

Participation in a standard Mindfulness Based Stress Reduction program was associated with improved dietary behaviors (specifically, decreased consumption of desserts and increased intake of fruits and vegetables), modest changes in physical

activity and drinking habits, and better sleep quality compared to baseline. No changes were observed in smoking behaviors.

There are only a limited number of studies examining the association between mindfulness and health behaviors. Large survey-based studies in college populations have shown that higher dispositional mindfulness (i.e., the capacity that individuals have to be mindful prior to training)[13, 14] is associated with increased physical activity, better sleep quality[15] and healthier dietary habits.[16] While preliminary studies investigating the effect of mindfulness interventions alone on dietary habits in adults are either not conclusive[17] or did not show an effect on the dietary intake of several nutrients,[18] mindfulness training delivered as part of a vegetable-based dietary intervention decreased the consumption of saturated fat and animal protein, increased the intake of vegetable protein, and improved physical activity in men with recurrent prostate cancer; changes that were self-maintained three months post-intervention.[19-21] Of note, the current study sample had overall good dietary behaviors at baseline, with an average of just over one fast food meal and unhealthy snack per week, resulting in a possible floor effect. A floor effect may also explain the lack of improvement in smoking behaviors, as the prevalence of smokers in this study was low. In fact, pilot studies of mindfulness interventions for smoking cessation have shown promising results on point prevalence abstinence rate.[22,23] Interestingly, one of these studies detected a positive association between compliance with mindfulness practice and smoking abstinence.[23]

There is no conclusive agreement in the literature in regard to the effects of mindfulness training on sleep. While a review of the literature has suggested that the positive effects of mindfulness training on sleep quality and duration have yet to be

demonstrated, [24] this study confirms more recent findings suggesting an effect of mindfulness training on sleep quality among breast cancer patients (although not maintained over time)[25] and in menopausal women with hot flashes.[26]

The change in the proportion of sedentary individuals observed in this study was driven by an increase in activities that promote flexibility. Since such activities (yoga) are taught as part of the Mindfulness-Based Stress Reduction curriculum, no conclusions can be drawn as to whether the training improved overall physical activity.

This study has several limitations. Due to its observational design and the lack of a control group, it cannot be ruled out that the observed changes are due to unspecific effects (i.e. generic support deriving from participation in a group-based program; participation in the program being part of a more general decision to improve health) that are unrelated to mindfulness training. Second, the study was conducted in individuals who voluntarily enrolled in a standard Mindfulness-Based Stress Reduction program. Such individuals differed from the general population in a number of respects, including that they mostly had white-collar professions and had a high prevalence of healthy behaviors at baseline. Third, all behaviors were self-reported; and fourth, we cannot exclude the presence of social desirability bias. Finally, due to the lack of follow-up assessments, it is unclear whether the observed changes would be maintained over time.

In conclusion, this study found that participation in a Mindfulness-Based Stress Reduction program was associated with changes in health-related behaviors, particularly in dietary behaviors, and in sleep quality. These encouraging findings deserve further study in larger randomized controlled trials to explore the possible role of mindfulness training in initiating and maintaining behavioral change.

Acknowledgements: none

Authors' contributions:

Elena Salmoirago-Blotcher conceived the study and wrote the manuscript; Matthew Hunsinger conducted the statistical analysis and revised the manuscript; Lucas Morgan conducted the statistical analysis; Daniel Fischer conducted literature reviews and assisted with the manuscript drafting; James Carmody conceived the study, collected the data and revised the manuscript. All authors approved the final version of the manuscript for publication.

Conflicting interests: none reported

Ethical approval: All participants gave their permission to use their de-identified information for research purposes.

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Table 1. Pre-post program change in health behaviors

Behavior	Pre	Post	Change (mean, CI)	P*
Drinking				
Overall drinking behavior score	12.45 (11.50)	12.10 (11.29)	0.349 (- 0.76, 1.45)	0.540
Days drank at least 1 drink during past month	8.84 (9.30)	8.01 (8.81)	0.82 (0.10, 1.55)	0.026
Number of drinks on drinking days	1.29 (1.04)	1.34 (1.07)	- 0.05 (- 0.19, 0.10)	0.543
Binge drinking† episodes over past month	2.40 (4.17)	3.00 (4.60)	- 0.61 (- 1.42, .20)	0.141
Smoking				
Smoked at least part of a cigarette over past week	15 (23)	13 (24)		0.705‡
Number of cigarettes during past week	1.48 (17.31)	2.52 (13.72)	- 1.03 (- 2.38, 0.31)	0.13
Dietary behaviors				
Overall dietary score	7.99 (3.60)	7.24 (3.58)	0.75 (0.35, 1.15)	0.001
Fast food meals or snacks (times/week)	1.27 (1.16)	1.10 (1.01)	0.16 (- 0.02, 0.34)	0.082
Fruit/veggies servings (servings/day)	0.70 (.85)	0.55 (.71)	0.16 (0.04, 0.27)	0.006

Sodas or sweetened beverages (servings/day)	1.02 (1.28)	0.89 (1.16)	0.12 (- 0.05, 0.30)	0.156
Chicken, beans or fish (times/week)	0.59 (.97)	0.55 (.93)	0.04 (- 0.13, 0.20)	0.673
Snacks-chips or crackers (times/week)	1.14 (1.07)	1.15 (1.11)	- 0.01 (- 0.16, 0.13)	0.876
Desserts or other sweets (times/week)	2.15 (1.08)	1.96 (1.11)	0.18 (0.06, 0.31)	0.005
Use of margarine, butter or meat fat for seasoning (times/week)	1.25 (.60)	1.18 (.54)	0.07 (- 0.02, 0.15)	0.115
Physical activity				
'Sedentary'	9 (5)	2 (1)		0.035‡
Rarely or no physical activity	19 (10)	11 (6)		0.021‡
'Underactive'	104 (60)	94 (61)		0.477‡
Some light or moderate physical activity, but not every week	153 (76)	145 (83)		0.659‡
'Underactive-regular'	25 (15)	27 (18)		0.782‡
Moderate physical activity every week, < 5	103 (51)	102 (59)		0.726‡

days per week or < 30 minutes at a time				
Vigorous physical activity every week, < 3 days per week or < 20 minutes at a time	41 (21)	38 (22)		0.547‡
'Active' Category	34 (20)	30 (20)		0.617‡
Moderate physical activity 30 minutes or more per day, 5 or more days/week	58 (28)	55 (32)		0.573‡
Moderate physical activity 20 or more minutes per day, 3 or more days/week	47 (24)	44 (26)		0.783‡
Overall strength/flexibility score	1.65 (1.30)	2.29 (.91)	- 0.64 (- 0.83, - 0.44)	0.001
Activities to increase muscle strength, such as lifting weights or calisthenics, once a week or more	0.47 (.99)	0.53 (.91)	- 0.03 (- 0.10, 0.03)	0.356
Activities to improve	0.53 (.24)	0.89 (.57)	- 0.63(- 0.80, -0.47)	0.001

flexibility, such as stretching or yoga, once a week or more				
Sleep quality				
Sleep quality scores	3.41 (0.10)	4.10 (0.10)	0.68 (0.47, 0.90)	0.01

Numbers are n (%) or means (SD)

Dietary and drinking score = sum of scores on individual answers, where a higher score indicates unhealthier dietary or drinking behaviors

* Two-tailed T test for paired data unless otherwise specified

† Binge drinking defined as ≥ 5 drinks (men) or ≥ 4 drinks (women)

‡ Chi-square

Figure 1 - Flow of patients through the study