University of Cincinnati

Date: 9/3/2014

I, Adrienne L. Johnson, hereby submit this original work as part of the requirements for the degree of Master of Arts in Psychology.

It is entitled:

Differences in Panic Psychopathology between Smokers with and without Asthma

Student's name: Adrienne L. Johnson

This work and its defense approved by:

Committee chair: Alison Mcleish, Ph.D.

Committee member: Bridgette Peteet, Ph.D.

Committee member: Sarah Whitton, Ph.D.

12691

University of Cincinnati

Date: 9/3/2014

I, Adrienne L. Johnson, hereby submit this original work as part of the requirements for the degree of Master of Arts in Psychology.

It is entitled:

Differences in Panic Psychopathology between Smokers with and without Asthma

Student's name: **Adrienne L. Johnson**

This work and its defense approved by:

Committee chair: Alison Mcleish, Ph.D.

Committee member: Bridgette Peteet, Ph.D.

Committee member: Sarah Whitton, Ph.D.

12691

Differences in Panic Psychopathology between Smokers with and without Asthma

A thesis submitted to the
Division of Graduate Education and Research
of the University of Cincinnati
in partial fulfillment of the
requirements for the degree of

Master of Arts

in the Department of Psychology
of the College of Arts and Sciences

2014

by

Adrienne L. Johnson

B.S., University of Wisconsin, 2010

Committee: Alison McLeish, Ph.D. (chair)
Bridgette Peteet, Ph.D.
Sarah Whitton, Ph.D.

Abstract

Despite the negative effects on lung function and health, 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 ($n = 125$; 70.4% male, $M_{age} = 36.5$ years, $SD = 13.0$) and without ($n = 126$; 54% male, $M_{age} = 37.7$ years, $SD = 12.1$) asthma in terms of anxiety sensitivity, panic symptoms, lifetime history of panic attacks, and lifetime history of panic disorder. 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 panic attacks ($OR = 2.93$) and panic disorder ($OR = 2.85$) 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.

Keywords: asthma, smoking, panic, anxiety

Page Intentionally Left Blank

Table of Contents

Abstract.....	ii
Table of Contents	iv
List of Tables and Figures.....	v
Introduction.....	1
Asthma	
Smoking.....	2
Asthma and Smoking.....	4
Panic Disorder and Panic Psychopathology	6
Panic and Smoking.....	8
Panic and Asthma	9
Conclusions and Limitations of Previous Research.....	11
Present Study.....	11
Method	12
Participants.....	12
Measures	14
Procedure.....	17
Analytic Approach	17
Results	18
Data Screening and Preparation	18
Analysis of Covariance	18
Logistic Regression	19
Follow-up Analyses	19
Discussion	20
Clinical Implications	22
Limitations and Future Directions	23
Conclusion.....	24
References.....	25

List of Tables and Figures

Table 1: Analysis of Covariance Results for Anxiety Sensitivity and Panic Symptoms as a Function of Asthma Diagnosis.....	45
Table 2: Asthma Diagnosis Predicting Lifetime History of Panic Attacks and Panic Disorder.....	46
Table 3: Analysis of Covariance Results for Anxiety Sensitivity and Panic Symptoms as a Function of Asthma Diagnosis for Individuals without a Lifetime History of Panic Attacks or Panic Disorder.....	47
Figure 1.....	48
Figure 2.....	49

Differences in Panic Psychopathology between Smokers with and without Asthma

Asthma

Asthma is a reversible obstructive airway disease consisting of chronic airway inflammation and episodes of exacerbation in response to certain stimuli (American Lung Association [ALA], 2012). These airway exacerbations, or “asthma attacks,” consist of increased swelling of the airways, constriction of the muscles surrounding the airways, and increased mucus production, resulting in symptoms of wheezing, coughing, chest tightness, and shortness of breath (ALA, 2012). Although the exact etiology of asthma is currently unknown, a great deal of information is currently available about the pathophysiology of the disease. A number of cells and immune system markers have been implicated in the developmental origins of asthma, such as mast cells, T cells, and Immunoglobulin E (IgE). Indeed, atopy, the genetic predisposition to develop an IgE-related response to common allergens, is the strongest risk candidate for developing asthma (National Heart, Lung, and Blood Institute [NHLBI], 2008). It is hypothesized that in addition to a genetic vulnerability, exposure to certain triggers early in life may contribute to the development of asthma (NHLBI, 2008). Common triggers for asthma attacks include changes in weather (e.g., increased humidity, cold temperatures), mold, pets, exercise, environmental tobacco smoke, and allergens and irritants (e.g., dust mites, cockroaches; ALA, 2012).

Asthma affects nearly 19 million, or 1 in 12, adults in the United States (U.S.; Centers for Disease Control and Prevention [CDC], 2012). Additionally, it is estimated that the proportion of individuals with asthma in the U.S. has increased by 15% in the last decade (CDC, 2012). Among adults in the U.S., a current diagnosis of asthma is more common among females (9.9%) than males (6.2%) and is most common among American Indians/Alaska Natives (14.3%)

followed by African Americans (9.8%), Caucasians (7.9%), and Asians (5.1%; CDC, 2012).

Asthma is also more common among non-Hispanics (8.5%) compared to Hispanics (6.1%; CDC, 2012) and those from low socioeconomic status backgrounds (CDC, 2012).

If not well controlled through medical intervention, asthma can result in significant rates of morbidity and mortality. For example, individuals with asthma are at higher risk for cardiovascular disease-related death (Iribarren, Tolstykh, Miller, Sobel, & Eisner, 2012) and complications from respiratory illnesses (e.g., influenza, bronchitis, pneumonia; ALA, 2012). As a result, asthma significantly negatively impacts the healthcare system in the U.S. and beyond. In 2009 alone, as one illustrative example, there were 8.9 million physician office visits, 1.9 million emergency department visits, and 14.2 million lost work days due to asthma in the U.S. (CDC, 2013). Moreover, it is estimated that the healthcare expenditures related to asthma (both direct and indirect) cost the U.S. approximately \$56 billion per year (CDC, 2013). Other work suggests that the cost of care for asthma from a worldwide perspective exceeds the economic costs associated with treating HIV/AIDS and tuberculosis combined (Braman, 2006).

Asthma is generally diagnosed by physician determination of the presence of recurrent episodes of airflow obstruction (usually at least partially reversible) or airway hyperresponsiveness (NHLBI, 2007). The classification of asthma severity is typically completed through physical exam to assess an individual's lung function, frequency of symptoms, and frequency of rescue inhaler use. Lung function is assessed via spirometry, which measures peak expiratory flow rates and forced respiratory volume in one second (FEV₁; Sims, 2006). In both cases, the lower the number, the more severe the level of impairment. Based on the findings from this assessment, patients can be placed into one of the following categories of severity: intermittent, mild persistent, moderate persistent, or severe persistent (NHLBI, 2007). Current

asthma guidelines suggest treating asthma using a stepwise approach, which tailors treatment to specific levels of asthma severity (NHLBI, 2007).

Treatment of asthma consists primarily of medication to control inflammation and decreasing exposure to asthma triggers (CDC, 2007). The two classes of medications typically used to control asthma include a controller medication (anti-inflammatory medications, typically inhaled corticosteroids) and a reliever medication (bronchodilators, such as short-acting beta-agonists). In terms of reducing exposure to environmental triggers, environmental tobacco smoke has been the primary target of research and prevention/intervention efforts. Substantially less research attention, however, has been paid to examining active smoking among individuals with asthma. Despite the negative impact of smoking on already compromised lung function, a substantial proportion of individuals with asthma are active cigarette smokers.

Smoking

Although there have been increased efforts to prevent the onset or maintenance of cigarette smoking, smoking remains a significant public health concern (Pleis, Lucas, & Ward, 2009). Currently, approximately 18% of U.S. adults are regular cigarette smokers (CDC, 2014). Smoking prevalence rates are higher among males (20.5%) compared to females (15.8%), and American Indians/Alaska Natives (21.8%) compared to Caucasians (19.7%), African Americans (18.1%), and Asians (10.7%; CDC, 2014). Smoking is also more common among non-Hispanics (26.1%) than Hispanics (12.5%) and among individuals from low socioeconomic backgrounds (27.9%; CDC, 2014). Although rates of smoking had been steadily decreasing until 2004, this rate of decline seems to have stalled in recent years (CDC, 2011). The onset of daily smoking typically occurs around 18 years of age and rarely after age 25 (Breslau, Johnson, Hiripi, & Kessler, 2001; Substance Abuse and Mental Health Services Administration [SAMHSA], 2010).

The average adult smoker in the U.S. smokes approximately 13 cigarettes per day, with males smoking, on average, more cigarettes per day than females (14 cigarettes and 12 cigarettes, respectively; SAMHSA, 2003).

Cigarette smoking is the leading preventable cause of death and disability in the U.S., accounting for over 443,000, or one in five, deaths each year (CDC, 2002; 2008; U.S. Department of Health and Human Services [USDHHS], 2004). Smoking harms nearly every organ of the body, resulting in approximately 8.6 million individuals in the U.S. who suffer from one or more serious illnesses associated with cigarette smoking (e.g., chronic obstructive pulmonary disease [COPD], lung cancer; ALA, 2010). Other conditions associated with smoking include coronary heart disease, various types of non-lung-related cancers (e.g., kidney, bladder, cervical), preterm deliveries, stroke, pneumonia, and asthma (ALA, 2010). Smokers are more likely to be absent from work, have longer-lasting illnesses, incur more medical costs, have more frequent doctor's visits, and be admitted to the hospital more often and for longer periods than nonsmokers (USDHHS, 2004). Recent reports estimate that the total costs of cigarette smoking are approximately \$193 billion per year or \$10.47 per pack of cigarettes sold in the U.S. (CDC, 2008).

Asthma and Smoking

Despite the known compromising effects of smoking on lung function and health, smoking is more prevalent 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). For example, both current and former smokers are more likely to have an asthma diagnosis than non-smokers (OR = 1.59 and 1.79, respectively; Frank et al., 2006). Similarly, among individuals with a current or lifetime asthma diagnosis, the

odds of being an active smoker are higher than of being a non-smoker (OR = 1.36 and 1.31, respectively; Gwynn, 2004). Smokers with asthma are also more likely to be regular smokers and heavy smokers than those without asthma (Avila, Soto-Martinez, Soto-Quiros, & Celedon, 2005; Precht et al., 2003). The association is even more striking when looking at nicotine dependent smokers. In a study using data from the National Comorbidity Survey-Replication, individuals with asthma were found to be nearly three times as likely as those without asthma to report nicotine dependence in the past 12 months (McLeish, Cougle, & Zvolensky, 2011). In this same study, approximately half of individuals with asthma reported their asthma diagnosis preceded smoking onset (McLeish et al., 2011), indicating asthma may serve as a risk factor for smoking. However, as studies have also found smoking to be a risk factor for developing asthma (Genuneit et al., 2006; Piipari, Jaakkola, Jaakkola, & Jaakkola, 2004; Polosa et al., 2008), there appear to be significant bidirectional associations, or multiple pathways, leading to the asthma-smoking co-occurrence.

In addition to increased prevalence rates of smoking among individuals with asthma, smoking also affects asthma symptom management. Research has consistently found that smoking results in poorer asthma control and decreased lung function (James et al., 2005; McLeish & Zvolensky, 2010; Suzuki et al., 2003). Smokers are 1.5 to 2.6 times more likely than non-smokers to have poorer asthma control and more frequent and severe asthma exacerbations (McCoy et al., 2006; Schatz, Zeiger, Vollmer, Mosen, & Cook, 2006). Similarly, Pedersen and colleagues (2007) found that patients classified as having not well-controlled asthma were more likely to be current or former smokers than those with well-controlled asthma, and smoking status had the greatest influence on whether or not patients achieved asthma control. Current

smokers also experienced asthma exacerbations at rates twice that of non-smokers (Pedersen et al., 2007).

Smoking is also associated with greater asthma severity. Compared to non-smokers with asthma, smokers with asthma experience increased levels of daily asthma symptoms, greater symptom severity for a variety of asthma symptoms (e.g., wheezing, nighttime awakenings), and greater interference with daily activities due to asthma (Althuis, Sexton, & Prybylski, 1999; Beeh, Mücke, Ksoll, & Buhl, 2001; Boulet, FitzGerald, McIvor, Zimmerman, & Chapman, 2008). Further, smokers with asthma are 2.4 times more likely than non-smokers with asthma to experience daily asthma attacks and 5.4 times more likely to report episodes of abnormal breathing in the previous 12 months (Siroux, Pin, Oryszczyn, Le Moual, & Kauffman, 2000). Smokers with asthma are also at a greater risk for asthma-related hospitalizations (OR = 1.86) or another type of hospital-based care for asthma (OR = 1.76; Eisner & Iribarren, 2007). Not only does smoking increase asthma severity and decrease asthma control, but it also decreases the effectiveness of the corticosteroids used to treat asthma (Chaudhuri et al., 2002). Due to these negative health outcomes, determining how smokers with asthma differ from smokers without asthma is a critical next step in this area of research. 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.

Panic Disorder and Panic Symptomatology

Panic disorder is a debilitating disorder that affects approximately 2.7% of the adult population in any given year, with nearly half these cases classified as severe (e.g., suicidal ideation or attempt, substantial role impairment, comorbid psychosis or bipolar disorder; Kessler, Chiu, Demler, Merikangas, & Walters, 2006). Panic disorder is characterized by recurrent,

unexpected panic attacks and anxious apprehension about the possibility of experiencing future panic episodes (American Psychiatric Association [APA], 2013). The disorder is often further complicated by agoraphobia that can limit social involvement and/or personal mobility (APA, 2013), other psychological disorders, and physical health problems (Brown, Antony, & Barlow, 1995).

It is noteworthy that a much larger percentage of the general population experience panic attacks without necessarily developing panic disorder (Norton, Cox, & Malan, 1992). Typically, individuals who experience these nonclinical panic attacks do not experience these attacks as “spontaneous” or “uncued” as is generally the case in panic disorder, but rather in certain threat-based contexts, such as stressful daily experiences or traumatic life events (Bernstein et al., 2005). In fact, panic attacks are a relatively common human experience, with 11.2% of adults in the U.S. reporting nonclinical panic attacks annually (Kessler et al., 2006). However, panic attacks are themselves risk factors for various forms of psychopathology (e.g., anxiety disorders, mood disorders, substance use disorders; Goodwin et al., 2004), making them worthy of empirical attention in their own right.

One well established risk factor for panic disorder is anxiety sensitivity, defined as the fear of arousal-related physical and psychological sensations (McNally, 2002; Reiss & McNally, 1985). Anxiety sensitivity reflects a relatively stable, albeit malleable, cognitive predisposition that is theoretically and empirically distinct from the tendency to experience negative emotional states (McNally, 2002). Anxiety sensitivity encompasses three lower-order dimensions: physical, cognitive, and social concerns that load onto a single higher-order factor (Deacon & Valentiner, 2001; Taylor, 1999; Zinbarg, Barlow, & Brown, 1997). When anxious, individuals high in anxiety sensitivity become acutely fearful due to beliefs that these anxiety-related interoceptive

sensations have harmful physical, social, or psychological consequences (Taylor et al., 2007). In line with this theory, anxiety sensitivity is concurrently and prospectively associated with an increased risk of anxiety symptoms and with the onset of panic attacks and panic disorder (Hayward, Killen, Kraemer, & Taylor, 2000; Li & Zinbarg, 2007; Maller & Reiss, 1992; Marshall, Miles, & Stewart, 2010; Schmidt, Lerew, & Jackson, 1997; 1999; Schmidt, Zvolensky, & Maner, 2006).

Panic and Smoking

Anxiety disorders co-occur with smoking at rates that exceed those found in the general population and many other psychiatric conditions (McCabe et al., 2004). Some of the most robust relations between smoking and anxiety disorders have been found for panic disorder, where the average rate of smoking is approximately twice that of the general population (40% vs. 18%; Lasser et al., 2000; Zvolensky, Feldner, Leen-Feldner, & McLeish, 2005). Indeed, daily cigarette smoking, especially at higher rates, is concurrently and prospectively related to an increased risk of panic symptoms, panic attacks, panic disorder, and agoraphobia (Breslau & Klein, 1999; Breslau, Novak, & Kessler, 2004; Isensee, Wittchen, Stein, Höfler, & Lieb, 2003; Johnson et al., 2000; Zvolensky, Leen-Feldner, et al., 2004). Compared to non-smokers, smokers are approximately 3.5 times more likely to develop panic attacks and panic disorder (Isensee, Wittchen, Stein, Höfler, & Lieb, 2003). This association is even more striking among heavy smokers. Johnson and colleagues (2000) found that adolescents who were heavy smokers (i.e., more than one pack per day) were 15.6 times more likely to develop panic disorder in adulthood.

Among smokers with comorbid panic disorder, smoking is associated with more severe panic problems. Smokers with panic disorder have been found to report more severe body vigilance and avoidance and greater social impairment than non-smokers with panic disorder

(McCabe et al., 2004; Morissette, Brown, Kamholz, & Gulliver, 2006; Zvolensky, Forsyth, Fuse, Feldner, & Leen-Feldner, 2002; Zvolensky, Leen-Feldner, et al., 2004; Zvolensky, Schmidt, & McCreary, 2003). A history of panic attacks and panic disorder is also associated with a greater likelihood for nicotine dependence (Farrell et al., 2001), the tendency to smoke primarily to reduce negative affective states (Zvolensky, Schmidt, et al., 2005), and more severe nicotine withdrawal symptoms (Zvolensky, Lejuez, Kahler, & Brown, 2004).

A growing corpus of work indicates that the panic-related risk factor of anxiety sensitivity is also associated with smoking behavior. For example, anxiety sensitivity is significantly associated with smoking to reduce negative affect, but not other motives (e.g., pleasure, handling; Battista et al., 2008; Gonzalez, Zvolensky, Vujanovic, Leyro, & Marshall, 2008; Zvolensky, Bonn-Miller, et al., 2006). Anxiety sensitivity is also associated with greater difficulties in smoking cessation. Specifically, while anxiety sensitivity is associated with increased motivation for smoking cessation (Zvolensky, Baker, et al., 2004; Zvolensky, Vujanovic et al., 2007) and a greater number of quit attempts (Zvolensky, Johnson, Leyro, Hogan, & Tursi, 2009), higher levels of anxiety sensitivity are also associated with decreased smoking cessation self-efficacy (Zvolensky, Bonn-Miller, et al., 2006) and greater perceived barriers to cessation (Gonzalez et al., 2008; Gregor, Zvolensky, McLeish, Bernstein, & Morissette, 2008). Further, anxiety sensitivity has been found to predict more intense nicotine withdrawal symptoms (Zvolensky, Baker, et al., 2004) and earlier lapses and relapses to smoking during a smoking cessation attempt, particularly in the first two weeks of the attempt (Brown et al., 2001; Zvolensky, Bernstein, et al., 2007; Zvolensky, Bonn-Miller, et al., 2006; Zvolensky, Stewart, Vujanovic, Gavric, & Steeves, 2009).

Panic and Asthma

Similar to the patterns seen among smokers, psychiatric diagnoses are more common among individuals with asthma compared to those without, and there is evidence of a relatively specific association between panic disorder and asthma. Indeed, 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). Interestingly, there appears to be a significant bidirectional relationship between panic and asthma. A 20-year longitudinal study found that individuals with asthma were 4.5 times more likely to develop panic disorder and that individuals with panic disorder were over 6 times more likely to develop asthma (Hasler et al., 2005). Moreover, these associations were stronger in smokers compared to nonsmokers (Hasler et al., 2005). Not surprisingly, having a comorbid panic disorder diagnosis adversely affects asthma. Research has consistently found that individuals with asthma and comorbid panic disorder, despite showing no differences in objective indices of lung function, report poorer asthma control and quality of life (Feldman, Lehrer, Borson, Hallstrand, & Siddique, 2005; Feldman, Siddique, Thompson, & Lehrer, 2009; Lavoie et al., 2005; Ritz, Rosenfield, Meuret, Bobb, & Steptoe, 2008) as well as increased impairment in daily functioning, increased bronchodilator use, and greater health care utilization (Feldman et al., 2005; Feldman et al., 2009; Schneider et al., 2007)

In order to better understand the mechanisms underlying the anxiety-asthma association, recent research has focused on the role of the panic-related risk factor of anxiety sensitivity. Results from this emerging body of literature indicate that, independent of asthma severity, anxiety sensitivity has been found to predict panic in response to asthma symptoms (Carr, Lehrer, & Hochron, 1995) as well as increased activity limitations due to asthma symptoms and poorer asthma-related physical and emotional health (McCauley, Katon, Russo, Richardson, &

Lozano, 2007). In an undergraduate sample of individuals with self-reported, physician-diagnosed asthma, McLeish, Zvolensky, and Luberto (2011) found that the physical concerns facet of anxiety sensitivity significantly predicted poorer levels of asthma control independent of gender, daily cigarette smoking, and negative affectivity. Similarly, Avallone, McLeish, Luberto, and Bernstein (2012) found that the physical concerns facet of anxiety sensitivity significantly predicted asthma control and asthma-related quality of life above and beyond the effects of gender, age, negative affectivity, and number of comorbid medical problems in a community sample of individuals with a physician-verified asthma diagnosis.

Conclusions and Limitations of Previous Research

Taken together, empirical evidence suggests that smoking is more common among individuals with asthma compared to those without and is associated with decreased asthma control and an increased risk of morbidity and mortality. However, the research focus thus far has been primarily documenting this association between smoking and asthma, and there has been little exploration of psychological factors that differ between smokers with and without asthma. Identifying such variables is important as it would not only allow researchers to further refine our understanding of the asthma-smoking co-occurrence, but also provide critically important information about unique factors that may maintain smoking behavior or hinder successful smoking cessation among smokers with asthma. As research has demonstrated strong associations between panic and both smoking and asthma, understanding how smokers with and without asthma differ in terms of panic-related variables is an important next step in this area of research.

Present Study

The purpose of the present study was to examine differences between smokers with and without asthma in anxiety sensitivity, panic symptoms, and rates 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

Participants were 235 daily cigarette smokers between the ages of 18 and 65 recruited from the local community: 115 smokers with asthma and 120 smokers without asthma. Eligibility criteria for the study were: (1) daily smoking rate greater than 10 cigarettes per day; (2) expired carbon monoxide levels greater than 10 parts per million (ppm; please see Measures section for details); and (3) regular, daily smoking for at least one year. 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.

Smokers without asthma. The smokers without asthma group consisted of 120 regular, daily cigarette smokers with no history of asthma (70.6% male, $M_{age} = 37.0$ years, $SD = 12.8$). The racial composition of the group was 72.5% Caucasian and 27.2 % African American. In

terms of education, 15.0% had less than a high school degree, 31.7% had a high school diploma, 31.7% had completed some college education, 11.7% had a 2-year college degree, 7.5% of the sample had at least a 4-year college degree, 1.7% had completed some graduate school education, and 0.8% had a graduate degree.

On average, smokers without asthma smoked 18.7 ($SD = 8.4$) cigarettes per day, considered themselves regular cigarette smokers by a mean age of 17.5 ($SD = 5.2$) years, and had been smoking for 18.6 years ($SD = 12.6$). The average expired carbon monoxide (CO) level was 21.9 ppm ($SD = 11.4$).

Participants were administered the mood and anxiety disorders (except specific phobia) modules of the Structured Clinical Interview for DSM-IV Axis I Disorders – Non-Patient Edition (First, Spitzer, Gibbon, & Williams 1995). They reported the following history of current or past psychiatric problems: 44.2% had major depressive disorder, 29.2% had experienced one or more panic attacks, 19.2% had social phobia, 16.7% had posttraumatic stress disorder, 10.8% had obsessive-compulsive disorder, 10% had generalized anxiety disorder, 8.3% had panic disorder, 5% had bipolar I disorder, 1.7% had bipolar II disorder, and 0.8% had agoraphobia without panic disorder.

Smokers with asthma. The smokers with asthma group consisted of 115 daily cigarette smokers with self-reported, physician-diagnosed asthma (55.3% male, $M_{age} = 38.4$ years, $SD = 11.9$). The racial composition of the sample was 44.3% Caucasian, and 55.7 % African American. In terms of education, 23.5% had less than a high school diploma, 39.1% had a high school degree, 20.4% had completed some college education, 1.7% had a 2-year college degree, 4.3% of the sample had at least a 4-year college degree, and 0.9% had some graduate school education.

On average, smokers with asthma smoked 20.9 ($SD = 12.9$) cigarettes per day, considered themselves regular smokers by the mean age of 16.7 ($SD = 4.3$), and had been regular smokers for 21.3 years ($SD = 11.8$). The average expired CO level was 21.7 ($SD = 10.5$). On average, smokers with asthma were 17.5 ($SD = 12.9$) years of age when diagnosed with asthma and 37.4% had been hospitalized for their asthma. In terms of asthma control, 25.2% of smokers with asthma reported troubling asthma symptoms most or all days/nights during the previous two weeks and a mean Asthma Control Test (Nathan et al., 2004) score of 15.6 ($SD = 4.1$), indicating difficulties with asthma control. Smokers with asthma reported the following history of current or past psychiatric problems: 58.3% had major depressive disorder, 44.3% had experienced one or more panic attacks, 14.8% had social phobia, 20.2% had posttraumatic stress disorder, 6.1% had obsessive compulsive disorder, 6.1% had generalized anxiety disorder, 16.5% had panic disorder, 0.9% had bipolar I disorder, 2.4% had bipolar II disorder, and 1.7% had agoraphobia without panic disorder.

Measures

Asthma diagnosis and severity. Participants were considered to have ‘current asthma’ if they endorsed: (1) having been diagnosed by a physician with asthma; (2) having a current prescription for an asthma-related medication; and (3) experiencing asthma-related symptoms within the past 12 months. This strategy has been successfully employed in previous research (e.g., Avallone et al., 2013; McLeish et al., 2011). Information was also gathered regarding age at diagnosis, number of hospitalizations, and recent symptoms and medication use.

Asthma Control Test (ACT). The ACT (Nathan et al., 2004) is a five-item self-report measure that assesses asthma control. The ACT measures frequency of symptoms (e.g., “How often have you had shortness of breath?”) and functional impairment due to symptoms (e.g.,

“How much of the time did your asthma keep you from getting as much done at work or at home?”) within the past 4 weeks. Scores range from 5-25 with higher scores indicating better control. Scores at or above 19 indicate that an individual’s asthma is well controlled. The ACT shows good reliability and is able to discriminate between groups of patients with different levels of asthma control (Nathan et al., 2004). Internal consistency for the ACT in the current sample was good ($\alpha = .78$). The ACT was used for descriptive purposes only and was not employed in any analyses.

Structured Clinical Interview for DSM-IV Axis I Disorders- Non-Patient Edition (SCID-NP). The SCID-NP (First et al., 1995) is a well-established diagnostic interview for psychiatric problems. The SCID-NP exhibits good internal reliability as well as good validity for anxiety and other psychiatric disorders (Kranzler, Kadden, Babor, Tennen, & Rounsaville, 1996). A modified version of the original SCID-NP was used that included assessment of mood disorders (major depressive disorder and bipolar disorder I and II) and all anxiety disorders excluding specific phobia. The SCID-NP was administered to participants by trained interviewers (either graduate- or an undergraduate-level research technicians trained in administering the SCID-NP). Reliability ratings by an independent rater (licensed clinical psychologist) were completed on a random selection of 10% of the protocols with only two cases of disagreement being noted. These disagreements (one obsessive-compulsive disorder diagnosis and one social phobia diagnosis) were resolved via consensus after being reviewed by an additional independent rater. 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 (Corcores, 1993). Obtained values at or above this cutoff were considered indicative of regular smoking.

Smoking History Questionnaire (SHQ). The SHQ (Brown et al., 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 et al., 2005). The SHQ was used for descriptive purposes and daily smoking rate (i.e., cigarettes per day) was used as a covariate in the proposed analyses.

Anxiety Sensitivity Index-3 (ASI-3). The 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 one higher-order 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 ($\alpha = .93$). The ASI-3 was used as a measure of anxiety sensitivity that was used as a dependent variable in the proposed analyses.

Inventory of Depression and Anxiety Symptoms (IDAS). The 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 $\alpha = .85$).

Procedure

Participants responding to community-based advertisements for a research study focused on smoking and emotions were scheduled for an individual 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 SCID-NP to determine the presence of current or past psychiatric diagnoses, including panic attacks and panic disorder. Participants then 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.

Analytic Approach

Group differences in terms of demographic variables (i.e., gender, age, race, education) were examined using the Mann-Whitney *U*-test, independent samples *t*-test, and Chi-square test. Results indicated significant differences between smokers with and without asthma with regard to gender [0 = male, 1 = female; $\chi^2(1) = 5.87, p < .01$], race [0 = Caucasian, 1 = African American; $\chi^2(1) = 19.20, p < .01$], and education ($U = 5415.50, p < .01$). Specifically, the smokers without asthma group had more males, fewer African Americans, and were more highly educated than the smokers with asthma group. There were no significant group differences in age

$t(233) = -.91, p = .49$]. Thus, gender, race, and education were used as covariates in the analyses.

A one-way Analysis of Covariance (ANCOVA) was used to determine whether there were significant group differences 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, race, education, and CPD were entered simultaneously as covariates at step 1 in the model. Asthma diagnosis was entered at the second step of the model.

Results

Data Screening and Preparation

Examination of the data indicated the presence of four multivariate outliers. These cases were deleted prior conducting the analyses. Also, the assumptions of normality of residuals and homogeneity of variance were not met. A logarithmic transformation successfully improved homogeneity of variance (Levene's t test, $p > .05$; Cohen, Cohen, West, & Aiken, 2003) for anxiety sensitivity and panic symptoms ($p > .05$), but did not improve normality of residuals for either anxiety sensitivity or panic symptoms (Shapiro Wilke's Test, $p > .05$; Shapiro & Wilke, 1965). Fortunately, ANCOVA is robust to violations of the assumption of normality, allowing us to continue with the proposed analyses (Hayes, 2013). The pattern of results was similar using both the transformed and non-transformed variables; thus, for ease of interpretation only the results using the non-transformed variables are presented.

Analysis of Covariance

Results of the ANCOVA analyses are presented in Table 1 and Figure 1. For anxiety sensitivity, there were significant gender differences [$F(1, 199) = 5.32, p < .05, \eta_p^2 = .03$], with females reporting higher levels of anxiety sensitivity than males. There were significant group differences for both anxiety sensitivity [$F(1, 199) = 8.08, p < .01, \eta_p^2 = .04$] and panic symptoms [$F(1, 201) = 9.39, p < .01, \eta_p^2 = .05$]. Specifically, after controlling for smoking rate, gender, race, and education, smokers with asthma reported greater anxiety sensitivity (*Adjusted M* = 25.41, *SE* = 1.55) and panic symptoms (*Adjusted M* = 14.83, *SE* = 0.55) compared to smokers without asthma (*Adjusted M* = 19.25, *SE* = 1.42 and *Adjusted M* = 12.47, *SE* = 0.50, respectively).

Logistic Regression

Results of the logistic regression analyses are presented in Table 2. In terms of lifetime history of panic attacks, gender ($OR = 2.74, p < .01, 95\% CI = 1.51-4.97$) and race ($OR = .52, p < .05, 95\% CI = .28-.96$) were the only variables significantly associated with a unique change in the odds of having a lifetime history of panic attacks 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 attacks ($OR = 2.93, p < .01, 95\% CI = 1.52- 5.63$).

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 ($OR = 2.85, p < .05, 95\% CI = 1.13-7.17$).

Follow-up 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 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 group differences for anxiety sensitivity [$F(1, 126) = 4.42, p < .05, \eta_p^2 = .03$] as well as 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 3, Figure 2).

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 (i.e., a panic-related risk factor), 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 current or past 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, Wittchen, Stein, Höfler, & Lieb, 2003; Johnson et al., 2000; Zvolensky, Leen-Feldner, et al., 2004) and among individuals with asthma compared to without (Goodwin, Jacobi, & Thefeld, 2003; Goodwin, Pine, & Hoven, 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.

Also of note, females reported higher levels of education and were at increased odds of having a lifetime history of panic attacks than males, and African Americans were approximately half as likely as Caucasians to have a lifetime history of panic attacks. These findings are consistent with higher reported rates of panic among females and Caucasians compared to males and African Americans (APA, 2013; Hunter & Schmidt, 2010). Lastly, the odds of having panic disorder and panic attacks among smokers with asthma were substantially larger than the effect sizes associated with the higher levels of anxiety sensitivity and panic symptoms among smokers with asthma. One possible reason for this disparity in effect size could be the continuous measurement of anxiety sensitivity and panic symptoms, versus the binomial measurement of a history of panic attacks and panic disorder. Specifically, it may be that since all people are likely to have some level of anxiety sensitivity and panic symptoms, rather than the presence of or lack thereof panic attacks and panic disorder, the effect size of the latter variables is larger.

Limitations and Future Directions

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, this study was cross-sectional in nature; thus, no statements regarding causality or directionality can be made. Longitudinal studies are needed to better understand how smoking, asthma, and panic impact one another over time. 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. The utilization of self-report methods does not fully protect against reporting errors and may be influenced by shared method variance. Thus, future studies could build on the present work by utilizing a multi-method assessment approach to address this concern. For example, laboratory-based studies could be used 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 more than 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. Fourth, although the violations of the assumptions of normality and homogeneity of variances for the ANCOVA analyses were adequately addressed, future studies may want to utilize alternative statistical approaches, such as structural equation modeling to examine these issues. 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.

Clinical Implications

Despite these limitations, there are a number of clinical implications for both prevention and intervention efforts that can be drawn from the findings of the present study. For example, assessments of anxiety sensitivity and panic symptomatology in smokers with asthma could identify individuals at risk for developing panic attacks and panic disorder or who might be in need of intervention for those with pre-existing panic psychopathology. Most importantly, these

findings suggest that smokers with asthma likely are in need of specialized smoking cessation interventions. A smoking cessation program targeting smokers high in anxiety sensitivity has been recently developed that uses interoceptive exposure-based techniques in combination with standard cognitive behavioral therapy for smoking cessation. Although no randomized controlled trials of the intervention have been conducted, initial pilot studies indicate increased abstinence rates (Zvolensky, Yartz, Gregor, Gonzalez, & Bernstein, 2008). It will, however, be important for future work to identify ways in which these interventions need to be tailored for individuals with asthma. For example, it may be necessary to incorporate an asthma psychoeducation component to address asthma-related concerns and to help these individuals recognize differences between asthma and anxiety symptoms.

Conclusions

Taken together, 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-related prevention and intervention efforts.

References

- Althuis, M. D., Sexton, M., & Prybylski, D. (1999). Cigarette smoking and asthma symptom severity among adult asthmatics. *The Journal of Asthma*, 36, 257-264.
- American Lung Association. (2010). *Tobacco use*. Retrieved from <http://www.lung.org/assets/documents/publications/solddc-chapters/tobacco.pdf>
- American Lung Association. (2012). *Asthma & children fact sheet*. Retrieved from <http://www.lung.org/lung-disease/asthma/resources/facts-and-figures/asthma-children-fact-sheet.html>
- American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: Author.
- Avallone, K. M., McLeish, A. C., Luberto, C. M., & Bernstein, J. A. (2012). Anxiety sensitivity, asthma control, and quality of life in adults with asthma. *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, 49, 57–62.
- Avallone, K. M., McLeish, A. C., Zvolensky, M. J., Kraemer, K. M., Luberto, C. M., & Jeffries, E. R. (2013). Asthma and its relation to smoking behavior and cessation motives among adult daily smokers. *Journal of Health Psychology*, 18, 788-799.
- Avila, L., Soto-Martinez, M. E., Soto-Quiros, M. E., & Celedon, J. C. (2005). Asthma, current wheezing, and tobacco use among adolescents and young adults in Costa Rica. *Journal of Asthma*, 43, 543-547.
- Battista, S. R., Stewart, S. H., Fulton, H. G., Steeves, D., Darredeau, C., & Gavric, D. (2008). A further investigation of the relations of anxiety sensitivity to smoking motives. *Addictive Behaviors*, 33, 1402–1408.

- Beeh, K. M., Micke, P., Ksoll, M., & Buhl, R. (2001). Cigarette smoking, but not sensitization to *Alternaria*, is associated with severe asthma in urban patients. *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, 38, 41–49.
- Bernstein, A., Zvolensky, M. J., Feldner, M. T., Lewis, S. F., Fauber, A. L., Leen-Feldner, E. W., & Vujanovic, A. A. (2005). Anxiety sensitivity taxon and trauma: discriminant associations for posttraumatic stress and panic symptomatology among young adults. *Depression and Anxiety*, 22, 138–149.
- Boulet, L.-P., FitzGerald, J. M., McIvor, R. A., Zimmerman, S., & Chapman, K. R. (2008). Influence of current or former smoking on asthma management and control. *Canadian Respiratory Journal: Journal of the Canadian Thoracic Society*, 15, 275–279.
- Bouton, M. E., Mineka, S., & Barlow, D. H. (2001). A modern learning theory perspective on etiology of panic disorder. *Psychological Review*, 108, 4–32.
- Braman, S. S. (2006). The global burden of asthma. *Chest*, 130, 4S-12S.
- Breslau, N., Novak, S. P., & Kessler, R. C. (2004). Psychiatric disorders and stages of smoking. *Biological Psychiatry*, 55, 69–76.
- Breslau, N., Johnson, E. O., Hiripi, E., & Kessler, R. (2001). Nicotine dependence in the United States prevalence, trends, and smoking persistence. *Archives of General Psychiatry*, 58, 810-816.
- Breslau, N., & Klein, D. F. (1999). Smoking and panic attacks: an epidemiologic investigation. *Archives of General Psychiatry*, 56, 1141–1147.
- Brown, T. A., Antony, M. M., & Barlow, D. H. (1995). Diagnostic comorbidity in panic disorder: effect on treatment outcome and course of comorbid diagnoses following treatment. *Journal of Consulting and Clinical Psychology*, 63, 408–418.

- Brown, R. A., Kahler, C. W., Zvolensky, M. J., Lejuez, C. W., & Ramsey, S. E. (2001). Anxiety sensitivity: relationship to negative affect smoking and smoking cessation in smokers with past major depressive disorder. *Addictive Behaviors*, 26, 887–899.
- Brown, R. A., Lejuez, C. W., Kahler, C. W., & Strong, D. R. (2002). Distress tolerance and duration of past smoking cessation attempts. *Journal of Abnormal Psychology*, 111 180-185.
- Carr, R. E., Lehrer, P. M., & Hochron, S. M. (1995). Predictors of panic-fear in asthma. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, 14, 421–426.
- Center for Disease Control and Prevention. (2003). Annual smoking-attributable mortality – U.S., 2000. *Morbidity and Mortality Weekly Report*, 52, 842-844.
- Center for Disease Control and Prevention. (2007). *Asthma control: Improving quality of life and reducing costs*. Retrieved from <http://www.cdc.gov/asthma/aag/2007/overview.html>
- Center for Disease Control and Prevention. (2008). Annual smoking-attributable mortality, years of potential life lost, and productivity losses – United States, 2000-2004. *Morbidity and Mortality Weekly Report*, 57, 1226-1228.
- Center for Disease Control and Prevention. (2011). Vital signs: Current cigarette smoking among adults aged ≥ 18 years – United States, 2005-2010. *Morbidity and Mortality Weekly Report*, 60, 1207-1212.
- Center for Disease Control and Prevention. (2012). Summary health statistics for U.S. adults: National health interview survey, 2011. *Vital and Health Statistics*, 10 (256).

- Center for Disease Control and Prevention. (2013). *Asthma's impact on the nation, data from the CDC National Asthma Control Program*. Retrieved from http://www.cdc.gov/asthma/impacts_nation/asthmafactsheet.pdf
- Center for Disease Control and Prevention. (2014). Current cigarette smoking among adults – United States, 2005-2012. *Morbidity and Mortality Weekly Report*, 63, 29-34.
- Chaudhuri, R., Livingston, E., McMahon, A. D., Thomson, L., Borland, W., & Thomson, N. C. (2002). Cigarette smoking impairs the therapeutic response to oral corticosteroids in chronic asthma. *American Journal of Respiratory and Critical Care Medicine*, 168, 1308-1311.
- Cocores, J. (1993). Nicotine dependence: Diagnosis and treatment. *Psychiatric Clinics of North America*, 16, 49-60.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences* (Third edition). Routledge Academic.
- Deacon, B. J. & Valentiner, D. P. (2001). Dimensions of anxiety sensitivity and their relationship to nonclinical panic. *Journal of Psychopathology and Behavioral Assessment*, 23, 25-33.
- Eisner, M. D., & Iribarren, C. (2007). The influence of cigarette smoking on adult asthma outcomes. *Nicotine and Tobacco Research*, 9, 53-56.
- Farrell, M., Howes, S., Bebbington, P., Brugha, T., Jenkins, R., Lewis, G., ... Meltzer, H. (2001). Nicotine, alcohol and drug dependence and psychiatric comorbidity: Results of a national household survey. *The British Journal of Psychiatry*, 179, 432–437.

- Feldman, J. M., Lehrer, P. M., Borson, S., Hallstrand, T. S., & Siddique, M. I. (2005). Health care use and quality of life among patients with asthma and panic disorder. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, 42, 179–84.
- Feldman, J. M., Siddique, M. I., Thompson, N. S., & Lehrer, P. M. (2009). The role of panic-fear in comorbid asthma and panic disorder. *Journal of Anxiety Disorders*, 23, 178–84.
- First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (1995). Structured Clinical Interview for Axis I DSM-IV Disorders - Patient Edition (SCID-I/P). New York: Biometrics Research Department, NY State Psychiatric Institute.
- Frank, P., Morris, J., Hazell, M., Linehan, M., & Frank, T. (2006). Smoking, respiratory symptoms and likely asthma in young people: Evidence from postal questionnaire surveys in the Wythenshawe Community Asthma Project (WYCAP). *BMC Pulmonary Medicine*, 6, 10-15.
- Genuneit, J., Weinmayr, G., Radon, K., Dressel, H., Windstetter, D., Rzehak, P., . . . Weiland, K. (2006). Smoking and the incidence of asthma during adolescence: Results of a large cohort study in Germany. *Thorax*, 61, 572-578.
- Gonzalez, A., Zvolensky, M. J., Vujanovic, A. A., Leyro, T. M., & Marshall, E. C. (2008). An evaluation of anxiety sensitivity, emotional dysregulation, and negative affectivity among daily cigarette smokers: relation to smoking motives and barriers to quitting. *Journal of Psychiatric Research*, 43, 138–147.
- Goodwin, R. D., Lieb, R., Hoefler, M., Pfister, H., Bittner, A., Beesdo, K., & Wittchen, H.-U. (2004). Panic attack as a risk factor for severe psychopathology. *The American Journal of Psychiatry*, 161, 2207–2214.

- Goodwin, R. D., Jacobi, F., & Thfeld, W. (2003). Mental disorders and asthma in the community. *Archives of General Psychiatry*, 60, 1125-1130.
- Goodwin, R. D., Pine, D. S., & Hoven, C. W. (2003). Asthma and panic attacks among youth in the community. *The Journal of Asthma: Official Journal of the Association for the Care of Asthma*, 40, 139–145.
- Gregor, K. L., Zvolensky, M. J., McLeish, A. C., Bernstein, A., & Morissette, S. (2008). Anxiety sensitivity and perceived control over anxiety-related events: associations with smoking outcome expectancies and perceived cessation barriers among daily smokers. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, 10, 627–635.
- Gwynn, R. C. (2004). Risk factors for asthma in U.S. adults: Results from the 2000 Behavioral Risk Factor Surveillance System. *Journal of Asthma*, 41, 91-98.
- Hasler, G., Gergen, P. J., Kleinbaum, D. G., Ajdacic, V., Gamma, A., Eich, D., ... Angst, J. (2005). Asthma and panic in young adults: a 20-year prospective community study. *American Journal of Respiratory and Critical Care Medicine*, 171, 1224–1230.
- Hayes, A.F. (2013). *Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression Based Approach*. The Guilford Press: New York, NY.
- Hayward, C., Killen, J. D., Kraemer, H. C., & Taylor, C. B. (2000). Predictors of panic attacks in adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 207–214.
- Hunter, L. R., & Schmidt, N.B. (2010). Anxiety psychopathology in African American adults: literature review and development of empirically informed sociocultural model. *Psychological Bulletin*, 136, 211-235.

- Iribarren, C., Tolstykh, I. V., Miller, M. K., Sobel, E., & Eisner, M. D. (2012). Adult asthma and risk of coronary heart disease, cerebrovascular disease, and failure: A prospective study of 2 matched cohorts. *American Journal of Epidemiology*, 176, 1014-1024.
- Isensee, B., Wittchen, H.U., Stein, M. B., Höfler, M., & Lieb, R. (2003). Smoking increases the risk of panic: findings from a prospective community study. *Archives of General Psychiatry*, 60, 692-700.
- James, A. L., Palmer, L., J., Kicic, E., Maxwell, P. S., Lagan, S. E., Ryan, G. F., & Musk, A. W. (2005). Decline in lung function in the Busselton Health Study, effects of asthma and cigarette smoking. *American Journal of Respiratory and Critical Care Medicine*, 171, 109-114.
- Johnson, J. G., Cohen, P., Pine, D. S., Kasen, S., Brook, J. S. (2000). Association between cigarette smoking and anxiety disorders during adolescence and early adulthood. *The Journal of the American Medical Association*, 284, 2348-2351.
- Kessler, R. C., Chiu, W. T., Jin, R., Ruscio, A. M., Shear, K., & Walters, E. E. (2006). The epidemiology of panic attacks, panic disorder, and agoraphobia in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 63, 415–424.
- Kranzler, H. R., Kadden, R. M., Babor, T. F., Tennen, H., & Rounsaville, B. J. (1996). Validity of the SCID in substance abuse patients. *Addiction*, 91, 859–68.
- Lavoie, K. L., Bacon, S. L., Barone, S., Cartier, A., Ditto, B., & Labrecque, M. (2006). What is worse for asthma control and quality of life: Depressive disorder, anxiety disorder, or both? *Chest*, 130, 1039-1047.

- Lavoie, K. L., Cartier, A., Labrecque, M., Bacon, S. L., Lemièrre, C., Malo, J.-L., ... Ditto, B. (2005). Are psychiatric disorders associated with worse asthma control and quality of life in asthma patients? *Respiratory Medicine*, 99, 1249–1257.
- Li, W., & Zinbarg, R. E. (2007). Anxiety sensitivity and panic attacks: A 1-year longitudinal study. *Behavior Modification*, 31, 145–161.
- Maller, R. G., & Reiss, S. (1992). Anxiety sensitivity in 1984 and panic attacks in 1987. *Journal of Anxiety Disorders*, 6, 241–247.
- Marshall, G. N., Miles, J. N. V., & Stewart, S. H. (2010). Anxiety sensitivity and PTSD symptom severity are reciprocally related: Evidence from a longitudinal study of physical trauma survivors. *Journal of Abnormal Psychology*, 119, 143–150.
- McCabe, R. E., Chudzik, S. M., Antony, M. M., Young, L., Swinson, R. P., & Zvolensky, M. J. (2004). Smoking behaviors across anxiety disorders. *Journal of Anxiety Disorders*, 18, 7-18.
- McCauley, E., Katon, W., Russo, J., Richardson, L., & Lozano, P. (2007). Impact of anxiety and depression on functional impairment in adolescents with asthma. *General Hospital Psychiatry*, 29, 214–222.
- McCoy, K., Shade, D. M., Irvin, C. G., Mastronarde, J. G., Hanania, N. A., Castro, M., & Anthonisen, N. R. (2006). Predicting episodes of poor asthma control in treated patients with asthma. *Journal of Allergy and Clinical Immunology*, 118, 1226–1233.
- McLeish, A. C., Cougle, J. R., & Zvolensky, M. J. (2011). Asthma and cigarette smoking in a representative sample of adults. *Journal of Health Psychology*, 16, 643-52.
- McLeish, A. C. & Zvolensky, M. J. (2010). Asthma and cigarette smoking: A review of the empirical literature. *Journal of Asthma*, 47, 345-361.

- McLeish, A. C., Zvolensky, M. J., Del Ben, K. S., & Burke, R. S. (2009). Anxiety sensitivity as a moderator of the association between smoking rate and panic-relevant symptoms among a community sample of middle-aged adult daily smokers. *The American Journal on Addictions / American Academy of Psychiatrists in Alcoholism and Addictions*, 18, 93–99.
- McLeish, A. C., Zvolensky, M. J., & Luberto, C. M. (2011). The Role of anxiety sensitivity in terms of asthma control: A pilot test among young adult asthmatics. *Journal of Health Psychology*, 16, 439–444.
- McNally, R. J. (2002). Anxiety sensitivity and panic disorder. *Biological Psychiatry*, 52, 938–946.
- Nathan, R. a, Sorkness, C. a, Kosinski, M., Schatz, M., Li, J. T., Marcus, P., ... Pendergraft, T. B. (2004). Development of the asthma control test: a survey for assessing asthma control. *The Journal of Allergy and Clinical Immunology*, 113, 59–65.
- National Heart, Lung, and Blood Institute. (2007). *Guidelines for the diagnosis and management of asthma (ERP – 3)*. Retrieved from <http://www.nhlbi.nih.gov/guidelines/asthma/index.htm>
- National Heart, Lung, and Blood Institute. (2008). *What causes asthma*. Retrieved from <http://www.nhlbi.nih.gov/health/health-topics/topics/asthma/causes.html>
- Norton, P. J., Cox, B. J., Malan, J. Nonclinical panickers: A critical review. *Clinical Psychology Review*, 12, 121-139.
- Payne, T. J., Smith, P. O., McCracken, L. M. McSherry, W. C., & Antony, M. M. (1994). Assessing nicotine dependence: A comparison of the Fagerström Tolerance

- Questionnaire (FTQ) with the Fagerström Test for Nicotine Dependence (FTND) in a clinical. *Addictive Behaviors*, 19, 307-317.
- Pedersen, S. E., Bateman, E. D., Bousquet, J., Busse, W. W., Yoxall, S., & Clark, T. J. (2007). Determinants of response to fluticasone propionate and salmeterol/fluticasone propionate combination in the Gaining Optimal Asthma control study. *The Journal of Allergy and Clinical Immunology*, 120, 1036–1042.
- Piipari, R., Jaakkola, J. J. K., Jaakkola, N., & Jaakkola, M. S. (2004). Smoking and asthma in adults. *European Respiratory Journal*, 24, 734-739.
- Pleis, J. R., Lucas, J. W., Ward, B. W. (2009). Summary health statistic for U.S. adults: National health interview survey, 2008. *National Center for Health Statistics: Vital Health Stat*, 10. Washington, DC: Government Printing Office.
- Pomerleau, C. S., Carton, S. M., Lutzke, M. L., Flessland, K. A., & Pomerleau, O. F. (1994). Reliability of the Fagerström Tolerance Questionnaire and the Fagerström Test for Nicotine Dependence. *Addictive Behaviors*, 19, 33-39.
- Polosa, R., Knoke, J. D., Russo, C., Piccillo, G., Caponnetto, P., Sarvá, M. . . . Al-Delaimy, W. K. (2008). Cigarette smoking is associated with a greater risk of incident asthma in allergic rhinitis. *Journal of Allergy and Clinical Immunology*, 121, 1428-1434.
- Precht, D. H., Keiding, L., Madsen, M. (2003). Smoking patterns among adolescents with asthma attending upper secondary schools: A community-based study. *Pediatrics*, 111, 562-568.
- Reiss, S., & McNally, R. J. (1985). Expectancy model of fear. In: S. Reiss, & R. R. Bootzin (Eds.), *Theoretical issues in behavior therapy* (pp. 107-121). San Diego, CA; Academic Press.

- Ritz, T., Rosenfield, D., Meuret, A. E., Bobb, C., & Steptoe, A. (2008). Hyperventilation symptoms are linked to a lower perceived health in asthma patients. *Annals of Behavioral Medicine : A Publication of the Society of Behavioral Medicine*, 35, 97–104.
- Schatz, M., Zeiger, R. S., Vollmer, W. M., Mosen, D., & Cook, E. F. (2006). Determinants of future long-term asthma control. *The Journal of Allergy and Clinical Immunology*, 118, 1048–1053.
- Schmidt, N. B., Lerew, D. R., & Jackson, R. J. (1997). The role of anxiety sensitivity in the pathogenesis of panic: prospective evaluation of spontaneous panic attacks during acute stress. *Journal of Abnormal Psychology*, 106, 355–364.
- Schmidt, N. B., Lerew, D. R., & Jackson, R. J. (1999). Prospective evaluation of anxiety sensitivity in the pathogenesis of panic: replication and extension. *Journal of Abnormal Psychology*, 108, 532–537.
- Schmidt, N. B., Zvolensky, M. J., & Maner, J. K. (2006). Anxiety sensitivity: prospective prediction of panic attacks and Axis I pathology. *Journal of Psychiatric Research*, 40, 691–699.
- Schneider, A., Löwe, B., Meyer, F. J., Biessecker, K., Joos, S., & Szecsenyi, J. (2008). Depression and panic disorder as predictors of health outcomes for patients with asthma in primary care. *Respiratory Medicine*, 102, 359–66.
- Shapiro, S. S., & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, 52, 591-611.
- Sims, J. M. (2006). An overview of asthma. *Dimensions of Critical Care Nursing*, 25, 264-268.
- Siroux, V., Pin, I., Oryszczyn, M. P., Le Moual, N., & Kauffmann, F. (2000). Relationships of active smoking to asthma and asthma severity in the EGEA study. Epidemiological study

- on the genetics of the environment of asthma. *The European Respiratory Journal*, 15, 470-477.
- Substance Abuse and Mental Health Services Administration. (2003). *Results from the 2002 national survey on drug use and health: Summary of national findings* (DHHS Publication No. 03-3836). Retrieved from <http://www.samhsa.gov/data/2k3/cigs/cigs.htm>
- Substance Abuse and Mental Health Services Administration. (2010). *Results from the 2010 national survey on drug use and health: Summary of national findings* (DHHS Publication No. 11-4658). Retrieved from <http://www.samhsa.gov/data/nsduh/2k10nsduh/2k10results.htm>
- Suzuki, K., Tanaka, H., Kaneko, S., Nishi, M., Teramoto, S., Itoh, S., & Abe, S. (2003). Respiratory symptoms and cigarette smoking in 3,197 pulmonologist-based asthmatic patients with a highly prevalent use of inhaled corticosteroid. *The Journal of Asthma*, 40, 243-250.
- Taylor, S. E. (1999). *Anxiety sensitivity: Theory, research, and treatment of the fear of anxiety*. Lawrence Erlbaum Associates Publishers.
- Taylor, S., Zvolensky, M. J., Cox, B. J., Deacon, B., Heimberg, R. G., Ledley, D. R., ... Cardenas, S. J. (2007). Robust dimensions of anxiety sensitivity: development and initial validation of the Anxiety Sensitivity Index-3. *Psychological Assessment*, 19(2), 176–88.
- U.S. Department of Health and Human Services. (2004). *The health consequences of smoking: A report of the surgeon general*. Atlanta, GA Centers for Disease Control and Prevention.
- Watson, D., O'Hara, M. W., Chmielewski, M., Mcade-Montez, E. A., Koffel, E., Noaragon, K., & Stuart, S. (2008). Further validation of the IDAS: Evidence of convergent, discriminant, criterion, and incremental validity. *Psychological Assessment*, 20, 248-259.

- Watson, D., O'Hara, M. W., Simms, L. J., Kotov, R., Chmielewski, M., McDade-Montez, E. A., ... Stuart, S. (2007). Development and validation of the Inventory of Depression and Anxiety Symptoms (IDAS). *Psychological Assessment, 19*, 253–68.
- Weiser, E. B. (2007). The prevalence of anxiety disorders among adults with asthma: A meta-analytic review. *Journal of Clinical Psychology in Medical Settings, 14*, 297-307.
- Zbikowski, S. M., Klesges, R. C., Robinson, L. A., & Alfano, C. M. (2002). Risk factors for smoking among adolescents with asthma. *Journal of Adolescent Health, 30*, 279-287.
- Zinbarg, R. E., Barlow, D. H., & Brown, T. A. (1997). Hierarchical structure and general factor saturation of the Anxiety Sensitivity Index: Evidence and implications. *Psychological Assessments, 9*, 277-284.
- Zvolensky, M. J., Baker, K. M., Leen-Feldner, E., Bonn-Miller, M. O., Feldner, M. T., & Brown, R. A. (2004). Anxiety sensitivity: association with intensity of retrospectively-rated smoking-related withdrawal symptoms and motivation to quit. *Cognitive Behaviour Therapy, 33*, 114–125.
- Zvolensky, M., Bonn-Miller, M., Bernstein, A., & Marshall, E. (2006). Anxiety sensitivity and abstinence duration to smoking. *Journal of Mental Health, 15*, 659-670.
- Zvolensky, M. J., Feldner, M. T., Leen-Feldner, E. W., & McLeish, A. C. (2005). Smoking and panic attacks, panic disorder, and agoraphobia: A review of the empirical literature. *Clinical Psychology Review, 25*, 761–789.
- Zvolensky, M. J., Forsyth, J. P., Fuse, T., Feldner, M. T., & Leen-Feldner, E. W. (2002). Panic attacks and smoking: An initial investigation of panic-relevant cognitive processes. *Cognitive Behaviour Therapy, 31*, 170-182.

- Zvolensky, M. J., Johnson, K. A., Leyro, T. M., Hogan, J., & Tursi, L. (2009). Quit-attempt history: relation to current levels of emotional vulnerability among adult cigarette users. *Journal of Studies on Alcohol and Drugs*, 70, 551–554.
- Zvolensky, M. J., Lejuez, C. W., Kahler, C. W., & Brown, R. A. (2004). Nonclinical panic attack history and smoking cessation: an initial examination. *Addictive Behaviors*, 29, 825–830.
- Zvolensky, M. J., Leen-Feldner, E. W., Feldner, M. T., Bonn-Miller, M. O., Lejuez, C. W., Kahler, C. W., & Stuart, G. (2004). Emotional responding to biological challenge as a function of panic disorder and smoking. *Journal of Anxiety Disorders*, 18, 19–32.
- Zvolensky, M. J., Schmidt, N. B., Antony, M. M., McCabe, R. E., Forsyth, J. P., Feldner, M. T., Leen-Feldner, E. W., Karekla, M., & Kahler, C. W. (2005). Evaluating the role of panic disorder in emotional sensitivity processes involved with smoking. *Journal of Anxiety Disorders*, 19, 673–686.
- Zvolensky, M. J., Schmidt, N. B., & McCreary, B. T. (2003). The impact of smoking on panic disorder: An initial investigation of a pathoplastic relationship. *Journal of Anxiety Disorders*, 17, 447–460.
- Zvolensky, M. J., Stewart, S. H., Vujanovic, A. A., Gavric, D., & Steeves, D. (2009). Anxiety sensitivity and anxiety and depressive symptoms in the prediction of early smoking lapse and relapse during smoking cessation treatment. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, 11, 323–331.
- Zvolensky, M. J., Vujanovic, A. A., Miller, M. O. B., Bernstein, A., Yartz, A. R., Gregor, K. L., ... Gibson, L. E. (2007). Incremental validity of anxiety sensitivity in terms of motivation to quit, reasons for quitting, and barriers to quitting among community-recruited daily

smokers. *Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco*, 9, 965–75.

Zvolensky, M. J., Yartz, A. R., Gregor, K., Gonzalez, A., & Bernstein, A. (2008). Interoceptive exposure-based cessation intervention for smokers high in anxiety-sensitivity: A case series. *Journal of Cognitive Psychotherapy*, 22, 346-365.

Table 1

Analysis of Covariance Results for Anxiety Sensitivity and Panic Symptoms as a Function of Asthma Diagnosis

Source	<i>df</i>	<i>MS</i>	<i>F</i>	η_p^2	<i>p</i>
Anxiety Sensitivity					
CPD	1	492.41	2.35	.01	.13
Gender	1	1113.94	5.32	.03	.02*
Education	1	135.40	.65	.00	.42
Race	1	372.26	1.78	.01	.18
Asthma	1	1692.81	8.08	.04	.01**
Error	199	209.54			
Panic Symptoms					
CPD	1	32.53	1.26	.01	.26
Gender	1	54.39	2.10	.01	.15
Education	1	22.40	.87	.00	.35
Race	1	85.38	3.30	.02	.07
Asthma	1	242.95	9.39	.05	.00*
Error	201	25.89			

* $p < .05$, ** $p < .01$

Note. *MS* = Mean Square. η_p^2 = partial eta squared; CPD = cigarettes per day.

Table 2

Asthma Diagnosis Predicting Lifetime History of Panic Attacks and Panic Disorder

	<i>B</i>	<i>SE</i>	OR	95% CI	Wald χ^2	<i>p</i>
Panic Attacks						
Step 1						
CPD	-.01	.01	1.00	.97 - 1.02	.10	.75
Gender	1.01	.30	2.74	1.51 – 4.97	10.97	.00**
Education	.20	.13	1.22	.95 - 1.56	2.32	.13
Race	-.66	.31	.52	.28 -.96	4.34	.04*
Step 2						
Asthma	1.08	.33	2.93	1.52 - 5.63	10.32	.00**
Panic Disorder						
Step 1						
CPD	-.00	.02	1.00	.95 - 1.04	.05	.83
Gender	.79	.42	2.20	.96 - 5.03	3.49	.06
Education	.07	.17	1.32	.94 - 1.85	2.53	.11
Race	-.07	.44	.93	.39 – 2.22	.03	.87
Step 2						
Asthma	1.05	.47	2.85	1.13 – 7.17	4.92	.03*

* $p < .05$, ** $p < .01$ Note. *B* = Unstandardized Beta; *SE* = Standard Error; OR = Odds Ratio.

Table 3

Analysis of Covariance Results for Anxiety Sensitivity and Panic Symptoms as a Function of Asthma Diagnosis for Individuals without a Lifetime History of Panic Attacks or Panic Disorder.

Source	<i>df</i>	<i>MS</i>	<i>F</i>	η_p^2	<i>p</i>
Anxiety Sensitivity					
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			
Panic Symptoms					
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			

* $p < .05$.

Note. *MS* = Mean Square; η_p^2 = partial eta squared; CPD = cigarettes per day.

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.

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.