Mindfulness Predicts Lower Affective Volatility among African Americans During Smoking Cessation

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Abstract

Recent research suggests that mindfulness benefits emotion regulation and smoking cessation. However, the mechanisms by which mindfulness affects emotional and behavioral functioning are unclear. One potential mechanism, lower affective volatility, has not been empirically tested during smoking cessation. This study examined longitudinal associations among mindfulness and emotional responding over the course of smoking cessation treatment among predominantly low-socioeconomic status (SES) African American smokers, who are at high risk for relapse to smoking and tobacco-related health disparities. Participants (*N* = 399, 51% female, mean age=42, 48% with annual income <$10,000) completed a baseline measure of trait mindfulness. Negative affect, positive affect, and depressive symptoms were assessed at 5 time points during smoking cessation treatment (up to 31 days post-quit). Volatility indices were calculated to quantify within-person instability of emotional symptoms over time. Over and above demographic characteristics, nicotine dependence, and abstinence status, greater baseline trait mindfulness predicted lower volatility of negative affect and depressive symptoms surrounding the quit attempt and up to one month post-quit, *p*s < 0.05. Although volatility did not mediate the association between greater mindfulness and smoking cessation, these results are the first to show that mindfulness is linked to lower affective volatility (or greater stability) of negative emotions during the course of smoking cessation. The present study suggests that mindfulness is linked to greater emotional stability and augments the study of mindfulness in diverse populations. Future studies should examine the effects of mindfulness-based interventions on volatility and whether lower volatility explains effects of mindfulness-based treatments on smoking cessation.

Keywords

Mindfulness; Volatility; Smoking; Emotion Regulation; African Americans

Although the majority of current smokers in the U.S. indicate a desire to quit smoking, actual quit rates are low (CDC, 2011). Negative affect is a core symptom of nicotine withdrawal (Hendricks, Ditre, Drobes, & Brandon, 2006) and a consistent predictor of relapse to tobacco use (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). Studies examining emotional patterns during quit attempts indicate that in addition to the severity of affective symptoms, greater volatility (i.e., lability/scatter over time) predicts lapse and relapse (Cofta-Woerpel et al., 2011; Piasecki, Jorenby, Smith, Fiore, & Baker, 2003a, 2003b; Piasecki et al., 2000). Identifying factors that reduce affective volatility could be useful in smoking cessation treatment, particularly for populations with higher rates of relapse such as those with low socioeconomic status (SES) and African Americans (AAs; CDC, 2011; Fagan, Moolchan, Lawrence, Fernander, & Ponder, 2007; Shavers, Fagan, & McDonald, 2007). Mindfulness is fundamentally linked to affective experience and shows promise for regulating emotion (Szanton, Wenzel, Connolly, & Piferi, 2011) and enhancing smoking cessation (Heppner et al., under review) in low-SES AAs.

Mindfulness has been defined as purposeful, present-focused attention with an accepting, non-judgmental attitude (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Kabat-Zinn, 1990, 1994). Mindfulness involves observing thoughts and emotions as mental events that are not necessarily "true" or reflective of reality. Thus, mindfulness may help people to experience thoughts and feelings without getting "stuck" in their content or reacting to them in impulsive ways. This way of paying attention to thoughts and emotions without overly identifying with them is hypothesized to foster more flexible, adaptive responses (rather than impulsive reactions) to stressors (Arch & Craske, 2006, 2010). Mindfulness is linked to improved mood, anxiety, and stress (Baer et al., 2006; Brown & Ryan, 2003; Smith et al., 2011). Mindfulness may also promote more successful smoking cessation. In a pilot study ($N = 18$), Davis and colleagues (2007) found that 8 weeks of Mindfulness-based Stress Reduction (which included mindfulness-based instructions for coping with cravings) was associated with greater abstinence rates at 6-week follow-up than comparable smoking cessation studies. In a randomized controlled trial ($N = 88$), Brewer et al. (2011) reported that 8 sessions of mindfulness-based smoking cessation treatment produced better abstinence rates at 17-week follow-up than a standard smoking cessation treatment. Furthermore, Heppner et al. (under review) found that among 399 AA smokers, those with higher levels of mindfulness were both more likely to successfully quit and to recover abstinence if they experienced an early lapse.

Although research suggests that mindfulness predicts more positive and less negative affect, a more in-depth study of mechanisms by which mindfulness influences affective experience is needed. Indeed, there appear to be relatively stable inter-individual differences in intra-individual affective variability (Chow, Ram, Boker, Fujita, & Clore, 2005; Eaton & Funder, 2001; Larsen, 1987). Greater affective instability has been linked to poorer psychological health (Peeters, Berkhof, Delespaul, Rottenberg, & Nicolson, 2006; Trull et al., 2008).

Mindfulness is thought to promote a "decentered" perspective in which thoughts and emotions are observed as temporary mental events that do not necessarily represent reality (Teasdale et al., 2002). This mode of relating to experiences (or "metacognitive awareness;" Teasdale et al., 2002) might reduce the tendency for automatic reactions. For example,

Teasdale and colleagues' model of mindfulness-based relapse prevention for depression (2002, 1995) posits that nonjudgmental attention to mild depressive symptoms prevents cognitive and emotional reactivity to these experiences, thus preventing further cycles of more extreme symptoms. Furthermore, research suggests that mindfulness (both trait mindfulness and mindfulness-based training) reduces emotional reactivity to experiences such as distressing images, pain, and social stressors (Arch & Craske, 2006, 2010; Britton, Shahar, Szepsenwol, & Jacobs, 2012; Brown, Goodman, & Inzlicht, 2012). By promoting a decentered approach to experience, mindfulness may attenuate reactivity to day-to-day emotional experiences, thereby reducing affective instability over time.

A "volatility index" (indicating intra-individual variability in emotions over time) provides a quantitative method to study affective instability. In the only known study of mindfulness and affective volatility, Hill and Updegraff (2012) examined patterns of emotions among college students who indicated their emotional experiences six times per day for one week. Mean within-person standard deviations of positive and negative emotions were calculated to indicate degree of emotional instability. Results indicated that greater baseline mindfulness predicted lower volatility with regard to both positive and negative emotion. To the best of our knowledge, associations between mindfulness and affective volatility have not been evaluated during smoking cessation.

Affective volatility may be a critical factor that interferes with smoking cessation in low-SES AAs. Compared to higher-SES and other racial/ethnic groups, individuals with low SES and AAs might be particularly likely to smoke in an attempt to alleviate negative emotions, which are consistent predictors of nicotine dependence and difficulty quitting in this population (Bennett, Wolin, Robinson, Fowler, & Edwards, 2005; Landrine & Klonoff, 2000; Ludman et al., 2002). Although the few studies of mindfulness in low-SES AAs suggest it to be beneficial to emotion regulation (Szanton et al., 2011) and smoking cessation (Heppner et al., under review), more research is needed, particularly regarding mechanisms underlying these effects.

The current study tested the hypothesis that mindfulness predicts lower affective volatility in predominantly low-SES AAs during smoking cessation. Secondary analyses were conducted using data from a larger smoking cessation trial (Cano et al., in preparation). We were specifically interested in volatility of negative affect, which is problematic during cessation (Piasecki et al., 2000). However, we also examined volatility of positive affect, consistent with a previous finding of an association between greater mindfulness and lower volatility of positive emotion in college students (Hill & Updegraff, 2012). Finally, given that trait mindfulness predicts enhanced cessation outcomes in the present sample of low-SES AAs (Heppner et al., under review), we examined whether reduced affective volatility mediates this association.

Method

Participants

Data were collected as part of a randomized clinical trial examining a culturally tailored, palmtop computer-delivered smoking cessation treatment for AA smokers (Kendzor et al.,

2008). Participants were eligible if they self-identified as AA, were between 21–65 years old, had been smoking 5 cigarettes per day for 12 months, had an expired carbon monoxide level of 8 parts per million, planned to quit smoking within 2 weeks, possessed a functioning home telephone number and permanent home address, and were able to understand English at a sixth grade level. Exclusion criteria were regular use of tobacco products other than cigarettes, use of pharmacological cessation treatments other than nicotine patches supplied by the study, medical contraindication of the nicotine patch, or current pregnancy/lactation. Procedures were approved by the Institutional Review Board, and informed consent was obtained from all participants.

Procedure

Participants attended 7 study visits between 2005 and 2007: Pre-Quit Day −19 (baseline), Day −12, Day −5, Post-Quit Day +3, Day +10, Day +31, and Week +26. Participants were provided $20 gift cards at each visit through Day +10, and $40 gift cards at Day +31 and Week +26. At baseline, participants were randomly assigned to a standard smoking cessation treatment (ST) that included the nicotine patch, culturally sensitive self-help materials, and individual counseling, or ST in combination with palmtop computer-delivered treatment (CDT). Both treatments were provided through the study. Although analyses revealed no effect of treatment on abstinence (Cano et al., in preparation), treatment group was included as a covariate. This study utilizes data up to Day +31 to capture affective responding during the process of quitting.

Materials

Demographic and smoking characteristics—Demographics (collected at baseline) were age, gender, years of education, total annual family income, and partner status. Two items assessed pre-quit nicotine dependence: "How many cigarettes a day do you smoke on average?" and "How soon after you wake up do you smoke your first cigarette?" ("time to first cigarette;" Heatherton, Kozlowski, Frecker, Rickert, & Robinson, 1989). These items are strong indicators of nicotine dependence (Heatherton et al., 1989) and predictors of relapse (Baker et al., 2007).

Trait mindfulness—The Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) was administered at baseline. Participants responded on a 6-point Likert scale (1=*Almost Always*, 6 =*Almost Never*) to 15 statements (e.g., "I could be experiencing some emotion and not be conscious of it until some time later," "It seems I am 'running on automatic,' without much awareness of what I'm doing"). The MAAS showed excellent internal consistency ($\alpha = 0.92$).

Positive and negative affect—The Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) was administered at Day −12, Day −5, Day +3, Day +10, and Day +31. Participants rated the extent to which they experienced each of 20 emotions (e.g., distressed, ashamed, enthusiastic, excited) in the past week (*1 =Very Slightly or Not at All, 5 =Extremely*). The PANAS yields two factors: Positive Affect (PA) and Negative Affect (NA; Watson et al., 1988). Both subscales showed excellent internal consistency (α: 0.92 – 0.93).

Depressive symptoms—The Center for Epidemiological Studies-Depression (CES-D; Radloff, 1977) is a 20-item scale of depressive symptoms. Participants rated how often they experienced each symptom during the past week from "rarely or none of the time" to "most or all of the time." Scores range from 0 to 60. The CES-D was administered at Day −12, Day −5, Day +3, Day +10, and Day +31, with acceptable internal consistency (α: 0.86 – 0.88).

Smoking abstinence—Abstinence (using an intent-to-treat approach) was assessed at Day +3 (abstinence since quit date), Day +10, and Day +31 (both as 7-day point prevalence abstinence). Abstinence was biochemically verified through expired carbon monoxide levels of <10 ppm (Hajek et al., 2001) and/or a cotinine value of <20 ng/ml (McBride et al., 1999).

Statistical Analyses

Several methods have been proposed to calculate volatility (Cofta-Woerpel et al., 2011; Jahng, Wood, & Trull, 2008; Piasecki et al., 2003a). Jahng et al. (2008) suggested that an optimal volatility index include information about general within-person variability as well as temporal instability (taking into account sequencing of scores over time). The exclusive use of within-person variance (or within-person standard deviation) accounts for general variability but not temporal instability. For this study, the mean square successive difference (MSSD), or average of the squared difference between successive observations at times $i + 1$ and i (Jahng et al., 2008), was chosen to capture both affective variability and temporal instability. Two volatility indices were created for each affective variable (PANAS NA, PANAS PA, CES-D) in order to examine emotional processes in the first month of quitting and also isolate the time period immediately surrounding the quit day (given that the vast majority of smokers lapse early in the quit attempt and greater volatility within the first week is linked to increased likelihood of an early lapse; Cofta-Woerpel et al., 2011). The first (indicating volatility surrounding the quit attempt) included Day −12, Day −5, Day +3, and Day +10. The second (indicating volatility surrounding the quit attempt and up to one month post-quit) also included Day +31. Given the unequal time intervals in the latter index, an adjustment in the calculation of the successive difference (lambda = 0.25) was made for all indices including Day +31 (Jahng et al., 2008).

Linear regression models were fit to predict volatility indices from trait mindfulness using Stata/SE 12.1. Analyses controlled for baseline demographic characteristics (age, gender, education, income, partner status; chosen on the basis of past research; e.g., Businelle et al., 2010), dependence, and treatment type (ST vs. CDT). Additional analyses were conducted adjusting for abstinence status at Day +3, Day +10, and Day +31 in order to control for changes in negative affect associated with nicotine withdrawal (Hendricks et al., 2006). To test the hypothesis that lower affective volatility mediates the association between mindfulness and smoking cessation, the PROCESS macro (Hayes, 2013) was used with SPSS 21.0. Models tested the indirect effects of mindfulness on Day +31 abstinence through volatility indices (without Day +31; PANAS NA, PA, and CES-D tested in separate models). For each indirect effect, a 95% percentile bootstrap confidence interval was computed based on 1,000 bootstrap samples.

Results

Three hundred and ninety-nine AA smokers participated in the study. Approximately half (50.9%) were female. Average age was 42.44 years (SD = 9.74), 21.7% were married or living with a partner, 51.6% had less than or equal to a high school education, and 48.3% reported total family annual income of <$10,000. Participants smoked 20.56 (*SD* = 12.16) cigarettes per day on average, and 58.6% reported smoking within 5 minutes of waking. Because of attrition, 308 participants had complete data up to Day +10, and 284 had complete data up to Day +31. Participants with complete data were older (*p* = 0.01) and had slightly higher MAAS scores (*p* = 0.03) than those with incomplete data; no other baseline differences emerged.

Greater baseline mindfulness was associated with lower volatility of negative affect and depressive symptoms, both surrounding the quit attempt and up to one-month post-quit (*p*s < .05). These associations remained significant after controlling for covariates, *p*s < 0.05 (Table 1). Baseline mindfulness was not associated with volatility of positive affect (*p*s > 0.12); this pattern remained once covariates were controlled (*p*s > 0.24; Table 1). Tests of indirect effects revealed that the volatility indices were not related to abstinence and were not significant mediators of associations between mindfulness and abstinence.

Discussion

Among predominantly low-SES AA smokers, those with greater baseline mindfulness exhibited lower volatility of negative emotions during the course of a smoking quit attempt. Although greater baseline mindfulness predicted enhanced smoking cessation in this sample (see Heppner et al., under review), affective volatility did not mediate this association. Findings support the hypothesis that greater mindfulness is linked to lower volatility of negative emotions when faced with major life stressors such as quitting smoking. This is the first known study to show a connection between greater mindfulness and lower volatility of negative emotion during the course of smoking cessation. Volatility of negative emotion is a critical determinant of relapse to smoking (Cofta-Woerpel et al., 2011) and is linked to poor psychological functioning more generally (Peeters et al., 2006; Trull et al., 2008). Regardless of the lack of support for volatility as a mediator in this particular study, findings suggest that mindfulness is linked to greater emotional stability, an important aspect of emotional functioning during the course of smoking cessation.

Research consistently shows mindfulness to be associated with greater positive and lower negative emotion (Baer et al., 2006; Brown & Ryan, 2003; Smith et al., 2011). Perhaps the benefits of mindfulness are not only due to more positive and less negative emotion, but also to less volatility of negative emotion. The tendency to observe experiences without impulsively reacting may lessen the likelihood of extreme shifts in negative emotion, thereby fostering a sense of equanimity. Researchers are striving to understand the construct of "mindful emotion regulation" (Chambers, Gullone, & Allen, 2009), and lower volatility of negative emotion might be one critical mechanism to consider.

In comparison to the only other known study of mindfulness and emotional volatility, Hill and Updegraff (2012) found that greater baseline mindfulness (particularly "nonreactivity") predicted lower volatility of both negative and positive emotion. The current study found a relationship between mindfulness and volatility of negative, but not positive affect. This discrepancy could be related to differences in the study samples and methodologies. Hill and Updegraff utilized a sample of mostly non-Latino white college students, collected data over a typical week of college, utilized a different measure of mindfulness (Five Facet Mindfulness Questionnaire; Baer et al., 2006), and calculated volatility using within-person standard deviations (capturing general variability but not temporal instability; Jahng et al., 2008). The current study examined volatility using the MSSD approach during smoking cessation among predominantly low-SES AA smokers. Perhaps mindfulness is more relevant to processes regarding negative affect (a core symptom of nicotine withdrawal) than positive affect during smoking cessation.

Moreover, optimal emotion regulation might be better reflected by low reactivity to negative events and higher reactivity to positive events. For example, mindful attention might lessen reactivity in the context of stressful events (such as smoking cessation) but increase the emotional benefits of pleasant experiences. Mindful attention to pleasant experiences is akin to the process of "savoring," through which individuals purposefully pay attention to positive life events to experience greater emotional benefit (Bryant & Veroff, 2007). Indeed, mindfulness is associated with greater reactivity to pleasant experiences (as evidenced by "boosts" in positive emotions; Catalino & Fredrickson, 2011). Further research is needed to elucidate associations between mindfulness and volatility with regard to positive emotions.

The current study is limited by self-reported questionnaire data, which may suffer from retrospective recall bias. There is a need for mindfulness research to examine moment-to-moment experiences in natural environments (e.g., using ecological momentary assessment [EMA]; Shiffman, Paty, Gnys, Kassel, & Hickcox, 1996). Only one known study has used EMA to study associations between mindfulness and volatility (Hill & Updegraff, 2012), and future research should use EMA to examine mechanisms of mindfulness in more diverse populations. We encourage researchers to revisit the question of whether volatility mediates the association between mindfulness and smoking using EMA data, which would provide a more fine-grained analysis than possible with the current study. Researchers should also examine other potential mechanisms (e.g., levels of negative and positive affect, self-efficacy, perceived social support) that might explain associations between mindfulness and abstinence on a moment-to-moment basis.

This study is also limited by a unidimensional measure of mindfulness. Although the MAAS appears reliable and valid (Brown & Ryan, 2003), recent research has emphasized the multidimensionality of mindfulness (Baer et al., 2006). Furthermore, given that our study examined correlational associations between mindfulness and affective volatility (which does not necessarily imply causality), research that examines the direct effects of mindfulness training on affective volatility is needed. Finally, given the specific nature of our sample, we do not know whether results would generalize to other populations. Although it is entirely possible that these findings might be relevant in other contexts, the

current data cannot speak to affective processes in non-smokers or in life circumstances other than quitting smoking.

This study is strengthened by its assessment of multiple affective variables, use of longitudinal data, control for socio-demographics, dependence, and abstinence status, use of a volatility indicator of both within-person variability and temporal instability (Jahng et al., 2008), and utilization of a sample of predominantly low-SES AAs (an underserved population at high risk for affectively-triggered smoking and tobacco-related disparities). Results revealed that greater mindfulness is associated with lower volatility of negative affect and depressive symptoms over the course of smoking cessation. Results provide information on how mindfulness might benefit emotion regulation (empirically elucidating mechanisms of mindfulness) and suggest benefits of mindfulness for low-SES AAs. Lower volatility of negative emotion may be one mechanism by which mindfulness enhances emotion regulation in underserved populations.

Acknowledgments

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Table 1

Predicting Affective Volatility Indices from Trait Mindfulness

Mindfulness Predicting Volatility of Negative Affect (PANAS NA)				
Volatility Index	**MAAS coefficient (b)**	**SE**	**95% CI**	***p***
Surrounding quit attempt	−10.30	4.91	−19.96, −.64	.037
Surrounding quit attempt (controlling for abstinence)	−9.85	4.93	−19.56, −.14	.047
Up to 1-month post-quit	−12.58	4.48	−21.41, −3.75	.005
Up to 1-month post-quit (controlling for abstinence)	−13.01	4.48	−21.84, −4.18	.004

Mindfulness Predicting Volatility of Positive Affect (PANAS PA)				
Volatility Index	**MAAS coefficient (b)**	**SE**	**95% CI**	***p***
Surrounding quit attempt	−2.42	4.16	−10.61, 5.76	.560
Surrounding quit attempt (controlling for abstinence)	−2.62	4.14	−10.78, 5.53	.527
Up to 1-month post-quit	−3.43	3.94	−11.19, 4.32	.384
Up to 1-month post-quit (controlling for abstinence)	−4.51	3.88	−12.15, 3.12	.246

Mindfulness Predicting Volatility of Depressive Symptoms (CES-D)				
Volatility Index	**MAAS coefficient (b)**	**SE**	**95% CI**	***p***
Surrounding quit attempt	−18.12	6.64	−31.18, −5.05	.007
Surrounding quit attempt (controlling for abstinence)	−17.34	6.68	−30.48, −4.19	.010
Up to 1-month post-quit	−20.36	6.12	−32.42, −8.30	.001
Up to 1-month post-quit (controlling for abstinence)	−19.59	6.19	−31.77, −7.40	.002

Notes. Linear regression models were fit to predict volatility indices (volatility of negative affect, positive affect, and depressive symptoms) from trait mindfulness.

MAAS = Mindful Attention Awareness Scale

PANAS NA = Positive and Negative Affect Schedule – Negative Affect

PANAS PA = Positive and Negative Affect Schedule – Positive Affect

CES-D = Center for Epidemiological Studies-Depression

All analyses control for baseline demographic characteristics (age, gender, education, income, partner status), dependence (baseline cigarettes per day and time to first cigarette), and treatment type (ST vs. CDT). Analyses controlling for abstinence surrounding the quit attempt also control for smoking abstinence at Day +3 and Day +10. Analyses controlling for abstinence up to 1-month post-quit also control for smoking abstinence at Day +3, Day +10, and Day +31.

Surrounding quit attempt = Day −12, Day −5, Day +3, Day +10

Up to 1-month post-quit = Day −12, Day −5, Day +3, Day +10, Day +31