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Emotion regulation among adults with asthma: Links with short-acting inhaler medication overuse and utilization of acute medical care

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EMOTION REGULATION AMONG ADULTS WITH ASTHMA: LINKS WITH SHORT-ACTING INHALER MEDICATION OVERUSE AND UTILIZATION OF ACUTE MEDICAL CARE

by
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A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College.

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ABSTRACT

VICTORIA A. GREEN: Emotion regulation among adults with asthma: Links with short-acting inhaler medication overuse and utilization of acute medical care
(Under the direction of Dr. Aaron Lee)

Effective control of asthma symptoms requires daily self-management activities, including use of short-acting or "rescue" inhaled medications. Overuse of short-acting inhaled medications, such as albuterol, can have negative side-effects, including respiratory infections and worse asthma symptom control. Existing research suggests that emotion plays an important role in airway inflammation and asthma symptom control. The objective of this study was to determine whether difficulties regulating emotion was associated with overuse of short-acting inhaled medications and acute medical care usage in adults with asthma. The sample included 401 adults with asthma recruited from an online panel of adults with chronic respiratory disease. Respondents completed a survey that included measures of short-acting medication use, acute medical service use, and emotion regulation (Difficulties in Emotion Regulation Scale [DERS]). Sequential binary logistic regression models were used to examine the association between DERS scores with two indicators of short-acting inhaled medication overuse: using >3 canisters of short-acting inhaled medications in the past three months or self-reported overuse (i.e., using short-acting inhaled medications more than prescribed) while controlling for patient characteristics (current smoking and health insurance status) and comorbid mental health conditions (probable depression and probable anxiety). The results showed that greater difficulties in emotion regulation was significantly associated with greater odds of using more

than three canisters in the past three months (*AOR* = 1.023, 95%CI [1.012, 1.035], $p < .001$) and using short-acting inhaled medications more than prescribed (*AOR* = 1.024, 95%CI [1.014, 1.035], $p < .001$) as well as with greater odds of emergency department visits (*AOR* = 1.018, 95%CI [1.009, 1.028], $p < .001$), and hospitalizations (*AOR* = 1.017, 95%CI [1.007, 1.028], $p = .001$) in the prior 12-months – even after adjusting for probable depression and probable anxiety, current smoking, and health insurance status. In conclusion, emotion dysregulation may play an important role in overuse of short-acting inhaled medications and acute medical care utilization among adults with asthma. Evidence-based interventions to reduce difficulties in emotion regulation may help improve problematic patterns of short-acting medication overuse among adults with asthma.

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INTRODUCTION

Asthma is a chronic respiratory disease with major public health impacts (National Heart Lung and Blood Institute, 2007). The prevalence of asthma in the United States is increasing (Centers for Disease Control and Prevention, 2011). Approximately 50 percent of adults with current asthma have poorly controlled asthma symptoms (Centers for Disease Control and Prevention, 2014). Poor asthma symptom control is associated with increased risk of permanent changes in respiratory severity (Gosavi, Nadig, & Haran, 2016), greater functional limitations (e.g., greater asthma symptom burden; Everhart, Smyth, Santuzzi, & Fiese, 2010), lower quality of life (Hossny, Caraballo, Casale, El-Gamal, & Rosenwasser, 2017), and greater disability (Le & Simon, 2006). Additionally, adults with poorly controlled asthma symptoms have higher use of acute medical care services (e.g., emergency department visits and hospitilizations; Braido, 2013) compared to those with adequate symptom control. Use of these acute healthcare services account for the largest proportion of health care costs among adults with asthma (Bahadori et al., 2009; Ivanova et al., 2012; Rabe et al., 2004). Overall, these results highlight the importance of asthma symptom control.

Effective control of asthma symptoms requires routine self-management activities, including use of short-acting or “rescue” inhaler medications (National Heart & Institute, 2007; Pinnock et al., 2017). However, overuse of short-acting inhaled medications, such as albuterol, can have negative side-effects (Taylor, 2009). For example, overuse of short-acting inhaled medications is associated with more severe asthma symptoms (O'Byrne, 2004). Patients with

asthma who overuse short-acting inhaled medications may experience more frequent symptom exacerbations, which are characterized by a progressive increase in dyspnea and respiratory symptoms (e.g., cough, wheezing or chest tightness) and by a decrease in pulmonary function (Rodrigo, Rodrigo, & Hall, 2004). Greater frequency of acute exacerbations is associated with long-term decline in lung functioning and increased risk of early mortality (Donaldson, Seemungal, Bhowmik, & Wedzicha, 2002; Matsunaga et al., 2014; Rennard & Farmer, 2004; Santibanez et al., 2016; Schmidt et al., 2014). Over time, more frequent acute symptom exacerbations may contribute to irreversible airway remodeling and permanent loss of functional respiratory capacity (Rennard & Farmer, 2004). A retrospective analysis using data from the Medical Expenditure Panel Study found that overuse of short-acting beta agonists was associated with worse mental and physical health (Hee Hong, Sanders, & West, 2006; Slejko et al., 2014). Finally, overuse of short-acting inhaled medications has been shown to be associated with coexisting medical conditions (e.g., chronic bronchitis and emphysema; Diette et al., 1999) and greater risk of developing metabolic syndromes, such as prediabetes and type 2 diabetes (Serafino-Agrusa, Spatafora, & Scichilone, 2015).

Overuse of short-acting inhaled medications is also linked with higher rates of costly acute healthcare use, such as emergency department visits and hospitalizations (Anis et al., 2001). In the United States of America, approximately 400,000 asthma patients were hospitalized in 2010 and hospital inpatient stays totaled roughly 200,000 in 2016 (Centers for Disease Control and Prevention, 2017, 2020). Individuals with asthma also accounted for approximately 1.7 million asthma-related emergency department visits in the United States in 2016 (Centers for Disease Control and Prevention, 2020). High rates of emergency department visits and hospitalizations among individuals with asthma result in major economic burden

(Bahadori et al., 2009). For example, in the United States, the average cost of emergency department visits and hospitalizations for adults with asthma per visit is approximately $1500 and $3100, respectively (Wang, Srebotnjak, Brownell, & Hsia, 2014). Prior studies show that emergency department visits alone, due to worsening of asthma symptoms or poor medication adherence, make up a third of total asthma costs in the United States (Hamdan et al., 2012). Asthma related emergency department visits and hospitalizations also increase an individual's risk of developing several nosocomial infections via contact with ill people and disease-causing pathogens (Monegro & Regunath, 2018). Together, these results underscore the substantial costs and medical complications associated with emergency department visits and hospitalizations.

Adults with asthma and comorbid depressive and anxiety disorders have poorer symptom control and more frequent use of acute services compared to adults without comorbid anxiety and depression (Baiardini, Sicuro, Balbi, Canonica, & Braido, 2015; Di Marco et al., 2010; Katon, Lin, & Kroenke, 2007; Kullowatz, Kanniess, Dahme, Magnussen, & Ritz, 2007). Moreover, evidence suggests that adults with asthma and comorbid depression and anxiety are more likely to overuse short-acting inhaled medications (Gerald, Carr, Wei, Holbrook, & Gerald, 2015; Kullowatz et al., 2007). Some authors have suggested that overuse of short-acting inhaled mediations (e.g., beta 2 agonists) may be a marker for psychological distress among patients with asthma (Gerald et al., 2015). Mental health conditions, such as depression and anxiety, share common underlying transdiagnostic vulnerabilities (Krueger & Eaton, 2015). Among patients with asthma, these vulnerabilities may contribute to the expression of mental health symptoms and maladaptive patterns of short-acting medication use. In addition to overuse of short-acting inhaled medications, psychiatric comorbidities have also been linked to greater use of acute medical care among individuals with asthma and other chronic respiratory diseases (Di Marco et

al., 2010; Leigh, 2019). In particular, anxiety and depression are associated with increased hospitalizations in adults in asthma, with depression playing a more significant role (Kullowatz et al., 2007). Similar studies indicate that among adults with asthma and depression, the likelihood of utilizing emergency department visits or acute medical care services is doubled when compared to those without depression (Patel, Patel, & Baptist, 2017). Overall, this evidence suggests that psychological distress may play an important role in the frequently observed association between mental health comorbidities and acute medical care use among adults with asthma.

Emotion Regulation is the modulating and processing of emotional experiences that is necessary to manage and understand the emotional stressors common in patients with chronic illnesses (Gratz & Roemer, 2004; Wierenga, Lehto, & Given, 2017). Patients who have difficulties with emotion regulation are less able to modulate strong emotional experiences and may have greater difficulty coping with adversities, hardships or daily life stressors. Importantly, dysregulation of emotions is common among patients with mental problems such as depression and anxiety (Amstadter, 2008; Bender, Reinholdt-Dunne, Esbjørn, & Pons, 2012; Mennin, Holaway, Fresco, Moore, & Heimberg, 2007). Emotion and difficulties regulating emotional experiences may also play an important role in symptom severity and respiratory function, among patients with asthma. For example, studies show that among adults with asthma, experimentally induced positive affect leads to greater inability to detect respiratory symptoms, whereas experimentally induced negative affect leads to over-perception of respiratory symptoms (Ghorbani, Khosravani, Ardakani, Alvani, & Akbari, 2017). In addition, experimentally induced negative emotions have been shown to precipitate physiological changes in respiration among patients with asthma, including airway inflammation and reduced forced

expiratory volume (Isenberg, Lehrer, & Hochron, 1992; Kullowatz et al., 2008; Levenson, 1979; Ritz & Kullowatz, 2005; Ritz & Steptoe, 2000; Ritz, Steptoe, DeWilde, & Costa, 2000; Rosenkranz et al., 2005; Von Leupoldt & Dahme, 2005). Some evidence suggests that individuals with chronic respiratory diseases, such as asthma, have more difficulty recognizing and controlling their emotions compared to adults without asthma (Janssens, Verleden, De Peuter, Van Diest, & Van den Bergh, 2009). Importantly, among young adults with asthma, negative affectivity predicts greater deliberate medication non-adherence and poorer respiratory function (Axelsson, 2013). Yet, no studies to date have examined whether difficulties with *regulating* emotion are linked with overuse of short-acting inhaled medications or with increased use of acute medical care services among adults with asthma.

Accordingly, the purpose of this study was to examine the associations of emotion regulation with short-acting inhaled medications and acute medical care use among adults with asthma. We hypothesized that greater difficulties in emotion regulation would be associated with greater short-acting inhaled medication overuse and with greater use of acute medical care (e.g., emergency department visits and hospitalizations) above and beyond probable depression and anxiety, and patient factors associated with worse asthma symptom severity and health care utilization (i.e., smoking, health insurance status).

METHODS

Participants

We recruited and surveyed members of a web-based panel of adults with chronic respiratory diseases, including asthma and COPD (i.e., chronic bronchitis, emphysema). To be included in this study, panel members had to 1) be 18 years of age or older, 2) report having *current* asthma, and 3) report using a short-acting or "rescue" inhaler during the prior three months. A total of 851 panel members initiated the survey. Of these panel members, 778 (91.4%) provided informed consent to participate in the study. Among those who provided informed consent, 428 (55.0%) indicated that they had been diagnosed with asthma by a health care professional. Of those who reported a prior diagnosis of asthma, 27 (6.3%) reported that they did not currently have asthma and were not included in this study. Thus, the total sample included 401 adults with asthma. A subsample of 326 (81.3%) respondents indicated that they had used a short-acting or "rescue" inhaler in the past 3 months.

Dependent Variables

Overuse of Short-Acting Inhaled Medications. We assessed short-acting inhaler use using two separate items. First, respondents were asked whether they had used more than three canisters of short-acting inhaled medications (e.g., albuterol) in the past three months (*Have you used more than three canisters of quick-relief or "rescue inhalers" in the past 3 months?*). Those who reported using more than three canisters in the last three months were categorized as overusing short-acting inhaled medications. This definition of inhaler medication overuse is based on findings from previous studies showing that patients using three or more canisters of

short-acting or "rescue" inhaler medication, during a prior three-month period, have three times greater risk of asthma-related emergency department visits and hospitalizations (Silver et al., 2010), greater symptom burden, lower symptom control and poorer quality of life (Gerald et al., 2015). Second, respondents were asked to rate the extent to which they used short-acting inhaled medications more than prescribed by their health care provider (*During the last three months, have you ever used your short acting or rescue inhaler more than your doctor prescribed because you felt that your symptoms were getting worse?*) on a Likert scale from 1 (*None of the time*), 2 (*A little of the time*), 3 (*Some of the time*), 4 (*Most of the time*), to 5 (*All of the time*). Respondents who endorsed using their short-acting inhaler medications "Most of the time" or "All of the time" were categorized as over-users. This single face-valid item was used to corroborate self-reported short-acting inhaler overuse as determined using respondents' reported use of more than three canisters of inhaler medications in the prior three-month period.

Use of Acute Medical Care. Two types of acute medical care usage were assessed in this study: emergency department visits and hospitalizations**.** We measured emergency department visits by asking respondents if they had visited the emergency room in the past twelve months (*Have you had to visit an emergency room in the past 12 months because of your respiratory condition?*). Similarly, respondents were asked whether they had to be admitted to the hospital in the past twelve months (*Have you had to be admitted to the hospital in the past 12 months because of your respiratory condition?*). Responses to both items were coded as "No" = 0, or "Yes" = 1.

Predictor Variables

Patient Characteristics. A single item from the Medical Expenditure Panel survey was used to determine whether or not a participant currently smokes cigarettes *(Do you now smoke*

cigarettes, every day, some days, or not at all?). A separate item was used to determine the health insurance status of each participant (*Have you had health insurance during the past 12-months?*).

Probable Depression. The Patient Health Questionnaire-2 (PHQ-2) is a two-item measure commonly used to screen for signs of depression. Respondents indicated the frequency, over the last two weeks, with which they have experienced "little interest or pleasure in doing things," and "feeling down, depressed or hopeless," on a four-point Likert scale from 0 (*not at all*) to 3 (*nearly every day*). Responses were summed and a respondent with a total score of three or greater was categorized as having probable depressive symptoms. In previous studies, a cut-point of three or greater on the PHQ-2 has demonstrated up to 97 percent sensitivity and 67 percent specificity among adults (Whooley, Avins, Miranda, & Browner, 1997).

Probable Anxiety. The Generalized Anxiety Disorder-2 (GAD-2) was used to determine whether respondents had a probable anxiety disorder. The GAD-2 is two-item measure that is commonly used in primary care clinics to screen for patients with anxiety disorders. Respondents indicated the frequency with which they have been "nervous, anxious, or on edge," and "not being able to stop or control worrying," on a four-point Likert scale from 0 (*not at all*) to 3 (*nearly every day*). Responses were summed and respondent total scores of three or greater were categorized as having a probable anxiety disorder. A cut-point of three or greater on the GAD-2 has demonstrated a high level of sensitivity (.80) and specificity (.81) for identifying anxiety disorders (Plummer, Manea, Trepel, & McMillan, 2016).

Difficulties with Emotion Regulation. The Difficulties in Emotion Regulation Scale (DERS) is a 36-item questionnaire that represents an individuals' difficulties with emotion regulation (Appendix A-1). Emotion regulation involves (a) recognition and comprehension of

emotions, (b) acceptance of emotions, (c) the ability to control spontaneous behaviors and behave appropriately when experiencing negative emotions and (d) the ability to use proper emotion regulation strategies to regulate emotional responses. DERS items focus on the management of negative emotional states (i.e., many items begin with the phrase "When I'm upset"). Responses to each item are made on a Likert scale from 1 (*almost never*) to 5 (*almost always*). The DERS includes six subscales measuring (a) nonacceptance of emotional responses, (b) difficulty engaging in goal-directed behavior when distressed, (c) impulse control difficulties when distressed, (d) lack of awareness of emotions, (e) limited access to strategies for regulation, and (f) lack of emotional clarity. Additionally, all items can be summed to calculate a total score (range 36-180) with higher scores representing greater difficulties in emotion regulation. The DERS has good predictive validity in predicting trait-like emotion dysregulation (Franklin et al., 2010). The DERS has demonstrated good test-retest reliability over a period of 4 to 8 weeks (Gratz & Roemer, 2004) and has shown good internal reliability in previous studies of adults with a chronic health condition ($\alpha = .94$; Hallion, Steinman, Tolin, & Diefenbach, 2018) and in the current sample ($\alpha = .96$).

Data Analysis

Descriptive statistics were used to characterize the sample. Four separate three-step binary logistic regression models were used to examine the association of DERS with both measures of short-acting inhaler overuse (i.e., using more than three canisters in the past three months and self-reported overuse), and emergency department visits and hospitalizations. Participant medical characteristics (i.e., smoking status and health insurance) were entered in a first step. Psychiatric variables (i.e., probable depression and probable anxiety) were entered in a

second step. The main predictor of interest, the DERS, was added in a third step. All analyses were performed using SPSS 26.0 (IBM Corp, 2016).

RESULTS

Sample Characteristics

The sample was relatively diverse in terms of demographic variables. See Table 1. More than half of the sample was female with an average age of 45.09 (*SD* = 16.43) years. With respect to race and ethnicity, the sample was approximately half White, nearly a quarter Black or African American, and 71.6% non-Hispanic. Three quarters of the sample had equivalent to or more than some college experience and about a third of the sample had an income greater than or equivalent to $55,000 a year. Approximately half of the sample were current smokers. Most participants had health insurance and a primary care provider during the prior 12-months. With regards to short-acting inhaled medication overuse, 38.3% of the sample used more than three canisters within the past three months and 19.4% of the sample reported that they had used their inhaler more than prescribed because they felt as if their symptoms were getting worse. In terms of acute medical care use, 30.7% of the sample visited the emergency department within the past twelve months and 22.4% of the sample had been admitted to the hospital within the past twelve months due to their respiratory condition.

Short-Acting Medication Adherence

A binary logistic regression model was used to assess whether greater emotion regulation difficulty was associated with using more than three canisters in the past three months. Smoking and health insurance status were added in the first step. See Table 2. Smoking was significantly associated with using more than three canisters in the past three months (*AOR* = 6.178, 95%CI [3.664, 10.419], $p < .001$), whereas health insurance status was not (*AOR* = 1.006, 95%CI [.418,

2.419], *p*=.990). Probable depression and probable anxiety were added in the second step. Probable depression was significantly associated with using more than three canisters of short-acting inhalers in the past three months (*AOR* = 3.536, 95%CI [1.496, 8.357], *p* = .004), whereas probably anxiety was not (*AOR* = 1.407, 95%CI [.604, 3.277], *p* = .429). Difficulties in emotion regulation, added in the third step, was significantly associated with greater odds of using more than three canisters of short-acting inhalers in the past three months above and beyond variables entered in the previous two steps (*AOR* = 1.023, 95%CI [1.012, 1.035], *p* < .001). In the third step, probable depression became non-significant (*AOR* = 2.130, 95%CI [.852, 5.323], *p* = .106).

A binary logistic regression model was used to assess whether greater emotion regulation difficulty would be associated with self-reported overuse of short-acting inhaled medications. Smoking and health insurance status were added in the first step. Smoking was significantly associated with short-acting rescue inhaler overuse (*AOR* = 4.178, 95%CI [2.587, 6.750], *p* <.001), whereas health insurance status was not (*AOR* = .997, 95%CI [.426, 2.333], *p* =.995). See Table 3. Probable depression and probable anxiety were added in the second step. Probable depression was not significantly associated with self-reported short-acting rescue inhaler overuse (*AOR* = 1.911, 95%CI [.855, 4.272], *p* = .114), and probable anxiety was also not a significant predictor (*AOR* = 1.043, 95%CI [.466, 2.334], *p* = .919). Difficulties in emotion regulation, added in the third step, was significantly associated with greater odds of self-reported short-acting rescue inhaler overuse, above and beyond variables entered in the previous two steps (*AOR* = 1.024, 95%CI [1.014, 1.035], *p* <.001).

Acute Medical Care

A binary logistic regression model was used to assess whether greater emotion regulation difficulty would be associated with more emergency department visits. Smoking and health

insurance status were added in the first step. Smoking was significantly associated with emergency room visits (*AOR* = 3.784, 95%CI [2.367, 6.047], *p* <.001), whereas health insurance status was not (*AOR* = 1.304, 95%CI [.589, 2.888], *p* =.512). See Table 4. Probable depression and probable anxiety were added in the second step. Probable depression (*AOR* = 1.913, 95%CI [.910, 4.023], *p* = .087) and probable anxiety (*AOR* = 1.101, 95%CI [.530, 2.289], *p* = .796) were not significantly associated with odds of an emergency department visit in the prior 12-months. Difficulties in emotion regulation, added in the third step, was significantly associated with greater odds of an emergency department visit in the prior 12-months, above and beyond variables entered in the previous two steps (*AOR* = 1.018, 95%CI [1.009, 1.028], *p* <.001).

A binary logistic regression model was used to assess whether greater emotion regulation difficulty would be associated with more hospitalizations. Smoking and health insurance status were added in the first step. Smoking was significantly associated with greater risk of a hospitalization in the prior 12-months (*AOR* = 3.991, 95%CI [2.328, 6.841], *p* <.001), whereas health insurance status was not (*AOR* = 1.698, 95%CI [.666, 4.327], *p* =.267). See Table 5. Probable depression and probable anxiety were added in the second step. Probable depression (*AOR* = 1.639, 95%CI [.761, 3.532], *p* = .207) and anxiety (*AOR* = 1.886, 95%CI [.897, 3.967], *p* = .094) were not significantly associated with hospitalizations. Difficulties in emotion regulation, added in the third step, was significantly associated with greater odds of any hospitalizations in the prior 12-months (*AOR* = 1.017, 95%CI [1.007, 1.028], *p* = .001), above and beyond the previous two steps.

Table 1

Sociodemographic and Clinical Sample Characteristics (n = 401).

Variable	*n* (%) or Mean (*SD*)
Age	45.09 ± 16.43
Female	57.9
Race	
White	49.6
Black	27.7
Asian	12.5
American Indian	4.2
Native Hawaiian	2.0
Multiracial	9.2
Ethnicity (Latino)	28.4
Education	
< High school	3.5
High school	21.2
≥ Some college	75.3
Income	
< 15,000	15.7
15,000 to 30,000	21.4
30,000 to 55,000	28.7
≥ 55,000	34.2
Current smoker	52.6
Health insurance	91.3
Primary care provider	94.0
Probable depression (PHQ-2 ≥ 3)	12.5
Probable anxiety (GAD-2 ≥ 3)	13.2
DERS	83.64 ± 28.43
Short-acting inhaled medication use	
>3 canisters in 3 months	38.3
Self-reported overuse	19.4
Emergency Dept. visits	30.7
Hospitalizations	22.4

PHQ-2 = Patient Health Questionnaire-2; GAD-2 = Generalized Anxiety Disorder-2; DERS = Difficulties in Emotion Regulation Scale

Table 2

Binary Logistic Regression Examining the Association between Emotion Regulation (DERS) and > 3 Canisters of Short-Acting Inhaled Medications (n = 326).

	AOR	*SE*	*p*	*95% CI*	
Step 1					
Current Smoker	6.178	.267	<.001	3.664	10.419
Health Insurance	1.006	.448	.990	.418	2.419
Step 2					
Current Smoker	6.039	.275	<.001	3.526	10.343
Health Insurance	1.046	.460	.922	.425	2.577
Probable Depression	3.536	.439	.004	1.496	8.357
Probable Anxiety	1.407	.431	.429	.604	3.277
Step 3					
Current Smoker	5.218	.282	<.001	3.003	9.067
Health Insurance	1.079	.467	.870	.432	2.696
Probable Depression	2.130	.467	.106	.852	5.323
Probable Anxiety	.855	.461	.734	.346	2.111
DERS	1.023	.006	<.001	1.012	1.035

AOR = Adjusted Odds Ratio; DERS = Difficulties in Emotion Regulation Scale

Table 3

Binary Logistic Regression Examining the Association between Emotion Regulation (DERS) and Self-Reported Overuse of Short-Acting Inhaled Medications (n = 326).

	AOR	*SE*	*p*	*95% CI*	
Step 1					
Current Smoker	4.178	.245	<.001	2.587	6.750
Health Insurance	.997	.433	.995	.426	2.333
Step 2					
Current Smoker	4.029	.246	<.001	2.485	6.531
Health Insurance	1.027	.436	.952	.437	2.412
Probable Depression	1.911	.410	.114	.855	4.272
Probable Anxiety	1.043	.411	.919	.466	2.334
Step 3					
Current Smoker	3.441	.256	<.001	2.085	5.679
Health Insurance	1.072	.444	.876	.448	2.561
Probable Depression	1.096	.440	.834	.463	2.596
Probable Anxiety	.626	.439	.287	.265	1.482
DERS	1.024	.005	<.001	1.014	1.035

AOR= Adjusted Odds Ratio; DERS = Difficulties in Emotion Regulation Scale

Table 4

Binary Logistic Regression Examining the Association between Emotion Regulation (DERS) and Emergency Department Visits during the past 12 months (n =401).

	AOR	*SE*	*p*	*95% CI*	
Step 1					
Current Smoker	3.784	.239	<.001	2.367	6.047
Health Insurance	1.304	.406	.512	.589	2.888
Step 2					
Current Smoker	3.606	.241	<.001	2.247	5.789
Health Insurance	1.302	.408	.518	.585	2.897
Probable Depression	1.913	.379	.087	.910	4.023
Probable Anxiety	1.101	.373	.796	.530	2.289
Step 3					
Current Smoker	3.139	.247	<.001	1.934	5.093
Health Insurance	1.272	.411	.558	.568	2.849
Probable Depression	1.229	.400	.606	.561	2.691
Probable Anxiety	.782	.389	.526	.365	1.674
DERS	1.018	.005	<.001	1.009	1.028

AOR = Adjusted Odds Ratio; DERS = Difficulties in Emotion Regulation Scale

Table 5

Binary Logistic Regression Examining the Association between Emotion Regulation (DERS) and Hospitalizations during the past 12 months (n =401).

	AOR	*SE*	*p*	*95% CI*	
Step 1					
Current Smoker	3.991	.275	<.001	2.328	6.841
Health Insurance	1.698	.477	.267	.666	4.327
Step 2					
Current Smoker	3.688	.278	<.001	2.137	6.363
Health Insurance	1.657	.485	.298	.640	4.289
Probable Depression	1.639	.392	.207	.761	3.532
Probable Anxiety	1.886	.379	.094	.897	3.967
Step 3					
Current Smoker	3.181	.284	<.001	1.823	5.549
Health Insurance	1.602	.488	.334	.616	4.166
Probable Depression	1.079	.412	.854	.481	2.421
Probable Anxiety	1.387	.393	.405	.642	2.997
DERS	1.017	.005	.001	1.007	1.028

AOR = Adjusted Odds Ratio; DERS = Difficulties in Emotion Regulation Scale

DISCUSSION

This study is among the first to examine the links between emotion regulation, medication adherence, and utilization of acute medical care among adults with asthma. As hypothesized, difficulties regulating emotion were associated with an increased probability of overusing short-acting inhaled medications and with having one or more emergency room visits or hospitalizations during the prior 12-months. These relationships remained significant even when controlling for patient characteristics (i.e., smoking and health insurance status), and current mental health symptoms (i.e., probable anxiety and depression).

Overuse of Short-Acting Inhaled Medications

Results from the present study suggest that difficulties with emotion regulation play an important role in overuse of short-acting inhaled medications, above and beyond anxiety and depression. A strength of this study is that overuse of short-acting inhaled medications was measured using two separate approaches. First, we assessed respondents self-reported overuse in terms of short-acting inhaled medications using a validated threshold (i.e., use of more than three canisters in the prior three months) associated with worse asthma related outcomes (e.g., greater use of acute medical care, greater asthma symptom burden; Gerald et al., 2015; Silver et al., 2010). Second, we assessed respondents self-reported overuse in terms of their non-adherence to their healthcare provider's recommendations (e.g., using medications more than prescribed because of asthma symptoms). Notably, our results showed that difficulties in emotion regulation was strongly associated with both measures of self-reported inhaled medication overuse.

Together, these results suggest that adults with asthma who experience greater difficulties regulating their emotions are more likely to overuse short-acting inhaled medications.

Prior studies have found that symptoms of anxiety and depression are associated with medication overuse among patients with asthma (Gerald & Moreno, 2016; Strek, 2006; Thomson, 2015). Together these findings suggest that difficulties in emotion regulation, rather than symptoms of anxiety and depression, could contribute to overuse of short-acting inhaled medications among adults with asthma. Specifically, difficulties in emotion regulation may represent an underlying vulnerability among adults with asthma associated with both increased risk of comorbid anxiety and depression as well as with a propensity for overusing short-acting inhaled medications. Indeed, prior studies have consistently identified difficulties with emotion regulation as a stable trait-like vulnerability associated with the development of depression and anxiety (Amstadter, 2008). Patients with anxiety who have emotion regulation difficulties are more likely to engage in compensatory behaviors (e.g., safety behaviors) to reduce aversive emotions (Cisler, Olatunji, Feldner, & Forsyth, 2010). Adults with asthma who have difficulties regulating aversive emotions may use short-acting inhaled medications as a similar compensatory strategy.

Our findings are consistent with prior studies which have shown that strong emotions may trigger asthma symptoms and that negative emotions may worsen asthma symptoms (Lehrer, Isenberg, & Hochron, 1993; Ritz, 2004; Ritz & Kullowatz, 2005). For example, previous studies have demonstrated that greater airway inflammation and bronchial constriction in response to experimental induction of strong emotions and that responsiveness to emotion induced airway were linked with greater patient reported frequency of psychological triggers for asthma symptoms (Ritz et al., 2010). Furthermore, previous research has linked changes in lung

functioning and emotional states (Ritz, 2012). Other studies provide evidence suggesting that negative emotional states are associated with a decrease in lung functioning in asthma patients (e.g., FEV1; Kullowatz et al., 2008; Ritz, 2004; Ritz & Kullowatz, 2005; Ritz & Steptoe, 2000). In addition, studies suggest that different emotions affect breathing patterns in unique ways (i.e., anxious and negative emotions correlate with quick and shallow breathing patterns while happy and positive emotions are associated with slow and full breaths; Philippot, Chapelle, & Blairy, 2002). It is possible that, among adults with asthma, difficulties regulating emotions may precipitate greater asthma symptoms, thus resulting in greater attempts to manage these symptoms using short-acting inhaled medications.

Use of Acute Medical Care

Results from the present study also suggest that difficulties with emotion regulation play a major role in greater use of acute medical care (e.g., emergency department visits and hospitalizations) in the prior 12 months. Prior studies have found that adults with asthma and depressive symptoms have higher rates of hospitalizations (Kullowatz et al., 2007). Collectively, these findings suggest that anxiety, depression, and difficulties with emotion regulation are linked with more emergency department visits and hospitalizations among adults with asthma. Moreover, at least one prior study found that adults with asthma have higher rates of depressive symptoms compared to adults without asthma and that depressive symptoms in adults with asthma are associated with increased risk of hospitalizations and poor health outcomes (Eisner, Katz, Lactao, & Iribarren, 2005; Kewalramani, Bollinger, & Postolache, 2008). The present study extends these findings by demonstrating that difficulties with emotion regulation are significantly associated with acute medical service use, above and beyond variance associated

with depression and anxiety. The present findings suggest that emotion regulation may be an important clinical factor in the treatment and management of asthma symptoms.

Limitations

Findings from this study are qualified by two important limitations. First, overuse of short-acting inhaled medications and acute medical service use were measured using respondents' self-report which is subject to recall errors. Future studies should use electronic medical records (e.g., pharmacy records of canister refills, emergency room visits, in-patient hospitalizations) to objectively assess overuse of short-acting inhaled medications and use of acute medical care. Additionally, future studies could use Metered Dose Inhalers to more accurately measure individuals daily frequency of inhaler use (Nowacki & Brisson, 1985). Such approaches would provide more precise estimates of the relationship between difficulties regulating emotions and overuse of short-acting inhaled medications. However, these strategies require time and expense. Second, we were not able to confirm the medical diagnosis of asthma. Third, this study used a cross-sectional design which undermines our ability to determine the causal relationship between difficulties in emotion regulation and the study outcomes.

Clinical Implications

Our results suggest that difficulties regulating emotion may represent an important vulnerability among adults with asthma. If confirmed by additional studies, our results suggest that certain adults with asthma may benefit from screening for emotion regulation by health care providers (e.g., pharmacists, nurses, physicians) to identify patients at risk for overuse of short-acting inhaled medications or acute service use. Such screening could help reduce risks associated with overusing rescue inhalers (e.g., more severe asthma symptoms, more frequent symptom exacerbations characterized by an increase in dyspnea and decrease in pulmonary

function, and greater risk of developing metabolic syndromes). Further, screening could help reduce unnecessary and costly emergency department visits and hospitalizations. Providing asthma patients with knowledge and skills to regulate emotions and control asthma symptoms could also help limit costly acute medical care use in adults with asthma.

Future research could examine whether patients with asthma may benefit from interventions to reduce overuse of short-acting inhaled medications and utilization of acute medical care. Interventions targeting overuse of inhaled medications and acute service use which focus on treatment of anxiety and depression may not be as effective as treatments targeting emotion regulation directly. For example, emotion regulation skills from existing empirically supported interventions such as Dialectic Behavioral Therapy (DBT) could be used to directly target difficulties with emotion regulation. DBT is a type of cognitive behavioral therapy that was initially developed to treat individuals with borderline personality disorder by providing them the skills necessary to improve their ability to modulate strong negative emotions (Linehan, 2014). These skills include mindfulness skills, interpersonal effectiveness skills, emotion regulation skills, distress tolerance skills and behavioral strategies (Linehan, 2014). The emotion regulation skills section of the DBT treatment manual recommends strategies to help you manage your emotions and increase your emotional resilience (Linehan, 2014). Future studies could assess whether such skill-based interventions could be used to improve emotion regulation in adults with asthma and thus improve medication adherence of short-acting inhaled medications and reduce utilization of costly acute medical care.

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APPENDIX A-1

Difficulties in Emotion Regulation Scale (DERS-36)

Directions: Please indicate how often the following statements apply to you by selecting the appropriate number from the scale above.

Response options: 1 - Almost never (0-10%), 2 – Sometimes (11-35%), 3 - About half the time (36-65%), 4 - Most of the time (66-90%), 5 - Almost always (91-100%)

1. I am clear about my feelings.

2. I pay attention to how I feel.

3. I experience my emotions as overwhelming and out of control.

4. I have no idea how I am feeling.

5. I have difficulty making sense out of my feelings.

6. I am attentive to my feelings.

7. I know exactly how I am feeling.

8. I care about what I am feeling.

9. I am confused about how I feel.

10. When I'm upset, I acknowledge my emotions.

11. When I'm upset, I become angry with myself for feeling that way.

12. When I'm upset, I become embarrassed for feeling that way.

13. When I'm upset, I have difficulty getting work done.

14. When I'm upset, I become out of control.

15. When I'm upset, I believe that I will remain that way for a long time.

16. When I'm upset, I believe that I will end up feeling very depressed.

17. When I'm upset, I believe that my feelings are valid and important.

18. When I’m upset, I have difficulty focusing on other things.

19. When I’m upset, I feel out of control.

20. When I’m upset, I can still get things done.

21. When I’m upset, I feel ashamed at myself for feeling that way.

22. When I’m upset, I know that I can find a way to eventually that way.

23. When I’m upset, I feel like I am weak.

24. When I’m upset, I feel like I can remain in control of my behaviors.

25. When I’m upset, I feel guilty for feeling that way.

26. When I’m upset, I have difficulty concentrating.

27. When I’m upset, I have difficulty controlling my behaviors.

28. When I’m upset, I believe there is nothing I can do to make myself feel better.

29. When I’m upset, I become irritated at myself for feeling that way.

30. When I’m upset, I start to feel very bad about myself.

31. When I’m upset, I believe that wallowing in it is all I can do.

32. When I’m upset, I lose control over my behavior.

33. When I’m upset, I have difficulty thinking about anything else.

34. When I’m upset, I take time to figure out what I’m really feeling.

35. When I’m upset, it takes me a long time to feel better.

36. When I’m upset, my emotions feel overwhelming.