Mindfulness Goes to Work

Impact of an Online Workplace Intervention

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Objective: The objective of this study was to determine whether a mindfulness program, created for the workplace, was both practical and efficacious in decreasing employee stress while enhancing resiliency and well-being. **Methods:** Participants (89) recruited from The Dow Chemical Company were selected and randomly assigned to an online mindfulness intervention ($n = 44$) or wait-list control ($n = 45$). Participants completed the Perceived Stress Scale, the Five Facets of Mindfulness Questionnaire, the Connor-Davidson Resiliency Scale, and the Shirom Vigor Scale at pre- and postintervention and 6-month follow-up. **Results:** The results indicated that the mindfulness intervention group had significant decreases in perceived stress as well as increased mindfulness, resiliency, and vigor. **Conclusions:** This online mindfulness intervention seems to be both practical and effective in decreasing employee stress, while improving resiliency, vigor, and work engagement, thereby enhancing overall employee well-being.

Occupational pressure is now recognized as the major source of stress for US adults, representing a serious hazard to employee health and productivity. Unfortunately, this is an expensive problem, in part due to the high medical costs associated with chronic long-term stress, which can contribute to adverse health habits such as alcoholism, smoking, and obesity.[1,2] Furthermore, chronic stress is a known risk factor in many disease states, including depression,[3–5] upper respiratory tract infections,[6] cardiovascular disease,[7–9] stroke,[10] autoimmune disorders,[11,12] and total mortality.[13,14] Unfortunately, the costs associated with workplace stress go well beyond higher health care utilization, to include inflated expenses due to increased absenteeism and presenteeism, reduced productivity, greater compensation claims, and rising health insurance expenses.[15] In addition, other mental health disorders, including anxiety and depression, add to this burden. According to Health and Safety Executive[16] statistics done in Great Britain, mental ill health, including stress, anxiety, and depression, gave rise to more working days lost than any other illness complaint, including musculoskeletal disorders, accounting for 9.3 million days lost in 2010. This difficult financial problem is further illustrated by a recent sample of 92,486 employees at seven organizations over an average of 3 years. In this sample, workers with depression cost $2184 more (48%) than those not at risk while workers reporting high stress were $413 more costly. This combined at-risk mental health group represented 4.2% of medical expenditures with a total cost of $15,396,934 annually. This compares, for example, with an annual cost of $7,472,894 for high blood pressure and a cost of $9,823,445 for tobacco use.[17] Because of the prevalence and cost of this problem, an intervention with the capacity to help mitigate employee stress, while simultaneously leading to the development of emotional well-being, could be beneficial to employers from both cost and performance perspectives.

The primary purpose of this study was to determine whether a shortened, workplace-specific mindfulness program could replicate the effectiveness of a traditional Mindfulness Based Stress Reduction (MBSR) program in reducing employee stress while enhancing measures of mindfulness and employee well-being. Mindfulness, the concept central to this intervention, has been conceptualized as a two-component model. The first component consists in focusing full attention on immediate experience.[18,19] The second component involves adopting a stance of acceptance, curiosity, and openness toward one's experience. In theory, this process of nonevaluative, nonjudgmental awareness of present moment experience allows for a detachment from ruminative and elaborate thought patterns regarding those experiences. With practice, this results in a learned skill or trait, which allows insight into the nature of one's mind and thoughts. This form of mental training, with its concomitant growth in awareness and insight, can lead to stress hardiness and an increased ability to skillfully cope with potentially harmful and maladaptive mental processes.[20]

Traditionally delivered MBSR programs, which teach core mindfulness concepts, have been well researched with beneficial therapeutic effects found in psoriasis,[21] fibromyalgia,[22] type 2 diabetes,[23] rheumatoid arthritis,[24,25] chronic pain,[26–29] chronic low back pain,[30] attention-deficit/hyperactivity disorder,[31,32] and insomnia.[33] Research also indicates that mindfulness-based therapies are beneficial in the treatment of depression,[34–36] anxiety disorders,[37,38] and bipolar disorder.[37–41] In addition, studies in the realm of business have found mindfulness to be beneficial in improving service quality in small to medium employers,[42] relationship quality in service employers,[43] marketing strategy,[44] quality and reliability in small and large employers,[45] quality management,[46] product failure management,[47] task performance,[48] employee turnover intentions,[49] and resonant leadership.[50]

A potential deterrent, however, to the utilization of a traditionally delivered MBSR program in a workplace setting is the expected participant time commitment. A typical MBSR program requires approximately 30 hours of teacher-led training, in addition to 30 to 45 minutes of home-based practice daily. To address the more time urgent needs of the workplace environment, we created a mindfulness intervention delivered via an online platform. This program was significantly modified in content from traditional MBSR to reflect workplace needs. In addition, this program was shortened, requiring approximately 25% of the time commitment typical to MBSR curriculum (Table 1). Important aims of this study were to determine whether such a modified program would (1) be practical in today's workplace, (2) provide the potential for scalability; and (3) remain efficacious in decreasing perceived stress and enhancing employee mindfulness.

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TABLE 1. MBSR vs Dow Mindful Resilience Program Components*

	MBSR	Dow Mindful Resilience Program
Class 1		
Class time	3 hr	1 hr (Theme—Overriding Autopilot)
Home practice	Body Scan (45 min) × 6	The Raisin (12 min) × 1 Breath Focus l (12 min) × 2 Body Scan l (22 min) × 2
Class 2		
Class time	2.5 hr	1 hr (Theme—Body Awareness)
Home practice	Body Scan (45 min) × 6	Coffee Break (11 min) × 1 Walking Focus l (17 min) × 2 Body Scan ll (25 min) × 2
Class 3		
Class time	2.5 hr	1 hr (Theme—Breath as an Anchor)
Home practice	Body Scan (45 min) × 3 Lying Yoga (45 min) × 3	Breath Focus ll (20 min) × 2 Lying Yoga (35 min) × 2 Three-Minute Breathing Pause
Class 4		
Class time	2.5 hr	1 hr (Theme—The Watcher and the Talker)
Home practice	Body Scan (45 min) × 3 Standing Yoga (45 min) × 3 Breath Meditation daily (20 min)	Focus on Physical Sensation (23 min) × 2 Walking Focus ll (22 min) × 2
Class 5		
Class time	2.5 hr	1 hr (Theme—Acceptance)
Home practice	Sitting Meditation (30 min) × 3 Body Scan or Yoga (45 min) × 3	Focus on Sound and Thought (23 min) × 2 Standing Yoga (37 min) × 1
Class 6		
Class time	2.5 hr	1 hr (Theme—Thought Is Not Reality)
Home practice	Sitting Meditation (30 min) × 3 Body Scan or Yoga (45 min) × 3	Choiceless Awareness Meditation (25 min) × 1 Focus on Bells and Poetry (20 min) × 1
Class 7		
Class time	2.5 hr	1 hr (Theme—Difficult Situations)
Home practice	Practice as desired (30–45 min) daily	Mindful Communication (15 min) × 1 Stress-free Driving (20 min) × 1 Stressful Situations (17 min) × 1
Class 8		
Class time	3.5 hr	No Class (Theme—Building Your Haven)
Home practice	Practice as desired (30–45 min) daily	The Window (23 min) × 1 The Oak (27 min) × 1 Progressive Muscle Relaxation (25 min) × 1
Day retreat	7.5 hr	None
Time commitment		
Classroom	29 hr	7 hr
Home practice	42–48 hr	10.8 hr
Individual interview	1.5 hr	None
Total	72.5–75.5 hr	17.8 hr

*All Dow mindfulness exercises were accessed by participants through Web-based audio recordings. Home practice time (ie, 45 minutes) denotes time per exercise.
MBSR, Mindfulness Based Stress Reduction.

AIMS AND HYPOTHESIS

The program utilized in this study was tested in a population of general employees at The Dow Chemical Company (Dow). The primary hypotheses of the study were that a shortened, Web-based workplace mindfulness program would (1) increase measures of mindfulness, (2) decrease stress, (3) enhance resiliency, and (4) improve employee vigor and work engagement, thereby resulting in an increase in positive organizational behavior and enhanced employee well-being. We also hypothesized that the online applied training portion of the program, which included personalized progress tracking and lifestyle coaching, could affect employee lifestyle choices such as (1) diet, (2) exercise time, and (3) hours slept per night, over the course of the program.

METHODS

Design

This study utilized a randomized controlled study design, which implemented a 2 (intervention vs wait-list control group) × 3 (baseline, postintervention, 6-month follow-up) format, thereby allowing between-groups comparisons. Participants were randomly assigned by computer algorithm to the 7-week workplace-specific mindfulness program or a wait-list control group. The wait-list control group received the identical mindfulness treatment immediately after the intervention group completed the program. Although exact data are not available, both groups were predominately meditation naive, with only one participant known to have had prior MBSR

experience. With regard to outcomes, baseline and postintervention measures were taken on both the intervention and wait-list control groups. In addition, wait-list control participants completed a third set of measures immediately after they received the mindfulness intervention (postintervention wait-list group [PIWL]). Follow-up measures for the intervention group were also obtained 6 months after treatment.

Participants

Participants were drawn from a sample of 600 Dow employees, located in Midland, Michigan, who had completed a health risk assessment (comprehensive questionnaire and biometrics) in the preceding 6 months. All employees are invited for health risk assessment with employees in given departments being scheduled throughout the year. This recruitment allowed for study access to a good cross section of employees because the standard process of invitations would include all elements of the employee base. Study participant recruitment occurred from March to April 2012 and consisted of one e-mail notification, which described the free mindfulness-based stress management program. The e-mail notification explained that the purpose of the program was to help employees reduce and manage workplace stress. In response to the e-mail notification, 135 employees signed up for the program and 90 were randomly selected to participate. Inclusion criteria included (1) having taken a health risk assessment in the last 6 months, (2) being a salaried employee of The Dow Chemical Company, and (3) having an age greater than 18 years. There were no exclusion criteria for this study, although the program was not offered to hourly workers. In addition, an open invitation was sent via e-mail to the 90 participants describing a Mindful Leaders program, which we had developed. This notification explained that the intent of the Mindful Leaders was to act as champions for the program within Dow. Of the 90 selected, 89 employees, aged 18 to 65 years, gave informed consent, enrolled in the program, and were subsequently randomly assigned to the mindfulness intervention group ($n = 44$) or wait-list control ($n = 45$). In addition, six participants in the intervention group chose to be Mindful Leaders or champions, as did five participants in the wait-list control group.

Measures

Five Facets of Mindfulness Questionnaire

Because researchers consider mindfulness to be a multidimensional construct with facets that include the ability to observe, describe, act with awareness, refrain from judgment, and nonreact,[51] we utilized the well-validated Five Facets of Mindfulness Questionnaire (FFMQ) to assess potential improvements in all five mindfulness domains. The FFMQ is a self-report instrument consisting of 39 items, which measures a trait-like, general tendency to be mindful on a daily basis.

The Perceived Stress Scale

The Perceived Stress Scale (PSS-14) was used to assess participants' levels of psychological stress. The PSS-14 is a well-validated stress measurement tool whose items are designed to tap into how unpredictable, uncontrollable, and overloaded individuals find their lives.[52,53]

Connor-Davidson Resilience Scale

We evaluated resiliency with the Connor-Davidson Resilience Scale (CD-RISC) scale. The CD-RISC consists of 25 items, which measure an individual's sense of personal competence, tolerance of negative emotion, positive acceptance of change, trust in one's instincts, sense of social support, spiritual faith, and an action-oriented approach to problem solving.[54] Research has shown resiliency to positively impact job performance, organizational commitment, and organizational citizenship behavior.[55,56]

Shirom Vigor Scale

We analyzed vigor and work engagement with the 12-item Shirom Vigor Scale. Shirom[57] conceptualized vigor as consisting of three facets, physical strength, emotional energy, and cognitive liveliness. The first facet, physical strength, references one's sense of high energy when carrying out daily tasks at work. The second facet, emotional energy, refers to one's capacity to emotionally invest in relationships with clients and coworkers, as well as the ability to express sympathy and empathy. The last facet, cognitive liveliness, refers to one's feelings of mental agility and flow of thought processes.[57–59] In addition, the Shirom Vigor measure is a common approach to work engagement developed by researchers. The Shirom Scale measures the three components of vigor, which reflects Kahn's (1990) original concept of engagement. This concept includes the use of physical, emotional, and cognitive energetic capacities at work. Some researchers believe that the Shirom Vigor approach to engagement may be the better measure in determining the effect of engagement on organizational outcomes.[60]

Lifestyle Survey Questions

In addition to the aforementioned outcome measures, we also analyzed self-reported lifestyle behaviors. Participants were asked the following questions via weekly online surveys over the course of 7 weeks: (1) average number of servings of fruits and vegetables daily; (2) average number of fast food meals per week; (3) days per week with at least 30 minutes of exercise; (4) average hours slept per night; (5) the number of high stress episodes per week; and (6) the number of days per week a participant felt too burned out to work.

Intervention

Mindfulness Program

The mindfulness intervention utilized in this study consisted of a 7-week program combining live, weekly hour-long virtual class meetings with accompanying online applied training. Once participants had been selected for the intervention and had submitted their completed baseline assessment scales, they were given access to their unique training dashboard through the program Web site. Participants also received a workbook, which corresponded to each weekly lesson and contained a practice guide. The intervention began with an introductory in-person class meeting, after which participants were instructed to read the corresponding section of the workbook and complete the assigned online applied training before the next class meeting. Subsequent class meetings (with the exception of the fifth class meeting, which was on site) were conducted via webinar and followed the same format. Participants could join these meetings together in a prescheduled conference room at Dow (which held a webinar broadcast screen) or, if they were traveling, remotely via the Internet or cell phone. In addition, meetings were recorded and sent out to participants in the event that they could not attend.

The program's weekly online applied training material consisted of three parts. The first part consisted of completion of the assigned experiential audio exercises, which became longer and more complex as the course progressed. Exercises were framed to participants as containing mental fitness and focusing techniques and included training in the following mindfulness practices: (1) seated focus exercises on the breath, physical sensation, sound, and thought; (2) a short body scan with progressive focus on physical sensation throughout the body; (3) walking meditation with focus on physical sensation and sight; (4) movement exercise with focus on various stretching postures and awareness of sensation inherent to body movement; and (5) 3-minute breathing pause with focus on the breath, physical sensation, and thought, designed to allow intentional connection with the present moment.[61] Additional exercises included

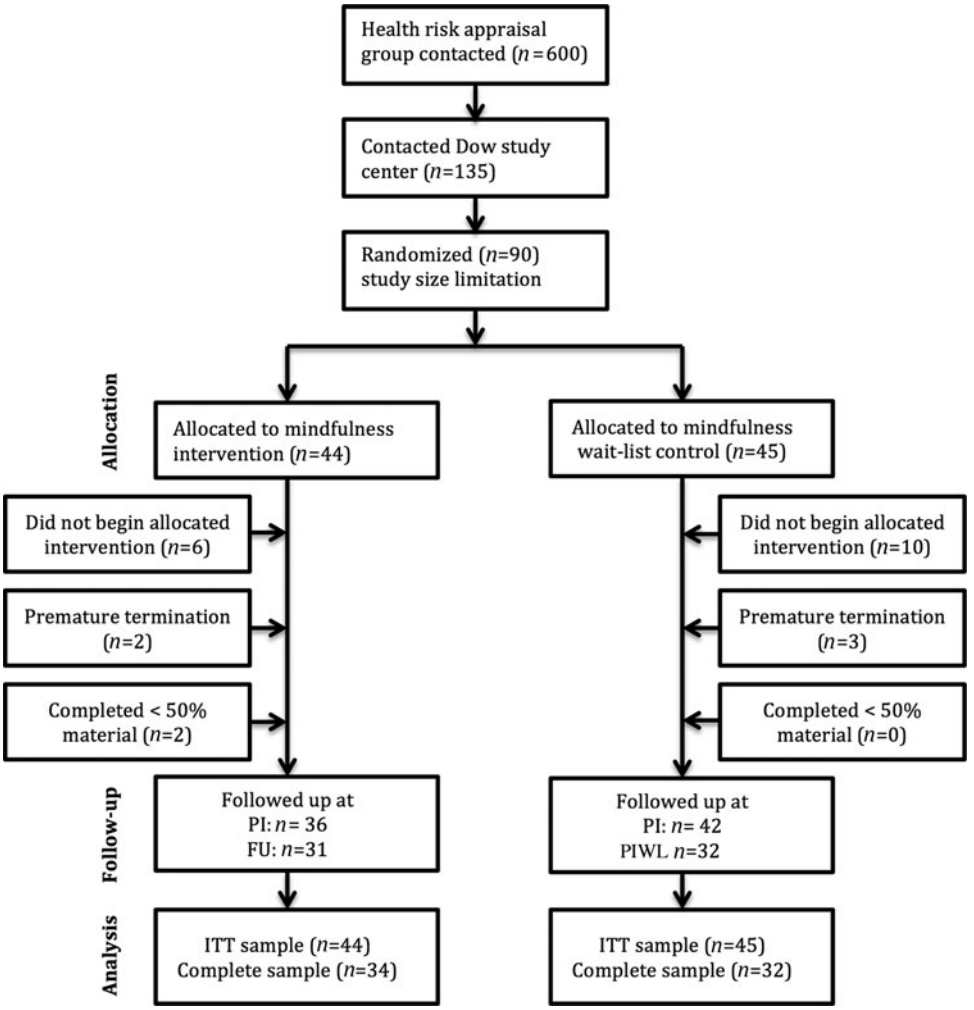

FIGURE 1. Participant flowchart. FU, follow-up; PI, postintervention; PIWL, post-intervention wait-list.

performance-oriented skills such as successful handling of stressful situations, recognition of autopilot and automatic mind scripts, mindful communication, presentation preparedness, and mindful problem solving.

The second part of the program's online applied training consisted of a weekly progress tracking survey. The intended purpose of this survey was twofold: (1) to assess participants' understanding of the concepts inherent in each week's mindfulness material and (2) to track healthy lifestyle habits and program usage. Each participant received pre-programmed e-mail coaching and feedback specific to his or her individual responses to survey questions. This feedback was programmed to provide educational material and coaching in areas where the participant needed improvement as well as encouragement in areas where the participant excelled.

The last piece of the online applied training program was a customized text messaging system. Participants who decided to "opt in" received a daily text that corresponded to his or her progress through the program. These texts provided daily practice reminders and encouragement specific to the participant's place in the program.

Wait-List Control

Participants randomized to this group received no active treatment but were offered the intervention at the conclusion of the post-intervention period.

Instructor

A board-certified internal medicine physician, with training in integrative medicine and MBSR, led the intervention. The same instructor who led the intervention group also led the wait-list control group sessions. Following the completion of the intervention group training, participants in the wait-list control group received the equivalent mindfulness program.

Statistical Analysis

Primary results are based upon intention-to-treat (ITT) analysis. The treatment effect was assessed through (1) comparison of all scores between intervention and wait-list control in the ITT sample at postintervention, adjusting for baseline scores, and (2) within-group comparisons of pre- and postintervention scores using baseline to postintervention for the intervention group, and from postintervention to program completion (PIWL) for the wait-list control group. In addition, a secondary analysis with study completers (participants who participated in at least 50% of the allocated intervention) is also reported.

Analysis of covariance was used for the first comparison. We report effect size (ES) for paired differences for the second comparison. In addition, the same analysis was performed for the participants who completed more than 75% of the material. Furthermore, to assess whether there was a linear trend of change in each lifestyle survey question score as the program progressed, we fit a

TABLE 2. ITT Sample Means and Standard Deviations for All Variables per Group for All 3 Timepoints: Baseline (BL), Postintervention (PI), and 6-Month Follow-Up (FU)*

	Mindfulness Intervention ($N = 44$)								Wait List Control ($N = 45$)							
	BL	PI	FU	*P*FU	ESPI†	ESFU‡	% PI§	% FU‖	BL	PI	PIWL	*P*PI	*P*PIWL	ESPI	ESPIWL¶	% PIWL#
FFMQ																
Observe	23.25 ± 5.54	28.81 ± 5.44	29.26 ± 5.05	<.001	1.00	1.08	23.9%	25.8%	24.22 ± 5.46	23.91 ± 5.90	29.91 ± 5.60	0.90	<.001	−0.06	1.02	25.1%
Describe	26.43 ± 4.73	28.72 ± 6.15	31.19 ± 5.57	<.001	0.48	1.01	8.7%	18.0%	25.29 ± 5.72	25.48 ± 4.79	27.16 ± 5.23	0.32	0.001	0.03	0.35	6.6%
Act aware	24.11 ± 5.01	27.67 ± 5.33	28.74 ± 5.01	<.001	0.71	0.92	14.8%	19.2%	23.96 ± 6.14	24.29 ± 6.35	26.50 ± 4.93	0.81	0.001	0.16	0.35	9.1%
Nonreact	21.14 ± 4.14	24.17 ± 4.51	25.26 ± 3.88	<.001	0.73	1.00	14.3%	19.5%	21.31 ± 4.52	21.43 ± 4.10	23.88 ± 3.77	0.57	<.001	0.03	0.60	11.4%
Nonjudge	28.50 ± 6.14	30.33 ± 5.89	31.68 ± 5.97	<.001	0.30	0.52	6.4%	11.2%	27.13 ± 5.40	27.98 ± 5.86	31.06 ± 6.26	0.12	<.001	0.16	0.53	11.0%
PSS-14	24.46 ± 6.29	18.00 ± 7.01	18.81 ± 6.72	<.001	1.03	0.90	−26.4%	−23.1%	24.76 ± 8.16	23.32 ± 8.45	19.81 ± 7.36	0.04	<.001	0.18	0.42	−15.1%
CD-RISC	68.50 ± 12.09	76.11 ± 12.14	76.71 ± 11.39	<.001	0.63	0.68	11.1%	12.0%	71.02 ± 14.29	67.71 ± 14.70	76.59 ± 13.60	0.90	<.001	−0.23	0.60	13.1%
Vigor																
PS	4.08 ± 0.96	4.77 ± 0.99	4.88 ± 0.76	<.001	0.72	0.83	16.8%	19.6%	4.17 ± 1.15	4.46 ± 1.07	4.81 ± 1.12	0.01	<.001	0.25	0.56	7.8%
CL	4.53 ± 0.96	5.11 ± 0.99	5.08 ± 0.86	0.003	0.60	0.57	12.9%	12.1%	4.75 ± 0.99	4.69 ± 1.03	5.06 ± 1.07	0.45	0.002	−0.06	0.31	7.9%
EE	5.07 ± 0.89	5.47 ± 0.68	5.63 ± 0.60	0.001	0.45	0.63	7.7%	11.0%	5.12 ± 1.06	5.12 ± .094	5.34 ± 1.09	0.89	0.01	0.00	0.21	4.3%

**P* Values represent within-group changes from baseline (BL) to postintervention (PI) except for *P*PIWL, which represents differences between PI and PIWL for wait-list control.
†ESPI represents within-group effect sizes that reflect differences between (BL) and (PI).
‡ESFU represents within-group effect sizes that reflect differences between (BL) and (FU).
§% PI represents % change at postintervention between BL and PI.
‖% FU represents % change at 6-month follow-up between BL and FU.
¶ESPIWL represents within-group effect sizes that reflect differences between (PI) and (PIWL).
#% PIWL represents % change for wait-list group between PI and PIWL.
BL, baseline; CD-RISC, Connor-Davidson Resilience Scale; CL, cognitive liveliness; EE, emotional energy; FFMQ, Five Facets of Mindfulness Questionnaire; FU, 6-month follow-up; PI, postintervention; PIWL, postintervention wait-list group; PS, physical strength; PSS-14, Perceived Stress Scale.

TABLE 3. Comparison Between Groups Mindfulness Intervention vs Wait List Control @ PI

	ITT vs Wait-List
FFMQ	
Observe	<0.001
Describe	0.008
Act aware	0.001
Nonreact	0.001
Nonjudge	0.227
PSS-14	<.001
CD-RISC	<.001
Shirom Vigor Scale	
Physical strength	0.021
Cog liveliness	<.001
Emotional energy	0.027

CD-RISC, Connor-Davidson Resiliency Scale; FFMQ -Five Facets of Mindfulness Questionnaire; ITT, intention-to-treat; PI, postintervention; PSS-14, Perceived Stress Scale.

linear mixed-effects model between the survey question score and progressing time (week) using a pooled sample (intervention and wait-list control). This pooled sample contained 69 participants, who showed varying levels of completion of the 8-week survey. We report estimated mean scores at weeks 1 and 8. A significance level of 0.05 was used for this analysis.

RESULTS

Attrition and Adherence to Treatment

The ITT intervention group sample consisted of 44 participants. The criterion for inclusion in the ITT sample was randomization. Of these 44 participants, 6 did not start the program, citing work obligations and busy schedules as the cause. Of the remaining 38, 2 (5.3%) terminated prematurely because of either scheduling problems or work commitments within the first 2 weeks of the intervention (Fig. 1).

The total, completed program sample comprised all participants who had participated in at least 50% of the allocated intervention and provided data at baseline and postintervention (n = 34; dropout rate = 10.5%). Of the 34 program completers in the intervention group, six participants (17.6%) reported completing

TABLE 4. Complete Sample and % Material Means and Standard Deviations for All Variables Per Group for All 3 Timepoints: Baseline (BL), Postintervention (PI and PIWL), and 6-Month Follow-Up (FU)*

	Mindfulness Intervention (N = 34)							
FFMQ	**BL**	**PI**	**FU**	***P*FU**	**ESPI†**	**ESFU‡**	**% PI§**	**% FU‖**
Complete sample: 50% of material completed								
Observe	23.15 ± 4.79	29.15 ± 5.41	29.26 ± 5.05	<.001	1.25	1.3	25.9	26.4
Describe	26.24 ± 4.57	29.15 ± 5.85	31.19 ± 5.57	<.001	0.64	1.1	11.1	18.9
Act Aware	24.38 ± 5.19	28.27 ± 4.73	28.74 ± 5.01	<.001	0.75	0.8	16.0	17.9
Nonreact	20.71 ± 4.30	24.44 ± 4.45	25.26 ± 3.88	<.001	0.87	1.1	18.0	22.0
Nonjudge	27.94 ± 6.42	30.24 ± 6.03	31.68 ± 5.97	<.001	0.36	0.6	8.2	13.3
PSS-14	24.79 ± 6.71	17.26 ± 6.46	18.81 ± 6.72	<.001	1.12	0.9	−30.4	−24.1
CD-RISC	68.24 ± 12.77	76.82 ± 12.89	76.71 ± 11.39	<.001	0.67	0.7	12.6	12.4
Vigor								
PS	4.11 ± 1.05	4.83 ± 0.97	4.88 ± 0.61	<.001	0.69	0.7	17.5	18.8
CL	4.47 ± 1.01	5.16 ± 0.99	5.09 ± 0.86	0.003	0.68	0.6	15.5	13.8
EE	5.13 ± 0.79	5.53 ± 0.65	5.63 ± 0.60	0.001	0.51	0.6	7.7	9.7
	Mindfulness Intervention (N = 28)							
	BL	**PII**	**FU**		**ESPI**	**ESFU**	**% PI**	**% FU**
Complete sample: 75%–100% material completed								
Observe	23.32 ± 4.56	30.00 ± 4.51	29.63 ± 5.09		1.46	1.38377193	28.6	27.1
Describe	26.89 ± 4.19	30.39 ± 4.79	32.07 ± 5.10		0.84	1.23627685	13.0	19.3
Act Aware	23.93 ± 5.15	28.79 ± 4.66	29.04 ± 5.12		0.94	0.99223301	20.3	21.4
Nonreact	20.79 ± 4.00	24.96 ± 4.57	25.67 ± 3.88		1.04	1.22	20.1	23.5
Nonjudge	28.75 ± 6.45	31.39 ± 5.60	32.60 ± 5.48		0.41	0.60	9.2	13.4
PSS-14	24.50 ± 6.16	16.39 ± 5.65	18.81 ± 6.62		1.32	0.923701299	−33.1	−23.2
CD-RISC	69.21 ± 12.39	79.61 ± 10.61	78.30 ± 10.67		0.84	0.733656174	15.0	13.1
Vigor								
PS	4.19 ± 1.00	4.86 ± 0.66	4.95 ± 0.68		0.67	0.76	16.0	18.0
CL	4.52 ± 1.05	5.21 ± 1.02	5.15 ± 0.81		0.66	0.60	15.3	13.8
EE	5.25 ± 0.8	5.65 ± 0.61	5.74 ± 0.53		0.50	0.6125	7.7	9.3

**P* values represent within-group changes from baseline (BL) to postintervention (PI) except for *P*PIWL, which represents differences between PI and PIWL for wait-list control.
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‖% FU represents % change at 6-month follow-up between BL and FU.
BL, baseline; CL, cognitive liveliness; EE, emotional energy; FU, 6-month follow-up; PI, postintervention; PIWL, postintervention wait-list group; PS, physical strength.

approximately 50% of course material and attending an average of 6.33 of eight class meetings. The remaining 28 participants (82.4%) reported completing 75% to 100% of the program material and attended an average of 7.4 class meetings. Participants reported practicing mindfulness exercises 4.5 days per week in week 1. By week 7, the average days practiced was 3.8. Overall, practice time averaged 13 minutes per day or 1.5 hours per week.

Treatment Effect—Intention to Treat

Outcomes obtained through analysis of covariance comparing postintervention scores for the treatment group versus wait-list controls are shown in Table 2. With regard to the FFMQ, the mindfulness intervention group rated themselves significantly higher postintervention on all facets of mindfulness, with the exception of nonjudgmental awareness, than control participants (Table 3). In addition, the intervention group rated themselves lower on perceived stress (PSS-14) and higher in resiliency (CD-RISC) than the control group at the postintervention time point ($P < 0.001$, $P < 0.001$, respectively). Furthermore, significant postintervention increases were found in the mindfulness treatment group on all components of vigor (Shirom Vigor Scale) including physical strength ($P = 0.021$), cognitive liveliness ($P < 0.001$), and emotional energy ($P = 0.027$).

Analysis of within-group pre- to post– ESs showed improvements over the course of the trial in all measures examined. In the ITT sample, average within-group ES from baseline to postintervention ranged from $d = 0.30$ to 1.03 (mean = 0.67) for the intervention group and $d = -0.23$ to 0.25 (mean = 0.03) for wait-list controls. Six-month follow-up showed that the intervention group ES continued to increase over time, ranging from $d = 0.52$ to 1.08 (mean = 0.81).

Treatment Effect—Completed Program Sample and % Material

Ten participants in the intervention group did not complete the treatment protocol at postintervention. After eliminating these participants, the effect of the percentage of program material completed was analyzed (Table 4). Within this sample, those who finished 75% to 100% of the course material had a 30% greater ES at postintervention (mean $d = 0.87$) than the ITT group (mean $d = 0.67$) and a 16% greater ES than the 50% group (mean $d = 0.75$). Nevertheless, at 6-month follow-up, this differential had decreased, with the 75% to 100% group showing an ES only 12.3% greater than the ITT group and 8.8% greater than the 50% group. This change was predominantly attributed to ongoing improvements in the latter two groups over the follow-up time period (Table 5).

Follow-Up

Thirty-one of 44 mindfulness participants completed assessment at 6 months. Because the wait-list group had received the intervention by the time of follow-up, they could no longer serve as a control group for this assessment. Therefore, between-group comparisons were not completed at this time. Nevertheless, baseline values were compared with 6-month follow-up values for the intervention group. At the time of follow-up, *P* values representing within-group changes from baseline for the intervention group were all significant. These values ranged from 0.003 to less than 0.001, indicating that treatment gains were either maintained or further improved over time. The only exception to this was a nonsignificant, slight increase in perceived stress. By follow-up, measures of mindfulness in the ITT sample had improved substantially. Improvements taken from the FFMQ ranged from an 11.2% increase in the "nonjudgmental awareness" facet from baseline, to a 25.8% increase in the "observe" facet. In addition, improvements in vigor ranged from 11% for emotional energy to 19.6% for physical strength, while resiliency increased 12% and perceived stress declined by 23.1% from baseline values. Figure 2 shows outcome trends for the intervention group through 6-month follow-up in comparison to waitlist controls as assessed at the post–wait-list intervention period (PIWL).

TABLE 5. Effect Size of ITT vs Complete Groups Based on % Material Completed @ PI and FU

	ITT Group	Material 50%	Material 75%–100%
FFMQ	ES	ES	ES
Observe			
PI	1.00	1.25	1.46
FU	1.08	1.28	1.38
Describe			
PI	0.48	0.64	0.84
FU	1.01	1.08	1.24
Act Aware			
PI	0.71	0.75	0.94
FU	0.92	0.84	0.99
Nonreact			
PI	0.73	0.87	1.04
FU	1.00	1.06	1.22
Nonjudge			
PI	0.30	0.36	0.41
FU	0.52	0.58	0.60
PSS-14			
PI	1.03	1.12	1.32
FU	0.90	0.89	0.92
CD-RISC			
PI	0.63	0.67	0.84
FU	0.68	0.66	0.73
Vigor			
Physical strength			
PI	0.72	0.69	0.67
FU	0.83	0.73	0.76
Cog liveliness			
PI	0.60	0.68	0.66
FU	0.57	0.61	0.60
Emotional energy			
PI	0.45	0.50	0.50
FU	0.63	0.63	0.61
Overall mean			
PI	0.67	0.75	0.87
FU	0.81	0.84	0.91

CD-RISC, Connor-Davidson Resilience Scale; ES, effect size; FU, follow-up; ITT, intention-to-treat; PI, postintervention; PSS-14, Perceived Stress Scale.

Mediation Analysis

To determine mediation, we followed the four-step regression procedure recommended by Baron and Kenny.[62] Using this model, we examined to what extent changes in mindfulness mediated the observed improvements in perceived stress and resilience postintervention. Analysis indicates that the observed increases in mindfulness partially mediated changes in resilience while mindfulness fully mediated the changes observed in perceived stress. In terms of vigor, results indicate that mindfulness partially mediated changes in cognitive liveliness and fully mediated changes in physical strength.

Lifestyle Survey Questions

Table 6 shows the results of mixed regression analysis for each lifestyle survey question and stage. The lifestyle survey questions that demonstrated significant decreasing trends included (1) the

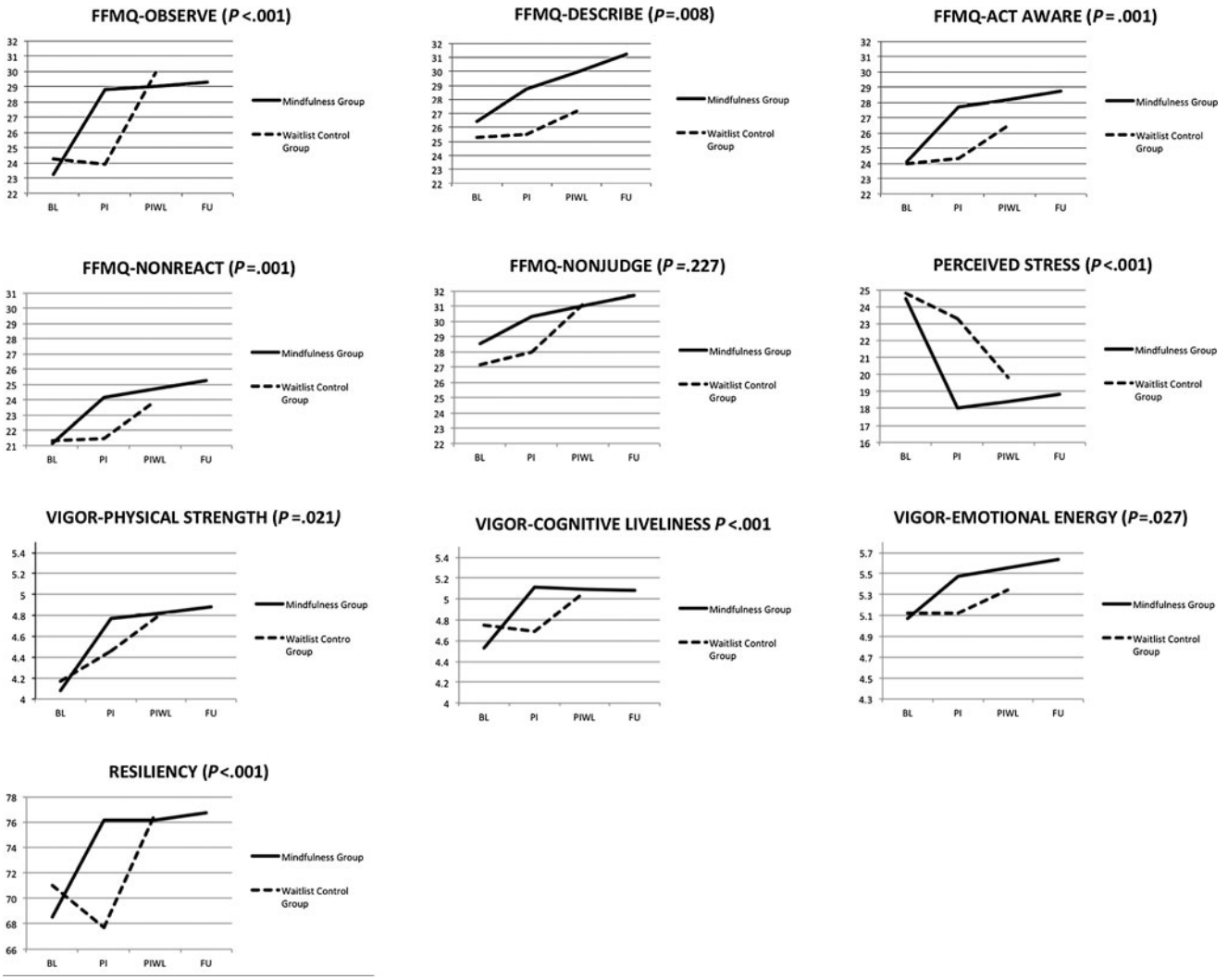

FIGURE 2. Outcome measures over time for ITT intervention vs waitlist control groups. *P* values for IIT intervention vs wait-list control group at PI. BL, baseline; FU, 6-month follow-up; PI, postmindfulness group intervention; PIWL, postintervention wait-list control group.

TABLE 6. Mixed Effect Regression Result for Lifestyle Survey Questions

Survey Question	Stage Estimate	SE	95% Confidence Interval	
			Lower Bound	Upper Bound
Fruits/vegetables	0.09**	0.02	0.05	0.12
Fast food meals	− 0.05*	0.02	− 0.08	− 0.02
Burn out days	− 0.15**	0.02	− 0.19	− 0.10
Stress episodes	− 0.18**	0.03	− 0.24	− 0.13
Exercise days	0.03	0.02	− 0.02	0.08
Sleep hours	− 0.003	0.01	− 0.02	0.02

*$P = 0.01$; **$P < 0.001$.

number of fast food meals eaten weekly ($P = 0.01$), (2) the number of high stress episodes weekly ($P < 0.001$), and (3) the number of days too burned out to work weekly ($P < 0.001$). Similarly, the survey question for daily fruit and vegetable intake showed a significant increasing trend ($P < 0.001$). No significant trends were found for either exercise or sleep.

DISCUSSION

We conducted a randomized, wait-list control study with adequate statistical power, to investigate the effects of a 7-week mindfulness intervention tailored for the workplace and delivered through an online platform. We investigated this program's impact on measures of mindfulness, perceived stress, and other parameters indicative of positive organizational behavior and employee well-being, such as resiliency, vigor, and work engagement. Comparisons were made among the mindfulness intervention group and the control group. Multivariate analysis, adjusting for baseline differences, of the ITT sample showed significant postintervention reductions in perceived stress as well as improvements in resiliency, vigor, and mindfulness as compared with controls. These results were either maintained or further improved at the 6-month follow-up mark. As we did not assess the degree of home practice at 6 months, we could not determine whether this continued response was due to an ongoing active meditation practice as opposed to a honeymoon effect or ongoing personal integration of critical cognitive behavioral course concepts.

Nevertheless, membership in the higher category for percentage of material completed did tend to predict ES, although this differential decreased over time.

In addition to the aforementioned findings, we analyzed program ratings and dropout rates. Intervention and wait-list control participants gave the program an average satisfaction rating of 87% of 100%. Furthermore, the intervention group dropout rate of 5.3% compares favorably with typically reported MBSR intervention dropout rates of less than 20%.[26,27]

With regard to lifestyle surveys, analysis of survey responses revealed significant trends in four of the six variables studied (Fig. 3). The combined intervention and wait-list groups showed a 31% reduction in the number of fast food meals eaten at 8 weeks, which was a significant decrease ($P = 0.005$). In addition, this combined group showed a 17% increase in fruit and vegetable intake, which was a significant increase ($P < 0.001$). These trends indicate that the online applied training segment of the program, with programmed educational responses based on weekly survey answers, could have a significant impact on healthy dietary choices. In addition, participants also reported a significant decrease in days too burned-out to work by one full day per week or 66% ($P < 0.001$). Participants also reported a decline in weekly high

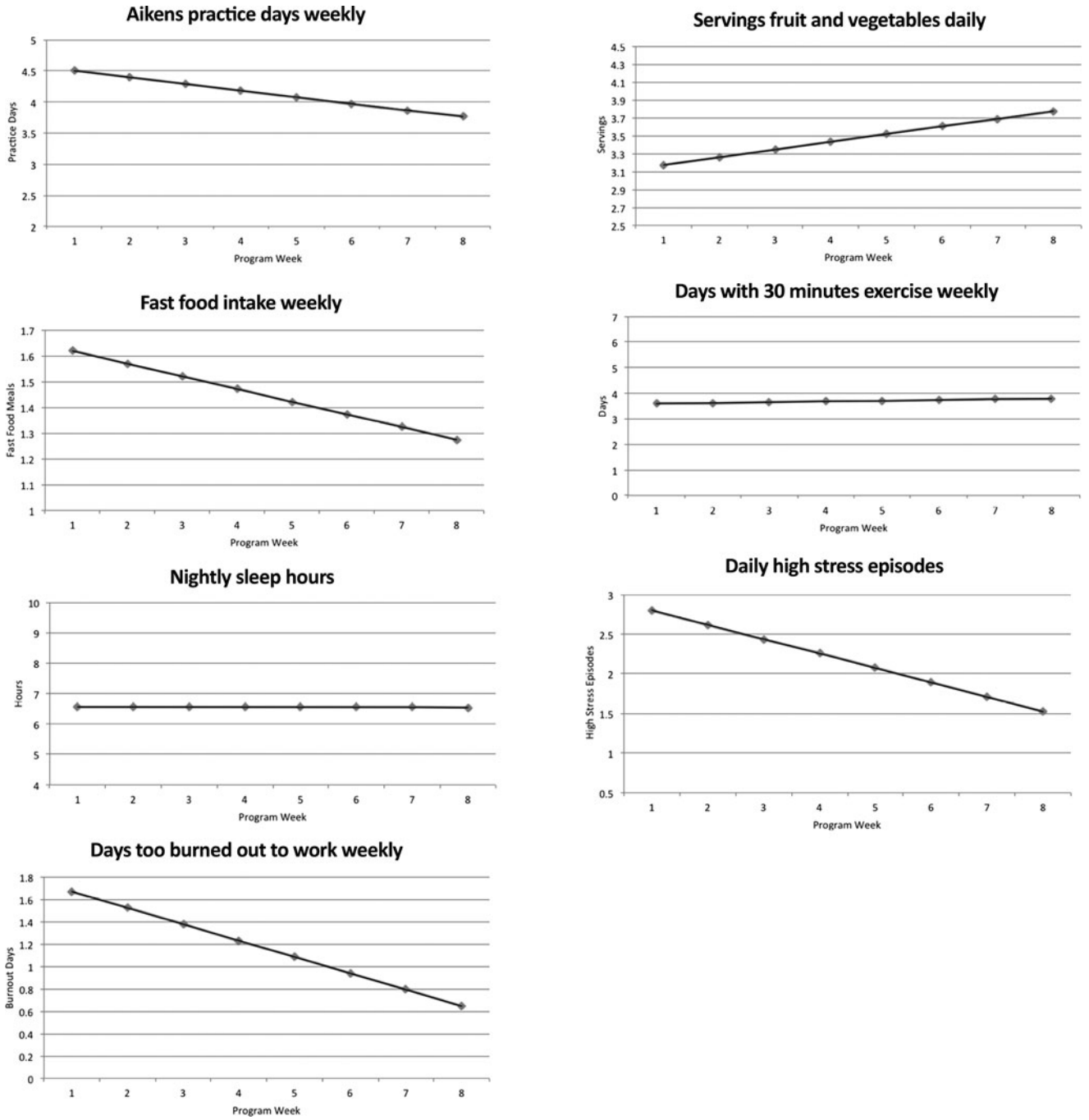

FIGURE 3. Mixed regression analysis of lifestyle survey trends over time.

stress episodes by 33%, which is a significant downward trend ($P < 0.001$).

An interesting point to these results is the timing of Dow's layoff announcements in 2012. These layoffs marked one of the largest in the company's history and occurred at the same location as the study. The first layoffs were announced in early April 2012, approximately 2 weeks before the baseline assessment scales were administered. A subsequent, more substantial, announcement occurred in late October 2012, which included the closing of a local plant. This second announcement coincided closely with the administration of follow-up outcome measures. It is possible that such events could have significantly impacted the perceived stress and resiliency measures of employees participating in the study. Our follow-up analysis showed only a very slight, nonsignificant increase in perceived stress from postintervention assessment. Furthermore, the follow-up analysis showed continued improvements in mindfulness, resiliency, and vigor. These results, which occurred despite widespread layoffs, may indicate that this intervention can have significant protective effects on employees, regardless of difficult corporate economic circumstances.

Another interesting element to this study is reflected in a cost–benefit analysis based on the program's survey question regarding self-reported burnout. This analysis showed a significant decline in self-reported burnout in both the intervention and wait-list groups, which decreased by one full day per week at postintervention ($P < 0.001$). This decrease in self-reported burnout represents a significant (20%) potential increase in worker productivity. Because the current average yearly wage for Dow reported in December 2012 was $112,900, a 20% increase in worker productivity could represent an employer savings of up to $22,580 per employee year, if the improvements in burnout are sustained over time. This savings is due to potential declines in absenteeism and presenteeism, perhaps associated with a decreased employee burnout rate.

LIMITATIONS AND CAVEATS

Some limitations and caveats to this study should be mentioned. First, this study had results from a relatively small number of participants ($n = 79$), creating the need for a larger randomized control trial to confirm the results. In addition, 12-month follow-up was not completed to avoid overburdening busy employees. This study limitation precludes us from making a more definitive assessment regarding the long-term effectiveness of the mindfulness intervention.

A further limitation is suggested by our mediation analysis, which showed that improvements in resiliency, as well as the emotional liveliness element of the Shirom Vigor Scale, were only partially mediated by mindfulness. On the basis of this finding, it is possible that nonspecific factors, such as receiving increased attention, being part of a credible treatment program, or social and group-related factors may have partially contributed to some of the study outcomes.

Reliance on self-report measures is yet another limitation that needs to be acknowledged. We used only self-report measures during the study, which makes it possible that there was some degree of response bias or social desirability affecting participant reporting on the study outcome measures.

A final study caveat is whether the study findings can be generalized to other employers. Employees vary in terms of education, compensation, motivation, and employer support. This holds even within the same sector, such as the petrochemical sector for Dow. Because we focused on Dow, we are not certain that these results can be generalized to other petrochemical employers or for employers in other sectors. Nevertheless, nothing in our results indicates that this impact would not hold true for comparable employers.

CONCLUSION

The present findings have significant potential implications for corporate health and human performance. The program studied was a mindfulness intervention, which was modified in length, content, and messaging to fit workplace needs and delivered through an online platform that included personal coaching. Overall, the ESs obtained in this study were in the moderate to large range and were either maintained, or further improved, over time. This indicates that a shortened, Web-based mindfulness program can replicate the results of traditionally delivered MBSR. In addition, program compliance was significant, suggesting that a workplace specific mindfulness intervention is practical within an employer setting. Furthermore, we looked at, not only levels of stress, but at outcome measures, which have been shown to impact human performance and are indicative of employee well-being. Our results suggest that mindfulness training is more than just an effective stress management solution but an efficacious intervention for the development of positive organizational behavior, which can be used throughout the employee base. Although return-on-investment is difficult to measure because of the many ways mindfulness can impact the organization, widespread application has the potential to result in significant employer competitive advantage through a combination of improved employee well-being, enhanced human performance, and decreased health care costs.

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