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Perceived stress mediates the relationship between mindfulness and negative affect variability: A randomized controlled trial among middle-aged to older adults

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Abstract

Despite the interest in mindfulness over the past 20 years, studies have only recently begun to examine mindfulness in older adults. The primary aim of this study was to evaluate pretreatment to post-treatment change in negative affect variability (NAV) following a mindfulness training among 134 mildly stressed, middle-aged to older adults. The secondary aim was to assess if the effects of mindfulness training on NAV would be partially explained by pretreatment to post-treatment reductions in perceived stress, a trend that would be congruent with several stress models. In this randomized control trial, participants were assigned to either a 6-week mindfulness meditation training programme or to a wait list control. Ecological momentary assessment, a data capturing technique that queries about present moment experiences in real time, captured NAV. Mixed-model ANOVAs and a path analysis were conducted. Participants in the mindfulness meditation training significantly reduced NAV when compared with wait list control participants. Further, there was a significant indirect group effect on reductions in NAV through change in perceived stress. Few studies have tested mechanisms of action, which connect changes that occur during mindfulness training with psychological outcomes in older adults. Understanding the mechanisms by which mindfulness enhances well-being may optimize interventions.

Keywords

ecological momentary assessment; mindfulness; negative affect variability; older adults; stress

1 | INTRODUCTION

All individuals are enriched by and entangled in emotional experience. These daily emotional experiences are an essential part of well-being. In recent years, literature has revealed not only the pervasiveness with which emotions are linked to health outcomes but also the complexity of these connections. In particular, negative affect (NA) has evidenced important implications on well-being among older adults (Kahn, Hessling, & Russell, 2003; Watson & Pennebaker, 1989). NA refers to undifferentiated, subjective distress and

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CONFLICT OF INTEREST

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subsumes a broad range of aversive mood states such as worry, anxiety, anger, self-criticism, and life dissatisfaction (Van Diest et al., 2005; Watson & Clark, 1984; Watson & Pennebaker, 1989). NA is highly correlated to other trait characteristics, such as neuroticism, and is associated with more health complaints and lower levels of health perception (Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Watson & Pennebaker, 1989). NA has also been associated with greater levels of perceived stress. More specifically, when individuals appraise that a situational demand is stressful or threatens to overwhelm their ability to successfully cope, they may be more likely to meet this demand with NA (Lazarus, 2006; Lazarus & Folkman, 1984). These affective responses may be the most proximal determinants for engaging in healthy or unhealthy behaviors to seek relief from stress (Epel et al., 2018).

Mindfulness is commonly defined as the awareness that emerges by way of paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience, moment by moment (Kabat-Zinn, 2002). Most contemporary mindfulness models include at least two essential elements: (a) the intentional awareness of the present moment and (b) a nonjudgmental, non-reactive, and curious willingness to experience the content (thoughts, sensations, and feelings) of the present moment (Bishop et al., 2004). Under this definition, mindfulness is conceptualized as both a dispositional trait and a mental training. Studies have increasingly explored mindfulness in older adults to increase emotional well-being (Fountain-Zaragoza & Prakash, 2017; Geiger et al., 2016; Oken et al., 2017; Wahbeh, Goodrich, & Oken, 2016). Among older adults, dispositional mindfulness has been associated with decreased NA (Baer, 2003; Brown & Ryan, 2003) and may be related to the buffering effects of age on NA (Raes, Bruyneel, Loeys, Moerkerke, & De Raedt, 2013). Recently, (Oken et al., 2017) published the results of a randomized controlled trial (RCT) among 134 at least mildly stressed 50- to 85-year-old adults who were assigned to a one-on-one, 6-week mindfulness meditation (MM) intervention or a wait list (WL) control. Outcome measures were assessed at baseline and 2 months later at Visit II. Self-rated measures of perceived stress and NA were significantly reduced following the mindfulness training when compared with WL control (Oken et al., 2017).

In this study, Oken and Colleagues assessed NA through trait reports (i.e., estimates of the frequency of experiencing negative states “in general” or “over the last year”). When faced with stressors throughout the day, however, people’s NA may fluctuate, and this daily fluctuation of NA may not be well-captured in mean-based estimates. NA variability (NAV) refers to within person variation or the standard deviation of NA over time (Eid & Diener, 1999) and contains unique information relevant to well-being, beyond that provided by mean-level measurements (Keng & Tong, 2016). NAV has been directly linked to most mood disorders (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Brown, Chorpita, & Barlow, 1998; Kirkegaard Thomsen, 2006; Young & Dietrich, 2015) and is positively correlated with elevated stress levels (Dua, 1993). It is postulated that the chronic activation of NA converts the immediate psychological and physiological stressors into prolonged physiological activation of several of the body’s systems (Brosschot, Verkuil, & Thayer, 2010), including the hypothalamic-pituitary-adrenocortical (HPA) axis and the sympathetic-adrenal-medullary (SAM) system. Prolonged or repeated activation of the HPA and SAM systems can result in chronic pathogenic states that lead to disease (Brosschot et al., 2010).

Relatedly, NAV has been shown to be predictive of several stress-responsive syndromes, including depression, hypertension, arthritis, respiratory disease, sleep disturbance, and dysregulated cortisol levels, even after other well-known sources of risk have been statistically controlled (Consedine, Magai, Cohen, & Gillespie, 2002; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Ormel et al., 2013; Proulx, Klee, & Oken, 2017). Taken together, previous research suggests that NAV may be an important factor in explaining how mindfulness affects well-being among middle-aged to older adults. Further, Oken and Colleagues reported significantly lower perceived stress among participants who completed the mindfulness training when compared with WL control participants; however, they did not explicitly explore the relationship between perceived stress and NA or NAV. Therefore, we conducted secondary analyses on the parent study (Oken et al., 2017).

Our first aim in the present investigation was to evaluate pretreatment to post-treatment change in NAV following a mindfulness training. We employed ecological momentary sampling assessment (EMA), a data capturing technique that queries about present moment experiences in real time, multiple times throughout the day. In this way, we were able to capture individuals' daily fluctuation of NA in a natural setting. Although this measurement method has limitations, it allowed for unique information to be captured, above and beyond what is gathered in retrospective, mean-based self-report measures. Additionally, EMA can potentially shed light on how mindfulness training impacts intraindividual fluctuation of negative affect. We hypothesized that following the mindfulness training, participants in the MM group would show greater reductions in NAV when compared with participants in the WL group.

The secondary aim was to assess if mindfulness training's effects on reduced NAV would be partially explained by pretreatment to post-treatment reductions in perceived stress, a finding that would be congruent with several stress theories (Creswell & Lindsay, 2014; Garland, 2007; Lazarus & Folkman, 1984). For example, the mindfulness stress buffering theory postulates that mindfulness training facilitates a capacity to observe and experience stressors as they arise with acceptance and equanimity. This impartial receptiveness buffers initial threat appraisals and reduces perceived stress, which subsequently reduces emotional reactivity (Creswell & Lindsay, 2014). Therefore, we hypothesized that the mindfulness training's effects on reduced NAV would be mediated through reductions in perceived stress.

2 | METHODS

This study examined de-identified, archival data collected as part of a larger study conducted at the Department of Neurology, Oregon Health and Science University (OHSU). The parent study was approved by the OHSU IRB, initial plan details were registered with [ClinicalTrials.gov](https://clinicaltrials.gov/ct2/show/study/NCT01386060) (NCT01386060), and all participants provided informed consent prior to assessments. The purpose of the parent RCT was to determine beneficial cognitive effects of mindfulness training among stressed middle-aged to older adults. The procedures of the parent RCT have been extensively described previously (Oken et al., 2017).

2.1 | Procedures and participants

Participants consisted of generally healthy adults, 50–85 years of age, who were at least mildly stressed as evidenced by a score on the Perceived Stress Scale (PSS) more than or equal to 9 (Table 1). Exclusion criteria included significant untreated psychiatric disorders requiring medical care, underlying illnesses and medications that might confound outcomes, and potential cognitive deficits, evidenced by a score less than or equal to 31 on the Modified Telephone Interview for Cognitive Status (Knopman et al., 2010). At Visit I, participants signed informed consent. Following baseline assessments at Visit I, participants were randomized to a 6-week, one-on-one, MM intervention or a WL control. All assessments collected at Visit I were repeated at Visit II, postintervention. All randomizations were performed by nonblinded research personnel using a computerized covariate adaptive randomization procedure (Pocock & Simon, 1975) aimed at balancing active and WL groups on age, gender, and baseline PSS (Cohen, Kamarck, & Mermelstein, 1983) scores using a predetermined projected median split for the continuous measures. The research assistant who led the MM training sessions performed the randomization, and the research assistants who conducted data-collection visits remained blinded. Participants in the MM group received the intervention between Visits I and II, and participants in the WL control received the intervention following Visit II.

Following telephone screenings, 134 participants were enrolled. The participant demographics (Table 1) were mostly women and primarily Caucasian non-Hispanic, with under-represented minority percentage comparable with the demographics of the Portland metropolitan area for this age range. Participants were also highly educated. Groups were comparable in age, gender, years of education, and baseline PSS.

2.2 | Intervention

2.2.1 | Mindfulness meditation—The MM in this RCT is a standardized and structured one-on-one programme that has been fully described (Wahbeh, Svalina, & Oken, 2014a). It is based on the mindfulness-based cognitive therapy (Segal, Williams, & Teasdale, 2002) and mindfulness-based stress reduction (Kabat-Zinn, 1982). Participants attended 60- to 90-min training sessions once a week for 6 weeks, along with recommended daily home practice. The six MM trainings all followed a similar format, although the length of the sessions varied to some degree by weekly syllabus length and by participant characteristics. Most sessions began with a 30-min-guided meditation, followed by discussion about the participant's meditation experience, presentation of new materials, and discussion of home practice. Formal meditation instruction included a 30-min body scan, 30-min sitting meditation, 30-min sitting with difficulty meditation, and 4-min breathing space. The research assistant leading the MM intervention was educated in Buddhist meditation with previous experience teaching secular one-on-one MM to adults in RCTs. Participants were instructed to use the home practice audio recordings to practice at home 30–45 min a day as a goal but to practice at least some amount every day.

2.2.2 | Wait list—Participants randomized to the WL arm between Visits I and II received the MM intervention after the WL period. This was done in part to facilitate recruitment and retention and to decrease disappointment following randomization.

2.3 | Measures

The primary outcomes of the parent study have been reported (Oken et al., 2017).

2.4 | Trait measures

2.4.1 | Perceived stress—Perceived Stress Scale (PSS) (Cohen et al., 1983) is a self-rated questionnaire that assesses the degree to which situations in one's life are appraised as stressful. Higher scores indicate more perceived stress in daily living. This self-report measure was completed by participants in their homes the week prior to the lab Visit I and again after the 6-week intervention (or WL control) prior to Visit II.

2.5 | Ecological momentary assessment

2.5.1 | Positive and Negative Affect—The Positive and Negative Affect Schedule (PANAS)—state short-form version is composed of 10 items, with five items measuring positive affect and five items measuring NA (afraid, ashamed, hostile, nervous, and upset). Positive affect and NA scores are generated independent of one another; we only examined NA in the current study. The state short-form version can be used to measure state affect, emotional fluctuations throughout a specific period of time, or emotional responses to events (Leue & Beauducel, 2011). Questions ask participants, "Right now, I feel ...." Higher NA scores indicate more negative affect. Due to the results from the parent study (no significant pretreatment to post-treatment change in positive affect), only NA data was analysed.

2.5.2 | Negative affect variability—During Visit I, participants were given a repurposed smartphone and required no cellular or internet connectivity. The preprogrammed handheld device sounded an alert up to four times a day during nonsleep periods for 2 days, signaling participants to answer questions regarding their current positive and negative emotional affect (PANAS short form; Watson et al., 1988). Participants could opt to delay the session by 30 min up to three times. Data were gathered for 2 days in consideration and minimization of the research burden imposed on participants. The individual's mean NA score was calculated across all available time points. Each individual time point was then centred by subtracting the individual's mean. Subsequently, the standard deviation (NAV) was calculated across the centred time points. This procedure was repeated at Visit II.

2.6 | Expectancy measures

2.6.1 | Expectancy/ Creditability—The expectancy/credibility questionnaire was administered to determine if expectancy was associated with improvements observed in the intervention, especially important because there was only a WL control. The questionnaire measures two factors: cognitively-based credibility and affectively-based expectancy. Participants responded to six questions on a 9-item Likert scale. Higher scores indicate more creditability and greater expectancy of positive benefits from treatment (Devilly & Borkovec, 2000).

2.7 | Data analysis

Prior to data analyses, all variables were examined in the Statistical Package for the Social Sciences (SPSS)-22 (Statistical Package for the Social Sciences, 2013) to evaluate data compliance with parametric analysis assumptions. Data were inspected to ensure there were no outliers and extreme outliers were deleted. Data were assessed for normality using the Shapiro–Wilk test. To test the primary hypothesis, we employed a mixed-model ANOVA. The within-subject variable was NAV, and the between-subject variable was group (MM/WL). Given their relationship with NA, age and gender were entered as covariates, along with treatment expectancy. Covariates were kept in the model if their p value was less than 0.10.

To test the secondary hypothesis, variables were centred. Residual change scores were calculated by regressing Visit II score onto Visit I score and saving the unstandardized residual. Pearson's correlations and Wilcoxon signed-rank tests were conducted to characterize the overall relationship between variables. To assess the possibility of a mediational effect of pretreatment to post-treatment change in perceived stress on pretreatment to post-treatment change on NAV, we conducted a path analysis using the PROCESS procedure for SPSS (Hayes, 2013). A path analysis uses unstandardized regression techniques to explore the predictive relationships between variables. Given their relationship with NA and perceived stress, the variables of age, gender, and income were entered as covariates, along with treatment expectancy. Covariates were kept in the model if their p value was less than 0.10. To compute an estimate of the indirect effects, we employed a bootstrapping method. Bootstrapping is a non-parametric resampling method that bypasses assumptions of normality common to traditional tests of mediation and is thus more powerful, particularly with smaller samples (Preacher & Hayes, 2004, 2008). A causal step approach would have severely limited our power (Hayes, 2009). Specifically, 5,000 samples of the original size were taken from the obtained data (with replacement after each specific number was selected), and indirect effects were calculated in each sample. The mean indirect effect computed over each of these 5,000 samples was used to compute the point estimate. The bias corrected and accelerated 95% confidence intervals (CI; i.e., with z score-based corrections for bias due to the underlying distribution) were then examined, and if these intervals did not contain 0, the point estimate of the indirect effect was considered significant. The α level was set at 0.05 (two-tailed) for all analyses.

3 | RESULTS

Mean scores, standard deviations, and correlations between self-report measures of interests are reported in Tables 2 and 3. Treatment expectancy did not differ between groups at baseline and was not a significant covariate in the models ($p = 0.10$). Therefore, it was removed from the models.

3.1 | Mixed-model ANOVA

3.2 | Pretreatment to post-treatment change in NAV

As predicted, the time (pre, post) X treatment group (MM, WL) interaction for NAV was significant, $F(1, 99) = 6.42$, $p = 0.01$. NAV decreased significantly at Visit II in the MM

group when compared with WL control group. Effect size for change in NAV was $\eta^2 = 0.06$ (see Figure 1).

3.2.1 | Pretreatment to post-treatment change in perceived stress—As previously reported (Oken et al., 2017), the time (pre, post) X treatment group (MM, WL) interaction for perceived stress was significant, $F(1, 124) = 14.38, p < 0.001$. Perceived stress was decreased significantly at Visit II in the MM group when compared with WL control group. Effect size for change in perceived stress was $\eta^2 = 0.10$.

3.3 | Mediation analysis

Pearson's correlation coefficients and Wilcoxon signed-rank tests revealed that group was significantly correlated with pretreatment to post-treatment change (as measured by residual change score) in NAV ($r = 0.25, p = 0.01$) and pretreatment to post-treatment change (as measured by residual change score) in perceived stress ($r = 0.32, p = 0.001$). Change in NAV was significantly correlated with change in perceived stress ($r = 0.30, p = 0.002$). The results of the path analysis are illustrated in Figure 2. Bootstrapping analyses indicated that there was a significant indirect group effect on reductions in NAV through change in perceived stress (95% CI [0.02, 0.69]).

4 | DISCUSSION

In this sample of 134 mildly stressed, middle-aged to older adults, we found that a one-on-one MM intervention significantly reduced NAV. We also found that the effect of mindfulness training on decreased NAV was mediated by a pretreatment to post-treatment reduction in perceived stress. Results of this current study make two unique contributions to the scientific literature.

First, this study provides more evidence that mindfulness training enhances well-being among middle-aged to older adults. Specifically, mindfulness training reduced fluctuation in negative affect. Despite the growing interest in mindfulness over the past 20 years, studies have only recently begun to examine mindfulness in older adults (Black & Olmstead, 2015; Fountain-Zaragoza & Prakash, 2017; Geiger et al., 2016; Oken et al., 2017; Wahbeh et al., 2016). A systematic review examined the effects of intentional mindfulness practice (or other forms of meditation) on cognitive functioning in older adults: The strongest finding was significantly enhanced attentional allocation after mindfulness-based practices (Gard, Hölzel, & Lazar, 2014). A somewhat smaller body of research has investigated the effects of mindfulness-based trainings on emotional well-being. A recent review found evidence for feasibility and acceptability of mindfulness-based interventions with older adults and enhanced emotional well-being of older adults following mindfulness training, with large effects on anxiety, depression, stress, and pain acceptance (Geiger et al., 2016) that would be further strengthened by this study's findings. Given that NAV has been shown to be predictive of several stress-responsive syndromes (Consedine et al., 2002; Nolen-Hoeksema et al., 2008; Ormel et al., 2013; Proulx et al., 2017), these findings suggest that NAV may be an important factor in explaining how mindfulness effects emotional and physical well-being among middle-aged to older adults. It is interesting to note that the dimension of social and group support, thought to be highly important in exerting a potentially positive effect on

well-being among this population, is minimal in this experimental design, as the intervention was conducted in a one-on-one setting.

Second, the results contribute to a growing understanding of how mindfulness mitigates the harmful effects of stress. Stress is considered a major health issue in the United States and has been shown to contribute to the development of depression (Fiske, Wetherell, & Gatz, 2009), anxiety (Kogan, Edelstein, & McKee, 2000), and age-related cognitive decline, hippocampal injury, and neurodegenerative diseases (Esch, Stefano, Fricchione, & Benson, 2002; Lupien et al., 1999; Oken, Fonareva, & Wahbeh, 2011). Of importance, however, is that not all individuals confronting stress develop poor health. Susceptibility to stress varies from person to person. Two factors that contribute to an individual's susceptibility to stress-related illness are the variability in people's appraisal of the stressor and, subsequently, the affective response to the stressor (Almeida, Piazza, Stawski, & Klein, 2011; Lovallo & Gerin, 2003). Stress susceptibility is associated with the individual's judgment or appraisal that the situational demands threaten to overwhelm one's ability to successfully cope (Lazarus & Folkman, 1984). Subsequently, those demands are met with NA. The variance in an individual's "stress signature" is, in part, thought to be imbedded in the person's historical and current contextual environments: Appraisals of events (or stressors) are shaped partially by one's personal history and memories, which inform the interpretation of current events (Barrett & Simmons, 2015). For example, early childhood adversity has been associated with greater threat appraisals and affective regulation difficulties, both associated with alterations in stress physiology (Repetti, Taylor, & Seeman, 2002; Woody & Szechtman, 2011). This pattern of appraisal and affective reactivity may be particularly salient in shaping physiological responses to stress and likely plays a prominent role in age-related processes and disease (Epel et al., 2018; Moskowitz et al., 2015).

In this sample, mindfulness training appeared to modify two factors that contribute to an individual's susceptibility to stress-related illness. Mindfulness training reduced perceived stress or stress appraisals, which, in turn, may have reduced NAV. These findings are consistent with and expand upon previous cross-sectional studies that report an inverse correlation between trait mindfulness and perceived stress (i.e., Bränström, Duncan, & Moskowitz, 2011) and a more recent cross-sectional study that reported perceived stress fully mediated the association of mindfulness with depression (Moskowitz et al., 2015). The results are also largely congruent with theoretical models of mindfulness (Baer, 2003; Brown, Ryan, & Creswell, 2007; Grabovac, Lau, & Willett, 2011) and stress (Creswell & Lindsay, 2014; Garland, 2007; Lazarus & Folkman, 1984), including the mindfulness stress buffering hypotheses. This theory postulates that mindfulness training facilitates a capacity to observe and experience internal reactions to a stressor as they arise with acceptance and equanimity. In turn, this impartial receptiveness buffers initial threat appraisals and, subsequently, reduces emotional reactivity, leading to greater health (Creswell & Lindsay, 2014). Therefore, mindfulness training may enhance awareness of the habitual and potentially historically influenced evaluations and appraisals that occur in reaction to a stressor. With continued practice, the cultivated non-reactive awareness may eventually allow for the de-automatization of maladaptive appraisal and affective reactivity patterns, promoting more adaptive responses to stress and buffering the individual from stress-related illness.

4.1 | Limitations

There are several limitations in the study that need to be considered. First, this was an underfunded study and, thus, was unable to include an active control group. Because non-specific treatment or placebo effects are a concern in all intervention studies (Oken, 2008), treatment expectancy was assessed and entered into the models to assess for possible association with treatment changes over time. An active control group would have been able to more robustly minimize the chance that differences between the intervention group and the control group were due to factors other than the treatment received. Therefore, these findings are preliminary and should be interpreted with caution. Second, the study was limited by the number of data points collected during the EMA. Researchers limited the collection to eight data points over 2 days after analysing feedback from participants in previous and ongoing studies. Participants reported that completing the intervention and in-lab testing sessions, engaging in the required daily home practice, and responding to the handheld device four times a day, for more than 2 days, resulted in respondent fatigue (XXX, unpublished data). Despite the increasing popularity of EMA, there has been limited evaluation of whether the added burden negatively impacts the quality or quantity of obtained data, especially among older adults. Because of the feedback we received and a literature that suggests EMA could be particularly sensitive to measurement reactivity, which refers to instances where the act of measurement undermines the accuracy of data obtained (French & Sutton, 2010), we decided to collect only eight data points, which may have limited our ability to adequately capture the full range of affect variability outside the 2-day measurement window. Third, although we employed a common approach to operationalize NAV by using the centred within-person standard deviation (iSD) scores (Grühn, Lumley, Diehl, & Labouvie-Vief, 2013), iSD may be theoretically limited as a measure of within-person affective variability. Two important dimensions of within-person emotional variability are affective intensity and frequency (Larson, 1987). Using the iSD, one can only index the average intensity of mood changes and not the frequency of those changes. Future funded studies will benefit from more data points, allowing for more complex models, such as a multilevel structural equation model, and active control WL control groups. Fourth, the population of this study was a representative of older adults in Portland, Oregon, with an overwhelmingly White population, making generalization to other more diverse communities difficult. Finally, it is important to note that the current findings only quantify the overall affective variability, without controlling for contextual factors. Participants' reductions in negative affect variability may have been due to reactivity to subtle contextual stimuli and contingencies, which could be predicted partially by stressor exposures. However, it is also possible that emotionally labile individuals are predisposed to such malleability, regardless of situational cues. Future research may consider controlling for stress exposure.

5 | CONCLUSION

Compared with the growing evidence demonstrating the effects of mindfulness training on wellness, relatively few studies have tested the mechanisms of action that connect changes that occur during mindfulness training with psychological outcomes, especially within a sample of older adults (Gu, Strauss, Bond, & Cavanagh, 2015). Our findings suggest that an

MM training may reduce NAV among middle-aged to older adults. Additionally, the effect of mindfulness training on reduced NAV was mediated by a reduction in perceived stress. Results provide additional evidence for the mindfulness stress buffering theory, which suggests that mindfulness training facilitates a capacity to observe and experience internal reactions to stressors as they arise with acceptance and equanimity. In turn, this impartial receptiveness buffers initial threat appraisals and, subsequently, reduces emotional reactivity (Creswell & Lindsay, 2014), potentially leading to greater health. Understanding the mechanisms by which mindfulness enhances well-being among this population may inform and optimize interventions and elucidate characteristics of treatment responders, both of which are important directions for future mindfulness-based research.

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FIGURE 1.
Pretreatment to post-treatment change in negative affect variability by group

FIGURE 2.

Mediation path analysis. Note: unstandardized regression coefficients. The unstandardized regression coefficient between treatment and change in negative affect variability (NAV), after controlling for change in perceived stress, is in parentheses. MM: mindfulness meditation intervention, WL: wait list control, NAV: pretreatment to post-treatment change in NAV as measured by residual change score, PSS: pretreatment to post-treatment change in Perceived Stress Scale as measured by residual change score

TABLE 1

Participant demographics by group

Variable	MM	WL
Number randomized (no. of female)	66 (51)	68 (56)
Age (mean, <i>SD</i>)	60 (7.4)	56.4 (6.3)
Years of education (mean, <i>SD</i>)	17.0 (2.5)	16.4 (2.8)
Under-represented groups (number)		
Hispanic	3	1
African American	1	1
Asian	2	4

Note. MM: mindfulness meditation; WL: wait list.

TABLE 2
Means, standard deviation, F values, and p values for pretreatment and post-treatment outcome variables by group

Outcome variables	MM ($n = 60$)		WL ($n = 68$)		ANOVA group X time		Effect size (η^2)
	Pre (M, SD)	Post	pre	Post	F	P	
NAV	1.80 (1.43)	1.27 (1.30)	1.77 (1.65)	1.85 (1.71)	5.42	0.02 *	0.05
PSS	18.67 (5.91)	15.17 (6.65)	18.51 (6.06)	18.53 (7.17)	14.38	<0.001 *	0.10

Note. MM: mindfulness meditation intervention; NAV: negative affect variability as measured by ecological momentary sampling; PSS: Perceived Stress Scale; WL: wait list control.

* $p < 0.05$.

** $p < 0.001$.

TABLE 3

Correlations between group and residual change scores for study variables

Variables	Group	Res. NAV	Res. PSS
Group	—	0.25 *	0.32 **
Res. NAV	0.25 *	0—	0.30 *
			—
Res. PSS	0.32 **	0.30 *	

Note. MM: mindfulness meditation intervention; Res. NAV: residual pretreatment to post-treatment change in negative affect variability; Res. PSS: residual pretreatment to post-treatment change in Perceived Stress Scale; WL: wait list control.

*
 $p < 0.05$.

**
 $p < 0.001$.