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Differences in panic psychopathology between smokers with and without asthma

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ABSTRACT

Cigarette smoking is more common among individuals with asthma compared to those without, resulting in increased risk of morbidity and mortality. However, there has been little exploration of psychological factors that differ between smokers with and without asthma. Thus, the aim of the current study was to examine differences between smokers with and without asthma in terms of anxiety sensitivity, panic symptoms, lifetime history of panic attacks, and lifetime history of panic disorder. Participants were 115 smokers with asthma (55.3% male, $M_{age} = 38.4$ years, $SD = 11.9$) and 120 smokers without asthma (70.6% male, $M_{age} = 37.0$ years, $SD = 12.8$) who were administered a structured diagnostic interview and completed self-report measures. As hypothesized, after controlling for the effects of cigarettes per day, gender, race, and education, smokers with asthma reported higher levels of anxiety sensitivity and panic symptoms and were at an increased risk for having a lifetime history of panic attacks ($OR = 3.01$) and panic disorder ($OR = 2.96$) compared to smokers without asthma. Further, group differences in anxiety sensitivity and panic symptoms remained even after removing participants with a lifetime history of panic attacks or panic disorder. These findings suggest that smokers with asthma are a particularly 'at-risk' population for panic psychopathology and likely in need of specialized smoking-related prevention and intervention efforts.

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Anxiety sensitivity; asthma; panic; smoking

Asthma is a reversible obstructive airway disease that occurs in approximately 1 in 12 adults in the U.S. (Centers for Disease Control and Prevention [CDC], 2012). Despite the well-established negative health effects, cigarette smoking is more common among individuals with asthma compared to those without (Frank, Morris, Hazell, Linehan, & Frank, 2006; Gwynn, 2004; Precht, Keiding, & Madsen, 2003; Zbikowski, Klesges, Robinson, & Alfano, 2002), resulting in poorer asthma control and increased asthma severity (Althuis, Sexton, & Prybylski, 1999; McLeish & Zvolensky, 2010). Indeed, compared to non-smokers with asthma, smokers with asthma are 2.4 times more likely to experience daily asthma attacks and nearly twice as likely to have had an asthma-related hospitalization (Eisner & Iribarren, 2007; Siroux, Pin, Oryszczyn, Le Moual, & Kauffmann, 2000). Due to these

negative health outcomes, it is important to understand how smokers with asthma differ from smokers without asthma in order to develop efficacious smoking cessation interventions for smokers with asthma.

The presence of psychopathology, particularly panic attacks and panic disorder, which has been linked to both smoking and asthma (Breslau & Klein, 1999; Hasler et al., 2005), may be important to examine in this regard. Indeed, daily cigarette smoking is concurrently and prospectively related to an increased risk of panic symptoms, panic attacks, and panic disorder (Breslau & Klein, 1999; Isensee, Wittchen, Stein, Höfler, & Lieb, 2003; Johnson, Cohen, Pine, Kasen, & Brook, 2000). Similarly, rates of panic attacks and panic disorder are as much as four times higher among individuals with asthma compared to the general population (Goodwin, Jacobi, & Thefeld, 2003; Goodwin, Pine, & Hoven, 2003; Weiser, 2007). Moreover, these associations are stronger in smokers compared to nonsmokers (Hasler et al., 2005).

Further, a growing corpus of work indicates that anxiety sensitivity, a panic-related risk factor that reflects the fear of arousal-related sensations, also demonstrates significant associations with both smoking and asthma. In terms of smoking, anxiety sensitivity is significantly associated with smoking to reduce negative affect (Battista et al., 2008; Gonzalez, Zvolensky, Vujanovic, Leyro, & Marshall, 2008; Zvolensky, Bonn-Miller, et al., 2006), a greater number of quit attempts (Zvolensky, Johnson, Leyro, Hogan, & Tursi, 2009), and earlier lapses and relapses to smoking during a quit attempt (Brown, Kahler, Zvolensky, Lejuez, & Ramsey, 2001; Zvolensky, Bernstein, et al., 2007; Zvolensky, Bonn-Miller, et al., 2006; Zvolensky, Stewart, Vujanovic, Gavric, & Steeves, 2009). Similarly, greater anxiety sensitivity is associated with poorer asthma control and quality of life (Avallone, McLeish, Luberto, & Bernstein, 2012; McCauley, Katon, Russo, Richardson, & Lozano, 2007; McLeish, Zvolensky, & Luberto, 2011).

Despite this evidence, there has been little exploration of differences in panic psychopathology between smokers with and without asthma. Identifying such variables is important as it would not only advance the theoretical understanding of smoking-asthma relations, but also provide critically important information about unique factors that may maintain smoking behavior or hinder successful smoking cessation among smokers with asthma. Thus, the purpose of the present study was to examine differences between smokers with and without asthma in terms of anxiety sensitivity, panic symptoms, and lifetime history of panic attacks and panic disorder. It was hypothesized that, after controlling for cigarettes per day and any demographic variables on which the groups differ (i.e. gender, age, race, education), smokers with asthma would report (1) higher levels of anxiety sensitivity; (2) greater panic symptoms; (3) a greater likelihood of a lifetime history of panic attacks; and (4) a greater likelihood of a lifetime history of panic disorder compared to smokers without asthma. Cigarettes per day was chosen as a covariate on an a priori basis due to its association with both asthma and panic (McLeish & Zvolensky, 2010; Zvolensky, Feldner, Leen-Feldner, & McLeish, 2005).

Method

Participants and procedure

Participants were 235 daily cigarette smokers between the ages of 18 and 65 recruited from the local Cincinnati, OH community: 115 smokers with asthma and 120 smokers without

asthma. Participants were recruited via community-based advertisements for a research study focused on smoking and emotions (for the smokers without asthma group) or smoking, emotions, and asthma (for the smokers with asthma group). Interested individuals were scheduled for an appointment by a trained research assistant. After providing informed, written consent, participants' smoking status was biochemically verified via CO analysis. Participants were then administered the Structured Clinical Interview for DSM-IV Axis I Disorders- Non-patient Edition (SCID-NP) and completed a self-report battery to assess smoking and affect-related variables. Participants were compensated \$30 for their time and effort. The Institutional Review Board approved all study procedures and materials prior to data collection.

For inclusion in the study, participants had to: (1) report a daily smoking rate of at least 10 cigarettes per day; (2) be regular, daily smoking for at least one year; and (3) be between the ages of 18 and 65. Participants were excluded from the study based on: (1) limited mental capacity and the inability to give informed, written consent; and (2) expired carbon monoxide levels ≤ 10 ppm (ppm; see Measures section for details). Individuals in the smokers without asthma group must not have endorsed a current or past diagnosis of asthma. Participants in the smokers with asthma group were required to have: (1) received a physician diagnosis of asthma; (2) a current prescription for asthma medication; and (3) experienced asthma symptoms within the past year. 10 people were excluded based on having an expired carbon monoxide level below 10 ppm.

Please see Table 1 for demographic information for both groups. There were significant group differences in terms of the following demographic variables: gender [$\chi^2(1) = 5.87$, $p < .05$], race [$\chi^2(1) = 19.20$, $p < .01$], and education [$\chi^2(1) = 5.71$, $p < .05$]. Specifically, the smokers without asthma group had more males ($n = 84$ vs. 63, respectively), fewer African Americans ($n = 33$ vs. 64, respectively), and were more highly educated (i.e. had some college education vs. no college education) than the smokers with asthma group ($n = 63$ vs.

Table 1. Demographic characteristics of the sample by asthma status.

	Smokers without asthma ($n = 120$)	Smokers with asthma ($n = 115$)	Test statistic
Gender (male)	84 (70.6%)	63 (55.3%)	$\chi^2(1) = 5.87^*$
Age (years)	37.0 (12.8)	38.4 (11.9)	$t(233) = -.91$
Race			$\chi^2(1) = 19.20^{**}$
Caucasian	87 (72.5%)	51 (44.3%)	
African American	33 (27.5%)	64 (55.7%)	
Education			$\chi^2(1) = 5.71^*$
No college	56 (47.1%)	72 (62.6%)	
Any college	63 (52.9%)	43 (37.4%)	
Cigarettes per day	18.7 (8.4)	20.9 (12.9)	$t(166.4) = -1.46$
Expired carbon monoxide (ppm)	21.9 (11.4)	21.7 (10.5)	$t(233) = .13$
Duration of regular smoking (years)	18.6 (12.6)	21.3 (11.8)	$t(232) = -1.67$
Panic symptoms	12.5 (4.5)	14.7 (5.8)	
Anxiety sensitivity	19.5 (13.1)	25.7 (16.7)	
Lifetime history of panic attacks	35 (29.2%)	51 (44.3%)	
Lifetime history of panic disorder	10 (8.3%)	19 (16.5%)	

Notes. Values in the table reflect M (SD) or n (%). Panic Symptoms: Inventory of Depression and Anxiety Symptoms - Panic Subscale (Watson et al., 2007); Anxiety Sensitivity: Anxiety Sensitivity Index-3 (Taylor et al., 2007); Lifetime History of Panic Attacks and Panic Disorder from Structured Clinical Interview for DSM-IV Axis I Disorders- Non-patient Edition- Panic Disorder module (First et al., 1995).

* $p < .05$.

** $p < .01$.

43, respectively). There were no significant group differences in age [$t(233) = -.91, p = .37$], cigarettes per day [$t(166.4) = -1.46, p = .15$], expired carbon monoxide levels [$t(233) = .13, p = .90$], and duration of regular smoking [$t(232) = -1.67, p = .10$]. Thus, gender, race, and education were used as covariates in the analyses. Although the groups did not differ significantly on cigarettes per day, this variable was retained as a covariate in the analyses due to its well-documented association with both asthma and panic (McLeish & Zvolensky, 2010; Zvolensky, Feldner, et al., 2005).

Measures

Structured Clinical Interview for DSM-IV Axis I Disorders- Non-Patient Edition (SCID-NP)

The SCID-NP (First, Spitzer, Gibbon, & Williams, 1995) is a well-established diagnostic interview for psychiatric problems. Reliability ratings by an independent rater (licensed clinical psychologist) were completed on a random selection of 10% of the protocols with no cases of disagreement being noted. The SCID-NP was used to determine lifetime history of panic attacks and panic disorder.

Expired carbon monoxide

Biochemical verification of smoking status was completed by carbon monoxide (CO) analysis of breath samples assessed using a Bedfont Micro 4 Smokerlyzer CO Monitor (Model EC50; coVita, Haddonfield, NJ). Research indicates that 10 ppm is an optimal cutoff score for reliably discriminating smoking status (Cocores, 1993). Obtained values at or above this cutoff were considered indicative of regular smoking.

Smoking History Questionnaire

The Smoking History Questionnaire (SHQ) (Brown, Lejuez, Kahler, & Strong, 2002) was used to assess smoking pattern and history, including items pertaining to smoking rate, age of onset at initiation, and number of serious quit attempts. The SHQ has been successfully used in previous studies and has been identified as a psychometrically sound descriptive measure of smoking history (Zvolensky, Schmidt, et al., 2005).

Anxiety Sensitivity Index-3

The Anxiety Sensitivity Index-3 (ASI-3) (Taylor et al., 2007) is an 18-item self-report measure that assesses the degree to which participants fear negative consequences stemming from anxiety symptoms. The ASI-3 is comprised of a higher-order global AS factor and three specific lower-order factors (Taylor et al., 2007). The three lower-order factors consist of physical (e.g. 'It scares me when my heart beats rapidly'), social (e.g. 'I worry that other people will notice my anxiety'), and cognitive (e.g. 'When my thoughts seem to speed up, I worry that I might be going crazy') concerns. The ASI-3 has demonstrated the strongest psychometric properties of any current measure of AS (Taylor et al., 2007). Internal consistency for the ASI-3 total score in the current sample was excellent ($\alpha = .93$).

Inventory of depression and anxiety symptoms

The Inventory of depression and anxiety symptoms (IDAS) (Watson et al., 2007) is a 64-item measure designed to assess specific symptom dimensions of major depression

and anxiety disorders. Participants rate the extent to which each statement applies to them on a 5-point Likert scale (1 = *not at all* to 5 = *extremely*). The IDAS contains 10 symptom scales (Suicidality, Lassitude, Insomnia, Appetite Loss, Appetite Gain, Ill Temper, Well-Being, Panic, Social Anxiety, and Traumatic Intrusions) and two broader scales (General Depression and Dysphoria). The IDAS shows strong convergent, discriminant, criterion, and incremental validity (Watson et al., 2008). In the current study, the panic subscale of the IDAS was used to assess symptoms of panic disorder (e.g. 'I felt a pain in my chest'). Internal consistency for the IDAS-Panic in the current study was good (Cronbach's $\alpha = .85$).

Analytic approach

All analyses were conducted on the full sample of smokers with and without asthma. A one-way Analysis of Covariance (ANCOVA) was used to determine whether there were significant group differences between smokers with and without asthma in panic symptoms and anxiety sensitivity. In these analyses, gender, race, education, and cigarettes per day were employed as covariates. Hierarchical logistic regression was used to determine whether asthma diagnosis was a significant predictor of lifetime history of panic attacks and lifetime history of panic disorder. Gender (0 = male, 1 = female), race (0 = Caucasian, 1 = African American), education (0 = no college education, 1 = any college education), and cigarettes per day were entered simultaneously as covariates at step 1 in the model. Asthma diagnosis (0 = no, 1 = yes) was entered at the second step of the model to determine whether smokers with asthma had a greater likelihood of having a lifetime history of panic attacks and panic disorder than smokers without asthma after controlling for the effects of the covariates.

Results

Analysis of covariance

Results of the ANCOVA analyses are presented in Table 2. For anxiety sensitivity, gender was the only significant covariate [$F(1, 198) = 5.10, p < .05, \eta_p^2 = .03$], such that females reporting higher levels of anxiety sensitivity than males regardless of asthma status. There were no significant covariates for panic symptoms. There were significant differences between smokers with and without asthma for both anxiety sensitivity [$F(1, 198) = 9.67, p < .01, \eta_p^2 = .05$] and panic symptoms [$F(1, 200) = 11.55, p < .01, \eta_p^2 = .06$]. Specifically, after controlling for the effects of cigarettes per day, gender, race, and education, smokers with asthma reported greater anxiety sensitivity (*Adjusted M* = 25.75, *SE* = 1.55) and panic symptoms (*Adjusted M* = 14.98, *SE* = 0.55) compared to smokers without asthma (*Adjusted M* = 19.00, *SE* = 1.42 and *Adjusted M* = 12.37, *SE* = 0.50, respectively; See Figure 1).

Logistic regression

Results of the logistic regression analyses are presented in Table 3. In terms of lifetime history of panic attacks, gender (OR = 2.45, $p < .01$, 95% CI = 1.33–4.52), education (OR = 1.86, $p < .05$, 95% CI = 1.00 – 3.46) and race (OR = .37, $p < .01$, 95% CI = .19–.72) were the only variables significantly associated with a unique change in the odds of having a lifetime history of panic attacks at step 1. Specifically, regardless of asthma status, females, those with some college education, and Caucasians were at increased odds of having a lifetime history

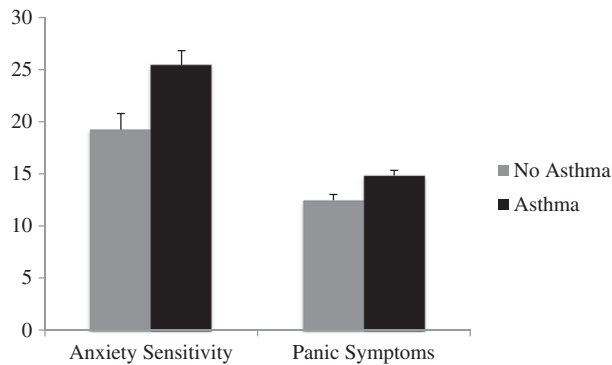
Table 2. Differences in anxiety sensitivity and panic symptoms between smokers with and without asthma.

Source	df	MS	F	η_p^2	p
<i>Anxiety sensitivity</i>					
CPD	1	723.86	3.45	.02	.07
Gender	1	1068.67	5.10	.03	.03*
Education	1	278.70	1.33	.01	.25
Race	1	255.95	1.22	.01	.27
Asthma	1	2028.15	9.67	.05	<.01**
Error	198	209.64			
<i>Panic symptoms</i>					
CPD	1	58.51	2.26	.01	.13
Gender	1	49.95	1.93	.01	.17
Education	1	37.94	1.47	.01	.23
Race	1	68.46	2.65	.01	.11
Asthma	1	298.81	11.55	.06	<.01**
Error	200	25.88			

Notes. MS = Mean Square; η_p^2 = partial eta squared; CPD = cigarettes per day; Gender: 0 = male, 1 = female; Education: 0 = no college, 1 = some college; Race: 0 = Caucasian, 1 = African American; Asthma: asthma diagnosis coded as 0 = no, 1 = yes.

* $p < .05$.

** $p < .01$.

**Figure 1.** Differences between smokers with and without asthma in anxiety sensitivity and panic symptoms after controlling for cigarettes per day, gender, education, and race.

of panic attacks. At step 2, asthma diagnosis was significantly associated with a unique change in the odds of having a lifetime history of panic attacks, such that smokers with asthma were more likely to have a lifetime history of panic attacks than smokers without asthma (OR = 3.01, $p < .01$, 95% CI = 1.56–5.81). For lifetime history of panic disorder, there were no significant predictors of lifetime history of panic disorder at step 1. At step 2, asthma diagnosis was significantly associated with a unique change in the odds of having a lifetime history of panic disorder, such that smokers with asthma were more likely to have a lifetime history of panic disorder than smokers without asthma (OR = 2.96, $p < .05$, 95% CI = 1.17–7.47).

Secondary analyses

To ensure that the significant group differences for anxiety sensitivity and panic symptoms reported above were not due simply to the fact that smokers with asthma were more likely

Table 3. Asthma diagnosis predicting the likelihood of having a lifetime history of panic attacks and panic disorder.

	<i>B</i>	SE	OR	95% CI	Wald χ^2	<i>p</i>
<i>Panic Attacks</i>						
Step 1						
CPD	−.01	.02	.99	.96–1.02	.69	.41
Gender	.90	.31	2.45	1.33–4.52	8.25	<.01**
Education	.62	.32	1.86	1.00–3.46	3.86	<.05*
Race	−1.01	.35	.37	.19–.72	8.54	.04**
Step 2						
Asthma	1.10	.34	3.01	1.56–5.81	10.76	<.01**
<i>Panic Disorder</i>						
Step 1						
CPD	−.02	.03	.98	.93–1.03	.65	.42
Gender	.69	.44	1.99	.85–4.66	2.50	.11
Education	.67	.45	1.96	.81–4.73	2.23	.14
Race	−.38	.47	.69	.27–1.72	.64	.42
Step 2						
Asthma	1.08	.47	2.96	1.17–7.47	5.24	.02*

Notes. *B* = Unstandardized Beta; SE = Standard Error; OR = Odds Ratio; CPD = cigarettes per day; Gender: 0 = male, 1 = female; Education: 0 = no college, 1 = some college; Race: 0 = Caucasian, 1 = African American; Asthma: asthma diagnosis coded as 0 = no, 1 = yes.

* $p < .05$.

** $p < .01$.

Table 4. Differences in anxiety sensitivity and panic symptoms between smokers with and without asthma without a lifetime history of panic attacks or panic disorder.

Source	<i>df</i>	MS	<i>F</i>	η_p^2	<i>p</i>
<i>Anxiety sensitivity</i>					
CPD	1	610.17	3.31	.03	.07
Race	1	72.35	.39	.00	.53
Asthma	1	814.64	4.42	.03	.04*
Error	126	184.53			
<i>Panic symptoms</i>					
CPD	1	54.99	2.51	.02	.12
Race	1	11.35	.52	.00	.47
Asthma	1	100.77	4.60	.04	.03*
Error	129	21.90			

Notes. MS = Mean Square; η_p^2 = partial eta squared; CPD = cigarettes per day; Race: 0 = Caucasian, 1 = African American; Asthma: asthma diagnosis coded as 0 = no, 1 = yes.

* $p < .05$.

to have a history of panic attacks and panic disorder, secondary analyses were conducted examining differences between smokers with and without asthma in terms of anxiety sensitivity and panic symptoms after removing 78 individuals with a lifetime history of panic attacks or panic disorder. Results of these ANCOVA analyses indicated significant differences between smokers with and without asthma for anxiety sensitivity [$F(1, 126) = 4.42$, $p < .05$, $\eta_p^2 = .03$] and panic symptoms [$F(1, 125) = 4.60$, $p < .05$, $\eta_p^2 = .04$]. Specifically, after controlling for cigarettes per day and race [the only demographic variable on which these two subgroups differed; $\chi^2(1) = 15.35$, $p < .01$], smokers with asthma reported greater anxiety sensitivity (*Adjusted M* = 22.36, SE = 1.98) and panic symptoms (*Adjusted M* = 13.64, SE = .71) compared to smokers without asthma (*Adjusted M* = 16.83, SE = 1.59 and *Adjusted M* = 11.64, SE = .54, respectively; see Table 4 and Figure 2).

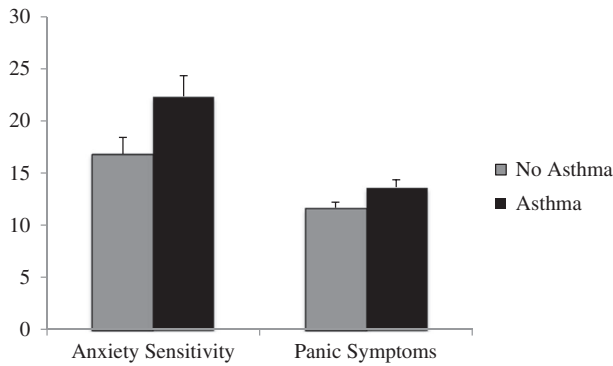


Figure 2. Differences between the subset smokers with and without asthma without a lifetime history of panic attacks or panic disorder in anxiety sensitivity and panic symptoms after controlling for cigarettes per day and race.

Discussion

There has been a growing level of clinical and research interest in examining associations between cigarette smoking and asthma. This interest is driven by the fact that individuals with asthma are more likely to smoke than those without asthma as well as the significant negative health effects of smoking, particularly among individuals whose lungs are already compromised (McLeish & Zvolensky, 2010). Although there is a well-established association between panic symptomatology and both smoking and asthma, the current study was the first to examine how smokers with and without asthma differ in terms of anxiety sensitivity, panic symptoms, lifetime history of panic attacks, and lifetime history of panic disorder.

Consistent with hypotheses, results indicated that smokers with asthma scored approximately six points higher on the ASI-3 and reported an average of two more panic symptoms compared to smokers without asthma. Further, smokers with asthma were approximately three times more likely to have a lifetime history of panic attacks or panic disorder compared to smokers without asthma. It should be noted that these differences were found even after controlling for the effects of cigarettes per day, gender, education, and race. Moreover, secondary analyses indicated that the findings for anxiety sensitivity and panic symptoms remained significant when looking only at individuals without a history of panic attacks or panic disorder. Thus, it appears that the combination of having an asthma diagnosis and being a regular smoker is particularly problematic in terms of panic psychopathology. These findings are consistent with the increased risk of panic psychopathology found among smokers compared to non-smokers (Breslau & Klein, 1999; Breslau, Novak, & Kessler, 2004; Isensee et al., 2003; Johnson et al., 2000; Zvolensky, Leen-Feldner, et al., 2004) and among individuals with asthma compared to without (Goodwin, Jacobi, et al., 2003; Goodwin, Pine, et al., 2003; Weiser, 2007).

Smoking results in a number of physical sensations related not only to the direct effects of nicotine (e.g. increased heart rate, increased respiration rate), but also to the long-term negative health effects of smoking (e.g. respiratory irritations, nicotine withdrawal symptoms experienced between cigarettes). Smokers with asthma experience such symptoms in the context of a pre-existing lung disease that manifests in chronic breathing difficulty coupled with episodic symptom exacerbations. Thus, compared to smokers without asthma,

smokers with asthma experience more frequent and likely more intense anxiety-provoking physical sensations. Such experiences could serve as conditioning experiences where the arousal-related physical sensations produced by both smoking and asthma are paired with high levels of anxiety (particularly for individuals high in anxiety sensitivity due to the fear of such sensations), placing smokers with asthma at increased risk for increased panic symptomatology and developing panic attacks and panic disorder. Such theorizing is consistent with the learning theory of panic disorder put forward by Bouton, Mineka, and Barlow (2001) in which conditioned anxiety potentiates a panic attack in a downward negative spiral that culminates in the development of panic disorder.

While the present study contributes to and extends previous work on asthma and smoking, there are a number of interpretive caveats that warrant consideration. First, the cross-sectional design does not permit causal-oriented hypothesis testing. Second, asthma diagnosis was based on self-report and was not objectively verified, although efforts were made to verify asthma diagnosis using proxy indicators (i.e. prescriptions for asthma medications, experiencing symptoms in the past year). Future studies should utilize objective measures of lung function (e.g. spirometry) and physician exam to verify asthma diagnosis. Similarly, self-report measures were utilized as the primary assessment methodology for many of the key constructs, which do not fully protect against reporting errors and may be influenced by shared method variance. Thus, future studies could benefit from using laboratory-based studies to induce asthma-like symptoms (e.g. via straw breathing) and assess participants' reactions to such symptoms using both subjective and objective (e.g. psychophysiological assessment) methods.

Third, the sample, by design, consisted of regular daily smokers who smoked at least 10 cigarettes per day, limiting the generalizability of the results to individuals who smoke less than that or do not smoke on a daily basis. Lastly, only information about lifetime history of panic attacks and panic disorder was gathered. Thus, it is unclear how these findings might differ for individuals who currently experience panic attacks or have a current panic disorder diagnosis compared to those who have a past history of panic but are currently asymptomatic. Despite these limitations, the present findings suggest that smokers with asthma have higher levels of anxiety sensitivity and panic symptoms and are at an increased risk for a lifetime history of panic attacks and panic disorder compared to smokers without asthma. Thus, smokers with asthma are a particularly 'at-risk' population for panic psychopathology and likely in need of specialized smoking cessation interventions.

Disclosure statement

No potential conflict of interest was reported by the authors.

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