Original Article

Mindfulness-Based Stress Reduction and Change in Health-Related Behaviors

Journal of Evidence-Based Complementary & Alternative Medicine
18(4) 243-247

DOI: 10.1177/2156587213488600
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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 data on dietary behaviors, drinking, smoking, physical activity, and sleep quality before and after attendance at an 8-week Mindfulness-Based Stress Reduction program. *T*-tests for paired data and χ^2 tests 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 physical activity but no changes in smoking and drinking habits. In conclusion, mindfulness training promotes favorable changes in selected health-related behaviors deserving further study through randomized controlled trials.

Keywords

mindfulness, mindfulness-based stress reduction, health behaviors, smoking, dietary, sleep, physical activity, drinking

Received February 12, 2013. Accepted for publication April 6, 2013.

Introduction

Health-related behaviors such as poor diet, 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 standard Mindfulness-Based Stress Reduction program at the University of Massachusetts 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 to 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 were formally asked for permission to use their de-identified information for research purposes.

The Mindfulness-Based Stress Reduction Program

The Mindfulness-Based Stress reduction program (described in detail elsewhere)[4] is a widely renowned, manualized program. It consists of 7 weekly classes of 2½ hours and an all-day weekend class during the sixth week. Mindfulness is taught through 3 formal

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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 nonjudgmental and nonreactive 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. While participants are encouraged to integrate mindfulness into their everyday activities, the program is not specifically aimed at inducing overt behavioral change, and typically its curriculum does not include the promotion of healthy behaviors.

Assessments

Baseline assessments were completed immediately prior to the orientation sessions, while postprogram 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 Outcome. 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 multisite studies: 9 items relate to physical activity and are derived from the Rapid Assessment of Physical Activity questionnaire[8]; 3 relate to alcohol consumption (from the Behavioral Risk Factor Surveillance System Survey Questionnaire)[9]; 3 to cigarette smoking[9]; and 7 (derived from the "Starting the Conversation" questionnaire)[10] to dietary patterns. In the present study, a final item was added assessing sleep quality during the previous week (using a 6-point Likert-type response scale ranging from "very poor" to "very good").

Other Variables: 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 items measuring a trait-like general tendency to be mindful in daily life. Items are rated on a Likert-type 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

Modifications to Health Behaviors Questionnaire Standard Scoring. For the 3 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 3 questions, with higher scores representing unhealthier drinking habits.

For 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 question was treated as a continuous variable; for both items, higher scores indicated less healthy smoking habits.

To assess dietary behaviors, responses were recoded 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 dietary behaviors, higher scores would indicate worse (ie, 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 treated as a continuous variable with higher scores representing better sleep quality.

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

To test pre–post program differences in means of relevant continuous variables (ie, dietary variables), we used 2-tailed *t*-tests for paired data, while the most appropriate nonparametric test (χ^2) was used to test pre–post differences in proportions (ie, physical activity, smoking). Spearman ρ 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 (CIs; $P = .05$ level of significance). All data analyses were conducted using SPSS statistical software version 20.

Results

During 2006, 206 individuals attended the standard Mindfulness-Based Stress Reduction program and consented to the use of personal data for research purposes. Complete baseline and posttraining data were available for 174 participants (Figure 1). The mean age was 47 (standard deviation = 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. More than 60% of the 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 posttreatment 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 6 or more of the 8 weekly sessions, whereas 5 (4%) participants attended 5 or fewer sessions.

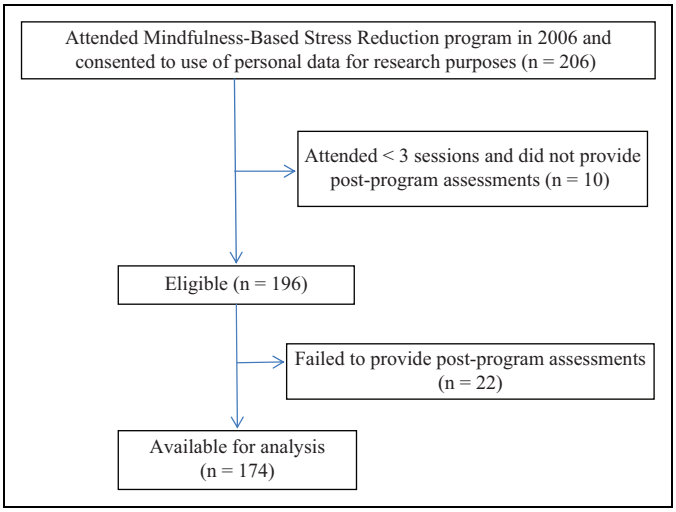

Figure 1. Flow of patients through the study.

Home Mindfulness Practice

Seventy percent (121/174) of the study participants provided some or their entire home practice data. The average number of returned logs was 6.16 (standard deviation = 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 the number of binge drinking episodes.

Smoking. Participation in mindfulness training was not associated with either changes in the proportion of participants who smoked at least part of a cigarette in the previous week or 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 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 period (Table 1).

Exploratory Analyses

Change in Mindfulness Skills and Health-related Behaviors. We did not detect correlations between changes in the overall mindfulness score or the various facets of mindfulness and changes in health behaviors. The one exception to this was sleep quality, which was positively associated with change in overall mindfulness scores ($\rho = 0.30$, $P < .01$) as well as with changes in 3 of the subscales: Observe ($\rho = 0.28$, $P = .01$), Acting with Awareness ($\rho = 0.19$, $P = .01$), and React ($\rho = 0.21$, $P < .01$).

Associations Between Individual Mindfulness Practice and Changes in Behaviors. Individual home practice was not associated with changes in dietary behavior or physical activity. The improvement in sleep quality was related to the amount of time participants spent in informal practice ($\rho = 0.23$, $P = .01$) but not with the duration of the other individual practices.

Discussion

Participation in a standard Mindfulness Based Stress Reduction program was associated with improved overall dietary behaviors, modest changes in physical activity, and better sleep quality compared to baseline. No changes were observed in smoking and drinking 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 (ie, 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; these changes were maintained 3 months postintervention.[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 can also explain the lack of improvement in smoking and drinking behaviors, as the prevalence of smokers in this study was low, and on average, participants reported healthy drinking habits at baseline. 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 with 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

Table 1. Pre–Post Program Change in Health Behaviors.[a]

Behavior	Pre	Post	Mean Change (95% CI)	P^b
Drinking				
Overall drinking behavior score (mean, SD)[c]	12.45 (11.50)	12.10 (11.29)	0.349 (−0.76, 1.45)	.540
Days drank at least 1 drink during past month (mean, SD)	8.84 (9.30)	8.01 (8.81)	0.82 (0.10, 1.55)	.026
Number of drinks on drinking days (mean, SD)	1.29 (1.04)	1.34 (1.07)	−0.05 (−0.19, 0.10)	.543
Binge drinking episodes over past month (mean, SD)[d]	2.40 (4.17)	3.00 (4.60)	−0.61 (−1.42, 0.20)	.141
Smoking				
Smoked at least part of a cigarette over past week	15 (23)	13 (24)		.705
Number of cigarettes during past week (mean, SD)	1.48 (17.31)	2.52 (13.72)	−1.03 (−2.38, 0.31)	.13
Dietary behaviors				
Overall dietary score (mean, SD)[c]	7.99 (3.60)	7.24 (3.58)	0.75 (0.35, 1.15)	.001
Fast food meals or snacks, times/week (mean, SD)	1.27 (1.16)	1.10 (1.01)	0.16 (−0.02, 0.34)	.082
Fruits or veggies, servings/day (mean, SD)	0.70 (0.85)	0.55 (0.71)	0.16 (0.04, 0.27)	.006
Sweetened beverages, servings/day (mean, SD)	1.02 (1.28)	0.89 (1.16)	0.12 (−0.05, 0.30)	.156
Chicken, beans, or fish, times/week (mean, SD)	0.59 (0.97)	0.55 (0.93)	0.04 (−0.13, 0.20)	.673
Snacks, chips, or crackers, times/week (mean, SD)	1.14 (1.07)	1.15 (1.11)	−0.01 (−0.16, 0.13)	.876
Desserts or other sweets, times/week (mean, SD)	2.15 (1.08)	1.96 (1.11)	0.18 (0.06, 0.31)	.005
Margarine, butter, or meat fat for seasoning, times/week (mean, SD)	1.25 (0.60)	1.18 (0.54)	0.07 (−0.02, 0.15)	.115
Physical activity				
Sedentary	9 (5)	2 (1)		.035
Rarely or no physical activity	19 (10)	11 (6)		.021
Underactive	104 (60)	94 (61)		.477
Some light or moderate physical activity, not every week	153 (76)	145 (83)		.659
Underactive-regular	25 (15)	27 (18)		.782
Moderate physical activity every week, <5 days per week or <30 minutes at a time	103 (51)	102 (59)		.726
Vigorous physical activity every week, <3 days per week or <20 minutes at a time	41 (21)	38 (22)		.547
Active category	34 (20)	30 (20)		.617
Moderate physical activity 30 minutes or more per day, 5 or more days/week	58 (28)	55 (32)		.573
Moderate physical activity 20 or more minutes per day, 3 or more days/week	47 (24)	44 (26)		.783
Overall strength/flexibility score (mean, SD)[e]	1.65 (1.30)	2.29 (0.91)	−0.64 (−0.83, −0.44)	.001
Activities to increase muscle strength, such as lifting weights or calisthenics, once a week or more (mean, SD)[e]	0.47 (0.99)	0.53 (0.91)	−0.03 (−0.10, 0.03)	.356
Activities to improve flexibility, such as stretching or yoga, once a week or more (mean, SD)[e]	0.53 (0.24)	0.89 (0.57)	−0.63 (−0.80, −0.47)	.001
Sleep quality				
Sleep quality scores (mean, SD)[f]	3.41 (0.10)	4.10 (0.10)	−0.68 (−0.47, −0.90)	.01

Abbreviations: CI, confidence interval; SD, standard deviation.
[a]Values are n (%) unless otherwise specified.
[b]Two-tailed *t* test for paired data or χ^2.
[c]*Overall* dietary and drinking scores = sum of scores on individual answers, where a higher score indicates unhealthier dietary or drinking behaviors. Other items are self-explanatory.
[d]Binge drinking defined as ≥5 drinks (men) or ≥4 drinks (women).
[e]Higher scores indicate higher flexibility or higher level of specified activity.
[f]Higher scores indicate better sleep quality.

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 (ie, 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 positive changes in health-related behaviors, particularly in dietary behaviors and 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

The authors are grateful for the support of the staff and instructors of the University of Massachusetts Medical School, Center for Mindfulness.

Authors Contributions

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

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Ethical Approval

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

References

1. Anderson LH, Martinson BC, Crain AL, et al. Health care charges associated with physical inactivity, overweight, and obesity. *Prev Chronic Dis*. 2005;2:A09.
2. Glasgow RE, Kaplan RM, Ockene JK, Fisher EB, Emmons KM. Patient-reported measures of psychosocial issues and health behavior should be added to electronic health records. *Health Aff (Millwood)*. 2012;31:497-504.
3. Williams PG, Thayer JF. Executive functioning and health: introduction to the special series. *Ann Behav Med*. 2009;37:101-105.
4. Kabat-Zinn J. *Full Catastrophe Living: Using the Wisdom of Your Body and Mind to Face Stress, Pain and Illness*. New York, NY: Delacorte, 1990.
5. Goldin P, Gross J. Effect of mindfulness meditation training on the neural bases of emotion regulation in social anxiety disorder. *Emotion*. 2010;10:83-91.
6. Chambers R, Gullone E, Allen NB. Mindful emotion regulation: an integrative review. *Clin Psychol Rev*. 2009;29:560-572.
7. Glasgow RE, Ory MG, Klesges LM, Cifuentes M, Fernald DH, Green LA. Practical and relevant self-report measures of patient health behaviors for primary care research. *Ann Fam Med*. 2005;3:73-81.
8. Topolski TD, LoGerfo J, Patrick DL, Williams B, Walwick J, Patrick MB. The rapid assessment of physical activity (RAPA) among older adults. *Prev Chronic Dis*. 2006;3:A118.
9. Center for Disease Control and Prevention. *Behavioral Risk Factor Surveillance System Survey Questionnaire*. Atlanta, GA: US Department of Health and Human Services; 2011.
10. Paxton AE, Strycker LA, Toobert DJ, Ammerman AS, Glasgow RE. Starting the conversation: performance of a brief dietary assessment and intervention tool for health professionals. *Am J Prev Med*. 2011;40:67-71.
11. Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. *Assessment*. 2006;13:27-45.
12. Baer RA, Smith GT, Lykins E, et al. Construct validity of the Five Facet Mindfulness Questionnaire in meditating and nonmeditating samples. *Assessment*. 2008;15:329-342.
13. Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological well-being. *J Pers Soc Psychol*. 2003;84:822-848.
14. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clin Psychol Sci Pract*. 2003;10:144-156.
15. Roberts KC, Danoff-Burg S. Mindfulness and health behaviors: is paying attention good for you? *J Am Coll Health*. 2011;59:165-173.
16. Gilbert D, Waltz J. Mindfulness and health behaviors. *Mindfulness*. 2010;1:227-234.
17. Daubenmier J, Kristeller J, Hecht FM, et al. Mindfulness intervention for stress eating to reduce cortisol and abdominal fat among overweight and obese women: an exploratory randomized controlled study. *J Obes*. 2011;2011:651936.
18. Kearney DJ, Milton ML, Malte CA, McDermott KA, Martinez M, Simpson TL. Participation in mindfulness-based stress reduction is not associated with reductions in emotional eating or uncontrolled eating. *Nutr Res*. 2012;32:413-420.
19. Hebert JR, Hurley TG, Harmon BE, Heiney S, Hebert CJ, Steck SE. A diet, physical activity, and stress reduction intervention in men with rising prostate-specific antigen after treatment for prostate cancer. *Cancer Epidemiol*. 2012;36:e128-e136.
20. Carmody J, Olendzki B, Reed G, Andersen V, Rosenzweig P. A dietary intervention for recurrent prostate cancer after definitive primary treatment: results of a randomized pilot trial. *Urology*. 2008;72:1324-1328.
21. Carmody JF, Olendzki BC, Merriam PA, Liu Q, Qiao Y, Ma Y. A novel measure of dietary change in a prostate cancer dietary program incorporating mindfulness training. *J Acad Nutr Diet*. 2012; 112:1822-1827.
22. Brewer JA, Mallik S, Babuscio TA, et al. Mindfulness training for smoking cessation: results from a randomized controlled trial. *Drug Alcohol Depend*. 2011;119:72-80.
23. Davis JM, Fleming MF, Bonus KA, Baker TB. A pilot study on mindfulness based stress reduction for smokers. *BMC Complement Altern Med*. 2007;7:2.
24. Winbush NY, Gross CR, Kreitzer MJ. The effects of mindfulness-based stress reduction on sleep disturbance: a systematic review. *Explore (NY)*. 2007;3:585-591.
25. Andersen SR, Wurtzen H, Steding-Jessen M, et al. Effect of mindfulness-based stress reduction on sleep quality: results of a randomized trial among Danish breast cancer patients. *Acta Oncol*. 2013;52:336-344.
26. Carmody JF, Crawford S, Salmoirago-Blotcher E, Leung K, Churchill L, Olendzki N. Mindfulness training for coping with hot flashes: results of a randomized trial. *Menopause*. 2011;18: 611-620.