

# A Web-Based Mindfulness Stress Management Program in a Corporate Call Center

## *A Randomized Clinical Trial to Evaluate the Added Benefit of Onsite Group Support*

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**Objective:** The objective of this study is to determine the effectiveness of an 8-week web-based, mindfulness stress management program (WSM) in a corporate call center and added benefit of group support. **Methods:** One hundred sixty-one participants were randomized to WSM, WSM with group support, WSM with group and expert clinical support, or wait-list control. Perceived stress, burnout, emotional and psychological well-being, mindfulness, and productivity were measured at baseline, weeks 8 and 16, and 1 year. **Results:** Online usage was low with participants favoring CD use and group practice. All active groups demonstrated significant reductions in perceived stress and increases in emotional and psychological well-being compared with control. Group support improved participation, engagement, and outcomes. **Conclusion:** A self-directed mindfulness program with group practice and support can provide an affordable, effective, and scalable workplace stress management solution. Engagement may also benefit from combining web-based and traditional CD delivery.

Psychosocial stress increases the risk for a multitude of diseases, including obesity, hypertension, and cardiovascular disease,<sup>1-4</sup> and results in greater utilization of health care services.<sup>5,6</sup> In the workplace, stress also leads to emotional exhaustion, job dissatisfaction, lower productivity,<sup>7,8</sup> and impaired performance.<sup>9,10</sup> As a result, in recent years, there have been efforts to design programs to assist employees in managing work-related stress<sup>11-13</sup> and interventions

based on mindfulness meditation have grown in popularity.<sup>14-19</sup> Mindfulness meditation consists of developing focused attention, nonjudgmental awareness, openness, curiosity, and acceptance of internal and external present experiences, all of which aim to help individuals act more reflectively rather than impulsively.<sup>16,20</sup> Practice of mindfulness meditation results in a decreased response to stress,<sup>21-26</sup> and mindfulness-based interventions have been effective at reducing workplace stress and burnout.<sup>14,15,19,27-29</sup>

Traditionally, stress management programs, including those based on mindfulness, have been taught by a trained instructor or counselor in group or one-on-one sessions.<sup>13</sup> For employers, this in-person format may be costly and difficult to arrange around employee work schedules; thus, in-person formats may result in an inability to engage a large proportion of employees and may limit the program's impact. Online programs may provide an effective and affordable alternative.<sup>30</sup> In fact, a recent meta-analysis found that web-based psychotherapeutic interventions using cognitive behavioral therapy (CBT) or psycho-education achieved similar benefits to those of traditional in-person therapy.<sup>31</sup>

To facilitate broad access to stress management at a lower cost than in-person programs, we developed an 8-week web-based stress management (WSM) program based on mindfulness meditation principles, titled *Stress Free Now*.<sup>32</sup> A feasibility study demonstrated its effectiveness in a general community-dwelling population (with no peer or expert support).<sup>33</sup> Participants with regular online activity during the 8-week program showed clinically meaningful improvement (Cohen d effect size  $\geq 0.5$ ) compared with wait-list control for most outcomes including perceived stress and well-being. However, engagement remained low with only 35% of participants showing regular activity. Engagement and retention remains a major limitation for web-based interventions with rates ranging from 10% to 90%,<sup>34-36</sup> with lower values for larger trials and open access programs.<sup>37-39</sup> Similar numbers are observed for web-based mindfulness program.<sup>14,15,19,33,37,40-46</sup>

Through the use of conceptual framework, recent efforts have been directed toward better understanding factors that influence adherence and effectiveness in behavioral web-based interventions.<sup>36,47</sup> In this regard, both peer and technical or clinical support have been consistently found to be beneficial,<sup>48-50</sup> while the level of qualification, the dosage, and the type of support (synchronous vs. asynchronous) seem to have little importance.<sup>49</sup> However, it is unclear whether these findings can be generalized to mindfulness stress management interventions. Various forms of peer or expert support have been implemented in web-based mindfulness interventions.<sup>14,15,19,33,40-42,44,46</sup> Support or delivery has been provided synchronously live such as via video-conferencing<sup>14,19</sup> or phone,<sup>15,42,46</sup> asynchronously via e-mails<sup>15,41,42</sup> or discussion board<sup>33,41,46</sup> and even virtually through the use of recorded group sessions<sup>42,44</sup> or automated messages.<sup>51</sup> A hybrid approach by blending web-based intervention with remote and in-person support has also been adopted.<sup>15,19</sup> Even though these studies were effective,

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The web-based stress management program, titled *Stress Free Now*, is owned by the Cleveland Clinic, a nonprofit organization. The employer where the study took place and who wants to remain anonymous shared the cost of the recruitment and statistical analysis. They were involved in the implementation of the study, but were not involved with data collection, analysis, or interpretation, or with manuscript preparation. Drs Walker and Roizen, and Ms Hunter have been employees of Cleveland Clinic since 2004, 2005, and 2000, respectively. Dr Bernstein, currently at Rally Health, was employed at Cleveland Clinic from 2011 to 2015. Dr Allexandre, currently at Kessler Foundation, was employed at Cleveland Clinic from 2004 to 2012. Dr Morledge, currently at Revati Wellness, was an employee at Cleveland Clinic until 2011. Both Drs Allexandre and Morledge have received consulting fees from the Cleveland Clinic for work unrelated to this study after leaving the organization.

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providing moderate to large effects,<sup>14,19,33,40–45</sup> adherence and attrition varied widely and the relative contribution of support and type of support to effectiveness remains unclear. Furthermore, most of those interventions, including those specifically designed for the workplace,<sup>14,15,19</sup> are faced with the resource and practical limitations of video- or tele-conference or clinical support, which may limit access and reach for some employers.

Deploying a web-based mindfulness program in the workplace offers the opportunity to use a self-directed group practice and support as a cost-effective and scalable solution to improve adherence. We therefore designed a randomized controlled trial in a large and busy telephone call center to (1) assess whether the WSM program can be an effective and engaging stress management program in the workplace and (2) determine the extent to which adding group support improves engagement, retention, and effectiveness. With prior findings suggesting that clinical support may have greater effect on adherence than peer support,<sup>36</sup> we also explored the potential benefit of combining group and low-dose (to remain cost-effective) clinical onsite support. The call center provides debt collection for major retail stores, creating a particularly suitable stressful and emotionally demanding work environment to assess the intervention.

## METHODS

### Study Population

We partnered with a corporate call center with nearly 900 employees located in Ohio. Most employees are debt collectors. Other employees are customer service or fraud representatives. The company's management team sent out an informational e-mail to employees with a short description of the online program and proposed study. Recruitment took place in April 2011, and enrollment between April and May 2011. The management e-mail directed interested employees to an informational webpage describing the study, its risks and benefits, and an online consent form. To be eligible for the study, employees needed regular Internet access and to complete a baseline questionnaire. Managers and supervisors were excluded so that participants would be able to freely share their experience should they be randomly allocated to the group support arms of the study.

### Study Design

The study was a 1-year, randomized controlled trial with three interventional arms (WSM, WSMg1, and WSMg2) and a wait-list control group (CTL) (Fig. 1). WSM participants were given access to the online mindfulness program, while WSMg1 had access to the WSM program along with group support, and WSMg2 had access to the WSM program along with group support and instruction and support from a clinical expert. WSMg2 was introduced to explore the potential benefit of having expert support, with the understanding that the study was not powered to detect small differences between WSMg2 and WSMg1. Eligible participants were randomly allocated to groups after completing the baseline questionnaire. Prior to starting the intervention, all participants were invited to a 15 to 45 min orientation providing an overview of the study, and of the intervention for active groups. In addition, the orientation was designed to motivate group participants to attend their weekly support groups meetings, practice the mindfulness exercises at least three times weekly on their own, and maximize use of the online program. With an expectation of higher dropout in WSM, participants were randomized in a ratio of 1:1.5:1:1 to Control, WSM, WSMg1, or WSMg2, respectively. A randomization table was generated using a block randomization design of block size 9 (2+3+2+2), stratified by night and day work-shift to accommodate weekly group meeting schedules.

## Intervention

### Mindfulness Program (WSM)

The WSM program is an 8-week online, interactive, educational program based on mindfulness meditation. Details of the intervention have been described elsewhere.<sup>33</sup> Briefly, each week, participants are introduced to a new mindfulness theme and meditation technique. They are first given access to an introductory talk in written and audio formats on the theme or particular meditation technique of the week. Mindfulness meditation techniques are then provided in audio format that can be either directly played from the website or downloaded in a portable mp3 format. Daily articles provide an overview of the science underlying the benefits of meditation. Participants receive twice a week e-mail reminders to access the website and practice meditation. Participants can access the program from any computer with Internet access, either at work or home. For the ease and convenience of participants who did not have Internet at home, the introductory talks and meditation exercises were also provided on CDs in mp3 format. WSM group participants had access to the online program only.

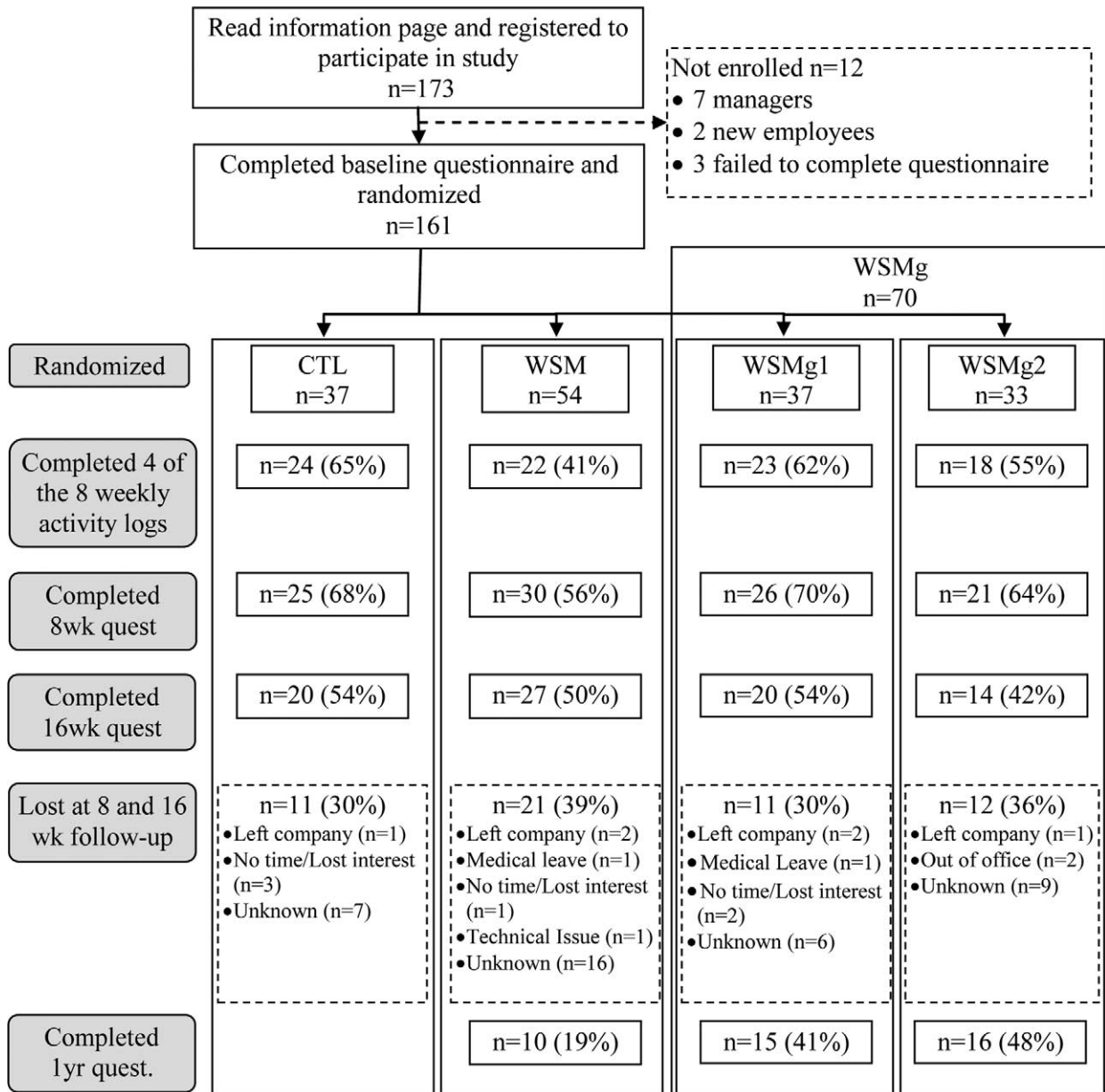
### WSM and Weekly Group Meeting (WSMg1)

Participants randomly assigned to WSMg1 had access to the WSM program and met in groups of 11 to 12 people for 1 hour once a week for the 8-week duration of the online program. The group size was kept small to minimize disruption to the call center workflow while still providing an intimate setting for group interaction and sharing. Meetings occurred during work hours but at periods of low call volume so as to minimize the impact on productivity. Group meetings were scheduled at different times and days of the week to accommodate various work shifts. Participants were assigned to one of three group meetings throughout the duration of the study to create cohesion and familiarity within each group.

The group meetings were facilitated by selected company employees who participated in the WSM program before the start of the study. Their role was to make sure the room was set up, to facilitate the conduct and transition of support group activities, and to hand out discussion questions for group discussion. There was an effort to communicate to the group that these organizers had no expertise in the subject matter. Participants started group meetings by practicing a deep breathing exercise for 2 minutes. They then listened to a 10-minute audio recording of the weekly lesson and practiced the 20 to 30 min guided meditation exercise of the week. For the remainder of the time (about 20 minutes), discussion questions related to the lesson of the week were presented to the group to foster the sharing of positive experiences and enhance group support. Participants discussed the questions in pairs before sharing their experience with the whole group. Each group had flexibility in whether they wished to first meditate and then discuss their experiences, or vice versa.

### WSM, Weekly Group Meeting, and Expert Clinical Support (WSMg2)

WSMg2 followed the same meeting schedule as WSMg1. However, to explore the adding value of having an in-person, yet cost-effective professional support throughout the program, group meetings on weeks 3, 6, and 8 were facilitated by a licensed clinical counselor or licensed social worker. The clinical experts' role was to lead the group practice and discussion and respond to questions about the program. They also spent 15 to 20-minute highlighting some of the CBT concepts and techniques presented throughout the online program. Concepts included letting go, acceptance, forgiveness, nonjudging, gratitude, cultivating connection, and compassion. The professional expertise was mainly provided in the



**FIGURE 1.** Flow of participants in the trial. CTL, Control; quest, questionnaire; WSM, Web-based stress management; WSMg1, Web-based stress management and group support; WSMg2, Web-based stress management and group and expert support; WSMg, WSMg1 and WSMg2.

area of stress management and CBT, in order to avoid creating an intervention that would be faced with the difficulty of finding a trained mindfulness teacher or therapist. The group training was followed by group practice of the WSM mindfulness meditation technique of the week and 10-minute group discussion. WSMg2 met in two groups of 15 and 18, which were fewer and slightly larger than the three WSMg1 groups to minimize clinical staff resources.

**Wait-List Control Intervention (CTL)**

Participants in the wait-list control group were asked to only fill out outcome questionnaires throughout the study. Those who completed at least one questionnaire were offered free access to the online program at the end of the study.

**Outcomes**

Questions about age, gender, race and ethnicity, prior relaxation techniques and practice, and expectation about the online program were asked at baseline. We also asked two nonvalidated questions: one question on self-rated stress and anxiety to prime participants to answer a second question about their need for a solution. The questions were: “On a scale of 1 (=Low) through 6 (=High), answer each of the following questions: How would you rate your overall level of stress and anxiety?” and “How would you rate your overall need to find a solution that would help cope with your stress and anxiety?”

In addition, seven validated and reliable patient-reported outcome measures were administered online at baseline, 8 weeks, 16 weeks, and 1 year. At each point, participants had 2 weeks to

complete the questionnaire, except at the 16-week mark, when they had 3 weeks to complete it. Past the allotted timeframe, the online link to the questionnaire was disabled. Mindfulness is hypothesized to change one's perception and response to stress through the cultivation of a nonjudgmental and nonreactive attitude toward one's experiences. Thus, perceived psychosocial stress measured using the *Perceived Stress Scale* (PSS) was chosen as the primary outcome.<sup>52</sup> PSS uses 10 items to measure a person's perception of, and response to, daily hassles and stress, resulting in a total stress score of 0 (best) to 40 (worst). Other outcomes were two separate dimensions of burnout, evaluated using two of the three subscales (to avoid questionnaire fatigue) of the *Maslach Burnout Inventory – General Survey* (MBI), exhaustion (MBI-EX), and professional efficacy (MBI-PE).<sup>53</sup> MBI-EX measures depletion of one's capacity to engage in and respond to work demands. The professional efficacy construct assesses satisfaction with one's level of work accomplishment with a focus on efficacy expectations. Whereas exhaustion reflects job demands including work overload and emotional demands, professional efficacy is more related to the lack of job resources such as social support and autonomy.<sup>54</sup> MBI-EX contains five and MBI-PE six items. Each is summed for a score of 0 (low) to 6 (high). Mindfulness was assessed using the *Mindfulness Attention Awareness Scale* (MAAS), which is composed of 15 items asking about the frequency of various mindful states in daily life, resulting in a total score of 1 (least mindful) to 6 (most mindful).<sup>55</sup> Overall psychological and emotional well-being and function was measured using three of the eight subscales of the RAND Corporation's Medical Outcomes Study *Short Form-36* (SF-36), including (1) emotional well-being; (2) vitality; and (3) emotional role functioning.<sup>56,57</sup> Emotional well-being is composed of five items and measures nervousness, depression, happiness, and calm. Vitality has four items measuring energy and/or fatigue. Emotional role functioning has three items assessing whether emotional problems affect work or daily activities. Subscales score ranges from 0 (low) to 100 (high).

Number of calls and dollars collected were originally chosen as work productivity measures. However, major changes in the use of these metrics to evaluate employees' work performance by the company during the intervention made these data an unreliable longitudinal measure of performance. Instead, productivity was evaluated using the company's own monthly global measure of work performance. It was computed for each employee on 1 (best) to 5 (worst) scale based on internal company metrics and adjusted for changes in the way productivity was assessed. These data are only available for participants who were debt collectors ( $N=102$ , 63% of participants) and who were absent fewer than 20% of the workdays in a given month. Monthly data was collected for the 2 months before start of the intervention, the duration of the intervention, and 4 months following the intervention.

### Study Compliance

Participants with access to the online program completed an activity log at the end of each week to assess compliance with the online program. They were asked how many times they practiced the mindfulness exercises that week and whether they mainly listened to audios from the website, CD, or via download. Estimates of average practice throughout the 8-week program were gleaned from participants who provided at least 4 weekly logs, including two in the last 4 weeks of the program. Program engagement was also assessed at 8 and 16 weeks and 1 year by asking about average weekly practice during the 8-week program, during the 8 weeks that followed, and at 1 year. Given the high percentage of missing data with self-reported measures, website activity was also assessed by tracking website login, which was available for all participants. Meeting attendance in WSMg1 and WSMg2 groups was also collected on a weekly basis.

### Participants' Feedback

Participants also completed a qualitative and quantitative program feedback questionnaire at 8 weeks. The questionnaire asked about frequency of exercise practice and group attendance as well as barriers to program participation and engagement. It also asked how beneficial (on a scale of 1 = least to 6 = most) and what was beneficial about the online program, group support, and expert support (when provided). It also inquired about how each of those components could be improved and whether there have been any technical problems accessing the online program and completing questionnaires online.

### Sample Size

Data from our other study<sup>32</sup> were not yet available at the time, and we were not aware of any prior study that carefully assessed the effect of a web-based mindfulness program. Our sample size estimate was thus largely based on data from a study of an onsite mindfulness program on burnout (MBI exhaustion subscale).<sup>58</sup> With an expected drop out of 30%<sup>34</sup> and perhaps greater drop out in the study arm without group support, we aimed for 30 participants in WSMg1, WSMg2, and control, and 45 for WSM group, for a total of 135 participants. This sample size would provide 80% power to detect a large effect size ( $d = 0.8$ ) at 0.05 alpha level for comparing WSM, WSMg1, and WSMg2 to control. Given the high interest in participating in the study, we eventually enrolled 161 participants.

### Statistical Methods

Between-group comparisons at baseline were made using analysis of variance (ANOVA) for continuous and ordinal measures and Chi-square tests for nominal measures. Within-group analyses were performed using pairwise Student *t*-tests on available data to compare changes from baseline (complete case analysis at each time point, providing an unaltered descriptive of the data). The primary analysis was by intention-to-treat using a mixed-effects model with a repeated measure approach to include all available data for all randomized participants. Change in perceived stress, mindfulness, burnout, quality of life, and productivity were compared between groups at 8 weeks, 16 weeks, 24 weeks (for productivity data only), and 1-year. The model included fixed effects for intervention group (control, WSM, WSMg1, WSMg2), time (baseline, 8 weeks, 16 weeks, and 1 year), and a group by time interaction, as well as a random effect for each participant. A mixed model is considered a proper approach when data are assumed to be missing at random, that is, the missingness may depend on the observed data but not on the unobserved data.<sup>59</sup> As this assumption is often difficult to satisfy, especially given differences observed in program participation between those with and without follow-up data (see results section), we also performed a sensitivity analysis with last observation carried forward method. This sensitivity analysis in essence makes the conservative assumption that any missing data were the result of participants no longer participating or benefiting from the intervention.<sup>60</sup> For productivity, analysis was performed on bimonthly averages resulting in four measures: at baseline (2 months before start of the intervention), ~8 weeks, ~16 weeks, and ~24 weeks follow-up.

Four posthoc contrasts in net changes from baseline for all outcomes were computed to compare (1) WSM to control, to assess the effectiveness of the web-based program; (2) WSM along with group support (combined WSMg1 and WSMg2) to control, to evaluate the effectiveness of the web-based program with group support; (3) WSM along with group support (combined WSMg1 and WSMg2) to WSM without group support (WSM), to assess the additional benefit of group support; (4) WSMg2 to WSMg1, to evaluate additional benefit of expert clinical support. To avoid type II error, the significance level was not corrected for multiple

**TABLE 1.** Baseline Characteristics of 161 Employees at a Corporate Call Center

	CTL	WSM	WSMg1	WSMg2	All	P
N	37	54	37	33	161	
Age (yrs)	38.4 (11.6)	40.5 (13.8)	40.1 (11.8)	40.8 (12.7)	40.0 (12.6)	0.83
Gender (% female)	83.8%	85.2%	83.8%	78.8%	83.2%	0.89
Race (%)						0.57
White	73.0%	82.7%	90.3%	78.8%	77.0%	
Black	10.8%	11.5%	19.4%	6.1%	11.2%	
Asian	2.7%	1.9%	0.0%	6.1%	2.5%	
Hispanic	5.4%	1.9%	3.2%	3.0%	3.1%	
Other	5.4%	0.0%	6.5%	3.0%	3.1%	
Not provided	2.7%	1.9%	0.0%	3.0%	3.1%	
Workshift and employment type (%)						0.25
Full-time days	48.6%	46.3%	48.6%	54.5%	49.1%	
Full-time nights	24.3%	22.2%	27.0%	30.3%	25.5%	
Part-time days	16.2%	22.2%	18.9%	0.0%	15.5%	
Part-time nights	5.4%	5.6%	2.7%	6.1%	5.0%	
Other	5.4%	3.7%	2.7%	9.1%	5.0%	
Rating of stress and anxiety levels (1 = Low; 6 = High) <sup>a</sup>	4.8 (1.1)	4.8 (0.9)	4.8 (1.0)	4.7 (0.9)	4.8 (1.0)	0.93
Need to address stress and anxiety (1 = Low; 6 = High) <sup>a</sup>	5.1 (1.2)	5.3 (1)	5.3 (1.1)	5.2 (0.9)	5.2 (1.1)	0.74

Data shown as mean (SD) or %. Statistical significance given for group effect using ANOVA for continuous and ordinal variables and Chi-square for nominal variables. CTL, Control; WSM, Web-based stress management; WSMg1, Web-based stress management and group support; WSMg2, Web-based stress management and group and expert support.  
<sup>a</sup>Nonvalidated questions. The first of the two questions on level of stress and anxiety was a way to evaluate self-assessment of stress and anxiety level and to prime respondents to answer the second question on perceived need to find a solution to address stress and anxiety. The actual questions were: “On a scale of 1 (=Low) through 6 (=High), answer each of the following questions: How would you rate your overall level of stress and anxiety?” And “How would you rate your overall need to find a solution that would help cope with your stress and anxiety?”

comparisons; the implication of this adjustment is reviewed in the Discussion.<sup>61</sup>

To quantify the magnitude of the intervention effect, we computed the Cohen d effect size using the ratio of the observed change in each outcome between or within each group over the baseline standard deviation for the whole population and adopted the conventional definition of small ( $0.2 \leq d < 0.5$ ), medium ( $0.5 \leq d < 0.8$ ), and large ( $d \geq 0.8$ ) effect size. A meaningful change was defined as d value at least 0.5, a commonly adopted clinically important difference (CID) criteria.<sup>62</sup> Simple between-group comparisons were performed using Student t-test for continuous and ordinal normally distributed measures, Mann–Whitney U test for non-normal data, and Chi-square tests for nominal measures. Mean and standard deviation, and median and interquartile range (IQR) were used to represent normally and non-normally distributed data for continuous or ordinal variables. Spearman correlation coefficients between average weekly meditation practice (defined as days of practice a week) during the 8-week program and outcomes at 16 weeks were computed. Similarly, correlation analyses were performed between change score in the MAAS and outcomes at 16 weeks.

Analyses were performed using SPSS (version 21) from IBM and SAS software (Version 9.2) from SAS Institute, Cary, North Carolina. Cleveland Clinic Institutional Review Board approved the study as exempt, waiving the need for formal in-person consenting. Before enrollment, participants read an informational webpage and checked a box, indicating that they understood the research and had all questions answered. The study was registered on clinicaltrials.gov (NCT0208789).

## RESULTS

### Baseline Characteristics

One hundred sixty-one individuals met eligibility criteria and were randomly allocated to one of the four groups (Fig. 1). Four individuals assigned to WSMg2 and one to WSMg1 had schedule conflicts and could not attend the group meetings and were

reallocated to the first available study group on the randomization list that fit their work schedule (pseudo-randomization): three were reassigned to WSMg1, one to WSMg2, and one to CTL. The final group allocation at baseline was 37 to the control group, 54 to WSM, 37 to WSMg1, and 33 to WSMg2.

The mean ( $\pm$ SD) age of participants was 40 ( $\pm$ 13) years (Table 1). Participants were largely female (83%), Caucasian (77%), employed full-time (75%), and working day shift (65%). Self-rated stress and anxiety was high ( $4.8 \pm 1.0$ ), while the need for finding a solution to address their stress and anxiety was also reported as high at ( $5.2 \pm 1.1$ ) (Table 1).

### Study Retention

There was no significant between-group difference in completion of questionnaires at 8 weeks [ $\chi^2$  (3) = 2.5,  $P = 0.48$ ] or 16 weeks [ $\chi^2$  (3) = 1.24,  $P = 0.74$ ], which was, on average across all groups, 63% and 50% at 8- and 16 weeks (Fig. 1). Overall, 34.2% of participants had data at neither 8- nor 16 weeks. At 1-year follow-up, completion rate was lower with a significant difference between groups: WSM (19%) and WSMg1 and WSMg2 (41% and 48%) [ $\chi^2$  (2) = 9.6,  $P = 0.01$ ]. Data from controls were not collected at 1 year.

When compared with those with 8- and/or 16-week data, participants lost to follow-up were slightly younger ( $37 \pm 12$  vs  $41 \pm 12$ ;  $P = 0.06$ ), felt their stress and anxiety level to be higher at baseline ( $5.0 \pm 0.8$  vs  $4.7 \pm 1.0$ , respectively;  $P = 0.03$ ), and felt a slightly greater need to find a solution to address it ( $5.5 \pm 0.8$  vs  $5.1 \pm 1.2$ ;  $P = 0.02$ ). Group attendance for those lost at follow-up was much lower than for those who provided follow-up data ( $2.0 \pm 2.3$  vs  $6.2 \pm 1.6$  meetings;  $P < 0.0001$ ), as was website activity (31% vs 75% were inactive and 5% vs 50% active 2 or more weeks).

### Online Program Participation and Stress Management Practice

Online usage of the WSM program was low: 42% to 52% of all participants ( $N = 28, 16, \text{ and } 14$  for WSM, WSMg1, and

WSMg2) never logged on to the WSM website and remained inactive during the 8-week program. The level of online participation over the 8-week program peaked between weeks 2 and 3 (when most website access issues at work were resolved) at 35% ( $N=24$ ) for WSMg1 and WSMg2, and 21% ( $N=12$ ) for WSM, and then progressively declined down to 10% to 15% ( $N=4, 5,$  and 3 for WSM, WSMg1, and WSMg2) at the end of the 8-week program for all groups. The number of participants who regularly accessed the website (4 or more of the 8 weeks) was low, but with rates among those with group support twice of those without group support: 19% ( $N=13$ ) for WSMg1 and WSMg2 compared with 7% ( $N=4$ ) for WSM [ $\chi^2(1)=2.4, P=0.12$ ].

Average weekly practice could be estimated from weekly logs for the 41%, 62%, and 55% of WSM, WSMg1, and WSMg2 participants, respectively, who provided data. The percentage of participants who reported practicing meditation at least once per week was greater among those with group support than without group support [weekly percentage values averaged over 8 weeks was 94% vs 54% ( $N=38$  vs 12);  $P<0.0001$ ]. Although this percentage for WSMg1 and WSMg2 remained constant over the 8 weeks, it progressively declined for WSM [70% ( $N=15$ ) during weeks 1 to 3 to 40% to 45% ( $N=9$  to 10) at weeks 6 to 8]. Furthermore, average weekly practice over the 8 weeks was greater for those with group support than without [median and IQR were 2.93 (1.87; 3.78) times per week vs 1.00 (0.40; 2.94) times per week;  $P=0.001$ ]. Participants reported practicing the exercises with the CD (in ~60% of weekly logs) more often than via the Web (30%) or via download (11% to 18%).

At 16 weeks, the number of participants who sustained regular meditation practice since the end of the 8-week program diminished from levels seen during the program but remained relatively high among those with group support: 64% ( $N=18/28$ ) for WSMg1 and 64% ( $N=9/14$ ) for WSMg2 versus 25% ( $N=7/28$ ) for WSM [ $\chi^2(1)=7.87, P=0.005$ ]. A substantial number of participants with group support also continued to practice at 1 year (38%,  $N=6$  for WSMg1 and 75%,  $N=12$  for WSMg2); the low response rate (19%) precluded analysis for WSM.

Meeting attendance was high for both WSMg1 and WSMg2, with only about 15% ( $N=11$ ) of all participants attending zero or one meeting and 57% ( $N=21$ , WSMg1) and 61% ( $N=20$ , WSMg2) attending five or more meetings.

### Within-Group Change

In this descriptive analysis using available data, the three intervention groups demonstrated significant improvements from baseline to 8 weeks in all outcome measures except productivity and professional efficacy (Table 2). By contrast, in the control group, a significant and much smaller improvement was observed only for perceived stress. Improvements were maintained or increased at 16 weeks in all the intervention groups, except for emotional exhaustion (WSMg2), professional efficacy (WSM, WSMg2), and mindfulness (WSM, WSMg2). Improvements were maintained at 1-year follow-up for perceived stress and emotional role functioning (WSMg1 and WSMg2), emotional well-being (WSMg1), and vitality (WSMg1 and WSM), and decreased and became nonsignificant otherwise in particular for WSM. The size of the effects overall was large ( $d \geq 0.8$ ) for perceived stress, emotional role functioning, emotional well-being, and vitality for WSMg1 and WSMg2 at all three time-points and medium ( $0.5 \leq d < 0.8$ ) to large for emotional exhaustion and mindfulness in WSMg1 at 8 and 16 weeks.

### Between-Group Analysis of Treatment Effect

In this primary intent-to-treat analysis, web-based program participants with and without group support showed greater reductions from baseline to 8 weeks than control for perceived

stress, and increases in emotional well-being and vitality (Table 3). These effects persisted at 16 weeks. Participants with group support also showed greater effect than control at 8 weeks for professional efficacy, emotional role functioning, and mindfulness even though this was not maintained at 16 weeks. Overall, effect sizes in comparison to control were larger for those with group support than for those without [mean and range for all outcomes except productivity: 0.8 (0.4 to 1.2) vs 0.4 (0.2 to 0.7) at week 8 and 0.7 (0.4 to 1.1) vs 0.4 (0.0 to 0.7) at week 16]. For those with group support, the effect sizes were large when comparing change in stress and measures of well-being, and moderate for mindfulness and burnout. Lesser effects were observed for the web-based program only group.

Group support was associated with improvements in stress, emotional well-being, and emotional role functioning at 8 weeks (WSMg compared with WSM;  $P=0.01$  to 0.03). At 16 weeks, the improvement in emotional well-being ( $P=0.01$ ) and stress ( $P=0.07$ ) was maintained. Effect size was small to moderate ( $d=0.4$  to 0.6). Even though magnitude of the effect was maintained at 1 year ( $d=0.4$  to 0.5), between-group changes did not remain significant ( $P=0.33$  and 0.11, respectively). No difference was observed when providing expert onsite support in addition to group support alone (WSMg2 vs WSMg1) except for emotional role functioning at 16 weeks where improvement was greater for WSMg1 ( $d=0.9$ ). The control group had access to WSM program at 16 weeks and thus precluded analysis of whether improvement among participants with access to the online program at 1 year was significant compared with control. Treatment effect estimates were slightly diminished, though largely unchanged, with last observation carried forward (see Supplemental Material, <http://links.lww.com/JOM/A250>).

We observed weak associations between weekly meditation practice and burnout (at week 8, Spearman  $\rho=-0.25$ ), role functioning (at week 8,  $\rho=0.26$ ), and productivity (at week 24,  $\rho=-0.29$ ), and moderate associations between weekly practice and mindfulness and emotional well-being (at week 8;  $\rho=0.37$  and 0.35, respectively) (see Supplemental Material, <http://links.lww.com/JOM/A250>). At week 16, an increase in mindfulness was moderately correlated with improvements in burnout (exhaustion), emotional well-being and role functioning, and vitality ( $\rho=0.40$  to 0.43). No correlation was found between meeting attendance and outcome.

### Participants' Feedback

The feedback questionnaire was completed by 46%, 54%, and 67% of WSM, WSMg1, and WSMg2 participants, respectively. Main results are presented here.

Regarding program participation, 70% ( $N=38$ ) of respondents stated that they would have liked to practice more, out of which 76% cited lack of time as the major reason for not being able to do so. The second reason ( $N=6$ ) was lack of access to program materials, including lack or limited access to a computer and inability to play mp3 content from CD with older audio system.

WSMg participants expressed a greater level of satisfaction from the overall program than WSM participants [median and IQR of 5 (5; 6) vs 3 (2.3; 4),  $P=0.0002$  on a scale of 1 = least beneficial to 6 = most beneficial]. On the basis of participants' feedback, group practice led to greater program engagement and participation. It first provided an opportunity to take time off work to de-stress and practice the techniques once a week. Group discussion also helped better understand and assimilate the program concepts and techniques and provided motivation and inspiration to practice.

Within a theoretical framework of group support,<sup>63</sup> participants expressed receiving both emotional (actual or perceived) and informational support from the group. Participants reported finding actual or perceived emotional support through the simple act of sharing each other's work or life challenges as well through

**TABLE 2.** Effect of a Web-Based Stress Reduction Program on Perceived Stress, Burnout, Quality of Life, Mindfulness, and Productivity

	Descriptive Statistics								Within-Group Change from Baseline					
	Baseline		8 Wks		16 Wks		1 Yr		8 Wks		16 Wks		1 Yr	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	Mean (SE)	d	Mean (SE)	d	Mean (SE)	d
Perceived stress (PSS)														
CTL	37	25.4 (5.7)	25	24.0 (7.2)	20	22.5 (7.2)			-1.8 (0.9) <sup>b</sup>	0.3	-3.3 (1.4) <sup>b</sup>	0.6		
WSM	54	25.6 (5.4)	30	19.8 (7.6)	27	19.4 (7.7)	10	22.7 (8.5)	-5.7 (1.0) <sup>d</sup>	1.0	-6.1 (1.0) <sup>d</sup>	1.1	-3.0 (1.9)	0.5
WSMg1	37	24.5 (5.8)	26	15.8 (4.4)	20	14.4 (5.1)	15	20.3 (8.3)	-8.4 (1.3) <sup>d</sup>	1.5	-10.1 (1.3) <sup>d</sup>	1.8	-4.7 (2.2) <sup>b</sup>	0.9
WSMg2	33	24.5 (5.1)	21	15.8 (7.0)	14	16.3 (5.6)	16	17.2 (9.6)	-7.7 (1.4) <sup>d</sup>	1.4	-8.1 (1.1) <sup>d</sup>	1.5	-7.6 (1.9) <sup>d</sup>	1.4
Emotional exhaustion (MBI-Ex)														
CTL	37	3.74 (1.65)	25	3.57 (1.60)	19	3.62 (1.48)			-0.07 (0.17)	0.0	-0.16 (0.24)	0.1		
WSM	54	4.36 (1.37)	30	4.11 (1.54)	26	4.05 (1.52)	10	4.40 (1.73)	-0.45 (0.21) <sup>b</sup>	0.3	-0.55 (0.27) <sup>b</sup>	0.4	-0.40 (0.29)	0.3
WSMg1	37	3.83 (1.62)	26	2.94 (1.55)	20	2.52 (1.63)	15	3.36 (1.67)	-0.87 (0.23) <sup>d</sup>	0.6	-1.31 (0.28) <sup>d</sup>	0.9	-0.37 (0.44)	0.3
WSMg2	33	4.32 (1.23)	21	3.50 (1.70)	13	3.71 (1.65)	16	3.88 (1.77)	-0.86 (0.20) <sup>d</sup>	0.6	-0.78 (0.30) <sup>b</sup>	0.5	-0.41 (0.28)	0.3
Professional efficacy (MBI-PE)														
CTL	37	4.35 (1.27)	25	4.29 (1.17)	19	4.18 (1.06)			-0.06 (0.19)	-0.1	-0.08 (0.27)	-0.1		
WSM	54	4.22 (1.09)	30	4.57 (1.15)	26	4.10 (1.59)	10	3.90 (1.21)	0.35 (0.18) <sup>a</sup>	0.3	-0.09 (0.26)	-0.1	0.00 (0.41)	0.0
WSMg1	37	4.32 (1.12)	26	4.80 (0.93)	20	4.98 (0.75)	15	4.58 (1.33)	0.48 (0.18) <sup>b</sup>	0.4	0.49 (0.19)	0.4	0.00 (0.27)	0.0
WSMg2	33	4.47 (1.23)	21	4.97 (1.05)	13	4.82 (0.90)	16	4.54 (1.54)	0.33 (0.15) <sup>b</sup>	0.3	0.05 (0.19)	0.0	-0.14 (0.21)	-0.1
Mindfulness (MAAS)														
CTL	37	3.48 (0.89)	24	3.37 (0.92)	18	3.47 (1.13)			0.17 (0.13)	0.2	0.18 (0.16)	0.2		
WSM	54	3.20 (0.87)	29	3.43 (1.16)	26	3.32 (1.07)	10	3.07 (1.27)	0.29 (0.12) <sup>b</sup>	0.3	0.27 (0.20)	0.3	0.09 (0.21)	0.1
WSMg1	37	3.54 (1.17)	26	4.15 (0.95)	20	4.46 (0.89)	15	3.70 (1.08)	0.67 (0.18) <sup>d</sup>	0.7	0.91 (0.19) <sup>d</sup>	1.0	0.46 (0.28)	0.5
WSMg2	33	3.28 (0.85)	21	3.77 (0.86)	13	3.66 (0.79)	16	3.47 (0.84)	0.38 (0.17) <sup>b</sup>	0.4	0.35 (0.19) <sup>a</sup>	0.4	0.19 (0.20)	0.2
Emotional well-being (SF-36)														
CTL	37	48.4 (18.1)	24	43.8 (21.2)	18	45.1 (20.5)			-2.3 (2.9)	-0.1	-3.6 (3.1)	-0.2		
WSM	54	44.7 (20.0)	29	55.2 (26.6)	25	54.1 (24.3)	10	43.6 (17.7)	10.1 (2.3) <sup>d</sup>	0.6	8.2 (3.0) <sup>b</sup>	0.4	5.2 (6.0)	0.3
WSMg1	37	53.0 (15.9)	25	73.0 (13.0)	20	74.2 (12.6)	15	60.8 (22.6)	18.7 (2.6) <sup>d</sup>	1.0	19.4 (2.9) <sup>d</sup>	1.1	12.8 (4.5) <sup>b</sup>	0.7
WSMg2	33	49.5 (17.4)	21	68.2 (19.0)	13	65.8 (17.9)	16	63.8 (22.4)	15.3 (2.9) <sup>d</sup>	0.8	12.5 (2.4) <sup>d</sup>	0.7	8.9 (4.5) <sup>a</sup>	0.5
Emotional role functioning (SF-36)														
CTL	36	30.6 (32.2)	24	47.2 (39.2)	18	51.9 (34.7)			14.5 (8.3)	0.5	17.6 (9.5)	0.6		
WSM	54	29.6 (32.8)	29	51.7 (40.4)	25	62.7 (41.2)	10	33.3 (35.1)	20.7 (7.8) <sup>b</sup>	0.7	30.7 (7.4) <sup>d</sup>	1.0	10.0 (8.7)	0.3
WSMg1	37	30.6 (33.7)	25	76.0 (35.4)	20	85.0 (27.5)	15	62.2 (43.4)	41.3 (7.3) <sup>d</sup>	1.3	45.0 (9.1) <sup>d</sup>	1.4	35.6 (11.9) <sup>c</sup>	1.1
WSMg2	33	33.3 (26.4)	21	71.4 (33.8)	13	56.4 (34.4)	16	51.0 (41.9)	39.7 (7.8) <sup>d</sup>	1.3	30.8 (8.8) <sup>c</sup>	1.0	24.0 (10.5) <sup>b</sup>	0.8
Vitality (SF-36)														
CTL	37	28.8 (17.8)	24	31.3 (20.5)	18	31.1 (17.6)			2.1 (3.1)	0.1	1.4 (3.8)	0.1		
WSM	54	22.8 (18.6)	29	35.7 (26.2)	25	36.1 (23.8)	10	28.0 (23.0)	11.2 (2.8) <sup>d</sup>	0.6	10.7 (3.3) <sup>c</sup>	0.6	9.5 (4.1) <sup>b</sup>	0.5
WSMg1	37	30.9 (18.5)	25	48.4 (19.2)	20	54.5 (20.3)	15	38.3 (25.3)	18.6 (3.0) <sup>d</sup>	1.0	23.3 (3.9) <sup>d</sup>	1.3	14.7 (5.9) <sup>b</sup>	0.8
WSMg2	33	31.8 (16.8)	21	51.3 (19.6)	13	48.8 (18.7)	16	42.5 (22.0)	15.4 (3.6) <sup>d</sup>	0.8	13.8 (3.7) <sup>c</sup>	0.8	6.3 (4.1)	0.3

	Descriptive Statistics								Within-Group Change From Baseline					
	Baseline		8 Wks		16 Wks		24 Wks		8 Wks		16 Wks		24 Wks	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)	Mean (SE)	d	Mean (SE)	d	Mean (SE)	d
Productivity														
CTL	26	2.62 (0.64)	21	2.63 (0.49)	24	2.66 (0.61)	25	2.52 (0.65)	0.08 (0.08)	-0.2	0.09 (0.10)	-0.2	-0.10 (0.10)	0.2
WSM	26	2.55 (0.49)	24	2.67 (0.42)	22	2.28 (0.58)	23	2.40 (0.60)	0.14 (0.08) <sup>a</sup>	-0.3	-0.20 (0.14)	0.4	-0.08 (0.14)	0.2
WSMg1	21	2.56 (0.44)	20	2.71 (0.39)	21	2.47 (0.76)	23	2.38 (0.63)	0.16 (0.10)	-0.3	-0.02 (0.16)	0.0	-0.13 (0.11)	0.2
WSMg2	23	2.67 (0.48)	20	2.65 (0.54)	21	2.57 (0.65)	21	2.35 (0.69)	-0.03 (0.10)	0.1	-0.09 (0.12)	0.2	-0.27 (0.15) <sup>a</sup>	0.5

CTL, Control; d, Cohen d effect size calculated by dividing change from baseline by overall population standard deviation at baseline, MBI-Ex, Maslach Burnout Inventory – Exhaustion Subscale; MBI-PE, Maslach Burnout Inventory – Professional Efficacy Subscale; PSS, Perceived Stress Scale; SD, standard deviation; SE, standard error of the mean; SF36, Rand SF36; WSM, Web-based stress management; WSMg1, Web-based stress management and group support; WSMg2, Web-based stress management and group and expert support. Positive d means improvement; small, medium, and large effect size for d ≥0.3, 0.5, and 0.8, respectively.

<sup>a</sup>P < 0.10.

<sup>b</sup>P < 0.05.

<sup>c</sup>P < 0.01.

<sup>d</sup>P < 0.001 for within-group comparison from baseline on available data.

recognizing that they are not alone facing those challenges. Some participants also found it informative and beneficial to hear others' various coping strategies.

### DISCUSSION

This 1-year randomized controlled trial demonstrates that a web-based program based on the principles of mindfulness

meditation can reduce stress and improve well-being in a stressful and emotionally demanding work setting. Providing 1 hour each week of peer-led group practice and discussion with minimal external support greatly improves participation rates and benefits achieved. Although active participation in the program decreased once the 8-week intervention ended, psychological improvements among participants persisted and benefits could be observed up to 1 year later.

**TABLE 3.** Group Comparisons of Treatment Effect From Baseline to 8 and 16 Wks and 1 Yr

Outcome: <i>F</i> - and <i>P</i> Values for Group x Time Interaction	8 Wks			16 Wks			1 Yr		
	Mean (SE)	<i>P</i>	<i>d</i>	Mean (SE)	<i>P</i>	<i>d</i>	Mean (SE)	<i>P</i>	<i>d</i>
Stress (PSS) – $F(8,69) = 4.19, P = 0.0004$									
WSM vs CTL	-4.02 (1.49)	0.008	0.7	-3.06 (1.56)	0.05	0.6			
WSMg vs CTL	-6.72 (1.37)	<0.0001	1.2	-5.58 (1.49)	0.0003	1.0			
WSMg vs WSM	-2.70 (1.28)	0.04	0.5	-2.51 (1.35)	0.07	0.5	-2.46 (2.49)	0.33	0.4
WSMg2 vs WSMg1	-0.04 (1.61)	0.98	0.0	1.85 (1.79)	0.3	-0.3	-2.58 (2.61)	0.33	0.5
Emotional exhaustion (MBI) – $F(8,72) = 1.58, P = 0.15$									
WSM vs CTL	-0.29 (0.29)	0.33	0.2	-0.44 (0.40)	0.28	0.3			
WSMg vs CTL	-0.76 (0.27)	0.005	0.5	-0.90 (0.38)	0.02	0.6			
WSMg vs WSM	-0.48 (0.25)	0.06	0.3	-0.47 (0.34)	0.17	0.3	-0.33 (0.48)	0.48	0.2
WSMg2 vs WSMg1	-0.02 (0.32)	0.95	0.0	0.20 (0.45)	0.66	-0.1	0.05 (0.52)	0.93	0.0
Professional efficacy (MBI) – $F(8,65) = 1.36, P = 0.23$									
WSM vs CTL	0.44 (0.23)	0.06	0.4	0.04 (0.31)	0.89	0.0			
WSMg vs CTL	0.51 (0.21)	0.02	0.4	0.44 (0.29)	0.14	0.4			
WSMg vs WSM	0.06 (0.20)	0.75	0.0	0.39 (0.27)	0.14	0.3	0.00 (0.37)	0.99	0.0
WSMg2 vs WSMg1	-0.08 (0.25)	0.76	-0.1	-0.47 (0.35)	0.19	-0.4	-0.24 (0.38)	0.53	-0.2
Emotional well-being (SF36) – $F(8,68) = 5.32, P < 0.0001$									
WSM vs CTL	12.1 (3.6)	0.001	0.7	12.6 (4.0)	0.002	0.7			
WSMg vs CTL	19.9 (3.3)	<0.0001	1.1	19.9 (3.7)	<0.0001	1.1			
WSMg vs WSM	7.8 (3.1)	0.01	0.4	7.3 (3.4)	0.03	0.4	9.1 (5.6)	0.11	0.5
WSMg2 vs WSMg1	-2.9 (3.9)	0.46	-0.2	-5.3 (4.4)	0.23	-0.3	-2.3 (6.0)	0.70	-0.1
Emotional role functioning (SF36) – $F(8,258) = 2.11, P = 0.04$									
WSM vs CTL	5.7 (9.7)	0.56	0.2	12.3 (12.0)	0.31	0.4			
WSMg vs CTL	24.4 (9.0)	0.007	0.8	18.5 (11.4)	0.11	0.6			
WSMg vs WSM	18.7 (8.3)	0.02	0.6	6.2 (10.3)	0.54	0.2	21.6 (13.4)	0.11	0.7
WSMg2 vs WSMg1	-4.7 (10.5)	0.66	-0.1	-29.1 (13.5)	0.03	-0.9	-19.0 (14.4)	0.19	-0.6
Vitality (SF36) – $F(8,66) = 3.46, P = 0.002$									
WSM vs CTL	8.3 (4.2)	0.05	0.5	12.0 (4.8)	0.02	0.7			
WSMg vs CTL	15.1 (3.8)	0.0002	0.8	17.7 (4.6)	0.0002	1.0			
WSMg vs WSM	6.8 (3.6)	0.06	0.4	5.7 (4.2)	0.17	0.3	-3.6 (6.1)	0.56	-0.2
WSMg2 vs WSMg1	-2.4 (4.5)	0.59	-0.1	-7.8 (5.5)	0.16	-0.4	-7.5 (6.3)	0.24	-0.4
Mindfulness (MAAS) – $F(8,222) = 1.25, P = 0.27$									
WSM vs CTL	0.15 (0.19)	0.42	0.2	0.09 (0.26)	0.73	0.1			
WSMg vs CTL	0.41 (0.17)	0.02	0.4	0.41 (0.24)	0.09	0.4			
WSMg vs WSM	0.26 (0.16)	0.11	0.3	0.32 (0.22)	0.14	0.3	0.28 (0.30)	0.35	0.3
WSMg2 vs WSMg1	-0.22 (0.20)	0.27	-0.2	-0.45 (0.29)	0.11	-0.5	-0.32 (0.33)	0.33	-0.3

Comparison	8 Wks			16 Wks			16 Wks Follow-Up		
	Mean (SE)	<i>P</i>	<i>d</i>	Mean (SE)	<i>P</i>	<i>d</i>	Mean (SE)	<i>P</i>	<i>d</i>
Productivity score (1 = high, 5 = low) – $F(9,85) = 1.49, P = 0.17$									
WSM vs CTL	0.07 (0.12)	0.54	-0.1	-0.32 (0.17)	0.07	0.6	-0.03 (0.16)	0.85	0.1
WSMg vs CTL	0.02 (0.11)	0.87	0.0	-0.12 (0.15)	0.44	0.2	-0.14 (0.14)	0.32	0.3
WSMg vs WSM	-0.06 (0.10)	0.6	0.1	0.20 (0.16)	0.21	-0.4	-0.11 (0.15)	0.45	0.2
WSMg2 vs WSMg1	-0.21 (0.13)	0.11	0.4	0.01 (0.18)	0.97	0.0	-0.14 (0.17)	0.42	0.3

Contrasts and results were computed from the mixed model analysis. Results shown as adjusted mean and standard error of the mean (SE). *d* = Cohen *d* effect size calculated by dividing the adjusted mean by overall population standard deviation at baseline. Positive *d* means improvement; small, medium, and large effect size for *d* ≥ 0.3, 0.5, and 0.8, respectively. CTL, Control; WSM, Web-based stress management; WSMg, WSMg1 and WSMg2; WSMg1, Web-based stress management and group support; WSMg2, Web-based stress management and group and expert support.

The employee population we studied was under high perceived stress and work-related exhaustion. Perceived stress at baseline (overall PSS mean score = 25.1 ± 5.5) was higher than the 2009 U.S. average of 16.<sup>64</sup> Similarly, the MBI-exhaustion score of 4.1 (±1.5) was higher than that of nurses (2.4 to 3.0),<sup>65,66</sup> service workers (3.2),<sup>67</sup> and many Americans (2.3 to 2.7).<sup>65</sup> MBI-professional efficacy score at baseline (4.3) was in the lowest range of North American normative values (4.3 to 4.6).<sup>53</sup> Prior studies have found that exhaustion was more often associated with mental and physical strain or work overload, whereas lack of professional efficacy with loss of satisfaction and organizational commitment.<sup>66</sup> In the call center, a committed management team, supportive environment, and monthly rewards for top performers, in the setting

of a stressful and emotionally demanding occupation, may explain the high level of burnout (exhaustion) accompanied by only a mild sense of diminished professional accomplishment.

In this study population, the web-based program alone reduced perceived stress and increased emotional well-being, role functioning, and vitality. With the addition of group support, there were additional improvements in mindfulness, burnout, and professional efficacy. The improvements for stress, emotional well-being, vitality, and burnout were sustained 8 weeks after the end of the intervention. For all three intervention groups, perceived stress substantially decreased, bringing PSS scores down to moderate levels (19 for WSM, 14 for WSMg1, and 16 for WSMg2) compared with the 2012 U.S. normative value of 16.<sup>64</sup> Similarly, for those



participants with group support, their exhaustion score decreased into a normative range (3.8 down to 2.5).<sup>53</sup> MBI-PE only minimally improved perhaps because perceived sense of accomplishment was not greatly impaired at baseline.

The high perceived stress and burnout at baseline was accompanied by poor psycho-emotional health as indicated by the SF-36. Emotional well-being, role functioning, and vitality were all low, more than 1 to 1.5 standard deviation below U.S. averages ( $48 \pm 18$ ,  $31 \pm 31$ ,  $28 \pm 18$  compared with  $75 \pm 18$ ,  $81 \pm 33$ , and  $61 \pm 21$ , respectively).<sup>57</sup> Our study population scores were thus similar to those observed in patients with major depression,<sup>68</sup> highlighting the severity of the health- and emotion-related functional impairment. All three measures were significantly improved at 8 and 16 weeks, especially for participants with group support, with scores close to the U.S. average. Such improvements have important implications given the relation between psychological distress severity and productivity loss.<sup>10</sup> Of note, the intervention beyond reducing negative manifests such as stress, anxiety, and depression was also effective in improving positive emotions such as engagement, happiness, calmness, energy, and vitality, which is important given its critical role to job performance and health.<sup>69,70</sup>

Overall, the magnitude of improvement with the web-based program was comparable to traditional face-to-face mindfulness programs<sup>14,16,19,71-73</sup> as well as other web-based or self-help mindfulness interventions.<sup>14,19,40,43,74</sup>

Even though online activity and weekly practice decreased once the program ended, improvements persisted, or even increased by week 16. Similarly, participants continued to show reductions in perceived stress and increases in emotional well-being, vitality, and emotional role functioning 1 year later.

Results from the correlation analysis provide support for a specific role of mindfulness to outcomes observed, as well as indicate potential mediating pathways for the observed benefit of the WSM program. The inverse relation found between improvement in mindfulness and exhaustion is consistent with a recent study demonstrating that emotional exhaustion in the workplace is negatively related to mindfulness and can be improved following a short mindfulness self-training.<sup>18</sup> Interestingly, this improvement was mediated by an increase in work-related emotional regulation, which may explain the observed association we found between mindfulness and emotional role functioning, and emotional well-being. These findings, as well as the negative correlation we observed between mindfulness and perceived stress, are also consistent with evidence supporting the theory that the salutary effect of mindfulness results from an increase in stress appraisal and the adoption of a more effective and adaptive, rather than habitual, coping strategy.<sup>75</sup> Future study designs may aim at further elucidating the relative and specific contribution of mindfulness to the overall therapeutic effect of the WSM programs with or without group support.

Online activity was lower than expected, with about 50% of participants never logging on and an overall average weekly online participation of 10% to 35% (average at 17% for WSMg1 and WSMg2 throughout the 8 weeks). This is consistent with participants reporting practicing the exercises with the CD more than via the Web or download suggesting that online activity accounted for only a small amount of overall program participation. Online activity was lower than our prior study<sup>33</sup> wherein 25% of participants never logged on, and weekly online participation reached 18% to 64% (43% on average). However, in the prior study, the program was only accessible online (no CD was provided) and participants needed access to a computer at home to enroll. In the current study, access and practical convenience seems to have been major factors driving CD over online use. Preference or greater adherence to conventional (printed materials) over web-based delivery has been previously reported for the older population,<sup>76,77</sup> highlighting the

importance of taking into account participants' characteristics in the intervention design. The low online participation may therefore be specific to our population and may change with the increased access and use of mobile technology. According to a survey data from the Pew Research Center,<sup>78</sup> smartphone and tablet computer ownership among U.S. adults rose from 35% to 68% and from 13% to 45%, respectively, between 2011 and 2015. Future research should evaluate the relative appeal and benefit of web-based over more traditional cost-effective delivery (such as CD and printed materials). Potential benefit of providing various delivery options to accommodate users' diverse preferences or practical constraints should also be investigated.

Beyond practical barriers to access, the progressive decrease in online participation over the course of the program suggests that there is a progressive disengagement over time, a constant findings in web-based interventions.<sup>37</sup> Model-based approaches such as the persuasive system design<sup>36,47</sup> may help guide efforts toward incorporating new design features that are more engaging and improve users' experience. Results of our studies have already led to a series of improvements to the program access and content. This includes (1) incorporating a direct personalized link to the program in the twice-weekly e-mail reminders forgoing the need to provide login and password credentials every time, (2) improving navigation through the program content and (3) shortening the program to 6 weeks and redesigning content to make concepts more practical and easier to assimilate, and (4) measuring and providing weekly feedback about usage and improvement to improve engagement. Future research efforts should validate the effectiveness and adherence of the new program.

Program participation (defined as practicing the mindfulness exercises at least once during the 8-week program) of 90% to 100% with group support was twice that without group support. However, the amount of weekly practice was lower than the recommended four times a week, with 30% of those with group support practicing three times or more a week and 30% once or twice a week, with the majority wanting to practice more and stating lack of time as the major reason for not being able to. Similarly, in this study, the opportunity to practice during work hours was important not only to program engagement but also for practice and relaxation, even if only once a week. This suggests that stress management programs that have limited requirements for formal or home practice may help improve accessibility and may be more broadly appealing in employee populations, especially for an employee population that finds itself facing the demands of a busy schedule.

As hypothesized, the addition of group practice and support was associated with greater program engagement and participation and an improvement in outcomes, which was echoed by participants who expressed a greater level of satisfaction from the program than WSM participants. On the basis of participants' feedback, what mediated the increased benefit of group practice is most likely multifactorial, including not only greater program engagement and participation but also social support in itself. Social support can help cope with stress and promote well-being<sup>63,79,80</sup> and has been associated with decreased burnout and increased job satisfaction.<sup>81,82</sup> Future research may investigate the relative contribution of social support versus program participation and engagement to the benefit of group practice as well as the relative contribution of group practice to the overall efficacy of the program.

It is unclear why adding onsite expert clinical support did not provide any additional benefit and even led to a small but consistent reduction in treatment effect. Given that the group comparison between WSMg1 and WSMg2 was exploratory in nature and underpowered, these results should be taken with caution. Future research is needed to confirm this finding.

Availability of data only for debt collectors (which represented 39% of all participants) precludes reaching any

conclusion regarding the effect of the intervention on productivity. Despite evidence linking increased stress and emotional burnout with poor engagement<sup>8,3</sup> and productivity loss,<sup>9,10</sup> demonstrating the benefit of stress management on productivity remains a challenge,<sup>14</sup> and points to the need for well designed, long-term studies with large sample sizes to test this relationship.

Several limitations of this study should be mentioned. The population under study was primarily female and Caucasian and from one call center. Moreover, given the nature of the study design, there was interaction with the research and clinical staff, and staff was present at the orientation session and the first group support session. It is unclear how much this interaction contributed to the observed effect of the intervention. Finally, due to some security features, there were some initial access issues to the program at work. Even though this was quickly resolved, it is unclear how much it affected participation to the online program. Other limitations include the small sample size and selective attrition at 1 year.

Future research may evaluate the efficacy of WSM programs, as they apply to different occupations and workforce populations. Methods are also needed to better track CD use and other stress reduction practices outside of web-based programs, and to better assess assimilation of mindfulness concepts. Future work may also consider collecting psychological and physical health outcomes, such as depression, given the associated cost to employers,<sup>10,84</sup> as well as systematic measures of productivity, health care costs, and absenteeism. These measures may all help provide return-on-investment estimates. As interventions delivered via phone or video conference have shown similar benefits to conventional approach,<sup>14,15,19,85</sup> future studies could look at minimizing onsite intervention support to further reduce intervention cost.

In conclusion, this 1-year study demonstrated the effectiveness of a self-directed mindfulness stress management program in the workplace in reducing stress and burnout and in improving emotional well-being. Group practice of mindfulness techniques, with minimal external support, significantly improved program participation and benefits, suggesting the intervention may be cost-effective and easily scalable. As online usage was low with participants favoring CD use and group practice, engagement may also benefit from offering various self-help delivery options to accommodate users' preferences.

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