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ORIGINAL ARTICLE

Dispositional Mindfulness Predicts Enhanced Smoking Cessation and Smoking Lapse Recovery

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Abstract

Background Although mindfulness has been hypothesized to promote health behaviors, no research has examined how dispositional mindfulness might influence the process of smoking cessation.

Purpose The current study investigated dispositional mindfulness, smoking abstinence, and recovery from a lapse among African American smokers.

Methods Participants were 399 African Americans seeking smoking cessation treatment (treatments did not include any components related to mindfulness). Dispositional mindfulness and other psychosocial measures were obtained pre-quit; smoking abstinence was assessed 3, 31 days, and 26 weeks post-quit.

Results Individuals higher in dispositional mindfulness were more likely to quit smoking both initially and over time. Moreover, among individuals who had lapsed at day 3, those higher in mindfulness were more likely to recover abstinence by the later time points. The mindfulness-early abstinence association was mediated by lower negative affect, lower expectancies to regulate affect via smoking, and higher perceived social support.

Conclusions Results suggest that mindfulness might enhance smoking cessation among African American smokers by operating on mechanisms posited by prominent models of addiction.

Keywords Mindfulness · Smoking cessation · Smoking lapse recovery

Dispositional Mindfulness Predicts Enhanced Smoking Cessation and Smoking Lapse Recovery

Mindfulness has been defined as purposeful attention to present-moment experiences [1]. Dispositional mindfulness

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(the tendency for mindful attention in daily life) appears to be multifaceted [2], and one of its most critical components is present-focused awareness [3]. Although researchers have hypothesized that mindfulness might promote positive health behavior changes such as smoking cessation and have developed interventions to increase dispositional mindfulness for this purpose (e.g., [4]), very little research has examined associations between dispositional mindfulness and smoking cessation. The current study examined whether dispositional mindfulness (i.e., present-focused awareness in daily life) predicts smoking cessation and to elucidate potential mechanisms underlying any association.

Mindfulness and Smoking Cessation: Rationale and Potential Mechanisms

Although the majority of smokers express interest in quitting, only a small portion quit successfully [5]. Most smokers attempting to quit lapse within the first few days [6], and as many as 95 % of lapses lead to full-blown relapse [7]. Thus, researchers have emphasized the study of "milestones" within the cessation process (i.e., initial abstinence, lapses to smoking, and the transition from lapse to relapse; 8). A better understanding of protective factors that promote initial abstinence, prevent lapses, and inhibit lapses from progressing into full-blown relapse could help inform intervention strategies at various stages of the cessation process [8]. Unfortunately, little is known about protective factors or personal characteristics that promote lapse recovery.

Mindfulness Mindfulness might promote cessation, lapse prevention, and lapse recovery. Smokers tend to have lower levels of dispositional mindfulness than non-smokers (as measured by the Mindful Attention Awareness Scale [MAAS], a commonly used measure of mindfulness that is also used in the present study; [3, 9]). Furthermore, among smokers, greater dispositional mindfulness (as assessed with the MAAS) is associated with lower tobacco dependence [10], lower negative affect and perceived stress [11], greater positive affect [12], and higher expectancies regarding abilities to regulate emotions without smoking [10]. In the only known study of the association between dispositional mindfulness and smoking cessation, Spears et al. [13] found that nonjudgmental acceptance (a subscale of the Five Facet Mindfulness Questionnaire; [2]) predicted higher odds of abstinence up to 26 weeks post-quit among Spanish-speaking smokers of Mexican heritage. In addition, mindfulness-based smoking cessation interventions (aimed at increasing mindful awareness) show promise [4, 14]. As such, mindfulness is hypothesized to enhance cessation through its effects on emotions, nicotine dependence and withdrawal, agency, and social support.

Emotions Negative affect and depressive symptoms predict increased smoking urges, difficulties with cessation, and greater risk for relapse [15, 16]. Given that mindfulness is linked to lower negative affect [3], mindfulness might improve cessation by reducing negative affect, and may also reduce the tendency to react to negative affect by smoking [17, 18]. Along these same lines, rather than becoming overwhelmed by negative affect associated with an early lapse [19], a highly mindful person might move on from this setback and resume their quit attempt. On the other hand, positive affect may protect against relapse [20]. Thus, mindfulness might increase cessation through reduced negative affect and enhanced positive affect. Mindful attention to positive life experiences (e.g., each day of abstinence) may generate further increases in positive emotions [21], which could counter negative affective processes during cessation (e.g., withdrawal-induced negative affect), and thus lessen urges to smoke in attempt to reduce distress.

Dependence and Withdrawal Greater tobacco dependence consistently predicts worse cessation outcomes [22]. However, smokers with greater mindfulness have lower levels of dependence [10]. Through conscious attention to thoughts, feelings, and external stimuli, mindfulness may "de-automate" the habitual processes and reactions that underlie addiction [23, 24]. Withdrawal symptoms are also strong predictors of relapse [25]. Negative affect is a core aspect of withdrawal [26], thus mindfulness might lessen withdrawal symptoms related to negative affect. Mindfulness might also reduce craving [27], and/or individuals' responses to the experience of craving [18].

Agency A sense of agency [28] about one's ability to quit smoking can include both smokers' beliefs that they can regulate affect without smoking and self-efficacy for avoiding smoking in high-risk situations [10]. Lower agency predicts greater difficulties in quitting smoking [29, 30]. Mindfulness may enhance agency by broadening perceived available thoughts and actions, thus strengthening individuals' personal coping resources, and loving kindness meditation (which increases mindful awareness) has been associated with increases in agentic thinking (that one has been/will be able to achieve one's goals; 33). Similarly, a broader perception of coping resources might enhance expectations to regulate emotions by means other than smoking. Indeed, more mindful smokers report both higher self-efficacy for not smoking and greater expectancies that they can regulate affect without smoking [10].

Social Support Mindfulness may lead to improved relationships, possibly through attunement to others' thoughts and perspectives or enhanced communication/interaction styles [31]. Mindfulness could foster more supportive relationships, which could promote abstinence and decrease likelihood of lapses [32, 33]. No research has examined links between

mindfulness and social support for smoking cessation. However, mindfulness is linked to improved social outcomes including reduced aggression [34], increased relationship satisfaction and constructive responses to conflict [35], and increased empathy [36].

Mindfulness and Smoking Cessation in African Americans

African Americans have disproportionately high rates of cancer, other chronic diseases, and mortality associated with smoking compared to the general population [37, 38]. Although African Americans are more likely to express interest in quitting and to have attempted to quit in the past year compared to Whites, they are less likely to have successfully quit smoking [39]. Higher levels of stress and depressive symptoms are associated with worse cessation outcomes among African American smokers [40, 41], and many stressors that are particularly prominent in minority populations (e.g., financial strain, discrimination) predict a lower likelihood of cessation [42, 43]. Given that mindfulness has been linked to lower levels of stress and depressive symptoms [3], mindfulness may reflect an important individual characteristic that could reduce negative affect and improve cessation outcomes among African American smokers attempting to quit. Unfortunately, few studies of mindfulness have included significant proportions of African Americans [44].

Current Study

No known research has examined whether dispositional mindfulness predicts smoking cessation or recovery from a lapse in African Americans. The current study investigated three questions: (1) Does mindfulness predict smoking abstinence early in a quit attempt and over time?; (2) Does mindfulness predict recovery of abstinence among smokers who lapse early in a quit attempt?; and (3) What are the mechanisms underlying relationships between mindfulness and cessation? The current study investigated whether naturally occurring individual differences in dispositional mindfulness predict abstinence. This study utilized a sample of African American smokers enrolled in smoking cessation treatment. We predicted that associations between mindfulness (assessed at baseline) and cessation outcomes over time (up to 26 weeks post-quit) would be mediated by emotions, dependence and withdrawal, agency, and social support.

Method

Data were collected as part of a randomized clinical trial examining the efficacy of a culturally tailored, palmtop computer-delivered smoking cessation treatment for African Americans compared to treatment-as-usual. Neither treatment specifically taught mindfulness. Rather, the current study examined associations between dispositional mindfulness and smoking cessation. Although analyses revealed no effect of treatment on smoking abstinence [45], treatment group was included as a covariate in all analyses.

Participants

Participants were recruited via local print advertisements. Individuals were eligible if they were African American, between 21 and 65 years old, had smoked ≥5 cigarettes per day for ≥12 months, had an expired carbon monoxide (CO) level of ≥8 ppm, planned to quit smoking within the next 2 weeks, possessed a functioning home telephone number and permanent home address, and were able to understand English at a sixth grade literacy level or higher. Exclusion criteria were: regular use of tobacco products other than cigarettes, use of pharmacological smoking cessation treatments other than nicotine patches, medical contraindication for the nicotine patch, and current pregnancy/lactation (see [46] for further details).

Procedure

Data were collected from participants at seven times: three pre-quit (days −19, −12, and −5 before quit date) and four post-quit (days 3, 10, and 31, and 26 weeks following quit date). The present study utilized data from day −19 pre-quit (baseline), day −5 pre-quit, days 3 and 31 post-quit, and week 26 post-quit. Following baseline, participants were randomly assigned to either standard treatment (ST) that included the nicotine patch, culturally sensitive self-help materials, and individual counseling, or to the palmtop computer-delivered treatment (CDT, which also included all components of ST). Participants received five brief in-person counseling sessions (from pre-quit day −12 through post-quit day 31). Counselors were blind to the baseline data.

Measures

Smoking Abstinence Three abstinence assessments were utilized for the current study, which were chosen to reflect three critical smoking cessation milestones: early abstinence, lapse recovery, and long-term abstinence. Specifically, day 3 abstinence reflected early abstinence as the majority (74 %) of participants had lapsed by day 3, and week 26 reflects a common long-term abstinence time point in smoking cessation

studies. Among participants who had lapsed by day 3, day 31 was selected to represent a reasonable time frame in which to regain abstinence and to permit assessment of 7-day point prevalence abstinence. Abstinence was biochemically verified through expired CO <10 ppm [47] and/or cotinine <20 ng/ml [48]. Self-reports of abstinence that were not consistent with biochemical verification were coded as not abstinent.

Mindfulness The Mindful Attention Awareness Scale (MAAS; 18) was administered at baseline. Participants responded to 15 statements (e.g., "I find myself doing things without paying attention") on a 6-point Likert scale with reversed endpoints (1=*Almost Always*, 6=*Almost Never*). Higher scores reflect greater mindfulness (i.e., present-focused attention). The MAAS has been associated with greater acting with awareness [49] and indicators of better psychological functioning (e.g., lower depression, anxiety, and rumination; higher positive affect; 3), as well as neural correlates of attention and emotion regulation [50]. Furthermore, meditation practitioners score higher on the MAAS than non-meditators [3], and MAAS scores increase after mindfulness-based treatment [51, 52]. The MAAS showed good internal consistency in the current sample (α=0.92).

Mediators

Emotions The Positive and Negative Affect Schedule [53] consists of 20 adjectives that form subscales for positive affect and negative affect. Higher scores indicate higher positive and negative affect. Both positive and negative affect were assessed at day −5, day 3, and day 31, with Cronbach's alpha ranging 0.92–0.93. The 20-item Center for Epidemiological Studies-Depression [54] scale, designed to assess symptoms of depression in the general population, was used to assess depressive symptoms at day −5, day 3, and day 31 (α=0.86–0.88 in current sample).

Dependence and Withdrawal The 68-item Wisconsin Inventory of Smoking Dependence Motives [55] provides scores indicating "primary dependence" (automaticity, craving, loss of control, and tolerance) and "secondary dependence" (e.g., cognitive enhancement, positive and negative reinforcement), as well as a total score. This measure was administered at baseline and at 31 days post-quit (α at both time points=0.98). The 28-item Wisconsin Smoking Withdrawal Scale [26] yields a total score and seven subscale scores (i.e., anger, anxiety, concentration difficulty, craving, hunger, sadness, and sleep problems) and was administered at day −5, day 3, and day 31 (α=0.78–0.90).

Agency Agency was assessed in two ways: self-efficacy for avoiding smoking in high-risk situations (the Self-Efficacy Scale; [56]) and beliefs about ability to regulate affect both

by smoking and by other means (the Affective Information Processing Questionnaire; [57]). The Self-Efficacy Scale (specific to smoking) yields a total and three subscale scores: positive affect/social situations, negative affect situations, and habitual/craving situations. Higher scores reflect greater confidence in one's ability to avoid smoking. The 9-item version of the Self-efficacy Scale was administered at day −5, day 3, and day 31 (α=0.87–0.94). The Affective Information Processing Questionnaire assessed individuals' expectations that they could regulate their mood either (a) by smoking or (b) by means other than smoking in negative affect situations described by 10 vignettes and was administered at baseline and at day 31 (α=0.90–0.96).

Social Support The Interpersonal Support Evaluation List [58] assessed perceived social support. Responses to this 12-item measure were scored such that higher scores indicate higher social support. In addition to a total score, the items form three subscales: appraisal, belonging, and tangible support. This measure was administered at baseline, day 3 and day 31 post-quit (α=0.86–0.87 across scales and times).

Covariates

Demographics Demographics included age, gender, education (≤high school vs. >high school), and partner status (single/separated/divorced/widowed vs. married/living with partner).

Pre-Quit Tobacco Use Two items were used to assess prequit tobacco use: "How many cigarettes a day do you smoke on average?" and "How soon after you wake up do you smoke your first cigarette?" [59].

Data Analysis Overview

To examine the relationship between mindfulness and smoking abstinence over time, logistic random coefficients regression models were utilized. An intention-to-treat procedure was followed, such that those with missing data were considered not abstinent. Models specified an unstructured covariance matrix for the vector of random intercept and slope of time for each subject. To examine associations between mindfulness and the specific processes of early lapse and lapse recovery, logistic regression analyses were conducted with the full sample and with the subsample of early lapsers at all applicable time points. Day 3 abstinence was used to separate early lapsers from early abstainers.

To examine mediators of associations between mindfulness and smoking abstinence, a series of analyses identified mediators of the relationship between: (1) baseline mindfulness and early abstinence, and (2) baseline mindfulness and lapse recovery among early lapsers. Potential mediators were tested in separate models. Simple mediation effects were obtained

from bootstrapping analyses utilizing 5000 re-sampling iterations and 95 % confidence intervals [60, 61]. Following typical mediation nomenclature, two paths were estimated for each simple mediation model: path *a* denotes the relationship between mindfulness and the candidate mediator, and path *b* denotes the relationship between the candidate mediator and abstinence (controlling for mindfulness).

For early smoking abstinence models, the total sample was utilized, and each simple mediation model included baseline mindfulness as the predictor, day 3 abstinence as the outcome, and each mediator of interest (individually). Potential mediators were measured prior to the quit date. For lapse recovery models, potential mediators for day 31 and week 26 abstinence (analyzed separately) were examined among the subset of early lapsers. Potential mediators were drawn from the previous abstinence assessment (day 3 mediators for day 31 abstinence, day 31 mediators for week 26 abstinence). Final models controlled for socio-demographics (gender, education, age, partner status), treatment group (ST vs. CDT), and pre-quit tobacco use (cigarettes per day, time to first cigarette). In analyses predicting week 26 abstinence, day 31 smoking status was entered as an additional covariate.

Results

Participant Characteristics

Participants were 399 African American smokers. Table 1 displays participant characteristics for the full sample and for the subsample of early lapsers. Participant attrition was 11.8 % on day −5, 18.5 % on day 3, 27.6 % on day 31, and 35.6 % at week 26. Compared to participants who did not attend the final week 26 visit, those who did attend tended to be older ($p=0.02$). Further descriptive data and relations among demographic variables, psychosocial variables, and smoking variables in this sample are presented by Businelle, Kendzor et al. [62], Kendzor, Businelle et al. [63], and Kendzor, Cofta-Woerpel et al. [64]. See Table 2 for means and standard deviations of potential mediators at each time point.

Mindfulness and Smoking Abstinence over Time

Both MAAS and time predicted abstinence longitudinally, such that increasing time from quit date reduced the odds of abstinence—from day 3 to day 31 ($OR=0.12$, $p<0.001$) and from day 3 to week 26 ($OR=0.007$, $p<0.001$)—and higher mindfulness scores increased the odds of abstinence such that an increase in MAAS score of 1 point approximately doubled the odds of abstinence ($OR=2.22$, $p<0.01$). MAAS scores significantly predicted abstinence in the unadjusted model ($OR=2.22$, $p=0.004$) as well as in the model adjusted for demographics, treatment, and pre-quit tobacco use ($OR=$

Table 1 Participant characteristics

	Full sample (N=399)	Early lapsers (N=295)
Female (%)	51	50
Married or living with partner (%)	21	18
≤High school education (%)	52	56
Age (mean, SD)	42.4 (9.74)	41.5 (9.75)
Mindfulness (mean, SD)	4.29 (1.03)	4.20 (1.04)
Cigarettes per day (mean, SD)	20.56 (12.16)	21.68 (12.90)
Smoke within 5 min of waking (%)	59	63.4

1.75, $p=0.04$). This analysis was also conducted with the subset of participants who completed the study ($N=259$). The pattern of results remained the same, although the finding that higher MAAS scores were associated with an increased odds of abstinence only approached significance ($OR=1.42$, $p=.088$). The interaction between mindfulness and time was not significant for any time contrasts (p's>0.16).[1] Fig. 1 displays abstinence rates over time for individuals who are low and high in mindfulness (using values $+/-$ 1 SD from the mean).

Mindfulness, Early Smoking Abstinence, and Lapse Recovery

Given the significant association between mindfulness and abstinence over time, simple logistic regression analyses were conducted examining associations of mindfulness with early abstinence (day 3) and recovery of abstinence among individuals who had lapsed by day 3. Among the total sample, greater mindfulness predicted greater odds of abstinence at day 3 ($OR=1.48$, $p=0.001$). Among early lapsers ($n=295$), those with higher mindfulness were more likely to be abstinent at day 31 ($OR=1.77$, $p=0.05$) and week 26 ($OR=2.17$, $p=0.009$). See Table 3.

Mediators of the Association Between Mindfulness and Early Smoking Abstinence

Of the individual models examined, three general types of variables emerged as significant mediators of the association between mindfulness and early abstinence: (1) negative

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[1] We also explored the possibility that trait mindfulness might moderate the effects of treatment (palmtop computer-delivered treatment vs. treatment-as-usual) on abstinence. In an unadjusted model predicting abstinence over time, the Treatment Group X MAAS effect was not significant ($OR=0.70$, $p=0.237$, 95 % CI=0.39, 1.26). The Treatment Group X MAAS effect was also not significant when controlling for time ($OR=0.66$, $p=0.23$, 95 % CI=0.33, 1.31), or when adjusting for demographics and tobacco use ($OR=.79$, $p=0.43$, 95 % CI=0.44, 1.41). The effect of MAAS on abstinence remained significant in all models (all OR's>1.55, all p's<0.05).

Table 2 Descriptive statistics of potential mediating variables across all time points

Potential Mediator	Baseline	Day 3	Day 31	Week 26
Emotion				
Positive affect		35.87 (8.77)	36.60 (9.01)	34.98 (9.75)
Negative affect		19.41 (8.88)	19.04 (8.63)	20.11 (8.90)
Depressive symptoms		14.80 (11.12)	14.11 (11.29)	14.74 (11.37)
Dependence				
Primary	4.87 (1.42)		2.85 (1.48)	3.09 (1.62)
Secondary	4.18 (1.37)		2.70 (1.27)	2.84 (1.34)
Withdrawal				
Anger		1.69 (1.13)	1.50 (1.12)	1.55 (1.02)
Anxiety		1.82 (0.89)	1.69 (1.05)	1.71 (0.94)
Sadness		1.41 (0.83)	1.40 (0.91)	1.47 (0.84)
Concentration		1.43 (0.87)	1.38 (1.01)	1.42 (0.85)
Craving		2.06 (1.01)	1.82 (1.03)	1.87 (1.01)
Hunger		2.31 (0.84)	2.19 (0.92)	2.02 (0.73)
Sleep		1.94 (0.98)	1.83 (1.07)	1.88 (0.91)
Self-efficacy				
Positive affect		3.50 (0.96)	3.50 (1.07)	3.19 (1.11)
Negative affect		3.10 (1.00)	3.20 (1.13)	2.95 (1.19)
Habitual/craving		3.62 (0.93)	3.60 (1.04)	3.29 (1.11)
Total		3.41 (0.88)	3.43 (1.00)	3.14 (1.06)
Affect regulation expectancies				
By not smoking	4.89 (1.29)		5.46 (1.31)	5.16 (1.40)
By smoking	4.20 (1.58)		3.62 (1.94)	3.99 (1.78)
Social support				
Appraisal	12.05 (3.04)	12.96 (2.58)	13.06 (2.66)	12.84 (2.72)
Belonging	12.08 (2.65)	12.88 (2.43)	13.07 (2.41)	12.90 (2.59)
Tangible	12.00 (2.89)	12.70 (2.55)	12.80 (2.66)	12.63 (2.78)
Total	36.12 (7.56)	38.54 (6.50)	38.86 (6.74)	38.37 (7.17)

emotional experiences, (2) affect regulation expectancies, and (3) social support. First, mindfulness predicted lower levels of anger, sadness, and depressive symptoms (each associated with smoking lapses), which then predicted higher likelihood of abstinence. Second, more mindful individuals indicated lower expectations that they would regulate their affect by smoking, which predicted higher likelihood of abstinence. Third, greater mindfulness was associated with higher levels of social support (total score, appraisal, and belonging), which was associated with greater likelihood of abstinence. See Table 4.

Mediators of the Association Between Mindfulness and Lapse Recovery

In predicting day 31 abstinence among early lapsers, none of the potential mediators (measured at day 3) produced significant indirect effects. In predicting week 26 abstinence among early lapsers, only negative affect emerged as a having a significant indirect effect on week 26 abstinence. Mindfulness predicted lower negative affect at day 31 ($b_{\text{path a}}=-2.81$, $p<0.001$), and lower negative affect predicted higher rates of abstinence ($b_{\text{path b}}=-0.12$, $p<0.05$). The indirect effect of mindfulness on abstinence through lower negative affect was statistically significant, $b_{\text{indirect}}=0.349$ (95 % CIs [0.096, 0.755], SE=0.23). Thus, whereas negative affect, social support, and affect regulation expectancies each mediated the association between mindfulness and early abstinence, none of the hypothesized variables was a mediator with regard to day 31 abstinence, and only negative affect mediated the relationship between mindfulness and long-term (week 26) abstinence.

Discussion

Dispositional mindfulness predicted smoking abstinence over time, early smoking abstinence, and lapse recovery among

Table 3 Dispositional mindfulness predicts smoking abstinence across time and cessation milestones

Logistic random coefficients regression models

	Abstinence across time (full sample)	
	OR	p
Mindfulness (unadjusted)	2.22	0.004
Mindfulness (adjusted for demographics and rreatment)	1.69	0.005
Mindfulness (adjusted for demographics, treatment, and pre-quit tobacco use)	1.75	0.04

Simple logistic regression models

	Early abstinence (day 3) among full sample		Lapse recovery (day 31) among early lapsers		Lapse recovery (week 26) among early lapsers	
	OR	p	OR	p	OR	p
Mindfulness (unadjusted)	1.48	0.001	1.77	0.050	2.17	0.009
Mindfulness (adjusted for demographics and treatment)	1.35	0.019	1.94	0.032	2.41	0.005
Mindfulness (adjusted for demographics, treatment, and pre-quit tobacco use)	1.27	0.069	2.04	0.024	2.27	0.011

Odds ratios reported are predicting smoking abstinence. Full sample $N=399$. Early lapsers (those who smoked by day 3) $N=295$. Demographic covariates were gender, education, age, and partner status. Pre-quit tobacco use covariates were cigarettes per day and time to first cigarette

African American smokers seeking treatment. The link between greater dispositional mindfulness and early abstinence was mediated by lower negative affect (i.e., depressive symptoms, anger, and sadness), lower expectancies regarding the ability of smoking to regulate negative affect, and higher perceived social support. The association between dispositional mindfulness and lapse recovery by week 26 was only mediated by lower negative affect. Overall, the mediators that most consistently linked mindfulness to abstinence and lapse recovery were indicators of negative affect. The importance of negative emotions as mediators is consistent with theories of addiction [69] that assert that avoidance of or escape from negative affect is a key determinant of relapse. In addition, theories on mechanisms underlying mindfulness [70, 71] place central importance on the role of mindfulness in promoting more effective
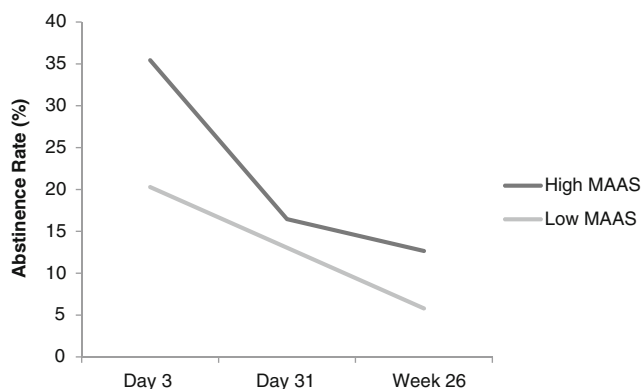

Fig. 1 Abstinence rates for individuals low and high in dispositional mindfulness. Low MAAS and High MAAS rates generated from values +/− 1 SD from the mean on the total sample MAAS scores. *MAAS* mindful attention awareness scale

regulation of unpleasant thoughts and emotions. The current findings extend previous work by showing that lower negative affect is a primary mechanism through which mindfulness predicts smoking cessation.

Social support, which also plays an important role in theories of cessation [32], has not yet been a prominent factor in models of mindfulness. Although mindfulness has been linked to positive interpersonal outcomes [34–36], the current study is the first known to link mindfulness to perceptions of social support specifically. The findings underscore the importance of social support as a key factor influencing early abstinence and extend the potential mechanisms of mindfulness from intrapersonal to interpersonal factors. Research suggests that having a strong social support network could be a protective factor with regard to smoking for African Americans [72–74]. Perhaps mindfulness-based interventions for smoking cessation, especially among African Americans, could be enhanced either by encouraging the use of mindfulness in social interactions, or by utilizing social media to capitalize on social support.

Theories of addiction also highlight the role of agency (e.g., self-efficacy to avoid drug use) as key in predicting abstinence [19, 32]. Fredrickson's broaden-and-build framework explains how mindfulness might enhance positive emotions, which could strengthen personal resources including agency [75]. However, the current study was the first known to explore agency as a potential mediator in the mindfulness-smoking abstinence link. The current study provides only partial support for the role of agency, specifically through expectancies to regulate negative affect by smoking. Given that mindfulness has been related to greater self-efficacy and expectations to regulate affect without smoking [10], future research on the role of agency in mediating the mindfulness-abstinence association may be warranted.

Table 4 Potential mediators of baseline mindfulness to day 3 abstinence

Potential mediator	Coefficients		Indirect effect (SE)	BC 95 % CI		PME
	a	b		Lower	Upper	
Emotion						
Positive affect	2.41	0.02	0.05 (0.04)	−0.024	0.140	0.20
Negative affect	−3.00	−0.03	0.09 (0.06)	−0.023	0.223	0.37
Depressive symptoms	*−4.71*	*−0.03*	*0.16 (0.08)*	*0.029*	*0.329*	*0.64*
Dependence						
Primary	−0.46	0.03	−0.016 (0.05)	−0.116	0.088	0.05
Secondary	−0.45	−0.04	−0.018 (0.05)	−0.132	0.087	0.07
Total	−5.84	0.004	−0.020 (0.06)	−0.135	0.088	0.08
Withdrawal						
Anger	*−0.43*	*−0.37*	*0.16 (0.07)*	*0.032*	*0.303*	*0.66*
Anxiety	−0.37	−0.29	0.11 (0.07)	−0.024	0.252	0.45
Sadness	*−0.28*	*−0.38*	*0.10 (0.06)*	*0.001*	*0.233*	*0.44*
Concentration	−0.41	−0.11	0.04 (0.08)	−0.101	0.207	0.19
Craving	−0.18	−0.09	−0.02 (0.04)	−0.100	0.050	0.06
Hunger	−0.13	−0.10	0.01 (0.03)	−0.028	0.080	0.05
Sleep	−0.32	−0.21	0.07 (0.06)	−0.029	0.188	0.29
Self-efficacy						
Positive affect	0.07	0.52	0.04 (0.03)	−0.009	0.119	0.15
Negative affect	0.07	0.38	0.03 (0.03)	−0.012	0.091	0.11
Habitual/Craving	0.05	0.49	0.02 (0.03)	−0.016	0.092	0.10
Total	0.06	0.62	0.04 (0.03)	−0.009	0.118	0.15
Affect regulation expectancies						
By not smoking	0.34	0.10	0.04 (0.04)	−0.040	0.119	0.14
By smoking	*−0.21*	*−0.15*	*0.03 (0.02)*	*0.001*	*0.091*	*0.13*
Social support						
Appraisal	*1.10*	*0.11*	*0.12 (0.07)*	*0.006*	*0.271*	*0.49*
Belonging	*0.93*	*0.13*	*0.12 (0.06)*	*0.018*	*0.251*	*0.50*
Tangible	1.11	0.09	0.100 (0.06)	−0.006	0.236	0.41
Total score	*3.14*	*0.05*	*0.151 (0.08)*	*0.025*	*0.315*	*0.63*

All models controlled for age, gender, education, partner status, pre-quit tobacco use, and treatment group. When tobacco dependence variables were tested as mediators without controlling for baseline cigarettes per day and time to first cigarette, the results did not change. Significant indirect effects are shown in *italics*. Unstandardized coefficients are reported for substantive interpretation [65]. A = unstandardized coefficient for relationship between mindfulness and potential mediator. b = unstandardized coefficient for relationship between potential mediator and abstinence. SE = standard error of indirect effect. BC 95 % CI = bias-corrected 95 % confidence intervals for total indirect effect. PME = Proportion of mediated effect. PME was calculated with the equation $ab/(c'+ab)$ [66] utilizing the absolute values of the direct and indirect effects [67]. PMEs have been shown to be unstable with sample sizes <500 [68] but are reported here for illustrative purposes

The current findings shed light on the process of abstinence recovery following a lapse, a critical "milestone" in the cessation process [8]. Given that most lapses lead to relapse [7], understanding the processes and personal characteristics that contribute to lapse recovery is critical. This study suggests that mindfulness could help prevent lapses from interfering with longer-term cessation. Furthermore, lower negative affect at day 31 mediated the effect of mindfulness on week 26 abstinence among early lapsers. Lower distress associated with lapses may be due to a "decentered" perspective [76]. The

tendency to observe thoughts and feelings without reacting to them might enable more mindful individuals to view a lapse as a single slip-up rather than as a devastating failure. This mindful responding might lessen the likelihood of smoking as a way of alleviating lapse-associated distress, and thus promote long-term abstinence.

Overall, our findings most consistently highlight lower negative affect as a primary mediator of associations between mindfulness and abstinence in African American smokers. Although greater negative affect is a consistent predictor of

lapse and relapse across various populations, the role of negative affect as a trigger for smoking may be even more prominent among African Americans. African Americans often face unique stressors, including chronic racial discrimination, which increase negative affect and contribute to health disparities [37, 77,]. Given that chronic stress and discrimination negatively impact smoking cessation in minority populations [41, 42], future research should also examine whether mindfulness-based interventions improve coping and reduce negative affect related to specific culturally relevant stressors.

Limitations and Future Directions

Given that the sample was entirely African American, it is unclear whether results will generalize to other racial/ethnic groups. This study is also limited by exclusive use of the MAAS as a unidimenional measure of mindfulness. Other research has highlighted that mindfulness may be a multidimensional construct [2]. Thus, the MAAS may not capture the full complexity of mindfulness [78], but it does appear to capture a core element of mindfulness (i.e., present-focused attention and awareness).

Future studies should examine whether particular facets of mindfulness predict cessation. For example, recent research [13] suggests that non-judgment is one aspect of mindfulness that predicts cessation. Given that mindfulness is associated with lower neuroticism [3, 79, 80], which has been linked to cessation [81], research might also examine whether personality variables might account for relationships between mindfulness and smoking.

This study found no significant mediators of abstinence recovery by day 31, and found only negative affect as a mediator of abstinence recovery by week 26. This could be due to an insufficient sample size or high relapse rates among the sample. In addition, mediation analyses were likely hampered by the significant time lags between measurement of the mediators and abstinence. Shiffman and Waters [82] demonstrated that rapid shifts in negative affect predicted relapse. Future research should measure moment-to-moment changes in potential mediators and examine how trajectories of these constructs over time might predict relapse [83, 84].

Finally, although this study examined potential mediators in separate models, these mediators likely affect one another. For example, the availability of a strong social support system may increase positive and reduce negative emotions during the quit process. In addition, mindfulness reduces negative emotions, which may then enhance agency. Future research might examine more integrative models and study designs that enable a more fine-grained analysis of the reciprocal relations among mindfulness and potential mechanisms.

Conclusions

This is the first known prospective study of associations between dispositional mindfulness and smoking cessation at both early and later stages of a quit attempt in African American smokers. Results suggest that dispositional mindfulness promotes smoking cessation and ability to recover from an early lapse. This improved lapse recovery appears to emerge primarily through lower negative affect. This research adds to the small but growing literature on the benefits of mindfulness in racial/ethnic minority populations. Findings support the development of mindfulness-based interventions (which aim to enhance dispositional mindfulness) for promoting smoking cessation at various stages within a quit attempt.

References

1. Kabat-Zinn J. *Full catastrophe living: using the wisdom of your body and mind to face stress, pain, and illness*. New York: Bantam Dell; 1990.
2. Baer RA, Smith GT, Hopkins J, Krietemeyer J, Toney L. Using self-report assessment methods to explore facets of mindfulness. *Assessment*. 2006; 13: 27-45.
3. Brown KW, Ryan RM. The benefits of being present: mindfulness and its role in psychological well-being. *J Pers Soc Psychol*. 2003; 84: 822-848.
4. Brewer JA, Mallik S, Babuscio TA, et al. Mindfulness training for smoking cessation: results from a randomized controlled trial. *Drug Alcohol Depend*. 2011; 119: 72-80.
5. CDC: Quitting smoking among adults–United States, 2001–2010. *Morbidity and Mortality Weekly Reports*. 2011, 60:1513–1519.
6. Hughes JR, Gulliver SB, Fenwick JW, et al. Smoking cessation among self-quitters. *Health Psychol*. 1992; 11: 331-334.

7. Kenford SL, Fiore MC, Jorenby DE, et al. Predicting smoking cessation. Who will quit with and without the nicotine patch. *JAMA*. 1994; 271: 589-594.

8. Shiffman S, Scharf DM, Shadel WG, et al. Analyzing milestones in smoking cessation: illustration in a nicotine patch trial in adult smokers. *J Consult Clin Psychol*. 2006; 74: 276-285.

9. Loucks EB, Britton WB, Howe CJ, Eaton CB, Buka SL. Positive associations of dispositional mindfulness with cardiovascular health: The New England family study. *Int J Behav Med*. 2014: 1–11.

10. Vidrine JI, Businelle MS, Cinciripini P, et al. Associations of mindfulness with nicotine dependence, withdrawal, and agency. *Subst Abus*. 2009; 30: 318-327.

11. Adams CE, Cano MA, Heppner WL, et al. Testing a moderated mediation model of mindfulness, psychosocial stress, and alcohol use among African American smokers. *Mindfulness*. 2015; 6: 315-325.

12. Waters AJ, Reitzel LR, Cinciripini P, et al. Associations between mindfulness and implicit cognition and self-reported affect. *Subst Abus*. 2009; 30: 328-337.

13. Spears CA, Houchins SC, Stewart DW, et al. Nonjudging facet of mindfulness predicts enhanced smoking cessation in Hispanics. *Psychol Addict Behav*. 2015.

14. Davis JM, Mills DM, Stankevitz KA, et al. Pilot randomized trial on mindfulness training for smokers in young adult binge drinkers. *BMC Complem Altern M*. 2013; 13.

15. Cinciripini PM, Wetter DW, Fouladi RT, et al. The effects of depressed mood on smoking cessation: mediation by postcessation self-efficacy. *J Consult Clin Psychol*. 2003; 71: 292-301.

16. Shiffman S, Paty JA, Gnys M, Kassel JA, Hickcox M. First lapses to smoking: within-subjects analysis of real-time reports. *J Consult Clin Psychol*. 1996; 64: 366-379.

17. Adams CE, Benitez L, Kinsaul J, et al. Effects of brief mindfulness instructions on reactions to body image stimuli among female smokers: an experimental study. *Nicotine Tob Res*. 2013; 15: 376-384.

18. Bowen S, Marlatt A. Surfing the urge: brief mindfulness-based intervention for college student smokers. *Psychol Addict Behav*. 2009; 23: 666-671.

19. Marlatt GA, Gordon JR. *Relapse prevention: maintenance strategies in addictive behavior change*. New York: Guilford; 1985.

20. Levine MD, Marcus MD, Kalarchian MA, Houck PR, Cheng Y. Weight concerns, mood, and postpartum smoking relapse. *Am J Prev Med*. 2010; 39: 345-351.

21. Catalino LI, Fredrickson BL. A Tuesday in the life of a flourisher: the role of positive emotional reactivity in optimal mental health. *Emotion*. 2011; 11: 938-950.

22. Kenford SL, Smith SS, Wetter DW, et al. Predicting relapse back to smoking: contrasting affective and physical models of dependence. *J Consult Clin Psychol*. 2002; 70: 216-227.

23. Brewer JA, Elwafi HM, Davis JH. Craving to quit: Psychological models and neurobiological mechanisms of mindfulness training as treatment for addictions. *Psychol Addict Behav*. 2012; 27: 366-379.

24. Tiffany ST. A cognitive model of drug urges and drug-use behavior: role of automatic and nonautomatic processes. *Psychol Rev*. 1990; 97: 147-168.

25. Piasecki TM, Fiore MC, Baker TB. Profiles in discouragement: two studies of variability in the time course of smoking withdrawal symptoms. *J Abnorm Psychol*. 1998; 107: 238-251.

26. Welsch SK, Smith SS, Wetter DW, et al. Development and validation of the Wisconsin smoking withdrawal scale. *Exp Clin Psychopharmacol*. 1999; 7: 354-361.

27. Bowen S, Chawla N, Collins SE, et al. Mindfulness-based relapse prevention for substance use disorders: a pilot efficacy trial. *Subst Abus*. 2009; 30: 295-305.

28. Bandura A. Toward a psychology of human agency. *Perspect Psychol Sci*. 2006; 1: 164-180.

29. Businelle MS, Kendzor DE, Reitzel LR, et al. Mechanisms linking socioeconomic status to smoking cessation: a structural equation modeling approach. *Health Psychol*. 2010; 29: 262.

30. Ockene JK, Emmons KM, Mermelstein RJ, et al. Relapse and maintenance issues for smoking cessation. *Health Psychol*. 2000; 19: 17-31.

31. Brown KW, Ryan RM, Creswell JD. Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychol Inq*. 2007; 18: 211-237.

32. Witkiewitz K, Marlatt GA. Relapse prevention for alcohol and drug problems: that was Zen, this is Tao. *Am Psychol*. 2004; 59: 224-235.

33. McCarthy DE, Piasecki TM, Jorenby DE, et al. A multi-level analysis of non-significant counseling effects in a randomized smoking cessation trial. *Addiction*. 2010; 105: 2195-2208.

34. Heppner WL, Kernis MH, Lakey CE, et al. Mindfulness as a means of reducing aggressive behavior: dispositional and situational evidence. *Aggress Behav*. 2008; 34: 486-496.

35. Barnes S, Brown KW, Krusemark E, Campbell WK, Rogge RD. The role of mindfulness in romantic relationship satisfaction and responses to relationship stress. *J Marital Fam Ther*. 2007; 33: 482-500.

36. Shapiro SL, Schwartz GE, Bonner G. Effects of mindfulness-based stress reduction on medical and premedical students. *J Behav Med*. 1998; 21: 581-599.

37. Fagan P, Moolchan ET, Lawrence D, Fernander A, Ponder PK. Identifying health disparities across the tobacco continuum. *Addiction*. 2007; 102(Suppl 2): 5-29.

38. Shavers VL, Fagan P, McDonald P. Health disparities across the cancer continuum. *J Health Care Poor Underserved*. 2007; 18: 1-5.

39. CDC: Quitting smoking among adults–United States, 2001–2010. *Morbidity and Mortality Weekly Reports*. 2011; 60:1513–1519.

40. Castro Y, Costello TJ, Correa-Fernandez V, et al. Differential effects of depression on smoking cessation in a diverse sample of smokers in treatment. *Am J Prev Med*. 2011; 41: 84-87.

41. Manning BK, Catley D, Harris KJ, Mayo MS, Ahluwalia JS. Stress and quitting among African American smokers. *J Behav Med*. 2005; 28: 325-333.

42. Kendzor DE, Businelle MS, Reitzel LR, et al. Everyday discrimination is associated with nicotine dependence among African American, Latino, and White smokers. *Nicotine Tob Res*. 2014; 16: 633-640.

43. Kendzor DE, Businelle MS, Costello TJ, et al. Financial strain and smoking cessation among racially/ethnically diverse smokers. *Am J Public Health*. 2010; 100: 702-706.

44. Fuchs C, Lee JK, Roemer L, Orsillo SM. Using mindfulness- and acceptance-based treatments with clients from nondominant cultural and/or marginalized backgrounds: clinical considerations, meta-analysis findings, and introduction to the special series. *Cogn Behav Pract*. 2013; 20: 1-12.

45. Cano MA, Mazas CA, Chen M, et al. Randomized clinical trial of a mobile device-delivered intervention for smoking cessation among African American smokers of low socioeconomic status. In preparation.

46. Kendzor DE, Costello TJ, Li Y, et al. Race/ethnicity and multiple cancer risk factors among individuals seeking smoking cessation treatment. *Cancer Epidemiol Biomark*. 2008; 17: 2937-2945.

47. Hajek P, West R, Lee A, et al. Randomized controlled trial of a midwife-delivered brief smoking cessation intervention in pregnancy. *Addiction*. 2001; 96: 485-494.

48. McBride CM, Curry SJ, Lando HA, et al. Prevention of relapse in women who quit smoking during pregnancy. *Am J Public Health*. 1999; 89: 706-711.

49. Baer RA, Smith GT, Allen KB. Assessment of mindfulness by self-report: The Kentucky inventory of mindfulness skills. *Assessment*. 2004; 11: 191-206.

50. Lu H, Song Y, Xu M, et al. The brain structure correlates of individual differences in trait mindfulness: a voxel-based morphometry study. *Neuroscience*. 2014; 272: 21-28.

51. Omidi A, Zargar F. Effect of mindfulness-based stress reduction on pain severity and mindful awareness in patients with tension headache: a randomized controlled clinical trial. *Nurs Midwifery Stud*. 2014; 3: e21136.

52. Phang CK, Mukhtar F, Ibrahim N, Keng SL, Mohd Sidik S. Effects of a brief mindfulness-based intervention program for stress management among medical students: The mindful-gym randomized controlled study. *Adv Health Sci Educ Theory Pract*. 2015.

53. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *J Pers Soc Psychol*. 1988; 54: 1063-1070.

54. Radloff LS. the Ces-D scale. *Appl Psychol Meas*. 1977; 1: 385-401.

55. Piper ME, Piasecki TM, Federman EB, et al. A multiple motives approach to tobacco dependence: The Wisconsin Inventory of Smoking Dependence Motives (WISDM-68). *J Consult Clin Psychol*. 2004; 72: 139-154.

56. Velicer WF, Diclemente CC, Rossi JS, Prochaska JO. Relapse situations and self-efficacy: an integrative model. *Addict Behav*. 1990; 15: 271-283.

57. Wetter DW, Brandon TH, Baker TB. The relation of affective processing measures and smoking motivation indices among college-age smokers. *Adv Behav Res Ther*. 1992; 14: 169-193.

58. Cohen S, Mermelstein R, Kamarck T, Hoberman H. Measuring the functional components of social support. *Social support: Theory, research and applications*. 1985:73–94.

59. Heatherton TF, Kozlowski LT, Frecker RC, Rickert W, Robinson J. Measuring the heaviness of smoking: using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. *Br J Addict*. 1989; 84: 791-800.

60. MacKinnon DP *Introduction to statistical mediation analysis*. Erlbaum Psych Press; 2008.

61. Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behav Res Methods*. 2008; 40: 879-891.

62. Businelle MS, Kendzor DE, Costello TJ, et al. Light versus heavy smoking among African American men and women. *Addict Behav*. 2009; 34: 197-203.

63. Kendzor DE, Businelle MS, Mazas CA, et al. Pathways between socioeconomic status and modifiable risk factors among African American smokers. *J Behav Med*. 2009; 32: 545-557.

64. Kendzor DE, Cofta-Woerpel LM, Mazas CA, et al. Socioeconomic status, negative affect, and modifiable cancer risk factors in African-American smokers. *Cancer Epidemiol Biomark*. 2008; 17: 2546-2554.

65. Zhao X, Lynch JG, Chen Q. Reconsidering Baron and Kenny: myths and truths about mediation analysis. *J Consum Res*. 2010; 37: 197-206.

66. MacKinnon DP, Fairchild AJ, Fritz MS. Mediation analysis. *Annu Rev Psychol*. 2007; 58: 593.

67. Alwin DF, Hauser RM. The decomposition of effects in path analysis. *Am Sociol Rev*. 1975; 40: 37-47.

68. MacKinnon DP, Warsi G, Dwyer JH. A simulation study of mediated effect sizes. *Multivar Behav Res*. 1995; 30: 41-62.

69. Baker TB, Brandon TH, Chassin L. Motivational influences on cigarette smoking. *Annu Rev Psychol*. 2004; 55: 463-491.

70. Hölzel BK, Lazar SW, Gard T, et al. How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspect Psychol Sci*. 2011; 6: 537-559.

71. Shapiro SL, Carlson LE, Astin JA, Freedman B. Mechanisms of mindfulness. *J Clin Psychol*. 2006; 62: 373-386.

72. Romano PS, Bloom J, Syme SL. Smoking, social support, and hassles in an urban African-American community. *Am J Public Health*. 1991; 81: 1415-1422.

73. Andrews JO, Felton G, Ellen Wewers M, Waller J, Tingen M. The effect of a multi-component smoking cessation intervention in African American women residing in public housing. *Res Nurs Health*. 2007; 30: 45-60.

74. Nollen NL, Catley D, Davies G, Hall M, Ahluwalia JS. Religiosity, social support, and smoking cessation among urban African American smokers. *Addict Behav*. 2005; 30: 1225-1229.

75. Fredrickson BL, Cohn MA, Coffey KA, Pek J, Finkel SM. Open hearts build lives: positive emotions, induced through loving-kindness meditation, build consequential personal resources. *J Pers Soc Psychol*. 2008; 95: 1045-1062.

76. Teasdale JD, Moore RG, Hayhurst H, et al. Metacognitive awareness and prevention of relapse in depression: empirical evidence. *J Consult Clin Psychol*. 2002; 70: 275-287.

77. Landrine H, Klonoff EA. Racial segregation and cigarette smoking among Blacks: findings at the individual level. *J Health Psychol*. 2000; 5: 211-219.

78. Grossman P. Defining mindfulness by how poorly I think I pay attention during everyday awareness and other intractable problems for psychology's (re) invention of mindfulness: comment on Brown et al.(2011). 2011.

79. Giluk TL. Mindfulness, big five personality, and affect: a meta-analysis. *Personal Individ Differ*. 2009; 47: 805-811.

80. Siegling AB, Petrides KV. Measures of trait mindfulness: convergent validity, shared dimensionality, and linkages to the five-factor model. *Front Psychol*. 2014; 5: 1164.

81. Cosci F, Corlando A, Fornai E, et al. Nicotine dependence, psychological distress and personality traits as possible predictors of smoking cessation. Results of a double-blind study with nicotine patch. *Addict Behav*. 2009; 34: 28-35.

82. Shiffman S, Waters AJ. Negative affect and smoking lapses: a prospective analysis. *J Consult Clin Psychol*. 2004; 72: 192-201.

83. Cofta-Woerpel L, McClure JB, Li Y, et al. Early cessation success or failure among women attempting to quit smoking: trajectories and volatility of urge and negative mood during the first postcessation week. *J Abnorm Psychol*. 2011; 120: 596.

84. Piasecki TM, Jorenby DE, Smith SS, Fiore MC, Baker TB. Smoking withdrawal dynamics: I. Abstinence distress in lapsers and abstainers. *J Abnorm Psychol*. 2003; 112: 3.