

Anxiety Sensitivity and Reactivity to Asthma-Like Sensations Among Young Adults With Asthma

Behavior Modification

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**Alison C. McLeish¹, Christina M. Luberto^{1,2},
and Emily M. O'Bryan¹**

Abstract

Anxiety sensitivity, particularly the physical concerns domain, is associated with more problematic asthma symptoms and greater functional limitations. It has been theorized that anxiety sensitivity fosters greater reactivity to asthma-related physical sensations; however, this theory has yet to be empirically tested. Thus, the present investigation sought to examine the role of anxiety sensitivity—physical concerns in terms of affective and physical reactivity to asthma-like symptoms. Participants were 101 undergraduates with asthma (76.2% female, $M_{\text{age}} = 19.69$ years, $SD = 3.77$ years, range = 18-49 years) who completed self-report measures and a straw-breathing task. Results indicated that after controlling for the effects of gender, asthma control (i.e., how well one's asthma symptoms are managed or controlled), and negative affectivity, greater levels of anxiety sensitivity—physical concerns significantly predicted greater anxiety (4.7% unique variance) and asthma symptoms (6.9% unique variance) and lower levels of lung function (4.4% unique variance) after the straw-breathing task. These findings suggest that individuals with asthma who are fearful of physiological arousal are a particularly “at-risk” population for poor asthma outcomes because of this greater reactivity and could benefit from interventions targeting anxiety sensitivity.

¹University of Cincinnati, OH, USA

²Massachusetts General Hospital/Harvard Medical School, Boston, USA

Corresponding Author:

Alison C. McLeish, Department of Psychology, University of Cincinnati, P.O. Box 210376, Cincinnati, OH 45221-0376, USA.

Email: alison.mcleish@uc.edu

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Asthma is a reversible chronic obstructive airway disease that occurs in approximately 1 in 12 adults in the United States (Blackwell, Lucas, & Clarke, 2014). If not well controlled through medical intervention, asthma can result in significant rates of morbidity and mortality (American Lung Association [ALA], 2012; Iribarren, Tolstykh, Miller, Sobel, & Eisner, 2012). Unfortunately, despite the existence of a wide range of treatment options, 85% of the individuals with asthma visiting pulmonary clinics report symptoms of poorly controlled asthma (Marcus et al., 2008), resulting in approximately US\$56 billion in health care costs each year (ALA, 2012). Indeed, each year there are approximately 14.2 million physician office visits, 1.8 million emergency department visits, and 14.2 million lost work days due to asthma (Centers for Disease Control and Prevention [CDC], 2013, 2015).

One important contributing factor to poor asthma control is the presence of psychopathology, particularly panic-related psychopathology (Feldman, Lehrer, Borson, Hallstrand, & Siddique, 2005; ten Brinke, Ouwerkerk, Zwinderman, Spinhoven, & Bel, 2001). Indeed, rates of panic attacks and panic disorder are as much as 4.5 times higher among individuals with asthma compared with the general population (Goodwin, Jacobi, & Thefeld, 2003; Goodwin, Pine, & Hoven, 2003; Hasler et al., 2005; Weiser, 2007). Not surprisingly, comorbid panic psychopathology adversely affects asthma. Research has consistently found that despite showing no differences in objective indices of lung function, individuals with asthma and comorbid panic psychopathology report poorer asthma control and quality of life (Feldman et al., 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 compared with individuals with asthma without comorbid panic psychopathology (Feldman et al., 2005; Feldman et al., 2009; Schneider et al., 2008).

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 (AS), defined as the fear of arousal-related physical and psychological sensations due to their perceived negative physical, cognitive, and social consequences (McNally, 2002; Reiss & McNally, 1985). AS reflects a relatively stable, albeit malleable, cognitive predisposition that results in an amplification of preexisting anxiety levels. Results from this emerging body of literature on AS and asthma indicate that independent of asthma severity, AS significantly predicts retrospectively reported anxiety associated with 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). More recent research has found that the physical concerns domain of AS, in particular, is associated with poorer asthma control and asthma-related quality of life (Avallone, McLeish, Luberto, & Bernstein, 2012; McLeish, Zvolensky, & Luberto, 2011).

Taken together, the current body of research indicates that individuals with asthma tend to be fearful of pulmonary-based and other bodily sensations, resulting in poorer asthma outcomes. Theoretically, because AS results in the amplification of fear and anxiety, it may be that AS, particularly the physical concerns domain, fosters greater reactivity to asthma-related physical sensations. Individuals with asthma who are high in AS-Physical Concerns would thus perceive bodily sensations associated with autonomic arousal as a sign of imminent harm, resulting in greater distress about these physical sensations and an increased tendency to catastrophize about them. As a result, these individuals would likely experience elevated levels of anxiety when faced with asthma symptoms, thereby increasing the risk for further asthma symptoms and exacerbations.

However, there has yet to be a direct empirical test of this theory. Moreover, previous research has relied primarily on retrospective recall of reaction to asthma symptoms via self-report measures rather than using laboratory-based biological challenge procedures. Therefore, the aim of the present study was to examine the unique predictive ability of the physical concerns facet of AS (AS-Physical Concerns) in terms of emotional and physical responding to asthma-like sensations among young adults with asthma. It was hypothesized that after controlling for the effects of gender, asthma control, and negative affectivity, AS-Physical Concerns would be predictive of greater anxiety and asthma symptoms as well as decreased lung function (forced expiratory volume in 1 s [FEV₁]) after participating in an asthma symptom induction task (i.e., straw breathing). Negative affectivity was chosen as a covariate on an a priori basis to ensure that any significant findings were due to AS-Physical Concerns and not the more general tendency to experience negative affect (NA). Gender was chosen as a covariate due to higher rates of asthma among females compared with males (CDC, 2012).

Method

Participants

Participants were 101 undergraduate students with asthma (76.2% female; $M_{\text{age}} = 19.69$ years, $SD = 3.77$ years, range = 18-49 years). Asthma diagnosis was based on (a) self-report of a physician diagnosis of asthma; (b) having

experienced asthma symptoms within the past 12 months; and (c) providing evidence of having a current prescription for an asthma-related medication (i.e., bringing their asthma medication(s) with them to the study visit). In terms of the ethnic and racial composition of the sample, 75.2% identified as Caucasian, 14.9% as African American, 5% as Hispanic, 3% as Asian, and 2% as Other. Participants were diagnosed with asthma at an average age of 9.86 years ($SD = 5.95$ years), 46.5% had been hospitalized for their asthma, and 9.7% had been intubated as a result of their asthma. The mean Asthma Control Test (Nathan et al., 2004) score for the sample was 19.47 ($SD = 3.54$), indicating well-controlled asthma.

Measures

Asthma Control Test (ACT). The ACT (Nathan et al., 2004) is a five-item self-report measure that assesses level of asthma control over the past 4 weeks. It measures frequency of asthma symptoms (e.g., “How often have you had shortness of breath?”) and degree of 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?”), with higher scores indicating better asthma control. The ACT shows good reliability, discriminates between groups of patients with different levels of asthma control, and correlates with specialists’ ratings of asthma control (Nathan et al., 2004). Internal consistency was good in the current sample ($\alpha = .82$).

Positive Affect Negative Affect Schedule (PANAS). The PANAS (Watson, Clark, & Tellegen, 1988) is a mood measure commonly used in psychopathology research. A large body of literature supports the reliability and validity of the PANAS (Watson, 2000; Watson et al., 1988). In the current study, only the NA subscale (PANAS-NA) was used to assess the broad-based disposition to experience negative affective states (e.g., anger, anxiety, and depression). Internal consistency for the PANAS-NA in the current sample was good ($\alpha = .81$).

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 derived from the original 16-item ASI (Reiss, Peterson, Gursky, & McNally, 1986) and is composed of one higher-order AS factor and three specific lower-order factors of physical, cognitive, and social concerns (Taylor et al., 2007). The ASI-3 has demonstrated the strongest psychometric properties of any current measure of AS (Taylor et al., 2007). In the current study, only the physical

concerns subscale (AS-Physical Concerns) was used (e.g., “It scares me when my heart beats rapidly”). Cronbach’s alpha for AS-Physical Concerns in the current study was acceptable ($\alpha = .77$).

Asthma Symptom Rating Scale (ASRS). The ASRS is a self-report measure that was developed for the current study that consisted of a list of 12 common symptoms of asthma: dizzy, upset stomach, pins and needles, headache, numbness, chest congestion, coughing, rapid breathing, chest tightness, choking, hard to breathe, and short of breath. Participants were asked to rate how strongly they were experiencing each symptom in the moment on a scale of 1 (*not at all*) to 5 (*extremely*), before and after the straw-breathing task. Internal consistency for the ASRS in the current sample was good ($\alpha = .87$).

Straw-breathing task. To induce asthma-like symptoms, participants were asked to breathe through a narrow straw (approximately 1/8th in. diameter) for as long as possible. This task has been successfully used in previous studies to induce symptoms of breathlessness (Antony, Ledley, Liss, & Swinson, 2006; Deacon et al., 2013). Participants completed three trials of the straw-breathing task, which were separated by 3-min recovery periods. Only data from the final straw-breathing trial were examined.

Subjective Units of Distress Scale (SUDS). The SUDS was used to index participants’ anxiety levels after each straw-breathing trial (Wolpe, 1958). Participants were asked to rate their anxiety on a Likert-type scale from 0 (*no anxiety*) to 100 (*extreme anxiety*).

Spirometry. FEV₁ was measured to assess lung function after each straw-breathing trial using a Piko-1 pocket spirometer (nSpire Health, Inc., Longmont, CO).

Procedure

Participants were recruited from Introductory Psychology courses at a large Midwest university via an online research participation portal (Sona Systems). Interested individuals who were over the age of 18 years and endorsed having asthma were scheduled for an individual study visit. After providing informed, written consent, participants’ eligibility was verified. Participants were eligible to participate in the study if they (a) were between the ages of 18 and 65 years, (b) had a physician diagnosis of asthma, (c) had a current prescription for an asthma-related medication, (d) had experienced asthma-related symptoms within the past 12 months, and (e) were nonsmokers. Only nonsmokers

were included given the known associations between cigarette smoking and both AS (Leventhal & Zvolensky, 2015) and asthma (McLeish & Zvolensky, 2010). Then, participants completed a battery of self-report measures followed by three straw-breathing trials. Participants provided SUDS ratings, rated their asthma symptoms, and had their lung function assessed via spirometry after each straw-breathing trial. Participants received course credit upon completion of the study. The university's institutional review board approved all study procedures prior to data collection.

Analytic Approach

First, zero-order correlations were computed to examine the relationship among all study variables. Then, the main effect of AS-Physical Concerns for the primary-dependent variables was evaluated using a hierarchical multiple regression procedure (Cohen, Cohen, West, & Aiken, 2003). Separate models were constructed for predicting anxiety (i.e., SUDS ratings), asthma symptoms, and FEV₁ after the straw-breathing task. In each model, gender, asthma control, and negative affectivity were entered simultaneously as covariates at Step 1 to control for these theoretically relevant factors. At the second step of the model, AS-Physical Concerns was entered to estimate the amount of variance accounted for by this variable.

Results

Associations between predictor and criterion variables are presented in Table 1. Gender was significantly associated with negative affectivity, AS-Physical Concerns, and post-task anxiety. Decreased asthma control was significantly associated with greater post-task anxiety and asthma symptoms and lower FEV₁. Greater negative affectivity was significantly associated with greater AS-Physical Concerns and post-task anxiety. Greater AS-Physical Concerns was associated with greater post-task anxiety and asthma symptoms and lower FEV₁.

Results for the regression analyses are presented in Table 2. For anxiety after the straw-breathing task, the first step accounted for 19.7% of the variance. Asthma control and negative affectivity were the only significant predictors at this step. Step 2 of the model accounted for 4.7% of unique variance, and, as hypothesized, AS-Physical Concerns was a significant predictor. In terms of asthma symptoms, Step 1 of the model was not significant. Step 2 of the model accounted for 6.9% unique variance, and, as hypothesized, AS-Physical Concerns was a significant predictor. For FEV₁, Step 1 of the model was not significant. At Step 2, consistent with prediction, there was a

Table 1. Descriptive Statistics and Zero-Order Correlations Among All Study Variables.

	1	2	3	4	5	6	7	M	SD	Observed range
1. Gender	—	—	.23*	.28**	.24*	-.05	-.03	—	—	—
2. ACT	—	—	.04	-.09	-.33**	-.24*	.22*	19.47	3.54	11-25
3. PANAS-NA	—	—	—	.43**	.25*	.11	-.05	22.18	6.36	11-42
4. AS-PC	—	—	—	—	.39**	.32**	-.26**	6.76	4.69	0-21
5. Anxiety	—	—	—	—	—	.54**	-.16	39.53	27.37	0-95
6. Asthma symptoms	—	—	—	—	—	—	-.31**	22.59	7.32	12-47
7. FEV ₁	—	—	—	—	—	—	—	0.80	0.22	0.23-1.28

Note. Gender: 0 = male, 1 = female; ACT = Asthma Control Test (Nathan et al., 2004); PANAS-NA = Positive Affect Negative Affect Schedule—Negative Affect subscale (Watson, Clark, & Tellegen, 1988); AS-PC = Anxiety Sensitivity Index—3-Physical Concerns subscale (Taylor et al., 2007); Anxiety = post-task Subjective Units of Distress Scale ratings (Wolpe, 1958); Asthma symptoms = post-task Asthma Symptom Rating Scale scores; FEV₁ = post-task forced expiratory volume in 1 s.

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

Table 2. AS-Physical Concerns Predicting Reactivity to Asthma-Like Sensations.

	ΔR^2	β	t	sr^2	p
Criterion variable: anxiety					
Step 1	.20				.00
Gender		.15	1.52	.02	.13
ACT		-.32	-3.35	.10	.00
PANAS-NA		.23	2.37	.05	.02
Step 2	.05				.02
AS-PC		.25	2.33	.05	.02
Criterion variable: asthma symptoms					
Step 1	.07				.06
Gender		-.15	-1.42	.00	.16
ACT		-.23	-2.30	.05	.02
PANAS-NA		.15	1.44	.02	.15
Step 2	.07				.01
AS-PC		.30	2.76	.07	.01
Criterion variable: FEV ₁					
Step 1	.04				.26
Gender		.03	0.31	.00	.76
ACT		.20	1.97	.04	.05
PANAS-NA		-.06	-0.54	.00	.59
Step 2	.04				.04
AS-PC		-.24	-2.12	.04	.04

Note. β = standardized beta weight; sr^2 = squared semi-partial correlation; ACT = Asthma Control Test; PANAS-NA = Positive Affect Negative Affect Schedule–Negative Affect subscale; AS-PC = Anxiety Sensitivity Index–3–Physical Concerns subscale; FEV₁ = post-task forced expiratory volume in 1 s.

significant main effect for AS-Physical Concerns, accounting for 4.4% of unique variance.¹

Discussion

The current study sought to examine the role of AS-Physical Concerns in terms of physical and emotional reactivity to asthma-like symptoms among young adults with asthma. As hypothesized, greater AS-Physical Concerns was significantly predictive of greater anxiety (4.7% unique variance), asthma symptoms (6.9% unique variance), and lower levels of lung function (4.4% unique variance) after the straw-breathing task. These significant effects were above and beyond the variance accounted for by gender, asthma

control, and negative affectivity. These findings suggest that individuals who fear anxiety-related physical sensations experience greater anxiety and exacerbation of asthma in response to asthma-like sensations.

These findings also support the cognitive-behavioral model of AS and asthma described above. Specifically, it appears that individuals with asthma who also fear anxiety-related physical sensations demonstrate greater emotional and physiological reactivity when confronted with asthma-related symptoms, which may explain the association between AS-Physical Concerns and poorer asthma control and greater functional limitations (Avallone et al., 2012; McCauley et al., 2007; McLeish et al., 2011). Moreover, the results of the current study suggest that individuals with asthma who are fearful of physiological arousal are a particularly “at-risk” population for poor asthma outcomes because of this greater reactivity. Thus, there may be utility in reducing AS in this population to improve asthma outcomes. Indeed, interventions using interoceptive exposure to elicit feared physical sensations have been shown to successfully reduce AS (e.g., Broman-Fulks & Storey, 2008; Feldner, Zvolensky, Babson, Leen-Feldner, & Schmidt, 2008; Gardenswartz & Craske, 2001). Anxiety Sensitivity Amelioration Training (ASAT; Schmidt et al., 2007) may be particularly useful for this population because it is a brief one-session intervention that can be easily implemented in a clinic setting.

Interestingly, contrary to previous research, AS-Physical Concerns was not significantly correlated with levels of perceived asthma control (Avallone et al., 2012; McLeish et al., 2011). The means and standard deviations for both AS-Physical Concerns and asthma control were similar to what was found in these previous studies; however, although the range for asthma control for the current study was also similar to previous research, the range for AS-Physical Concerns was somewhat smaller. Specifically, the highest AS-Physical Concerns score in the current sample was 21 out of 24, whereas previous studies had participants with a maximum score of 24. Thus, this lack of participants with the highest levels of AS-Physical Concerns may have resulted in the nonsignificant correlation with asthma control. It is also worth noting that Step 1 of the regression model was not significant for both of the asthma outcomes. However, Step 1 approached significance ($p = .06$) for asthma symptoms, and asthma control was a significant predictor at Step 1 despite the overall step only approaching significance. For FEV₁, asthma control also approached significance as a predictor at Step 1, although the overall step did not.

These findings do need to be considered in the context of the study's strengths and limitations. In terms of strengths, the current study had a sizable number of African American participants (15%), which is particularly

important given that asthma is more prevalent among minority populations (Akinabi et al., 2012). Furthermore, this is the first study to use a multi-method approach to experimentally induce asthma-like symptoms and use both subjective and objective assessments of asthma symptoms and lung function. Thus, the current findings extend the existing literature on the anxiety–asthma association by establishing effects of anxiety-related risk factors on real-time emotional and physical responding to asthma-like symptoms. There are, however, also a number of interpretive caveats that warrant consideration. First, the study sample was relatively homogeneous in terms of gender and age and had relatively well-controlled asthma. Future studies investigating AS-Physical Concerns and asthma would benefit from more demographically and clinically diverse samples. 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 using individuals with a physician-verified asthma diagnosis are needed. Third, baseline SUDS ratings were not obtained from participants. Although controlling for the effects of negative affectivity mitigates concerns about differences in baseline anxiety levels to some degree, it will be important for future studies to take baseline SUDS ratings into consideration.

Finally, the present cross-sectional design does not permit causal-oriented hypothesis testing. Longitudinal studies are needed to better understand how AS-Physical Concerns affects asthma symptoms and reactivity to such symptoms over time. It is also likely that there are bidirectional associations between AS-Physical Concerns and asthma, and future studies should investigate how asthma-related variables influence AS as well. Despite these limitations, the results of the current study highlight the importance of AS-Physical Concerns in reactivity to asthma symptoms and the potential utility for improving asthma outcomes through targeted interventions to reduce AS-Physical Concerns.

Declaration of Conflicting Interests

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Note

1. To ensure that the findings were specific to the Anxiety Sensitivity (AS)–Physical Concerns and not the other domains of AS, regression models substituting AS-Social Concerns and AS-Cognitive Concerns for AS-Physical Concerns for all criterion variables were examined. None of these models were significant. Results from these analyses can be obtained from the corresponding author upon request.

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Author Biographies

Alison C. McLeish, PhD, is an associate professor in the Department of Psychology at the University of Cincinnati and director of the Health and Anxiety Research Lab. Her research interests focus on understanding associations between anxiety, substance use, and chronic health conditions.

Christina M. Luberto, PhD, is a postdoctoral fellow in Integrative Medicine Research Fellowship at Harvard Medical School and Massachusetts General Hospital. Her research interests focus on understanding the co-occurrence of anxiety-related cognitive risk factors, substance use, and physical health problems and the efficacy of mindfulness and integrative medicine techniques in treating these problems.

Emily M. O'Bryan, BS, is a third-year graduate student in the clinical psychology doctoral program at the University of Cincinnati. Her primary research interest centers on understanding the role of anxiety in health and health behaviors.