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Brief Report

Assessing the Role of Attention-Deficit/Hyperactivity Disorder Symptoms in Smokers With and Without Posttraumatic Stress Disorder

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Abstract

Introduction: Smoking prevalence among individuals with posttraumatic stress disorder (PTSD) is elevated relative to non–PTSD smokers, and there is evidence to suggest that affect regulation may be a motivation for smoking among those with this disorder. Previous studies have also indicated that (a) PTSD is frequently comorbid with attention-deficit/hyperactivity disorder (ADHD), (b) individuals with ADHD smoke at significantly higher rates than the general population, (c) subclinical ADHD symptoms are a risk factor for smoking, and (d) affect regulation is a motivation for smoking in ADHD. The goal of this study was to assess the degree to which ADHD symptoms were uniquely associated with smoking-related affective functioning (SRAF) variables above and beyond the variance already explained by PTSD symptoms.

Methods: Smokers with (n = 55) and without PTSD (n = 68) completed measures assessing PTSD symptoms, ADHD symptoms, and SRAF.

Results: The PTSD group endorsed significantly more severe levels of *DSM-IV* inattentive and hyperactive–impulsive ADHD symptoms. A series of hierarchical regressions among the entire sample indicated that, after accounting for PTSD symptoms, ADHD symptoms were associated with lower positive affect, higher negative affect, higher emotion dysregulation, higher anxiety sensitivity, and higher urges to smoke to increase positive affect.

Conclusions: Taken together, these findings suggest that ADHD symptoms may increase affective dysregulation difficulties already faced by smokers, particularly those with PTSD, which may, in turn, confer increased risk for smoking relapse in those with higher levels of symptomatology of both disorders.

Introduction

Cigarette smoking co-occurs with a broad range psychiatric disorders (Lasser et al., 2000). Individuals with posttraumatic stress disorder (PTSD) or attention-deficit hyperactivity disorder (ADHD) endorse rates of smoking two to three times higher (Beckham et al., 1995; Breslau, Davis, & Schultz, 2003; Lambert & Hartsough, 1998; Lasser et al., 2000; Milberger, Biederman, Faraone, Chen, & Jones, 1997; Molina & Pelham, 2003; Pomerleau, Downey, Stelson, & Pomerleau, 1995) and have more difficultly quitting than nondiagnosed samples (Covey, Manubay, Jiang, Nortick, & Palumbo, 2008; Humfleet et al., 2005; Lasser et al., 2000). Furthermore, subclinical ADHD symptoms are associated with increased risk for smoking (Kollins, McClernon, & Fuemmeler, 2005).

Dysregulated affective functioning has been proposed as a potential mechanism underlying the risk for smoking in both PTSD and ADHD, which are frequently comorbid themselves (Adler, Kunz, Chua, Rotrosen, & Resnick, 2004; Cook, McFall, Calhoun, & Beckham, 2007; Gehricke et al., 2007; Hurtig et al., 2007; Kessler et al., 2006; McClernon & Kollins, 2008; Park et al., 2011; Smalley et al., 2007). However, no studies have assessed the association of ADHD symptoms with smoking that also consider PTSD symptoms or includes individuals with PTSD. It is possible that PTSD and ADHD are associated with nicotine dependence via shared affective mechanisms and that the risk for smoking to regulate affect is associated with higher levels of PTSD and ADHD symptoms. The overall aim of this

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study was to assess the role of ADHD symptoms in a sample of smokers with and without PTSD. We hypothesized that (a) smokers with PTSD would endorse higher levels of ADHD symptoms than those without PTSD and (b) ADHD symptoms would be a significant predictor of smoking-related affective functioning (SRAF) after taking PTSD symptoms into account in a sample of smokers.

Methods

Participants and Procedures

Participants were smokers with (n = 55) and without (n = 68) PTSD (see Table 1 for sample characteristics) willing to make a smoking cessation attempt as part of a larger study. Participants were recruited via clinician referrals from local outpatient clinics and fliers and were eligible if they were 18–65 years of age and currently smoking at least 10 cigarettes/day with expired carbon monoxide (CO) concentrations ≥9 ppm. Participants were excluded for major unstable medical problems, using noncigarette forms of nicotine, non-English speaking, current substance abuse/dependence, schizophrenia, current manic syndrome, lifetime but not current PTSD, and current bupropion and/or benzodiazepine use. Only baseline session data prior to any changes in smoking behavior or intervention were assessed in the current report.

Measures

Psychiatric diagnoses were determined with the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1995) and the Structured Clinical Interview for *DSM-IV* Disorders (SCID; First, Spitzer, Williams, & Gibbon, 2002). The CAPS is a structured clinical interview and "gold standard" for PTSD assessment (Weathers, Keane, & Davidson, 2001). PTSD symptoms were considered present based on the CAPS frequency ≥ 1 intensity ≥ 2 rule (Blake et al., 1995; Weathers et al., 2001). Other Axis I disorders were assessed with the SCID. Smoking intensity was measured by self-reported cigarettes per day, Fagerström

Table 1. Participant Demographic Summary

Variable	PTSD (n = 55)	Non-PTSD (n = 68)	Test statistic
Age, *M* (*SD*)	42.31 (10.12)	42.13 (10.01)	$F(1, 121) = 0.01$, ns
Education, *M* (*SD*)	12.61 (1.82)	12.68 (2.84)	$F(1, 118) = 0.02$, ns
Gender (% female)	53 (29 of 55)	43 (29 of 68)	χ^2 (1) = 1.24, ns
Race			
% Black	53 (29 of 55)	68 (46 of 68)	χ^2 (3) = 4.55, ns
% Caucasian	40 (22 of 55)	31 (21 of 68)	
% Married	15 (8 of 55)	13 (9 of 68)	χ^2 (4) = 0.90, ns
% Veteran	26 (14 of 55)	24 (16 of 68)	χ^2 (1) = 0.06, ns
DTS	66.67 (31.53)	20.19 (26.05)	$F(1, 121) = 80.16$, $p < .001$
CAARS *DSM-IV* inattention symptom severity (raw)	11.47 (5.76)	5.50 (3.79)	$F(1, 121) = 47.72$, $p < .001$
CAARS *DSM-IV* hyperactive–impulsive symptom severity (raw)	11.31 (4.71)	6.82 (3.60)	$F(1, 121) = 35.84$, $p < .001$
CAARS *DSM-IV* inattention symptom count	3.33 (2.86)	0.66 (1.22)	$F(1, 121) = 48.29$, $p < .001$
CAARS *DSM-IV* hyperactive–impulsive symptom count	3.25 (2.25)	1.41 (1.47)	$F(1, 121) = 29.97$, $p < .001$
Cigarettes per day	17.20 (7.87)	15.66 (7.03)	$F(1, 121) = 1.31$, ns
Time to first cigarette, %			χ^2 (3) = 1.55, ns
Within 5 min	4 (2 of 55)	3 (2 of 68)	
6–30 min	7 (4 of 55)	10 (7 of 68)	
31–60 min	35 (19 of 55)	43 (29 of 68)	
After 60 min	55 (30 of 55)	44 (30 of 68)	
FTND	6.10 (1.83)	5.22 (1.95)	$F(1, 121) = 6.56$, $p = .012$
Carbon monoxide level at screen	23.31 (12.12)	24.00 (10.89)	$F(1, 121) = 0.11$, ns
Months since trauma	204.15 (160.73)	192.16 (210.54)	$F(1, 114) = 0.12$, ns
MDD	31% (17 of 55)	4% (3 of 68)	χ^2 (1) = 15.68, $p < .001$
Trauma types			N/A
Combat	8	1	
Childhood physical/sexual abuse	11	8	
Adult physical assault	11	6	
Motor vehicle accident	2	11	
Domestic violence	1	4	
Death of someone	12	17	
Adult violence	4	6	
Natural disaster	0	3	
Childhood violence	1	2	
Other	4	6	

Note. CAARS = Conners Adult ADHD Rating Scale; DTS = Davidson Trauma Scale; FTND = Fagerström Test for Nicotine Dependence; MDD = major depressive disorder; PTSD = posttraumatic stress disorder. *df* vary for education and months since trauma variables due to missing participant responses.

Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991), time to first cigarette after waking, and expired CO.

PTSD Symptoms

The Davidson Trauma Scale (DTS; Davidson et al., 1997; McDonald, Beckham, Morey, & Calhoun, 2009) includes 17 self-reported items corresponding to the *DSM-IV* symptoms of PTSD that are rated by both frequency and severity. Reliability and validity of the DTS have been demonstrated in veterans (Davidson et al., 1997; McDonald et al., 2009) and community samples (Davidson et al., 1997).

ADHD Symptoms

The Conners' Adult ADHD Rating Scale (CAARS; Conners, Erhardt, & Sparrow, 1999) is a 66-item self-report measure of ADHD behaviors in adults. The CAARS yields symptom scales based on *DSM-IV* criteria for ADHD (i.e., inattentive and hyperactive–impulsive symptoms). Inattentive and hyperactivity–impulsivity symptom severity scores were used in the current study. The CAARS has adequate reliability and validity (Erhardt, Epstein, Conners, Parker, & Sitarenios, 1999).

Smoking-Related Affective Functioning

Four questionnaires were administered to collect information on SRAF. The 20-item Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Carey, 1988; Watson, Clark, & Tellegen, 1988) was completed. Both positive and negative affect scales are largely uncorrelated with one another, are fairly reliable over a 2-month period, and have demonstrated validity (Watson, Clark, et al., 1988).

Emotion dysregulation was assessed by items from the CAARS Impulsivity/Emotional Lability scale (Conners et al., 1999). Items from this subscale do not overlap with inattentive or hyperactive–impulsive *DSM-IV* ADHD symptoms. Previous studies have administered the child version of this subscale to assess emotion dysregulation (Anastopoulos et al., in press) and demonstrated that this scale partially mediates the association between ADHD and various outcomes (e.g., functional impairment and treatment service utilization). We calculated a total score from the six emotion regulation items (e.g., "I am easily frustrated" and "Many things set me off easily") on this subscale by summing them as in previous studies (Mitchell, Robertson, Anastopolous, Nelson-Gray, & Kollins, 2011). This subscale assesses temper, irritability, stress intolerance, and labile mood. Internal consistency for this scale is very good ($\alpha = .94$; Mitchell et al., 2011).

The 36-item Anxiety Sensitivity Index-R (ASI-R; Peterson & Reiss, 1992; Reiss, Peterson, Gursky, & McNally, 1986; Taylor & Cox, 1998) assesses concerns about the emotional and physical consequences of experiencing anxiety symptoms. The ASI-R has excellent psychometric properties in both clinical and nonclinical samples (Maller & Reiss, 1992; Peterson & Reiss, 1992; Taylor & Cox, 1998; Telch, Lucas, & Nelson, 1989).

The 10-item Brief Questionnaire on Smoking Urges (QSU) composed of two smoking expectancy subscales was administered. On Factor 1, a high score indicates urge to smoke in order to obtain positive reinforcement associated with rewarding aspects of smoking. On Factor 2, a high score indicates urge to smoke in order to obtain negative reinforcement associated with relief from negative affect (Tiffany & Drobes, 1991). This scale has demonstrated factor structure and internal consistency (Cox, Tiffany, & Christen, 2001).

Data Analysis

PTSD and nonPTSD smokers were compared on self-reported *DSM-IV* ADHD symptoms following analysis of variance. Eta square (η^2) was calculated and was interpreted in accordance with standard guidelines (i.e., effect sizes $\geq$.0099 are small, $\geq$.0588 are medium, and $\geq$.1379 are large; Cohen, 1988). Then, groups were collapsed together to assess the relationship between PTSD symptoms, ADHD symptoms, and SRAF. A series of separate hierarchical linear regression models were then conducted to assess if ADHD symptoms predicted these affective variables after partialling out variance accounted for by PTSD symptoms.

Results

Groups did not differ in age, education, sex, race, marriage, veteran status, expired CO, or months since experiencing some form of trauma (Table 1). However, the PTSD group endorsed higher scores on the DTS and FTND. PTSD smokers also endorsed significantly higher levels of inattentive and hyperactive–impulsive ADHD symptoms than controls, supporting the first hypothesis. Eta-square values were .28 and .23 for inattentive and hyperactive–impulsive symptoms, respectively, which are considered large effect sizes (Cohen, 1988). Finally, the PTSD group endorsed higher rates of current major depressive disorder (MDD).

Values for skewness and kurtosis indicated that the variables were normally distributed when the groups were collapsed together (Kline, 2005). There were no sex differences for predictor or outcome variables (all *F*s ranging from 0.29 to 2.90, ns). Bivariate correlations were considered among PTSD symptoms, ADHD symptoms, and SRAF variables. ADHD symptoms were significantly correlated with each outcome variable in the predicted direction (all ps $< .05$). PTSD symptoms were also correlated with criterion variables (all ps $< .01$) with the exception of QSU Factor 1 (i.e., smoking to regulate positive affect; $r = .06$, ns).

To address the possibility that the correlation between ADHD and SRAF measures was inflated because of a high PTSD–ADHD symptom correlation ($r = .55$, $p < .01$), a series of separate hierarchical linear regressions were conducted after partialling out variance accounted for by PTSD symptoms. PTSD and ADHD total scores were entered into the model, given the high overlap among subscale scores for each respective psychopathology subscale (all rs $\geq .78$, ps $< .01$). To conduct a more stringent test of our hypotheses about the unique relationship between ADHD symptoms and SRAF, we included MDD diagnosis in the first step of the regressions. Tolerance (ranging from .62 to .83) and variance inflation factor (ranging from 1.21 to 1.60) were considered and minimized concerns about multicollinearity following standard guidelines (Menard, 1995).

Regression analyses indicate that PTSD symptoms were significantly associated with lower positive affect, higher negative affect, higher emotion dysregulation, higher anxiety sensitivity, and approached significance ($p = .05$) for higher urges to smoke

to improve negative affect; MDD was significantly associated with lower positive affect, higher negative affect, and approached significance for higher urges to smoke to improve negative affect (Table 2). After partialling the variance accounted for by PTSD symptoms and MDD diagnosis, ADHD symptoms were significantly associated with lower positive affect, higher negative affect, higher emotion dysregulation, higher anxiety sensitivity, higher urges to smoke to increase positive affect, and approached significance for higher urges to smoke to improve negative affect.

Discussion

This study assessed the unique association between ADHD symptoms and affective functioning in smokers with and without PTSD. Results indicated that smokers with PTSD endorsed higher ADHD symptom severity than non-PTSD smokers. Also, after accounting for PTSD symptoms and MDD diagnosis, ADHD symptoms continued to be associated with lower positive affect, higher negative affect, higher emotion dysregulation, higher anxiety sensitivity, and higher urges to smoke to increase positive affect. ADHD symptom severity scores approached significance in their association with higher urges to smoke to decrease negative affect. Although PTSD symptom severity and MDD diagnosis were also related to many of the criterion variables listed in Table 2, ADHD symptom severity exhibited a unique relationship with urges to smoke to increase positive affect, suggesting that ADHD symptoms may increase risk for smoking to regulate affect in individuals with elevated ADHD symptoms. Since ADHD symptoms were elevated in the PTSD

Table 2. Hierarchical Linear Regression Results Examining the Association Between PTSD Symptoms, Depression, ADHD Symptoms, and Affective Functioning

Outcome variable	Adjusted R^2	Predictor variable	*B*	*SE*	β	*p* Value
Positive affect						
	.18	Step 1				
		PTSD	−.07	.03	−.27	.003
		MDD	−6.48	2.46	−.24	.009
	.22	Step 2				
		ADHD	−.27	.10	−.26	.008
Negative affect						
	.28	Step 1				
		PTSD	.09	.02	.40	<.001
		MDD	5.25	1.99	.23	.009
	.36	Step 2				
		ADHD	.32	.08	.36	<.001
Emotion dysregulation						
	.31	Step 1				
		PTSD	.06	.01	.52	<.001
		MDD	1.06	.91	.10	.25
	.57	Step 2				
		ADHD	.25	.03	.61	<.001
Anxiety Sensitivity						
	.12	Step 1				
		PTSD	.38	.09	.40	<.001
		MDD	−7.13	9.02	−.07	.43
	.25	Step 2				
		ADHD	1.59	.34	.43	<.001
QSU 1						
	<.01	Step 1				
		PTSD	<.01	<.01	.04	.70
		MDD	.12	.30	.04	.69
	.02	Step 2				
		ADHD	.03	.01	.23	.04
QSU 2						
	.08	Step 1				
		PTSD	.01	<.01	.19	.05
		MDD	.60	.35	.17	.09
	.09	Step 2				
		ADHD	.02	.01	.18	.09

Note. ADHD = *DSM-IV-TR* attention-deficit/hyperactivity disorder symptom scores derived from the Conners Adult ADHD Rating Scale; MDD = major depressive disorder diagnostic status derived from the structured clinical interview for *DSM-IV* disorders; PTSD = posttraumatic stress disorder symptom scores derived from the Davidson Trauma Scale; QSU 1 = QSU Factor 1 (smoking to regulate positive affect); QSU 2 = QSU Factor 2 (smoking to regulate negative affect). $N = 123$, except for QSU 1 and 2 where $n = 120$.

group, these findings suggest that this increased risk conferred by ADHD symptoms may be particularly relevant for smokers with PTSD. The unique relationship between ADHD and smoking to regulate positive affect is consistent with findings that transdermal nicotine improved self-ratings of positive affect in adults with ADHD (Levin et al., 1996). Given that ADHD symptoms were elevated in PTSD smokers, these findings suggest that PTSD smokers higher in ADHD symptoms may represent a phenotype exhibiting greater problems with affect and affective regulation. This PTSD/high ADHD symptom subgroup may be more likely to smoke to regulate positive affect than the PTSD/low ADHD symptom group, which is one proposed mechanism motivating smoking in PTSD smokers (Cook et al., 2007).

Our findings also have implications that PTSD and ADHD may be comorbid with nicotine dependence via shared affective mechanisms, which is consistent with the hypothesis that comorbid psychiatric disorders may share common underlying mechanisms (Angold, Costello, & Erkanli, 1999). Given recent research suggesting a common neurological basis for affective dysregulation in PTSD and ADHD via the dopaminergic reward system (Laucht et al., 2007; Lu et al., 2008), our identification of a psychological mechanism of affective dysregulation common to ADHD, PTSD, and nicotine dependence may be particularly useful. One challenge for future research in this domain involves establishing what may be affective dysregulation in ADHD from that seen in PTSD since emotion dysregulation has been increasingly identified as a core feature in ADHD (Barkley, 2010; Martel, 2009) and is already a core feature in PTSD.

The current findings should be considered alongside several limitations. First, statistical power may have been reduced by sample size. Despite this limitation, the majority of the predicted relationships emerged across different measures of affective functioning and effect sizes were large. Second, although current depression was considered in our analysis, a dimensional measure of depressive symptoms was not included. Third, although the goal of the current study was to assess the role of subclinical ADHD symptoms, given that they share a significant relationship with smoking among non-ADHD samples (Kollins et al., 2005), only current self-reported ADHD symptoms were assessed. Future studies should rely on reporting sources other than self-report. Relatedly, though our findings have implications for the role of ADHD as a diagnosis, the sample was not fully assessed for ADHD. Future studies should include individuals diagnosed with ADHD so that the role of ADHD as a diagnosis can be examined. Fourth, our recruitment method did create a somewhat unique sample and limits the generalizability of our findings. Primarily, we excluded those with a lifetime, but not current, history of PTSD. It is unclear how our findings apply to such a sample.

In conclusion, this study demonstrated that ADHD symptoms were associated with SRAF in smokers with and without PTSD after considering the effects of PTSD symptoms and MDD diagnosis. These findings demonstrate the relative contributions differing symptoms of psychopathology may uniquely confer in adult smokers. ADHD symptoms appear to play a role in smoking to regulate affect. Given that the PTSD group was higher in ADHD symptoms, our findings have implications for the role of elevated ADHD symptoms in PTSD smokers. The current study provides a foundation for future studies to assess affective functioning in PTSD smokers and the role of co-occurring ADHD symptoms.

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