Original Investigation

Preliminary Evidence That Adherence to Counseling Mediates the Effects of Pretreatment Self-efficacy and Motivation on Outcome of a Cessation Attempt in Smokers with ADHD

Jaimee L. Heffner, Ph.D., Daniel F. Lewis, B.A., & Theresa M. Winhusen, Ph.D.

Department of Psychiatry and Behavioral Neuroscience, University of Cincinnati College of Medicine, Cincinnati, OH

Corresponding Author: Jaimee L. Heffner, Ph.D., Department of Psychiatry and Behavioral Neuroscience, 260 Stetson St., Suite 3200, Cincinnati, OH 45219, USA. Telephone: 513-558-7187; Fax: 513-558-4805; E-mail: Jaimee.Heffner@uc.edu

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Abstract

Background: Few studies have evaluated predictors of smoking cessation outcomes in smokers with attention-deficit/hyperactivity disorder (ADHD), which could help to improve suboptimal treatment outcomes in this population. The purpose of this study was to examine pretreatment thoughts about smoking abstinence (i.e., desire to quit, perceived difficulty quitting, and expected success in quitting) as predictors of smoking cessation outcomes in smokers with ADHD and to determine the extent to which treatment adherence mediates these relationships.

Methods: Participants were adult smokers with ADHD ($n = 255$), who were enrolled in a multisite smoking cessation study and received either osmotic-release oral system methylphenidate (OROS-MPH) or placebo in combination with transdermal nicotine replacement and brief cessation counseling. Bootstrapped logistic regression models were generated to test main effects of thoughts about abstinence on smoking cessation outcomes and to examine treatment adherence as a mediator of these relationships.

Results: Desire to quit and expected success in quitting, but not perceived difficulty quitting, predicted smoking cessation outcomes, as did all of the treatment adherence variables (i.e., percent sessions attended, counselor ratings of counseling adherence, and percent patch adherence). Counseling adherence partially mediated the relationship between smoking cessation outcomes and both pretreatment desire to quit and expected success.

Conclusions: Smokers with ADHD who have higher self-efficacy (i.e., expected success) and motivation (i.e., desire) to quit are more adherent to smoking cessation counseling and have better smoking cessation outcomes. Additional research is

needed to determine whether treatment-seeking smokers with ADHD would benefit from an intervention designed to increase self-efficacy and motivation to quit.

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a strong risk factor for initiation of regular cigarette smoking (Lee, Humphreys, Flory, Liu, & Glass, 2011; Wilens et al., 2011), and smoking prevalence among adults with ADHD is approximately twice as high as in the general population (Lambert & Hartsough, 1998; McClave, McKnight-Eily, Davis, & Dube, 2010). There is also some indication of poorer response to smoking cessation treatment among individuals with ADHD (Covey, Manubay, Jiang, Nortick, & Palumbo, 2008; Humfleet et al., 2005), although the available evidence to address the question of differential treatment efficacy is limited. Despite the high rates of smoking among individuals with ADHD and some indication that quitting may be more difficult, few studies have focused on identifying efficacious smoking cessation interventions to reduce the prevalence of smoking in this group.

Identifying factors associated with treatment success can be translated into improved intervention effectiveness. Motivation to quit and self-efficacy in quitting are two factors that have been examined extensively in relation to smoking cessation outcomes and are specifically targeted by theory-based interventions to treat tobacco dependence, including cognitive-behavioral therapy and motivational interviewing. There is fairly robust evidence that self-efficacy predicts successful smoking cessation, particularly when assessed close in time to the assessment of smoking cessation outcome (Gwaltney, Metrik, Kahler,

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& Shiffman, 2009). Similarly, it has been demonstrated that perceived difficulty in quitting smoking, a construct related to self-efficacy, predicts cessation success (Etter & Perneger, 2001; McCarthy, Piasecki, Jorenby, Lawrence, Shiffman, & Baker, 2010), as well as initiation of a quit attempt (Duffy, Scheumann, Fowler, Darling-Fisher, & Terrell, 2010). The evidence for a relationship between motivation and successful cessation is more mixed and appears to manifest primarily in motivation predicting quit attempts as opposed to sustained abstinence from tobacco (Borland et al., 2010; Smit, Fidler, & West, 2011; Zhou, Nonnemaker, Sherrill, Gilsenan, Coste, & West, 2009), although a number of studies have demonstrated associations between motivation and tobacco abstinence (e.g., Shmueli, Fletcher, Hall, Hall, & Prochaska, 2008).

Despite the theoretical and empirical support for examining treatment outcomes in relation to self-efficacy, perceived difficulty in quitting, and/or motivation to quit smoking, the prognostic value of these cognitive factors has not been assessed in treatment-seeking smokers with ADHD. In addition, generally speaking, there has been limited attention focused on the mechanisms through which these variables may affect treatment outcome. One potential mechanism is treatment adherence, including adherence to smoking cessation pharmacotherapy, as well as adherence to behavioral treatment. Several studies have demonstrated that cognitive factors such as motivation and self-efficacy predict adherence to pharmacotherapies for smoking cessation and/or to behavioral interventions for addictions (Alterman, Gariti, Cook, & Cnaan, 1999; Joe, Simpson, & Broome, 1999; Simpson & Joe, 2004). In addition, greater adherence to transdermal nicotine replacement has been linked to better treatment outcomes in smoking cessation studies (Cooper et al., 2004; Shiffman, Sweeney, Ferguson, Sembower, & Gitchell, 2008), and there is strong evidence for a relationship between adherence to behavioral treatments and substance-abuse outcomes in general (Simpson & Joe, 2004). To our knowledge, however, the extent to which adherence to pharmacotherapy and counseling mediate the relationship between self-efficacy in quitting, perceived difficulty in quitting, or motivation to quit and successful smoking cessation has not yet been examined.

In order to determine whether these pretreatment cognitions predict smoking cessation outcomes in smokers with ADHD and the extent to which these relationships are mediated by treatment adherence, we conducted a secondary analysis using data from a large trial of combined pharmacotherapy and counseling for smoking cessation in smokers with ADHD, conducted through the National Institute on Drug Abuse's Clinical Trials Network. The main findings of this study were that osmotic-release oral system methylphenidate (OROS-MPH), when provided in combination with nicotine patch and brief counseling, did improve ADHD symptoms but did not enhance smoking cessation outcomes relative to placebo (plus nicotine patch and counseling; Winhusen et al., 2010). For these secondary analyses, we hypothesized that pretreatment desire to quit (i.e., motivation), expected success in quitting (i.e., self-efficacy), and perceived difficulty quitting would predict smoking cessation treatment outcomes and that treatment adherence (i.e., adherence to nicotine patch, session attendance, and adherence to counseling) would mediate this effect.

Methods

Participants

Participants in this study were 255 adults with a DSM-IV diagnosis of ADHD, who were enrolled in a study comparing the effects of transdermal nicotine replacement and brief cessation counseling in combination with OROS-MPH or placebo. In order to be included in the study, participants had to be between 18 and 55 years; in good physical health, with no personal history of narrow angle glaucoma, tics, or a seizure disorder, or a family history of Tourette syndrome; smoke at least 10 cigarettes per day, with an expired carbon monoxide (CO) level ≥ 8 ; have smoked for at least 3 months; and exceed the specified threshold of ADHD symptom severity, as defined by a DSM-IV ADHD Rating Scale (DuPaul, Power, Anastopoulos, & Reid, 1998) score > 22 . Major exclusion criteria were current non-nicotine substance abuse or dependence, current mood or anxiety disorders (except specific phobia), lifetime antisocial personality disorder or psychosis, positive screen for illicit drug use, having received pharmacotherapy or behavioral treatment for smoking cessation in the prior 30 days, and having received pharmacotherapy for ADHD in the prior 30 days. Pregnant or breastfeeding women were also excluded. See Table 1 for a description of the sample. All participants provided informed consent, and the study was reviewed and approved by the Institutional Review Boards of the six sites that participated in the trial.

Assessments

The Composite International Diagnostic Interview (Robins et al., 1988) was used to determine whether psychiatric inclusion/exclusion criteria were met. ADHD diagnosis was made using the Adult ADHD Clinical Diagnostic Scale (Adler & Spencer, 2004), and severity of ADHD was assessed using the DSM-IV ADHD Rating Scale (DuPaul et al., 1998). The three-item Thoughts About Abstinence scale (Hall, Havassy, & Wasserman, 1991) was administered at baseline to assess desire to quit (i.e., motivation), expected success in quitting (i.e., self-efficacy), and perceived difficulty quitting on a 10-point rating scale. Predictive validity of single-item ratings of these constructs has been established in previous studies (Gwaltney et al., 2009; Hendricks, Delucchi, & Hall, 2010; Shmueli et al., 2008). Self-reported nicotine patch adherence, calculated by dividing the number of patches reported used by the number dispensed, was utilized as the nicotine patch adherence measure because the data were more complete for this measure than for nicotine patch count. The agreement between self-reported adherence and nicotine patch count was very good. Of 964 comparisons of self-report to nicotine patch count, the self-report and the patch count were consistent for 900 comparisons (e.g., the two measures agreed in 93.4% of the cases). Adherence to counseling was measured in two ways: (a) session attendance, defined as the percent of scheduled sessions which the participant attended, and (b) average counseling compliance, which was rated by counselors at each visit on a 1 (*not at all*) to 5 (*extremely*) scale based on homework completion and session participation.

Procedures

For a complete description of procedures for the trial, see Winhusen et al. (2010). Briefly, the study was an 11-week,

Table 1. Sample Demographic and Clinical Characteristics (N = 255)^a

Age	37.8 (10.0)
Sex (male)	56.5%
Hispanic	7.1%
Race	
African American	5.9%
White	82.6%
Asian	1.6%
Native American/Alaskan	0.4%
Mixed	5.5%
Other	4.0%
Marital status	
Married	34.2%
Divorced/separated/widowed	21.3%
Never married	44.5%
Years of education	14.4 (2.4)
Employed full-/part-time %	91.0%
Lifetime psychiatric comorbidity %	
Lifetime major depression	34.1%
Lifetime anxiety disorder	33.7%
Lifetime SUD	60.8%
ADHD Rating Scale score	36.4 (7.3)
ADHD subtype	
Hyperactive-impulsive	3.9%
Inattentive	34.3%
Combined	61.8%
FTND	5.5 (2.2)
Years of smoking	19.7 (9.6)
Cigarettes per day, baseline	19.9 (7.7)
Number of past quit attempts	6.9 (10.0)

Note. SUD = substance use disorder; ADHD = attention-deficit/hyperactivity disorder; FTND = Fagerström Test for Nicotine Dependence.

^aWhere not specifically indicated, numbers represent means (SD).

double-blind, placebo-controlled, parallel-group trial of OROS-MPH versus placebo in combination with nicotine patch and counseling as a treatment for smoking cessation in adults with ADHD. OROS-MPH was titrated to a maximum of 72 mg/day over the first 2 weeks of the study and continued at the maximum tolerated dose until the end of the active treatment period (Week 11). All participants received brief weekly individual smoking cessation counseling for 11 weeks and 21 mg/day nicotine patch starting on the smoking quit day (Day 27) through study week 11. Participants were compensated for their time at a rate of \$25 per study visit (with the exception of a \$50 payment at the Week 11 study visit due to the higher assessment burden).

All participants received brief, manual-guided counseling (10 min/week) based on the Mayo Clinic's Smoke Free and Living It manual, which incorporates evidence-based elements of effective tobacco cessation counseling (i.e., problem solving, skills training, social support), consistent with U.S. Public Health Service guidelines (Fiore et al., 2008). Trained study interventionists delivered the treatment under the supervision of a site trainer, with ongoing monitoring of treatment fidelity through videotape review by site supervisors and Mayo Clinic Nicotine Research Program staff.

The primary efficacy endpoint for the study was prolonged abstinence, which was defined as not meeting the criteria for treatment failure during study weeks 7–10. Based on the guidelines proposed by the Society for Research on Nicotine and Tobacco Workgroup (Hughes, Keely, Niaura, Ossip-Klein, Richmond, & Swan, 2003), treatment failure was operationally defined as smoking on seven consecutive days or smoking at least once per week for two consecutive weeks. Secondary efficacy endpoints were complete abstinence (i.e., CO-confirmed self-report of no smoking during study weeks 7–10) and Week 10 point prevalence abstinence (PPA) (i.e., CO-confirmed self-report of no smoking during the last full week of the treatment phase).

Statistical Analysis

Relationships between thoughts about abstinence (i.e., predictor variables: desire to quit, perceived difficulty, and expected success in quitting), treatment adherence (i.e., mediating variables: average counselor rating, percent session attendance, and percent patch compliance), and smoking abstinence (i.e., outcome variables: prolonged abstinence, complete abstinence, and Week 10 PPA) were tested for consistency with the simple mediation model introduced by Baron and Kenny (1986) and expounded on in more contemporary approaches (MacKinnon & Dwyer, 1993), after which we modeled our analyses. Each assessment involved a single outcome variable (Y); a single predictor variable (X), and a single compliance variable as a potential mediator (M). Making the appropriate adjustment for dichotomous outcomes (Herr, 2011), each assessment involved three regressions: (1) testing X as a predictor of Y , which gives an estimate of the overall strength of the relationship between X and Y (c); (2) testing X as a predictor of M , which gives an estimate of strength of the overall relationship between X and M (a); and (3) jointly testing X and M as predictors of Y , which gives an estimate of both the direct effect of X on Y (c') and the effect of M on Y when X is accounted for (b). The indirect effect of X on Y through M (also known as the mediation effect) was estimated by the product, ab . Ideally, the mediation effect (ab) plus the direct effect of X on Y independent of M (c') should roughly equal the total effect of X on Y (c). Therefore, $c - c'$ was used as a confirmatory estimate of the mediation effect (Kenny, 2011). The statistical significance of each estimate (a , b , c , c' , ab , and $c - c'$) was tested using a 95% confidence interval estimated using a bootstrap procedure with 5000 iterations. Prolonged abstinence was used as the primary outcome (Y) in these analyses, with complete abstinence and Week 10 PPA serving as confirmatory outcome measures. All analyses pooled data across the two treatment groups from the original study (OROS-MPH and placebo), as we previously established that there was no effect of OROS-MPH on smoking cessation outcomes in the study sample (Winhusen et al., 2010).

Results

Effects of Predictors (X) on Outcomes (Y)

Table 2 shows the results of bootstrapped regressions examining the three predictor variables—desire to quit, perceived difficulty quitting, and expected success in quitting—in relation to the primary outcome of prolonged abstinence and the secondary outcomes of complete abstinence and Week 10 PPA. Although the estimates of the total effects of X on Y (c) varied slightly

Table 2. Summary of Analyses Testing Treatment Adherence as a Mediator of the Association Between Thoughts About Abstinence and Smoking Outcomes^a

	Average counselor rating of adherence (<i>M</i>)			Percent session attendance (<i>M</i>)			Percent patch adherence (<i>M</i>)		
	Prolonged abstinence (<i>Y</i>) with 95% <i>CI</i>	Complete abstinence (<i>Y</i>)	PPA Week 10 (<i>Y</i>)	Prolonged abstinence (<i>Y</i>) with 95% <i>CI</i>	Complete abstinence (<i>Y</i>)	PPA Week 10 (<i>Y</i>)	Prolonged abstinence (<i>Y</i>) with 95% <i>CI</i>	Complete abstinence (<i>Y</i>)	PPA Week 10 (<i>Y</i>)
Desire to quit (<i>X</i>)									
c	0.217 (0.078, 0.359)*	0.210*	0.138*	0.217 (0.079, 0.371)*	0.210*	0.138	0.231 (0.087, 0.377)*	0.215*	0.147*
a	0.183 (0.056, 0.301)*	0.183*	0.183*	0.663 (-0.345, 0.902)	0.663	0.663	-0.424 (-0.920, 0.842)	-0.424	-0.424
b	0.650 (0.361, 0.869)*	0.180*	0.420*	0.266 (0.130, 0.419)*	0.369*	0.181*	0.342 (0.193, 0.518)*	0.324*	0.309*
c'	0.133 (0.026, 0.259)*	0.176*	0.083	0.196 (0.063, 0.345)*	0.179*	0.122	0.240 (0.101, 0.378)*	0.217*	0.154*
ab	0.119 (0.040, 0.233)*	0.033*	0.077*	0.176 (-0.024, 0.349)	0.244	0.120	-0.145 (-0.390, 0.304)	-0.137	-0.131
c - c'	0.084 (0.025, 0.173)*	0.034*	0.055*	0.021 (-0.007, 0.061)	0.031	0.016	-0.008 (-0.047, 0.031)	-0.002	-0.007
Perceived Difficulty	-0.008 (-0.152, 0.128)	-0.010	0.010	-0.008 (-0.147, 0.136)	-0.010	0.010	-0.021 (-0.167, 0.122)	-0.019	-0.001
a	-0.003 (-0.150, 0.130)	-0.003	-0.003	-0.484 (-0.838, 0.451)	-0.484	-0.484	-0.393 (-0.916, 0.867)	-0.393	-0.393
b	0.661 (0.377, 0.874)*	0.205*	0.432*	0.282 (0.144, 0.430)*	0.386*	0.195*	0.331 (0.179, 0.509)*	0.319*	0.304*
c'	-0.007 (-0.137, 0.103)	-0.010	0.007	0.013 (-0.125, 0.157)	0.016	0.024	-0.013 (-0.157, 0.127)	-0.013	0.006
ab	-0.002 (-0.119, 0.076)	-0.001	-0.001	-0.137 (-0.313, 0.099)	-0.187	-0.095	-0.130 (-0.387, 0.316)	-0.125	-0.120
c - c'	-0.001 (-0.070, 0.055)	-0.000	0.003	-0.021 (-0.059, 0.009)	-0.026	-0.014	-0.008 (-0.047, 0.030)	-0.007	-0.007
Expected Success in quitting (<i>X</i>)	0.199 (0.065, 0.347)*	0.204*	0.179*	0.199 (0.063, 0.337)*	0.204*	0.179*	0.227 (0.087, 0.370)*	0.221*	0.203*
a	0.150 (0.045, 0.249)*	0.150*	0.150*	0.719 (-0.183, 0.905)	0.719	0.719	-0.467 (-0.933, 0.873)	-0.467	-0.467
b	0.639 (0.366, 0.868)*	0.182*	0.407*	0.257 (0.116, 0.393)*	0.359*	0.172*	0.343 (0.195, 0.513)*	0.324*	0.313*
c'	0.113 (0.003, 0.237)*	0.180*	0.128*	0.173 (0.037, 0.313)*	0.167*	0.162*	0.243 (0.109, 0.385)*	0.229*	0.217*
ab	0.096 (0.040, 0.181)*	0.027*	0.061*	0.185 (0.020, 0.338)*	0.258*	0.124*	-0.160 (-0.402, 0.327)	-0.151	-0.146
c - c'	0.087 (0.035, 0.181)*	0.025*	0.051*	0.026 (-0.003, 0.069)	0.037*	0.018	-0.016 (-0.056, 0.023)	-0.009	-0.014

Note. PPA = Point Prevalence Abstinence; *M* = mediator, *X* = predictor, *Y* = outcome; *c* = total effect of *X* on *Y*; *a* = effect of *X* on *M*; *b* = effect of *M* on *Y*; *c'* = indirect effect of *X* on *Y* through mediator *M* (main effect of interest, shown in bold); *CI* = confidence interval.

^aValues shown in table are regression coefficient estimates, with 95% bootstrap confidence intervals shown only for the primary outcome of prolonged abstinence.

*95% bootstrap confidence intervals indicate alpha = 0.05 statistical significance.

across mediation models due to different sample sizes for each analysis, the conclusions were nonetheless consistent across models. That is, greater desire to quit and expected success in quitting predicted prolonged abstinence, whereas perceived difficulty quitting did not. The use of alternative outcome measures of smoking abstinence (i.e., complete abstinence and 10-week PPA) almost invariably yielded the same conclusions.

Effects of Predictors (X) on Mediators (M)

The effects of the three predictors on the three hypothesized mediators (i.e., average counselor rating of adherence, percent patch adherence, and percent session attendance) are also shown in Table 2 as the (a) effect. As shown in the Table 2, greater desire to quit and expected success in quitting predicted higher average counselor ratings of treatment adherence, whereas perceived difficulty in quitting did not. None of the predictors were associated with percent patch compliance or percent session attendance. These results were consistent across all of the models.

Effects of Mediators (M) on Outcomes (Y), Factoring Out the Effects of the Predictors (X)

All three of the potential mediators—average counselor rating of adherence, percent patch adherence, and percent sessions attended—predicted prolonged abstinence in analyses that sequentially factored out the effects of desire to quit, perceived difficulty in quitting, and expected likelihood of quitting, shown as the (b) effect in Table 2. The finding that better treatment adherence predicted better treatment outcomes was consistent across both the primary and the secondary measures of smoking cessation.

Tests of Mediation

Primary tests of mediation (i.e., tests of the ab effect) suggested that the effects of both desire to quit and expected success in quitting were partially mediated by counselor-rated adherence to counseling. As shown in Table 2, this finding was robust across

both the primary and the secondary measures of treatment outcome and was confirmed by the secondary test of mediation, the effect estimate for $c - c'$. There was no evidence that nicotine patch adherence mediated the relationship between pretreatment thoughts about abstinence and smoking cessation outcomes. Although the estimate of the primary mediation effect (test of the ab effect) suggested that session attendance mediated the relationship between expected success in quitting and prolonged abstinence, this effect was not confirmed in the alternative test of mediation, the effect estimate for $c - c'$. Thus, the results of our mediation analyses provide strongest support for adherence to counseling, as rated by counselors, as a mediator of the effects of pretreatment desire to quit and expected success in quitting on smoking cessation outcome (see Figure 1 for a depiction of the primary findings).

Discussion

Our findings indicated that pretreatment motivation (i.e., desire to quit) and self-efficacy (i.e., expected success in quitting) were independently associated with smoking cessation outcomes in adults with ADHD, as were all three of the indicators of adherence to smoking cessation treatment that we examined: session attendance, adherence to counseling, and nicotine patch adherence. These findings are in agreement with previous studies documenting, with varying degrees of consistency, that increased self-efficacy (Gwaltney et al., 2010) and motivation (Schmueli et al., 2008) and better treatment adherence (Cooper et al., 2008; Shiffman et al., 2008) predict better smoking cessation outcomes. The novel aspect of our findings is that, to our knowledge, this is the first study to demonstrate these relationships in treatment-seeking smokers with ADHD, who are typically excluded from smoking cessation studies and who have generally been under-represented in tobacco treatment research despite the high prevalence of smoking among individuals with the disorder (Lambert & Hartsough, 1998; McClave et al., 2010).

In contrast to the findings of previously published studies in smokers without ADHD (Etter & Perneger, 2001; McCarthy

Figure 1. Summary of findings from the mediation analyses, demonstrating that counselor-rated adherence mediates the relationship between pre-treatment thoughts about abstinence (i.e., desire to quit and expected success in quitting) and outcome of a smoking cessation attempt in adults with ADHD. *95% bootstrap confidence intervals.

et al., 2010), we did not observe a relationship between perceived difficulty quitting and successful smoking cessation. Inconsistent findings regarding this relationship may be attributable to a number of factors. For example, findings from prior studies that did not include smokers with ADHD may not generalize to this special population of smokers, and there may also be conflicting reasons for endorsing the belief that quitting smoking will be difficult. That is, quitting could be perceived as difficult due to low self-efficacy for quitting, yet an individual with high self-efficacy for quitting could also endorse perceived difficulty on the basis of past successes at quitting and the resultant, realistic expectation that it will not be an easy task (Owen & Brown, 1991). These two hypothetical scenarios are likely to produce different outcomes, possibly washing out any potential relationship between perceived difficulty quitting and successful smoking cessation. Yet another possibility for the disconnect between perceived difficulty quitting and successful smoking cessation is the positive illusory bias, reliably documented in children with ADHD, which produces unrealistic optimism regarding confidence to succeed (Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007).

In addition to testing the overall effects of self-efficacy, motivation, and perceived difficulty quitting on smoking cessation, we also examined the extent to which treatment adherence mediated these relationships. Two of the meditation models we tested produced evidence that adherence to counseling mediated the relationship between pretreatment thoughts about abstinence and smoking cessation outcome. Specifically, adherence to counseling, as rated by the participant's counselor based on in-session participation and homework completion, mediated the relationship between both motivation (i.e., desire) to quit and self-efficacy (i.e., expected success) in quitting and smoking cessation. Although this type of mediation model has been tested previously in the substance-abuse treatment literature (Simpson & Joe, 2004), to our knowledge, it has not been tested specifically in the context of smoking cessation treatment and not in this special population of treatment-seeking smokers with ADHD.

The primary limitation of our analyses is that our statistical models of mediation are not sufficient to establish cause and effect, particularly given that desire to quit and expected success in quitting were not experimentally manipulated, and the possibility of reverse directionality (i.e., success at quitting smoking influences adherence to counseling) cannot be ruled out. Expected success in quitting, perceived difficulty quitting, and desire to quit may also be context dependent, as well as time-dependent, and future work in this area may benefit from the use of multidimensional rather than unidimensional measures of these constructs. An additional limitation was the use of a global, single-item rating of participants' adherence to counseling, which encompasses behaviors both within (i.e., session participation) and outside of (i.e., homework completion) the session. At the same time, these ratings demonstrated strong relationships with treatment outcome ($\beta = .64-.66$ in predicting prolonged abstinence, as shown in Table 2), suggesting that the counselors were, in fact, rating behaviors that are relevant to successful smoking cessation. Of course, the validity and the reliability of ratings from this preliminary study could be improved in future studies by using multiple raters and methods to reduce the possibility that this measure

of treatment process was contaminated by awareness of treatment outcomes.

Although our conclusions are tentative given the correlational nature of the data, these preliminary mediation analyses were intended to be hypothesis generating and do demonstrate a pattern of interrelationships among pretreatment thoughts about smoking abstinence, adherence to treatment, and smoking cessation outcomes that lay the groundwork for future studies to explore causal relationships among these variables. Given that individuals with ADHD have higher rates of smoking (Lambert & Hartsough, 1998; McClave et al., 2010) and perhaps a lower rate of quitting (Covey et al., 2008; Humfleet et al., 2005) than individuals without the disorder, improved strategies for smoking cessation are needed. We identified two factors—pretreatment self-efficacy in quitting and motivation—that predicted the outcome of an assisted quit attempt in adult smokers with ADHD. Taken together with previous findings that increases in self-efficacy and motivation during treatment predict better smoking cessation outcomes (Hendricks et al., 2010), our findings raise the question of whether smokers with ADHD may benefit from an intervention that effectively enhances one or both of these factors, and, if so, whether these effects are mediated by improved treatment adherence. Interventions such as contingency management, for example, have been shown to increase motivation and self-efficacy for quitting in non-treatment-seeking adult smokers (Romanowich, Mintz, & Lamb, 2009), and results of a recent pilot study showed that contingency management was associated with initiation of abstinence in smokers with ADHD (Kollins, McClernon, & Van Voorhees 2010). Additional research is needed to determine whether contingency management, or other behavioral interventions, can effectively promote long-term abstinence in smokers with ADHD and through what mechanisms.

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Declaration of Interests

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