2020

Understanding the Comorbidity of Asthma and Anxiety in Childhood: Characteristics, Vulnerabilities, and Treatment Implications

Nicole Fleischer
Philadelphia College of Osteopathic Medicine

Philadelphia College of Osteopathic Medicine

School of Professional and Applied Psychology

Department of Clinical Psychology

UNDERSTANDING THE COMORBIDITY OF ASTHMA AND ANXIETY IN CHILDHOOD: CHARACTERISTICS, VULNERABILITIES, AND TREATMENT IMPLICATIONS

By Nicole Fleischer

Submitted in Partial Fulfillment of the Requirements for the Degree of

Doctor of Psychology

January 2020

SCHOOL OF PROFESSIONAL AND PSYCHOLOGY

DISSERTATION APPROVAL

This is to certify that the thesis presented to us by Nicole Fleischer

on the 24th day of June, 2019, in partial fulfillment of the requirements for the degree of Doctor of Psychology, has been examined and is acceptable in both scholarship and literary quality.

COMMITTEE MEMBERS' SIGNATURES

Chairperson

Chair, Department of Clinical Psychology

Dean, School of Professional & Applied Psychology

ACKNOWLEDGEMENTS

I was incredibly lucky to have the guidance and support of three amazing mentors throughout this challenging process. Dr. Elizabeth Gosch provided a strong balance between structure and independence, giving me the opportunity to develop my own interests and ideas. Dr. Gosch was always challenging me and pushing me harder to do my best, but in an incredibly positive and supportive way. Next, I would like to thank Dr. Susan Panichelli-Mindel. Every time we had a meeting, it would start with a story of some sort that helped reduce my anxiety and put me at ease. Whether this was the purpose of these stories or not, I was grateful for the brief interlude before jumping into work. I would also like to thank Dr. Phil Kendall. In addition to providing me access to the data for my dissertation, Dr. Kendall provided challenging questions and stellar advice throughout this process. I appreciate all the opportunities and mentorship granted to me by my committee throughout my educational career. I also would like to extend a thank you to Lesley Norris for helping me organize the data and to Dr. Michael Roberts for helping with the statistical analyses.

Those who know me best know my obsession with coffee, which, naturally, played a role in this whole process. I'm grateful for all the local coffee shops I patronized, where I spent hours organizing, outlining, and writing. Coffee shops provided me with a quiet, serene, and calming atmosphere where I could be productive. Along these lines, I am appreciative of the music by Iron and Wine, who placed me in a mindset that allowed me to work without distraction for hours.

I also very much need to thank my friends and family for their constant support. First, my parents, Ken and Lamis, have always been incredibly supportive of me chasing

my dreams, no matter what they were. I couldn't have done this without your love. Thank you also to all my friends who have been unconditionally by my side throughout this process, unwavering in your encouragement. Whether it was helping me clean, taking me rock climbing, or making sure we got in a girl's night (with or without Ryan), I am incredibly grateful for all of you. Amelia, Kat, Kristian, Allison, Lara, Courtney, and everyone else, I couldn't have done this without you. And finally, I am incredibly grateful for Sean, never being hesitant to jump head first into the chaos the moment we met. Though your involvement has been more recent, it is incredibly appreciated.

TABLE OF CONTENTS

ABSTRACT 1

CHAPTER 1: INTRODUCTION 2

Purpose of the Study 8

Hypotheses 9

Hypothesis 1 9

Hypothesis 2 9

Hypothesis 3 10

Hypothesis 4 10

CHAPTER 2: REVIEW OF THE LITERATURE 11

Childhood Asthma 11

Prevalence 12

Medical Treatments 13

Asthma and Anxiety Comorbidity 18

Childhood Anxiety Disorders 19

Biological and Natural Causes of Anxiety Disorders 24

Environmental Etiology of Anxiety 28

Implications of Asthma and Anxiety Comorbidity 33

Characteristics of Children with Anxiety and Asthma 34

Classical Conditioning and Anxiety Acquisition 39

Rachman's Model of Anxiety 41

Treatment of Childhood Anxiety and Asthma 43

Anxiety Disorders 43

Treating Anxiety and Asthma 45
Conclusion 52
CHAPTER 3: METHODS 54
Design ..... **Error! Bookmark not defined.**
Participants 54
Inclusion Criteria 54
Exclusion Criteria 55
Measures 55
Demographics 55
Screen for Child Anxiety Related Emotional Disorders (SCARED; Birmaher et al., 1997; Birmaher, Khetarpal, Cully, Brent, &McKenzie, 1999) 55
Pediatric Anxiety Rating Scale (PARS; Research Units on Pediatric Psychopharmacology Anxiety Study Group, 2002). 56
Coping Questionnaire – Child (CQ-C; Kendall & Marrs-Garcia, 1999) 57
Negative Affective Self-Statement Questionnaire (NASSQ; Ronan et al., 1994). 58
Physical Symptoms Checklist (PSC; Emslie et al., 2006) 58
State-Trait Anxiety Inventory (STAI; Spielgberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) 58
Medical Questionnaire 59
Responder vs. Non Responder: The Clinical Global Impressions-Investigator (CGI-I) 59
Procedure 60
Original Study Procedure 60

Current Study Procedures 60

CHAPTER 4: RESULTS 62

Preliminary Analyses 62

Inferential Statistics 63

CHAPTER 5: DISCUSSION 67

Parental Psychopathology, Anxiety, and Physical Symptoms 67

Negative Self-Talk 70

Worry Themes in Youth with Asthma and Anxiety 71

Response to Treatment 73

Flexibility within Fidelity 74

Medication 74

Generalizability 75

Limitations 75

Future Directions 76

REFERENCES 78

ABSTRACT

This study examined potential differences in youth (aged 7-17 years, 76% Caucasian, 52% female) with comorbid asthma and anxiety compared to youth with anxiety without asthma who received cognitive-behavioral therapy (CBT) alone, pharmacotherapy alone, the combination of pharmacotherapy or placebo pill in the Child/Adolescent Multimodal Study. Two groups were compared on negative self-talk; number of physical symptoms; parental anxiety; content of their worries; and presence of panic, generalized anxiety, and separation anxiety disorders across treatment conditions. Findings indicated that youth with asthma and anxiety were more likely to exhibit higher rates of negative self-talk than youth without asthma, possibly related to the realistic nature of asthma-related anxiety. This study also demonstrated that youth with asthma and anxiety demonstrated similar responses to traditional CBT when compared to youth without asthma. Given the large sample size, these findings support that traditional CBT and pharmacotherapy for anxiety may be an effective treatment for youth with mild to moderate asthma. Further research is needed to determine the efficacy of traditional CBT for youth with severe asthma.

CHAPTER 1: INTRODUCTION

Statement of the Problem

More than 8% of children suffer from asthma, making it the most common chronic illness diagnosed in children (Centers for Disease Control [CDC], 2017). Asthma is characterized by an inflammation of the airways, making breathing difficult (National Institute of Health [NIH], 2014). Symptoms present as chronic, with daily symptoms of breathing difficulties, or episodic, with occasional episodes of severe symptoms. In the latter case, children and adults with asthma may require hospitalization to manage asthma attacks (NIH, 2014). Asthma is often treated with short-term medications to target daily symptoms and long-term medications to prevent and reduce the severity of asthma attacks (McQuaid & Walders, 2003). Asthma treatment requires a level of adherence to medication and an action plan for monitoring symptoms (Bruzzese, Carcone, Lam, Ellis, & Naar-King, 2014; Farrel, Donovan, Turner, & Walker, 2011; Tiggelman, van de Ven, van Schayck, & Engels, 2015). Psychological comorbidities can often reduce asthma adherence and increase complications related to the condition.

Anxiety disorders and asthma are frequently comorbid conditions (Meuret, Ehernreich, Pincus, & Ritz, 2006). Research indicates that the prevalence of anxiety disorders is higher in children with asthma than in the general population (Meuret et al., 2006). Individuals diagnosed with asthma present with increased panic disorder (PD), generalized anxiety disorder (GAD), and separation anxiety disorder (SAD; Roy-Byrne et al., 2008). Anxiety and asthma comorbidity is linked to various negative health conditions (Roy-Byrne et al., 2008; Vila et al., 2003). Individuals with asthma and anxiety may have poor asthma control and an increased use of medication compared to

children with asthma but without anxiety. Children with anxiety coping with asthma are also more likely to report an increase in severity of asthma symptoms, use of healthcare resources, and costs associated with healthcare than are children without anxiety (Roy-Byrne et al., 2008; Vila et al., 2003).

Previous psychosocial treatment modalities have separately addressed asthma management and anxiety in children, with only recent research integrating the treatment and adherence of both disorders into one protocol (Sicouri et al., 2017a). Cognitive-behavioral therapy (CBT) is a treatment that can address the behavioral components of both asthma and anxiety (e.g., treatment adherence, avoidance of potential triggers) along with cognitions that may accompany both conditions (e.g., I will fail, I am going to have an asthma attack at school). However, the research on CBT treatments for comorbid anxiety and asthma is limited. In one study, children with this comorbidity showed some improvement in response to CBT for anxiety, yet the improvement was not as significant as the improvement for children with anxiety without medical diagnoses (Papneja & Manassis, 2006). Other research has demonstrated that CBT paired with asthma education may be effective in helping adults and children with comorbid asthma and anxiety (Ross, Davis, & Macdonald, 2005; Sicouri et al., 2017a). However, small sample sizes make difficult the generalization of the current research to all youth experiencing comorbid asthma and anxiety. More information is needed to determine the best type of psychological treatment to decrease symptoms, increase adherence, and increase quality of life (QOL) for children experiencing comorbid asthma and anxiety.

Why have traditional CBT anxiety treatments failed to significantly improve the life and outcome of individuals with comorbid asthma and anxiety? What are some of the

differences between individuals with this comorbidity and youth with anxiety disorders who do not suffer from asthma? What may be interfering with the success of CBT treatments, specifically for these individuals? To answer these questions, an understanding of the characteristics unique to these individuals and of how these characteristics may moderate CBT treatment outcomes is necessary.

CBT for anxiety targets several behavioral and cognitive components that may maintain a child's anxiety. While not every child with anxiety develops an anxiety disorder in the same way, cognitive vulnerabilities, parental facilitation, and learning experiences contribute to the development and maintenance of anxiety in children. Cognitive vulnerabilities that may increase the likelihood of developing anxiety in childhood include negative self-talk (Kendall & Treadwell, 2007) and anxiety sensitivity (Muris, Mayer, Freher, Duncan, & van den Hout, 2010). Family factors often contribute to the development and maintenance of anxiety in children through family stress, parental psychopathology, and parental accommodation (Pahl, Barrett, & Gullo, 2012; Thompson-Hollands, Kerns, Pincus, & Corner., 2014). Classical conditioning, social learning, and instructional learning also increase a child's susceptibility to developing anxiety (Domjan, 2018; McCleod, Wood, & Avny, 2011; Rachman, 1977). To complicate things further, an asthma comorbidity may interact with these various factors, potentially increasing susceptibility in children with asthma and anxiety.

Children with anxiety disorders often present with higher levels of negative self-talk than those of children without anxiety (Kendall & Treadwell, 2007). Negative self-talk is comprised of various self-statements characterized by common themes of threat and harm typically specific to the child's fears or worries (Kendall & Treadwell, 2007).

These self-statements are associated with higher levels of anxiety in children and may contribute to an increase in severity of anxiety symptoms (Treadwell & Kendall, 1996). However, in regard to negative self-talk, children with asthma and anxiety comorbidities may differ from children with anxiety alone. While research is still limited on negative self-talk in children with this comorbidity, the current literature suggests that children with comorbid asthma and anxiety may focus more on health worries than on other forms of anxious self-talk (e.g., social worries, academic worries; Lind, Nordin, Palmquist, & Nordin, 2014; Lowther, Newman, Sharp, & McMurray, 2016). Studies of adults have demonstrated that increased anxiety and asthma comorbidity is associated with increased health-related worries (Lind et al., 2014). Therefore, children with asthma and anxiety may not necessarily have less negative self-talk; however, the content of the self-talk may differ from that of children without an asthma comorbidity.

Many children with anxiety also present with increased anxiety sensitivity, which prompts these children to appraise physical symptoms as threatening or dangerous (Muris et al., 2010). They may misconstrue increased heart rate, difficulty breathing, or other physical symptoms as symptoms indicative of danger rather than as anxiety-related somatic symptoms. An increase in anxiety sensitivity may be related to anxiety disorders, such as panic disorder (Viana, Kiel, Alfano, Dixon, & Palmer, 2017). Increased anxiety sensitivity is also present in individuals with comorbid asthma and anxiety (Avallone, McLeish, Lubero, & Bernstein, 2012). However, given the nature of asthma treatment, discerning anxiety sensitivity from adaptive awareness of physical symptoms is difficult. Awareness of symptom presentation is an important aspect of asthma treatment management (Farrell et al., 2011), yet some children with anxiety sensitivity may

overread physical symptoms, misinterpreting somatic anxiety symptoms as a warning of an oncoming asthma exacerbation.

Family factors also contribute to the development and maintenance of anxiety disorders in children. Family stress, parental psychopathology, and parental accommodation act as contributing factors to childhood anxiety (Pahl et al., 2012; Thompson-Hollands et al., 2014). Both traumatic events and everyday stressors can interact with a child's ability to cope and manage stress (Thompson-Hollands et al., 2014). Additionally, stressors can increase parental psychopathology, thus impacting a child's own psychopathological development through learning, parental styles, and the development of coping skills (Pahl et al., 2012; Sales, Fivush, & Teague, 2008). Parents can also increase the maintenance of anxiety disorders through accommodation. Accommodation occurs when parents reduce a child's anxiety by removing the child from the anxiety-provoking situation (Lebowitz et al., 2013). While accommodation can be helpful in dangerous situations, accommodation can prevent a child from learning new associations with various situations and fear stimuli. Parental accommodation and modeling may stem from their own psychopathologies. Parents may increase their accommodation because of previous physical threats related to legitimate asthma concerns; however, accommodations may also increase when children are faced with nondangerous situations or triggers. Increased severity in asthma symptoms in children is associated with a trauma history in parents (Wamboldt, Weintraub, Krafchik, Berce, & Wamboldt, 1995). Children with asthma also demonstrated increased anxiety symptoms when at least one parent had a history of psychopathology (Feldman, Ortega, Koinis-

Mitchell, Kuo, & Canino, 2010). These findings suggest that parental psychopathology may act as a risk factor for increased anxiety in children with asthma.

Finally, children may develop anxiety-related thoughts and behaviors through learning. Classical conditioning may increase a child's inclination to view seemingly neutral stimuli as threatening (Domjan, 2018). Furthermore, children may learn to fear certain objects or situations as the result of parental information or transmission of fears from the parents (McCleod et al., 2011; Rachman 1977). Children with asthma have also demonstrated an increase in asthma-related symptoms in response to context clues – symptoms that do not have any biological indicators of pulmonary dysfunction (De Peuter, Lemaigre, Diest, & Van den Bergh, 2008; Rietveld & Brosschot, 1999). Parental psychopathology may also explain an increase of fear learning in children with asthma (Wright, Reiser, & Delparte, 2017). Children with asthma and anxiety learn to fear physical symptoms, potentially asthma-inducing situations, and potential triggers, in part through contextual learning and parental instruction and modeling.

Overall, while research has examined some of the factors that may be related to psychological treatment of asthma and anxiety comorbidity, more information is needed to truly understand the profile of children struggling with asthma and anxiety comorbidity. Children with comorbid asthma and anxiety may present to treatment with higher rates of physical symptoms than children without asthma, as a result of the physiological nature of their medical condition and the increased awareness of physical symptoms related to asthma management strategies. These children may also present with negative self-talk that has different themes than that of children with anxiety alone. Specifically, the negative self-talk may focus more on physical- and health-related

worries than on worries regarding academics or social situations. Given the physical nature of asthma, children with asthma and anxiety sensitivity may be at higher risk for developing panic disorder than children without asthma. In addition, parental psychopathology may increase the presence of GAD or SAD in children with asthma, potentially as a result of vicarious or informational learning about increased asthma health risks. The differences in children with asthma and anxiety comorbidity may impact traditional CBT treatments for anxiety disorders, necessitating the integration of addressing asthma-related symptoms into treatment for children with asthma and anxiety.

Purpose of the Study

Anxiety and asthma are two of the most prevalent conditions facing children (Merikangas, Nakamura, & Kessler, 2009; Meuret et al., 2006). Owing to the negative health consequences associated with a comorbidity of anxiety and asthma, the development of specific treatments for these children may be important. Research on CBT treatments for asthma and anxiety comorbidities is mixed and limited in determining an effective course of treatment for these individuals. More information is needed to understand the presentation of anxiety in children with asthma, and the factors that may differentiate them from patients without asthma anxiety. Understanding these characteristics may help researchers and clinicians explain why current treatments may not be effective and how to effectively treat youth with asthma and anxiety. The purpose of this study is to investigate the differences between children with anxiety and asthma and children with anxiety without asthma. Specifically, this study aims to determine if negative self-talk, content of worries, parental psychopathology, and presentation of physical symptoms are different in children with anxiety with asthma and without

asthma. This study also aims to determine if children with comorbid asthma and anxiety present with higher rates of panic, generalized anxiety, and separation anxiety symptoms when compared to youth without asthma. This study further aims to determine if outpatient CBT in a clinical setting is as effective in treating anxiety in a medically comorbid sample when compared to a nonmedical sample. The results of this study may help determine best practices for informing CBT treatments for children with a comorbid diagnosis of asthma and anxiety.

Hypotheses

This study utilized archival data from the Child/Adolescent Anxiety Multimodal Study (CAMS) trial (Walkup et al., 2008), a randomized control trial comparing cognitive-behavioral therapy (CBT) with sertraline therapy for the treatment of childhood anxiety. The following hypotheses were proposed:

Hypothesis 1

Hypothesis 1: Children with comorbid asthma and anxiety would exhibit higher levels of physical symptoms (PSC), panic symptoms (SCARED), generalized anxiety symptoms (SCARED), separation anxiety symptoms (SCARED), and parental anxiety (STAI), when compared to children without comorbid asthma. A power analysis was computed and determined that 234 subjects were required for a medium effect size at .05 with a power of $\alpha = .80$.

Hypothesis 2

Hypothesis 2: Children with comorbid asthma and anxiety would demonstrate less general negative self-talk (NASSQ) than children with anxiety but without asthma. A

power analysis was computed and determined that 200 subjects were required for a medium effect size at .05 with a power of $\alpha = .80$.

Hypothesis 3

Hypothesis 3: Children with comorbid asthma and anxiety would demonstrate higher occurrences of physical/natural worries (CQ-C) than children with anxiety but without asthma. A power analysis was computed and determined that 143 subjects were required for a medium effect size at .05 with a power of $\alpha = .80$.

Hypothesis 4

Hypothesis 4: Children with comorbid asthma and anxiety would be less likely to be a treatment responder than children with anxiety but without asthma. Alternatively, children with comorbid asthma and anxiety would demonstrate higher levels of anxiety (PARS) in response to the treatment conditions (CBT, Sertraline, Combined CBT and Sertraline, and Placebo) when compared to children with anxiety but without asthma. A power analysis was computed and determined that 200 subjects were required for a medium effect size at .05 with a power of $\alpha = .80$.

CHAPTER 2: REVIEW OF THE LITERATURE

Childhood Asthma

Asthma is such a common illness in childhood that it is discussed by medical professionals and families on a daily basis. Children and adults throughout the world suffer from this chronic illness that inflames and narrows the airways and causes difficulty in breathing (National Institute of Health [NIH], 2014). Individuals may experience chronic symptoms in response to the inhalation of substances (e.g., dog hair, cigarette smoke) on a daily or weekly basis. Constricted airways may require mild medical intervention, such as an inhaler, to reduce impact on breathing (NIH, 2014). Exposure to triggering substances causes the muscles around airways to tighten, reducing airflow in the lungs. Additionally, airways may swell and fill with mucus, further restricting airflow. Chronic symptoms may include wheezing, coughing, tightness of chest, and shortness of breath (Lowther, Newman, Sharp, & McMurray, 2016). However, despite its chronic nature, asthma can also have episodes of severe symptoms resistant to common medical intervention. In these cases, patients with asthma require emergency medicine to manage and reduce symptoms (NIH, 2014).

Asthma is a condition that varies from child to child. Chronic symptoms may not be detectible, or may produce only minor irritation (McQuaid & Walders, 2003). In other situations, a child may experience significant asthma attacks, or exacerbations, in which symptoms are more severe and active. During acute exacerbations, the airways constrict and narrow to reduce exposure to stimuli, also referred to as bronchoconstriction (National Asthma Education and Prevention Program [NAEPP], 2007). This disorder may persist over time or may fall into remission (NAEPP, 2007).

Severity and progression of asthma greatly depend on the child's age (NAEPP, 2007). Children who are diagnosed with asthma before the age of 3 years often have a worse prognosis when entering early adolescence than other children who experienced asthma symptoms later in childhood. This early diagnosis is associated with lung function deficits and atypical lung growth. Overall, age of onset and current age of the child are more highly predictive of symptom severity than are environmental factors.

While asthma puts children at risk for severe health problems and potential death, it also increases risk for many other environmental problems (Farrell et al., 2011; Sales et al., 2008). Children with asthma may also be at risk for school absences, perhaps interfering with their academic performances. Additionally, these children may experience social restrictions because of their asthma (Farrell et al., 2011). For example, a child may not be able to attend a sleepover because he or she may be at risk for an asthma attack, or the friend may have pets that trigger the child's asthma. Overall, asthma presents many social and community limitations to a child's life.

Prevalence

Asthma affects at least 8.4% of children in the United States, and the rates continue to rise each year (Akinbami, Moorman, Garbe, & Sondik, 2009). Asthma is initially more prevalent in boys, but the ratio of diagnoses evens out as children reach puberty (NAEPP, 2007). Children with mixed ethnic backgrounds have the highest rates of asthma (14.1%), while the lowest rates are seen in Asian Americans (5.2%; Centers for Disease Control [CDC], 2017). Asthma is also more often diagnosed in lower income populations, where at least 11.2% of children with asthma fall under the poverty line. Although asthma is prevalent among all demographics, it is most prevalent in lower

socioeconomic status minority youth (McQuaid & Walders, 2003). This prevalence may be related to specific environmental triggers in lower income neighborhoods (e.g., dust, air pollution) or to an increase in severity associated with the reduced access to healthcare in low-income neighborhoods (Pearlman et al., 2006).

Patients with asthma are often more likely to use healthcare services than are individuals without a chronic medical condition. While use of primary-care settings in asthma-related cases is declining, emergency department rates are maintaining stability across time (CDC, 2017). Approximately 1.8 million people are admitted to the emergency room each year as the result of asthma-related symptoms, while asthma-related physician visits are estimated at 14.2 million per year (Asthma and Allergy Foundation of America, 2017). Asthma-related problems include healthcare costs estimated at $56 million per year and 13.8 missed school days (Asthma and Allergy Foundation of America, 2017). Asthma is a condition that involves the use of many resources and prevents children from engaging in normal academic attendance.

Medical Treatments

Medical treatment of asthma depends on the level of care needed and the severity of symptoms. Different levels of healthcare providers may also be involved, depending on the severity of the condition (McQuaid & Walders, 2003). Daily management and mild symptoms may be treated by a primary-care physician or pediatrician. However, more severe symptoms may be treated by a pulmonologist or allergist. Complicated cases may require the referral of a pediatric asthma specialist, who is more qualified than a general provider to manage severe asthma that may be at a higher risk for morbidity (McQuaid & Walders, 2003).

The overall goal of asthma treatment is to reduce the number of exacerbations and active symptoms (Mayo Clinic, 2019). By treating the main symptoms, healthcare professionals also aim to reduce use of short-term asthma medications, physical limitations, and school absences. Asthma treatment includes a combination of medication, exacerbation prevention, and an asthma action plan to target mild symptoms, increase symptom perception, measure peak flow, and choose an appropriate level of care for more severe symptoms (Farrell et al., 2011; Mayo Clinic, 2019). Patients have also shown to benefit from asthma education, from which they learn more about the disorder, potential causes, and treatment options (Farrell et al., 2011). However, the first level of care is determining which asthma medication is appropriate given the child's presenting asthma symptoms.

Asthma medication is typically classified into two categories: short-term relief medications and long-term control medications (Mayo Clinic, 2019; McQuaid & Walders, 2003). Table 1 outlines the common short-term and long-term medications used for asthma. Short-term medications are intended for quick relief during the event of an asthma exacerbation (Mayo Clinic, 2019). They are additionally used before any strenuous activity, such as exercise or sports. Long-term medications aim to reduce the overall inflammation in the patient's respiratory system (Mayo Clinic, 2019). A combination of long-term prevention medications and short-term relief medications provides the best treatment and maintenance for asthma symptoms. Although incidence is low (approximately 3%), some children may experience anxiety as a side effect of long-term corticosteroid use (Ciriaco et al., 2013). This similarity between anxiety and asthma

may be related to some of the physical sensations caused by the medication, including increased heart rate.

Table 1

Medications for Chronic and Acute Asthma Symptoms

Short-term medications	Long-term medications
Anticholinergeics – relieve acute bronchospasms; relax airways; reregulate breathing	Inhaled corticosteroids – reduce overall airway inflammation and prevent use of short-term medications
Beta antagonists – relieve acute symptoms by relaxing smooth muscles; prevent airway from becoming constricted during physical activity	Oral and systemic corticosteroids – control some of the chronic symptoms; helpful at maintaining control during stabilization of long-term medications
Oral corticosteroids – moderate to severe attacks, with more long-term effects; however, may have more severe side effects	Cromolyn sodium and nedocromil sodium – long-term prevention of symptoms; most effective when administered prior to triggers
	Leukotrine modifiers – prevent exacerbations within 24 hours
	Methylxanthines – reduce persistent nocturnal symptoms
	Combined inhalers – contain inhaled corticosteroid and long-acting beta antagonists; long-term control of bronchospasms and anti-inflammatory

In addition to medication, treatment adherence is extremely important to the reduction of asthma symptoms. Consistent use of medications is required to prevent hospital admissions and emergency room visits (Herndon, Mattke, Cuellar, Hong, & Shenkman, 2012). Nonadherence to asthma regimens is associated with asthma-related death (Bruzzese et al., 2014). Nonadherence to medication may additionally reduce the overall effectiveness of reducing asthma symptoms (Murphy et al., 2012; Tiggelman et al., 2015). Medical adherence with asthma is associated with many factors, including relationship with the physician (Bruzzese et al., 2014) and better quality of life (QOL; Tiggelman et al., 2015).

In a study conducted by Bruzzese et al. (2014), the researchers demonstrated that family routines associated with asthma maintenance were predictive of treatment adherence in a sample of African American adolescents. As the family shares the responsibility of medication management, adolescents learn to develop routines for regular asthma treatment. Parental modeling may help these adolescents develop their own competencies in medication routines, resulting in asthma management becoming less intrusive and more habitual. Findings also indicated that parental support was correlated with, but not predictive of, medical adherence (Bruzzese et al., 2014), reflecting the growing autonomy that often accompanies adolescent development.

In a longitudinal study, Tiggelman et al. (2015) demonstrated that QOL was predictive of better medical adherence over 3 years. Adolescents with a higher QOL at baseline were more likely to maintain medication adherence at the end of the 3-year period. Adolescents may associate their QOL with reduced symptoms as a result of medication adherence (Tiggelman et al., 2015). However, the study also demonstrated

that overall medical adherence decreased over time. This decrease may be the result of adolescents' lack of education regarding the importance of medication maintenance or of their perception that the medication is no longer necessary. Yet, this decrease in adherence was not associated with worsening asthma symptoms (Tiggelman et al., 2015). Findings demonstrate the importance of a higher QOL on overall maintenance of asthma symptoms. Children who may have comorbid psychopathology may not be as likely to adhere to medical recommendations than children without a psychological comorbidity.

Research has demonstrated that medical adherence is important for asthma control (Bruzzese et al., 2014; McQuaid & Walders, 2003; Tiggelman et al., 2015). Controlling asthma symptoms through medication management and trigger avoidance can help reduce the occurrence of asthma exacerbations (McQuaid & Walders, 2003) and mortality associated with asthma (Bruzzese et al., 2014). However, more research is needed to determine the factors most efficient at increasing medical adherence among children and adolescents. While family routines (Bruzzese et al., 2014) and a high QOL (Tiggelman et al., 2015) may be helpful in increasing medical compliance, many patients with asthma still struggle to adhere to effective asthma treatment plans. In some cases, adherence may be more difficult for children who have a parent struggling with psychopathology or family stress. More research is needed to understand the best method for increasing medical compliance in patients with asthma, especially when other factors, such as psychological comorbidity, may interfere with QOL.

Currently, asthma action plans are used to develop a daily regimen for children to help reduce their symptoms and increase treatment adherence (Farrell et al., 2011). Within these action plans, children are encouraged to identify their asthma triggers.

Triggers can be environmental (e.g., animals, smoke, pollen), emotional (e.g., crying, anger), and physical (e.g., exercise, dancing). By identifying triggers, the children can learn to avoid the stimuli or be prepared when confronted by the trigger. Additionally, action plans include the monitoring of peak flow – the indication that the airway is changing or narrowing (Farrell et al., 2011). Action plans help children monitor when their airways may be narrowing, allowing them either to take medication or to figure out the next steps of their healthcare plan. Action plans also help children with symptom perception training (Farrell et al., 2011), allowing children to learn when even the slightest symptoms are present, prompting them to take action with medication or get medical help before symptoms become too severe. However, increasing children's perceptions of their asthma symptoms may also increase their perceptions of non-asthma-related physical symptoms, potentially increasing their anxiety about their health. As many asthma symptoms overlap with the physical symptoms of anxiety, symptom perception training may be teaching children to become more sensitive to all the physical sensations in their bodies.

Asthma and Anxiety Comorbidity

Children with asthma are at increased risk of developing anxiety disorders (Katon et al., 2007; Lu et al., 2012). In a recent meta-analysis, Lu et al. (2012) found that adolescents with asthma were significantly more likely to develop anxiety when compared to healthy controls. Specifically, 33% of adolescents with asthma experienced comorbid anxiety, while 21% of healthy adolescents experienced anxiety. Findings have demonstrated that children with asthma are at increased risk of developing anxiety

disorders; however, research is still exploring whether asthma diagnosis and treatment acts as a pathway to certain anxiety disorders.

Asthma is highly comorbid with panic disorder, separation anxiety disorder (SAD), and generalized anxiety disorder (GAD; Katon et al., 2007; Lu et al., 2012; Roy-Byrne et al., 2008). These comorbidities may result from many factors. Children with asthma may develop hypervigilance and fear toward their somatic symptoms, resulting in increased panic attacks (Lu et al., 2012). Asthma and anxiety comorbidity is associated with increased somatic complaints, perhaps explaining diagnoses of panic disorder and GAD (Farrell et al., 2011). These children may experience increased chest tightness, wheezing, and coughing, which may mimic panic symptoms. Asthma exacerbations are also often paired with anxiety and fear, and children may develop a learned aversion to environmental and situational triggers of asthma (e.g., animals, physical activity; Farrell et al., 2011). Furthermore, children with asthma may develop separation anxiety as they may fear what would happen to them if separated from a caregiver.

Childhood Anxiety Disorders

Anxiety disorders are one of the most common psychological problems in childhood and adolescence (Beesdo, Knappe, & Pine, 2009). Anxiety can be characterized as an emotional sense of fear or worry, typically in response to a situation or object (Barlow, 2000). Anxiety is prevalent in individuals from birth and is often a natural, adaptive response to dangerous or threatening situations (Beesdo et al., 2009). Anxiety becomes problematic when the reactions are maladaptive given the circumstances (Spiegler & Guevremont, 2010). Excessive anxiety can interfere with a child's ability to function in school, at home, or in social situations. More than 25% of

adolescents between the ages of 13 and 18 years suffer from anxiety disorder within their lifetime (Anxiety and Depression Association of America, 2017). Furthermore, within 1 year, approximately 13% of children meet criteria for an anxiety disorder (Wilmhurst, 2015). Anxiety disorders are typically more prevalent in female individuals (30% lifetime prevalence) than male individuals (20% prevalence; National Institute of Mental Health, 2017). Anxiety disorders may be caused by multiple factors, including genetics, psychobiology, and conditioning (Beesdo et al., 2009). Symptoms may present as physical sensations, thoughts of negative outcomes, and avoidance of anxiety-provoking situations (Barlow, 2000).

Some childhood anxiety is developmentally appropriate in response to specific situations and events (Beesdo et al., 2009). Most children experience mild levels of anxiety and often have anxious responses when faced with such situations as separation from parents, unfamiliar animals, or school and performance situations (Beesdo et al., 2009). This developmental anxiety can make differentiating normal and maladaptive anxiety in children difficult. Despite being developmentally normal, anxiety can still be distressing for individuals; infants may cry when separated from their parents, and children may feel ill when asked to read a report in front of the class (Beesdo et al., 2009). However, most children naturally learn to adapt to new and anxiety-provoking situations as they age.

Anxiety becomes a disorder rather than just a symptom when it meets the criteria in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5;* American Psychiatric Association [APA], 2013). Children with anxiety disorders experience moderate to intense fear or worries, often resulting in significant distress or excessive

avoidance of the anxiety-inducing situation (Crozier, Gillihan, & Powers, 2011). Fears often revolve around a central theme, including specific items, separation worries, or worries of negative perception (Crozier et al., 2011). However, at times, these worries can be more general and encompass many themes within a short amount of time (e.g., safety, future worries, academic worries).

The most common anxiety disorders in children are SAD, specific phobias (e.g., animal, natural environment, blood-injection-injury, situational), GAD, and panic disorder (PD; Crozier et al., 2011). While these disorders may have overlapping symptoms and presentations, differential diagnosis of anxiety disorders in children can be determined by understanding the central theme of the worries (Crozier et al., 2011). Characteristically, anxiety disorders have two common symptoms: avoidance of anxiety-producing situations and significant cognitive or physical distress. Additionally, anxiety disorders significantly interfere with the individual's functioning at home, school, or in social situations (Cohen et al., 2011).

SAD is an anxiety disorder unique to childhood (Crozier et al., 2011). Children affected by SAD are often anxious about being separated from a caregiver (APA, 2013). They may worry about something frightening happening to the caregiver (e.g., accident, death) or themselves (e.g., kidnapping, injury) when separated. Children with SAD may experience school refusal or tantrums in response to situations in which they may be separated from the caregiver (APA, 2013; Crozier et al., 2011). Children may also have difficulty spending time with friends or going to sleepovers. Furthermore, this fear is out of proportion to the likelihood of occurrence (e.g., parent has never been in a car accident, but the child fears one will happen; Crozier et al., 2011). SAD is most prevalent

in younger children, with approximately 1.9% of children presenting with this diagnosis every year (APA, 2013). However, the rate of SAD diagnoses decreases as children grow older. Childhood asthma may increase the likelihood of developing separation concerns, as children with asthma and anxiety may worry about an attack occurring when separated from their parents.

Another type of anxiety disorder commonly found in children is GAD (APA, 2013). This disorder is characterized by excessive and persistent worrying that is difficult to control (APA, 2013). Children may worry about their performance in school, something happening to their family (e.g., divorce), safety concerns (e.g., burglaries, natural disasters), and new situations or a change in plans. According to diagnostic criteria, children also must be experiencing at least one physical symptom (e.g., muscle tension, sleep disturbance, headaches). However, many children with GAD experience a wide variety of physical symptoms, including shakiness, restlessness, and racing hearts (Cohen, Mychailyszyn, Settipani, Crawley, & Kendall, 2011). GAD is prevalent in approximately 3% of individuals, but decreases in adolescence (0.9%; APA, 2013). Asthma may be a risk factor for GAD, as children with asthma may learn to worry about their overall safety, their health, and the impact asthma has on their lives.

PD is another anxiety disorder that may occur in childhood, though diagnosis is often in late childhood or early adolescence (APA, 2013). Panic disorder results from unexpected and recurrent panic attacks, which are characterized by four or more physical symptoms. Symptoms include racing heart, stomachaches, hyperventilation, sweating, shaking, and dizziness among many others (APA, 2013). Children with PD often develop a fear of these panic attacks occurring and may avoid situations that could trigger their

panic attacks or places they would be unable to seek help if they had a panic attack (e.g., public transportation). PD rates are lower in younger children (less than 0.4%) but increase in adolescence, with a yearly prevalence rate of 2 to 3%. However, panic attacks may still occur in early childhood. Asthma symptom training may increase anxiety sensitivity and overperception of physical symptoms, potentially increasing the risk of children developing PD.

As previously noted, two major symptoms are prevalent across anxiety disorders: the avoidance or intense fear reaction in response to the provoking stimuli and physical symptoms. According to Barlow (2000), the level of avoidance depends on the intensity of anxiety when presented with cues or triggers. Therefore, children with anxiety disorders either avoid the anxiety-provoking situations or endure them with extreme duress (APA, 2013). Endurance may include avoidance as well by not attending to the anxiety stimulus (e.g., closing one's eyes). Children may avoid school, where social evaluation situations may occur, or when they are not prepared for a project or exam. Children may avoid dances, parties, and camps because of separation concerns or fear of evaluation from peers. Additionally, new situations may be handled with intense anxiety, as children may worry about what is going to happen. Furthermore, clinicians theorize that children with GAD may use their constant worrying as a form of avoidance (Cohen et al., 2011). Avoidance may also present as somatic complaints, such as stomach aches, nausea, or muscle tension (APA, 2013; Crozier et al., 2011).

Another common symptom of anxiety disorders is the presentation of somatic symptoms. Somatic symptoms are especially prevalent in children suffering from anxiety disorders (Cohen et al., 2011). These children often experience physical complaints, such

as headaches, muscle tension, restlessness, and stomachaches. Physical symptoms are often linked to increase anxiety sensitivity and impairment in children with anxiety disorders (Cohen et al., 2011). Children may misinterpret their physical symptoms, thinking that something more serious than anxiety is occurring (Pilecki & McKay, 2011). Physical symptoms appear to vary based on the child presentating with anxiety, but their presence remains consistent across diagnoses (Cohen et al., 2011), making differentiating anxiety disorders based on physical symptoms alone difficult. Research has shown that children with GAD, social phobia, and SAD exhibit the same frequency of somatic complaints despite their different themes in worries (Hofflich, Hughes, & Kendall, 2006). As such, manualized treatments targeting somatic symptoms may be effective in reducing physical symptoms across anxiety disorders.

Biological and Natural Causes of Anxiety Disorders

While anxiety is caused by a multitude of factors, genetics and biological etiology can contribute to the development of anxiety disorders in children. Decades of research demonstrate that many individuals who develop anxiety disorders have a biological vulnerability to anxiety (Barlow, 2000; Beesdo et al., 2009). Anxiety may also be the result of neurological abnormalities emergent throughout developmental periods (Jacob, Thomassin, Morelen, & Suveg, 2011). Furthermore, anxiety may be related to different temperamental factors present at birth (Winter & Bienvenu, 2011). While none of these factors singlehandedly leads to an anxiety in children, the role they play in the development of anxiety should be considered.

Genetic vulnerabilities for anxiety. Anxiety disorders in children appear to be related to parental psychopathology (Beesdo et al., 2009). Specifically, children are at

increased risk for an anxiety disorder when both parents are coping with anxiety. Additionally, children with a strong genetic component may be at risk for early onset of anxiety (Arnold & Taillefer, 2011). Despite this heritability, determining the specific gene that is linked to the development of an anxiety disorder is difficult. Instead, multiple genes interact with the environment to increase the likelihood of an anxiety disorder in children (Arnold & Taillefer, 2011).

Genes alone, however, do not determine whether an individual will develop an anxiety disorder (Arnold & Taillefer, 2011; Beesdo et al., 2009). Twin studies have demonstrated that while the heritability for genetic anxiety is moderate, variance in symptoms is better explained by environmental factors (Beesdo et al., 2009). Therefore, anxiety does not have a single genetic cause, but is the result of a relationship between genetic make-up and environmental factors. These interactions may also result in the abnormal development of various brain structures associated with anxiety disorders.

Neurological and biological differences in anxiety. Many variations in brain structure and functioning are present across anxiety disorders in children (Larson, South, & Merkley, 2011). Children with anxiety may demonstrate differences in the size and neural connections between brain structures (Beesdo et al., 2009; Jacob et al., 2011; Larson et al., 2011). Additionally, other biological processes, including the hypothalamic, pituitary, adrenocortical (HPA) axis, may play a role in the onset of anxiety symptoms within the body. When stressful life events occur, the HPA axis triggers the release of cortisol, a stress hormone, into the bloodstream (Faravelli et al., 2012). While HPA axis activity is normal and necessary for fight-or-flight responses in humans, excess stress can

result in increased activity in the HPA axis. These stressors may result in HPA axis hyperactivity in some children.

The most common brain region implicated in anxiety disorders is the amygdala (Beesdo et al., 2009; Larson et al., 2011). The amygdala is often associated with fear and is involved in triggering the fight-or-flight system in response to threatening stimuli. Additionally, the amygdala is involved in various steps of the learning process; neuroimaging research has demonstrated the amygdala's involvement in learning to associate fear with neutral objects and in the amygdala-frontal cortex connection in the extinction process of learning (Beesdo et al., 2009). While the amygdala is a functional component of all humans, some research has demonstrated that it may be more active in children with anxiety. Increased amygdala activity is also associated with inhibition in adolescents (Beesdo et al., 2009).

In addition to the amygdala, other brain structures and connections may play a role in anxiety symptoms (Larson et al., 2011). Children with anxiety may demonstrate abnormalities in the hippocampus, anterior cingulate cortex, insular cortex, orbitofrontal cortex, and prefrontal cortex. As a result, anxiety may be associated with difficulties in executive functioning, memory, and attention. Children with anxiety disorders may have difficulty focusing and shifting attention because of their preoccupation with anxious thoughts. Memories may be affected by anxious emotions. Children with anxiety have also shown difficulty with concentrating, planning, and organizing information as a result of their anxious thoughts (Gualtieri & Morgan, 2008).

Additionally, children with social phobia may demonstrate abnormalities in the basal ganglia, medial temporal lobe, and orbitofrontal cortex (Larson et al., 2011). These

children may demonstrate some motor delays or language issues in addition to anxiety. Children with GAD demonstrate deficits in the superior temporal gyrus and temporal lobe. Deficits, specifically within verbal abilities, complex attention, and delayed memory, may be detectible using neuropsychological functioning. In addition to these neurological differences in anxious children, temperament can play a role in a child's susceptibility to developing pathological anxiety.

Temperament and anxiety. Temperament can generally be understood as an individual's response pattern to emotional or environmental stimuli (Winter & Bienvenu, 2011). Temperament often remains stable over time, from infancy to adulthood. In fact, temperament is thought of as a precursor to personality development. Most theoretical models of temperament describe four specific components: emotionality, extraversion, activity, and persistence (De Pauw & Mervielde, 2010). Emotionality refers to a child's experience of different emotions, including, but not limited to, negative affectivity. Extraversion describes the child's social capacity and social inhibition. Activity specifically references a child's physical-activity levels. Finally, persistence indicates a child's determination and encompasses such concepts as effortful control.

Specific temperamental traits have been linked to later development of anxiety in children. Behavioral inhibition, a specific temperamental style, is characterized by high inhibition, high emotionality, and hypervigilant attention to the environment (Degnan, Almas, & Fox, 2010). Children with behavioral inhibition may also demonstrate behavioral restraint, especially around unfamiliar people, situations, or events (Pahl et al., 2012). Specifically in toddlers, behavioral inhibition may present as withdrawal from the environment (Jacob et al., 2011). Extreme inhibition is associated with the development

of anxiety disorders (Jacob et al., 2011), while approximately 15% of behaviorally inhibited children continue to develop normally without any psychopathology (Pahl et al., 2012).

In a study conducted by Pahl et al. (2012), researchers discovered that higher rates of behavioral inhibition in early childhood predicted higher levels of anxiety. While not all children with behavioral inhibition will develop anxiety, many of the traits overlap with anxiety symptoms. Inhibition may reflect avoidance in certain unfamiliar or anxiety-provoking situations. However, environmental factors may influence the effect of behavioral inhibition on later anxiety development (Pahl et al., 2012).

Environmental Etiology of Anxiety

Parental factors and anxiety etiology. Several parental factors, including family stress, parental psychopathology, and parental accommodation, have been identified that contribute to the etiology of anxiety disorders (Pahl et al., 2012; Thompson-Hollands et al., 2014). Parental and family stress involve various events and situations that may burden the family or child (Pahl et al., 2012). These situations may vary from specific traumatic events, such as a death, to daily stressors, such as financial problems. Additionally, research has demonstrated that parental stress can negatively impact the outcome of anxiety treatment for children (Crawford & Manassis, 2001). Parental stress may also be related to a parent's own psychopathology.

Parental psychopathology can also increase the prevalence of anxiety disorders in children (Pahl et al., 2012). Parental psychopathology can affect the ability to cope, problem solve, and parent effectively (Pahl et al., 2012; Sales et al., 2008). Parents struggling with their own anxiety may use more avoidant coping styles, increasing their

own and their child's anxiety around certain situations or stimuli (Sales et al., 2008). Parental anxiety may also result in anxious parenting styles, potentially acting as a social or informational learning model for later childhood anxious responses.

Parental accommodation has recently evolved as a significant factor in childhood anxiety development and maintenance (Lebowitz et al., 2013; Thompson-Hollands et al., 2014). Parents often intervene when their children are in distress, which is a natural and protective response for many parents. However, parental involvement many sometimes interfere with a child's ability to learn new associations regarding anxious situations and stimuli (Thompson-Hollands et al., 2014). With anxiety disorders, parents may intervene when their children exhibit physical anxious symptoms, helping their children avoid these anxiety-provoking situations. Parents may change their own behaviors to ensure their children's anxiety is reduced (Lebowitz et al., 2013); for example, they may quit their jobs or avoid certain places (e.g., long vacations requiring use of an airplane for transportation). However, because the children are unable to learn that they can tolerate their anxiety or that the situation may not be dangerous because of this avoidance, parental accommodation can increase anxiety severity in children (Lebowtiz et al., 2013). Clinicians may benefit by approaching asthma and anxiety conceptualization from a developmental perspective, including the possibility of parental psychopathology and accommodation as facilitating factors that work in combination with other environmental and biological characteristics.

Cognitive vulnerability and childhood anxiety. According to the cognitive model, one's thoughts affect one's emotions, thereby affecting one's behaviors (Beck, 1967). This theory holds true in both children and adults. As children experience various

situations throughout their development, automatic thoughts arise, leading to potentially anxious emotions. Children with specific cognitive vulnerabilities are more susceptible to developing anxiety disorders than other children (Hong, Lee, Tsai, & Tan, 2017). Intolerance of uncertainty, fear of negative evaluation, and anxiety sensitivity may aid in the development of anxiety disorders in children. While these vulnerabilities alone may be risk factors for anxiety in children, the interaction of vulnerabilities may lead to increased anxiety (Hong et al., 2017). Negative self-talk and anxiety sensitivity are two prominent cognitive vulnerabilities found in children at risk for anxiety disorders.

Negative self-talk. Negative self-talk and negative self-statements are associated with higher levels of anxiety (Treadwell & Kendall, 1996). Children with increased negative self-talk have demonstrated lower psychological adjustment (Treadwell & Kendall, 1996). Even in normal controls, higher reports of anxious self-talk are associated with higher reports of anxiety symptoms (Muris, Merckelbach, Mayer, & Snieder, 1998). In a study conducted by Muris et al. (1998), negative self-talk was found to be positively correlated with anxiety symptoms. Children with more negative self-talk and less positive self-talk are especially more likely to report anxiety symptoms (Sood & Kendall, 2007). Self-reports of negative self-talk are responsive to anxiety treatment (Kendall et al., 2016; Peris et al., 2015; Treadwell & Kendall, 1996); however, higher levels of negative self-talk are associated with less favorable treatment outcomes (Muris et al., 1998).

Negative self-talk in children with anxiety is typically specific to their fears and worries (Muris et al., 1998; Sood & Kendall, 2007). For example, a child with GAD may have increased negative self-talk regarding academic performance or thoughts of failure.

Researchers have demonstrated that children with anxiety often worry about social situations, academic performance, and their families' and friends' well-being (Weems, Silverman, & La Greca, 2000), correlating with symptoms of GAD, SAD, and panic disorder (Muris et al., 1998). Overall, the content of the self-talk of children with anxiety can potentially increase anxious symptoms.

Anxiety sensitivity. Anxiety sensitivity is the cognitive appraisal of physical symptoms as dangerous or harmful (Muris et al., 2010). Children with anxiety sensitivity may perceive their physiological symptoms as having severe psychological consequences, such as humiliation or losing control. Anxiety sensitivity is associated with increased anxiety symptoms, especially panic-related symptoms (Viana et al., 2017). Additionally, anxiety sensitivity is related to higher levels of behavioral inhibition and negative affectivity. Viana et al. (2017) found that elevation among anxiety sensitivity and temperamental predispositions for anxiety may affect the cognitions associated with physical anxiety symptoms.

Children reporting anxiety sensitivity may be specifically vulnerable to developing anxiety disorders (Dia & Bradshaw, 2008), as they learn to fear their own body arousal and psychological sensations (McNally 2002; Reiss & McNally, 1985). Children with anxiety sensitivity perceive these sensations as potentially having negative consequences, including physical problems and social embarrassment (McLeish, Luberto, & O'Bryan, 2016). Anxiety sensitivity represents an underlying fear associated with many different anxiety disorders (McNally, 2002). As children develop a fear of their physical symptoms, they may increase their risk of various anxiety disorders based on the situations in which these physical symptoms are experienced.

Anxiety sensitivity differs from negative self-talk in that it consists of four factors that may contribute to and fuel a child's fears (Silverman, Goedhart, Barrett, & Turner, 2003). Children with anxiety sensitivity worry that something is wrong with them mentally. They also worry that their somatic symptoms may represent a harmful physical disease or sickness. These children further worry that their various symptoms may make them physically weak. Finally, children may worry that others will be able to perceive their physical symptoms or anxiety. These four factors may be present together, separately, or in a variety of combinations, potentially leading to various anxiety disorders.

Researchers have demonstrated that children with anxiety sensitivity have a greater risk of developing anxiety disorders (Dia & Bradshaw, 2008). Anxiety sensitivity is especially elevated in individuals with PD (Craske & Barlow, 2014), as children may associate their physical symptoms with a loss of control, going "crazy," or a significant illness. In a study conducted by Dia and Bradshaw (2008), researchers examined the relationship between anxiety disorders and anxiety sensitivity in 185 adolescents receiving treatment for an anxiety disorder. Dia and Bradshaw (2008) demonstrated that these four factors of anxiety sensitivity were associated with different anxiety disorders. GAD in adolescents was associated with concerns of mental well-being, while social anxiety was associated with fear of social perception regarding their anxiety. Additionally, PD was associated with disease concerns and concerns about feeling weak. Disease concerns also predicted increased SAD (Dia & Bradshaw, 2008). Thus far, the research suggests that children's perceptions of their own bodily sensations can shape their future psychopathology.

Anxiety sensitivity may explain how some children develop anxiety disorders while others are able to move past developmentally normal anxiety. All children experience physical symptoms of anxiety at some point, yet the response to their symptoms varies from child to child (McNally, 2002). Research has demonstrated that anxiety sensitivity may predispose children to develop pathological levels of anxiety when experiencing physical symptoms in certain situations (e.g., when performing in front of others, when separating from a caregiver; McNally, 2002); however, more research is needed to determine the role anxiety sensitivity may play in anxiety comorbidity with medical illnesses.

Implications of Asthma and Anxiety Comorbidity

The co-occurrence of anxiety and asthma is associated with many severe medical and psychosocial consequences. Anxiety disorders are positively correlated with asthma severity (Farrell et al., 2011). While more research is needed to understand these correlations, researchers have hypothesized that the consequences of unmaintained asthma may increase anxiety (Farrell et al., 2011). Additionally, comorbidity of anxiety and asthma increases complications associated with asthma, possibly resulting from the association of anxiety with poor asthma control (Roy-Byrne et al., 2008). Comorbidity is specifically associated with increased use of healthcare services and an overall increase in the cost of healthcare. Children with asthma and anxiety are more likely to use the emergency room and be hospitalized for their asthma. Anxiety and asthma are related to increased school absenteeism (Farrell et al., 2011), as these children may miss school as a result of hospitalization and healthcare use.

School absenteeism and asthma severity can also contribute to impaired QOL in children with comorbid anxiety and asthma. In a study conducted by Vila et al. (2003), researchers found that comorbid asthma and internalizing psychological problems accounted for decreases in QOL in adolescents. Additionally, researchers demonstrated that QOL was negatively affected by children's limitations in activity (Vila et al., 2003). This negative effect may result from disruptions in interacting with peers or participating in age-normative activities. Children with asthma may have difficulty engaging and interacting with peers, potentially resulting in anxiety in social situations or low self-esteem.

Anxiety sensitivity and attentional bias may have a negative effect on asthma control. Given the intention of action plans and symptom perception training, children with asthma are educated to become more perceptive of their physical symptoms to increase awareness of potential asthma exacerbations (Farrell et al., 2011). As a result, children with asthma may read symptoms, such as an increased heart rate or difficulty breathing, as early signs of an asthma exacerbation, despite no physiological cause for these symptoms. Anxiety sensitivity and attentional bias may increase the chances of developing anxiety disorders in children with asthma. Additionally, these characteristics may contribute to the generalization of learning from certain situations and triggers to broader contexts that might trigger an asthma exacerbation. For example, children who are often triggered by pet dander may develop anxiety symptoms whenever they see an animal from a distance.

Characteristics of Children with Anxiety and Asthma

As previously mentioned, certain childhood characteristics may predispose children to developing anxiety. Given the high comorbidity between anxiety and asthma, researchers have examined various characteristics within these children that may increase their likelihood of developing anxiety. Additionally, some of these factors may interfere with psychological and medical treatment for asthma and anxiety. Table 2 summarizes the literature outlining anxiety sensitivity, health worries, attentional biases, and negative self-talk in individuals with asthma and anxiety.

Patients with asthma may have an attentional bias toward their symptoms and any cues that remind them of an asthma exacerbation (Dudney et al., 2017; Lowther et al., 2016). Parental anxiety has also been shown to increase these attentional biases children have regarding their asthma symptoms (Lowther et al., 2016). This attentional bias may increase a child's perception of actual asthma symptoms or asthma-like somatic symptoms, potentially causing him or her to overlearn a fear response toward somatic symptoms. Furthermore, attentional bias toward asthma symptoms may be a learned response from observing parents' fear reactions regarding airway constriction concerns.

Children with asthma and anxiety may also exhibit anxiety sensitivity in response to their various physical symptoms (McLeish et al., 2016). Children with anxiety sensitivity are more likely to view their asthma symptoms negatively, possibly leading to the misinterpretation of potential panic-like symptoms as something more medically related (Carr, Lehrer, Rausch, & Hochron, 1994). Thus, anxiety sensitivity is likely to predispose patients with asthma to increased and unnecessary panic attacks. Anxiety sensitivity in patients with asthma was also related to poor asthma control (McLeish et

al., 2016). Anxiety responses may increase their reactivity to asthma-like symptoms, potentially decreasing their ability to adaptively cope to both panic and asthma attacks.

Table 2
Literature Summary of Psychological Characteristics of Anxiety and Asthma

Articles	Sample	Research outcomes
Dudeney et al., 2017	Children aged 8-13 years; asthma and anxiety group compared with anxiety only group	Poor asthma control was associated with increased attentional biases toward asthma-like symptoms.
Lowther et al., 2015	Children between 9-12 years old; asthma group compared with nonasthma group	Children with asthma demonstrated an attentional bias toward asthma-like words, but not any other negative words. Children in the asthma group had higher rates of caregiver anxiety than children without asthma. Higher paternal anxiety was associated with increased attentional bias in children with asthma.
Rietveld & Brosschet, 1999	Literature review	Children may experience increased negative self-talk during asthmatic exacerbations, potentially leading them to experience panic.
McLeish et al., 2010	Adults with asthma	Fear of asthma symptoms related to anxiety sensitivity was linked to decreased asthma control.
McLeish et al., 2016	Undergraduate students with asthma	Increased anxiety sensitivity was associated with decreased lung functioning, indicating that individuals with asthma and anxiety may have increased reactivity to asthma symptoms.
Lind et al., 2014	Adults with various allergic and	Allergic asthma was more likely to be associated with anxiety than nonallergic asthma. Increased health worries in these

	nonallergic medical conditions	individuals were more likely to be associated with increased anxiety.
Carr et al., 1994	Adults with and without asthma	Panic attacks are more common among individuals with negative cognitions regarding their somatic symptoms regardless of asthma diagnosis. Individuals with asthma and panic disorder were more likely to have more catastrophic beliefs and negative cognitions regarding body sensations than individuals without asthma.
Avallone et al., 2012	Adults from an asthma and allergy clinic	Anxiety sensitivity of physical sensations predicted worse asthma control, increased asthma symptoms, lower emotional function, and a greater effect of environmental stimuli on symptoms.
Feldman et al., 2010	Puerto Rican parents and their children	Parental psychopathology was associated with higher rates of anxiety and asthma comorbidity. These rates of parental psychopathology were not demonstrated with children with depression.
Wamboldt et al., 1995	Children with asthma and their parents	Children with severe, chronic asthma were more likely to have a parent with a history of trauma than children without asthma. This trauma history was associated with increased parental emotional distress and psychopathology. Parental trauma was also associated with child psychopathology.

The literature further examines the role of negative cognitions on higher rates of anxiety and asthma comorbidity. Individuals with both anxiety and asthma demonstrate greater health worries and negative cognitions regarding their somatic presentations than children with asthma alone (Carr et al., 1994; Lind et al., 2014). Specifically, their

cognitions were more likely to be catastrophic in response to asthma-like symptoms. While children with comorbid asthma and anxiety may still exhibit increased negative self-talk, the content of this self-talk may be different from that of anxious children without a medical comorbidity. Children with comorbid asthma and anxiety may focus more on their health-related worries and less on other worries that typically accompany anxiety disorders (e.g., school, social situations; Lind et al., 2014).

Findings also demonstrate the potential relationship between parental psychopathology and increased asthma and anxiety. Children of parents with a history or current presentation of psychological distress were more likely to have an anxiety disorder themselves when compared to other developing children (Feldman et al., 2010; Wamboldt et al., 1995). In some cases, childhood illness may act as a trigger for parental psychopathology, potentially leading to retraumatization (Wamboldt et al., 1995). While parental psychopathology apparently affects the development of childhood anxiety and the medical trajectory of asthma, more information is needed to understand the interaction between genetics, parental modeling, and vicarious learning.

Overall, findings demonstrate that a relationship may exist between anxiety sensitivity and the role cognitions play on the presentation and development of an asthma and anxiety comorbidity. Anxiety sensitivity has many negative effects on asthma functioning and should be addressed in treatment of children with asthma and anxiety comorbidity. Additionally, negative self-talk may present with a larger focus on health-related worries in this population, again showing the need to specifically address the different content of these worries in treatment. However, more research is needed to further understand how these characteristics may present in children with an asthma and

anxiety comorbidity, as much of the research so far has been conducted only on adults. Additionally, more research is needed to understand how anxiety sensitivity and negative self-talk in asthma and anxiety comorbidities may affect treatment protocols for this population.

Classical Conditioning and Anxiety Acquisition

One of the most commonly studied methods of behavioral learning is classical conditioning, also known as Pavlovian conditioning. According to classical conditioning theory, individuals learn to perform a conditioned response when a conditioned stimulus is presented (Domjan, 2018). This learning is the result of pairing a neutral stimulus with a stimulus that elicits a particular response. Specifically, for anxiety, the neutral stimulus (e.g., dog) is paired with a previous stimulus (e.g., dog bark) eliciting a fear response (e.g., startle). Through repeated pairings of the neutral stimulus and unconditioned stimulus, the individual begins to associate the neutral stimulus with the unconditioned response. This pairing causes the neutral stimulus to then become a conditioned stimulus, creating an association between the conditioned stimulus and conditioned response. After sufficient learning, the unconditioned stimulus is no longer needed for the response to occur.

Within specific disorders, fear conditioning is demonstrated to increase avoidance or fear response regarding specific triggers, situations, and even body sensations. Within panic disorder, individuals learn that specific body sensations (e.g., increased heart rate) are associated with an increased sense of danger (Clark & Barlow, 2014). SAD may develop in individuals who have previous experiences of adverse social relationships (Heimberg & Magee, 2014). For example, bullying in childhood may lead someone to

develop a conditioned fear response to social situations. In cases of GAD, individuals may learn that the actual act of worrying (e.g., what is going to happen in the future) can act as a means of avoiding the present moment (Roemer & Orsillo, 2014). For example, a child may worry about her future in college to avoid the present anxiety she may feel while taking a test. Overall, conditioning is a major factor in the development of anxiety disorders and plays a role in the type of disorder a child may acquire.

Some research has demonstrated that asthma-related symptoms may also result from contextual learning. Children and adults with asthma may develop asthma-like somatic symptoms in response to contextual cues versus actual physiological triggers (De Peuter et al., 2007; Rietveld & Brosschot, 1999). Rietveld, Van Beest, and Everaerd (1999) demonstrated that adolescents can have an asthma exacerbation caused by mental stress, yet biological indicators of pulmonary functioning remain normal throughout the attack. Additionally, many studies have demonstrated that asthma symptoms can increase when individuals are presented with a placebo asthma drug (De Peuter et al., 2007) or contextual cues that previously preceded an asthma attack (De Peuter et al., 2007). Children and adults may learn to associate various settings, situations, or thoughts with their asthma, potentially resulting in an uncued asthma attack. However, more research is needed to determine the role that conditioning and contextual learning have in asthma attacks.

Rachman (1977) proposed several limitations to the explanation of classical conditioning in fear acquisition. First, classical conditioning does not explain why some potentially fear-inducing situations do not result in learned anxiety or fear. For example, traumatic situations may not result in classical conditioning of neutral stimuli despite

repeated and intense exposure. Second, classical conditioning is not easily produced in humans in a laboratory setting. Although examples such as Little Albert (Watson & Rayner, 1920) exist, other research has demonstrated that creating long-lasting fears in humans is difficult in a laboratory setting. Third, classical conditioning research has not demonstrated the equipotentiality premise. That is, not all neutral stimuli are likely to become conditioned fear stimuli. Instead, conditioning is more likely to occur when the stimuli have a stronger biological significance (e.g., fear of dogs vs. fear of glasses). Fourth, classical conditioning does not account for the distribution of fears. Specifically, some fears are too common or too rare to be attributed to classical conditioning alone. Fifth, many individuals are unable to report a significant event or situation that is associated with the onset of their fear. As such, fear onset is difficult to attribute to classical conditioning alone. Finally, classical conditioning does not take into account vicarious transmission of fears. Individuals may develop anxiety or fears based on modeling and fear reactions from others. To address these limitations, Rachman (1977) updated the theory to include the transmission of information and vicarious acquisition of trauma.

Rachman's Model of Anxiety

Rachman proposed an expansion of the classical conditioning theory to address the limitations of the conditioning theory in explaining the development of anxiety disorders in children. While the classical conditioning theory is helpful in explaining many ways anxiety can formulate in children, it fails to explain the acquisition of fear or failure to develop fear in certain situations (Rachman, 1977). More so, classical conditioning is not enough for individuals to associate seemingly neutral stimuli as

fearful or anxiety provoking (McLeod et al., 2011). Therefore, Rachman (1977) developed an alternative theory that elaborated on other ways children may develop anxiety.

While still acknowledging the importance of conditioning on the development of anxiety, Rachman (1977) recommended two additional explanations for anxiety development in children. First, children may develop fears from the transformation of information, or instruction-based learning (McCleod et al., 2011; Rachman, 1977). A child may develop a fear of strangers after a mother warns her child time and again of the potential dangers of strangers. Second, children may develop anxiety based on vicarious transmission of fears (McCleod et al., 2011; Rachman, 1977). Children develop fears because their parents model anxious behaviors. In this case, children may hear their parents verbalize their own anxious self-talk when separating from their child. Overall, these additions to conditioning theory are helpful in explaining why children may acquire fears despite not having direct exposure to the feared stimulus (Rachman, 1977). A similar theoretical approach can be used to explain why some children with asthma develop physical symptoms without a biological explanation.

Parental psychopathology, specifically health anxiety, has been shown to increase children's own anxiety regarding their health (Marshall, Jones, Ramchandani, Stein, & Bass, 2007; Wright et al., 2017). Findings from Wright et al. (2017) demonstrated that parental depression and health anxiety are linked to increased health anxiety in their children. This association may be the result of parental modeling or informational learning; children learn that physical sensations and illness are to be feared because of their own parents' fears. Additionally, Marshall et al. (2007) compared the cognitions of

children with medically ill parents and those of children with a parent diagnosed with somatoform disorder. Findings exhibited that children of parents with a psychological illness scored higher on negative health cognitions, with increased fear of body sensations (Marshall et al., 2007). While these studies on parental psychopathology and its effects on child health anxiety are just preliminary, they demonstrate the potential impact that parental modeling may have on anxiety acquisition in children.

As previously stated, while classical conditioning can explain some aspects of anxiety and asthma development, other learning styles should be examined as potential causes of increased anxiety and asthma exacerbations (Rachman, 1977). Children with both anxiety and asthma may develop increased symptoms as a result of modeling and vicarious learning, typically from their parents. With asthma, children who have parents with more emotional difficulties demonstrate lower asthma functioning and increased internalizing symptoms (Al Ghriwati, Winter, Everhart, & Fiese, 2017). Furthermore, families associated with more positive problem-solving capabilities and increased functioning were associated with decreased internalizing psychopathology in children with asthma (Al Ghriwati et al., 2017). This association may be the result of learning from the parent's own fears and anxiety regarding the child's medical condition. Whether this learning is the result of modeling or vicarious-information processing is unclear; however, the significance of family emotionality on childhood asthma and anxiety functioning should be noted.

Treatment of Childhood Anxiety and Asthma

Anxiety Disorders

Cognitive-behavioral therapy (CBT) has shown to be effective in treating anxiety disorders in children (Kendall et al., 2016). CBT has shown to decrease physiological symptoms and cognitive symptoms and to increase coping skills associated with anxiety disorders in children. CBT is also helpful in targeting the maladaptive thoughts associated with childhood anxiety by challenging these negative thoughts (e.g., what evidence is there that mom will be fine?; Kendall et al., 2016; Peris et al., 2015). Meta-analyses have demonstrated that CBT for children with anxiety continues to be one of the most effective treatment modalities for reducing anxiety symptoms (Crowe & McKay, 2017; Hofmann, Asnaani, Vonk, Sawyer, & Fang, 2012). Findings from a recent meta-analysis conducted by Crowe and McKay (2017) supported that CBT is significantly more effective than no treatment for anxiety and is the standard treatment for childhood anxiety disorders.

A meta-analysis conducted by Hofmann et al. (2012) concluded that CBT is the preferred treatment for childhood anxiety disorders. One of the most commonly implemented CBT protocols for childhood anxiety is the Coping Cat, which was initially developed for children with GAD, social phobia, and SAD (Kendall & Hedtke, 2006). The Coping Cat integrates cognitive techniques, such as addressing cognitive distortions, with behavioral tasks, such as exposure and problem solving. The Coping Cat has demonstrated an increase in coping skills and a decrease in reports of distress associated with anxiety (Albano & Kendall, 2002; Kendall & Hedtke, 2006). The Coping Cat has also demonstrated a reduction in clinical levels of anxiety disorder symptoms (Albano & Kendall, 2002). Research further demonstrates that children continue to show positive results after a year's follow-up (Albano & Kendall, 2002). However, cognitive-

behavioral treatment of anxiety disorders in children has been enhanced by the use of medical interventions (Compton et al., 2010).

In one of the largest studies researching the efficacy of CBT treatment, medication, and combined approaches to anxiety disorders in children, Walkup et al. (2008) examined the treatment of 488 children and adolescents with anxiety disorders. Children were randomized into four treatment conditions: CBT only, psychopharmacology, combined CBT and psychopharmacology treatment, and placebo pill treatment. Both the CBT and combined treatment groups used the CBT as a treatment protocol, while the psychopharmacology and combined groups were prescribed sertraline. Findings demonstrated that while all treatment groups were more effective than the placebo pill, the combined CBT and sertraline group showed the most improvement after 12 weeks of treatment (Walkup et al., 2008). Recent research has demonstrated that CBT remains the front-line treatment for youth with anxiety disorders (Silk et al., 2016). Children with anxiety disorders respond to a variety of treatment conditions; however, when other complicating factors, such as medical diagnoses, act as a potential risk factor, treatment may need to be modified.

Treating Anxiety and Asthma

Various cognitive-behavioral treatments have been implemented in pediatric populations to treat both medical illnesses and comorbid psychological distress. Furthermore, research has demonstrated the success of medical interventions on childhood anxiety. Table 3 summarizes the various CBT research that has been conducted on anxiety, asthma, and comorbid samples. The research presented in this table demonstrates that CBT plus medication and lifestyle management can be effective

in treating pediatric populations; however, special considerations should include the impact of the medical disorder on psychopathology symptoms.

Table 3
Summary of Treatments for Anxiety and Asthma

Authors	Sample	Outcome
Sicouri et al., 2017a	Children with comorbid anxiety and asthma (*n* = 5)	Group cognitive –behavioral therapy (CBT) for anxiety and asthma specifically tailored to the comorbidity was effective in reducing anxiety and improving asthma-associated quality of life. Treatment was effective regardless of whether the child's asthma and anxiety were related.
Weersing et al., 2017	Children aged 8-16 years, recruited from pediatric clinics (*n* = 185)	A brief behavioral intervention targeting anxiety and depression in a pediatric sample was more effective than outpatient therapy.
Papneja et al., 2006	Children aged 8-16 years, comparing comorbid anxiety and asthma group with anxiety-only group (*n* = 36)	Children with comorbid anxiety and asthma showed improvement with CBT treatment, but not as much as those without a comorbid medical diagnosis.
Feldman et al., 2016	Latino adults with asthma (*n* = 53)	Individuals in both the cognitive behavioral psychophysiological therapy (CBPT) group and music relaxation therapy group demonstrated reduced panic disorder, anxiety, and asthma symptoms. The CBPT group was associated with better medication adherence.
Ross et al., 2005	Adult women with comorbid asthma and anxiety (*n* = 25)	Women in a CBT group with asthma education demonstrated improved panic, general anxiety, and anxiety sensitivity. However, significant

		asthma-related improvements were not demonstrated.
Lehrer et al. 2008	Adults with comorbid asthma and panic disorder (*n* = 15)	Adults in both the 14-week and 8-week treatment (CBT and asthma adherence) demonstrated reduced asthma symptoms, reduced panic symptoms, and increased asthma quality of life. Also demonstrated reduced use of albuterol.

Researchers are currently exploring effective treatments for asthma and anxiety comorbidity. Papneja and Manassis (2006) examined the effects of traditional CBT for childhood anxiety on a sample with comorbid asthma and anxiety, comparing this group to children with anxiety alone (*N* = 170). The children in the comorbid group did not respond as well to CBT when compared to children with anxiety alone. Given that children with asthma did not respond as well to traditional CBT, adaptations to the protocol may be necessary to decrease anxiety symptoms and asthma-related complications. However, these children were recruited from the general population for the treatment of anxiety. While asthma was present in 36 children in the sample, asthma was not the primary complaint for these participants.

In an initial pilot study conducted with five children, Sicouri et al. (2017a) implemented a CBT protocol, integrating asthma-related psychoeducation and interventions for children with comorbid asthma and anxiety who had their asthma under control with medical treatments. In addition to standard CBT techniques (e.g., cognitive restructuring, problem solving, exposures), children also received psychoeducation on asthma and learned how to differentiate between asthma and anxiety symptoms. Despite the small sample size for this study, the adjusted CBT treatment was effective at reducing

overall anxiety for all five children, with three of them no longer meeting diagnostic criteria. QOL also improved in three of the children and helped increase asthma symptom control in two children. However, conclusions regarding the psychological treatment of children with asthma and anxiety are severely limited by the small number of studies to date. Therefore, an examination of the treatment of adults with asthma and anxiety is helpful.

Adult studies have also suggested that addressing asthma within CBT treatment for anxiety can help reduce both anxiety symptoms and asthma symptoms (Feldman et al., 2016; Lehrer et al., 2008; Ross et al., 2005). In a pilot study of treatment for PD and asthma comorbidity, Lehrer et al. (2008) compared a 14-week asthma and anxiety protocol to an 8-week protocol. The 14-week protocol incorporated asthma psychoeducation (e.g., peak flow monitoring, use of medications, asthma physiology) and asthma-specific CBT techniques (e.g., problem solving, etc.) into a panic treatment based on Barlow, Craske, and Meadow's (2000) panic control therapy. Subjects were provided with information regarding cognitive restructuring, problem solving, identifying panic symptoms versus asthma symptoms, asthma management, and effective communication tools for speaking with medical professionals about their asthma. The 8-week protocol was a shortened version of this treatment to address attrition and difficulty with recruitment. Findings from this pilot study demonstrated that both protocols were effective in reducing panic symptoms, decreasing asthma symptoms, and increasing QOL for patients (Lehrer et al., 2008). Despite high attrition rates in this study (i.e., 50% of participants dropped from the 14-week protocol), this study sets a foundation for addressing both asthma and anxiety in treatment.

Further research with adults has demonstrated mixed findings. Integrating asthma education into CBT treatment for anxiety may be helpful to individuals with this comorbidity. For example, in a study conducted by Feldman et al. (2016), adult participants with comorbid asthma and anxiety were treated with a combined CBT and heart rate biofeedback treatment condition (i.e., cognitive-behavioral psychophysiological therapy; CBPT). This treatment included peak flow monitoring to help differentiate asthma and panic symptoms. When compared to a music therapy group, the CBPT demonstrated increased medical adherence, although both treatment conditions showed equal improvement in panic symptoms. In addition, a study conducted by Ross et al. (2005) demonstrated similar findings. Their CBT protocol was modified again from Barlow, Craske, and Meadow's (2000) PD treatment to include asthma education. This adaptation included information on asthma, correct use of asthma medication, peak flow education and training, and action plan development. This treatment was effective in reducing frequency of panic episodes and in increasing QOL. However, long-term maintenance of improvements was not demonstrated at a 6-month follow-up. While this study did help reduce panic symptoms in women with comorbid asthma and anxiety, it did not demonstrate long-term improvements in anxiety and asthma treatment management.

Current research on adult or child treatment of comorbid asthma and anxiety has not demonstrated consistently significant findings regarding the increased efficacy of asthma education/CBT treatments for asthma and anxiety. These findings may be related to several limitations regarding the current research on effective treatments for asthma and anxiety comorbidity. First, many of the studies conducted had small sample sizes

(e.g., five children, 15 adults). Consequently, the effectiveness of these treatments is difficult to determine for children and adults with comorbid asthma and anxiety. Second, not many of these studies have been replicated. While a few studies have demonstrated that addressing asthma can be helpful, many do not conceptualize CBT treatment for asthma and anxiety in a similar fashion, making difficult the generalization of the results to other individuals with this specific comorbidity. Finally, more research is needed using a standardized treatment protocol to address consistency across research studies. The current research uses different protocols developed by each researcher, thus lacking consistency among studies. Thus, e the type of asthma and anxiety treatment that is effective in helping individuals with both disorders is difficult to determine.

Research findings thus far suggest that addressing asthma symptoms in treatment is effective in both reducing anxiety symptoms and increasing asthma adherence in the short term. These findings may explain that the asthma-related fears are being both validated and addressed in treatment. While some worries may be exacerbated by such characteristics as anxiety sensitivity, these worries may be grounded in an adaptive need to avoid certain triggers (Feldman et al., 2016). Important aspects of asthma treatment may incorporate techniques that increase susceptibility to anxious thoughts (Farrell et al., 2011). For example, symptom perception training may increase awareness of panic-like symptoms. However, CBT treatments addressing asthma-related worries can acknowledge this threat while reducing any overavoidance of triggers. Additionally, psychoeducational components of psychotherapy that specifically involve asthma may help patients understand the importance of asthma treatment adherence (Sperry, 2009). Asthma psychoeducation alone is not sufficient to increase adherence. Therefore,

integration of both asthma and anxiety symptoms into the content of CBT treatment may be necessary to help reduce psychological effects and improve physical health.

However, studies have demonstrated that certain cognitive and behavioral techniques typically used for anxiety may not be appropriate for individuals with comorbid asthma. For example, interoceptive exposures, such as hyperventilation exercises, may be physically dangerous for clients with asthma (Feldman et al., 2016). While some researchers have demonstrated that this type of treatment can be safely conducted with patients with asthma (Ross et al., 2005), precautions should be taken with this specific population to ensure safety. Physician clearance is necessary, and the therapist should be cognizant not to introduce the technique too early, so as to reduce chances of any medical side effects (Ross et al., 2005). However, the research on interoceptive exposure with patients with asthma is limited, and more information is needed before this treatment can be introduced as a standard treatment for anxiety and asthma comorbidity.

Further studies are needed to determine the best course of treatment for comorbid asthma and anxiety disorders in children. While CBT is considered an extremely effective treatment for childhood anxiety (Crowe & McKay, 2017; Hofmann et al., 2012; Kendall et al., 2016), more information is needed to demonstrate the benefits of incorporating asthma-specific cognitive, behavioral, and psychoeducational components into traditional CBT treatments for anxiety. CBT treatment of anxiety alone does not address the underlying cause of some of the anxiety symptoms exhibited by children with asthma. Children with asthma may have rational hesitancies toward certain triggers, leading to an increase in anxiety in situations that may exacerbate asthma symptoms.

Additionally, children may be conditioned to interpret physical symptoms as an asthma attack, rather than as symptoms of anxiety. By addressing both asthma and anxiety in treatment, clinicians may be able to increase adherence to asthma treatment, decrease anxiety, and prevent further episodes of both conditions.

Conclusion

Overall, the interaction between anxiety and asthma in children can result in severe medical and psychosocial consequences. Children with this comorbidity may have lower medical adherence, lower QOL, and increased levels of anxiety than children without anxiety. Asthma and anxiety may share similar developmental characteristics, such as anxiety sensitivity, presentation of physical symptoms, and the learning associated with perceived physical symptoms. Additionally, comorbid asthma and anxiety can result in significant impairment in functioning, including increased healthcare use and increased symptom presentation for both disorders. Comorbidity between anxiety and asthma has been shown to respond to CBT treatments that incorporate asthma education and adherence in the protocol. However, traditional CBT treatments do not seem to be effective in decreasing anxiety or increasing medical adherence for individuals with this comorbidity. Furthermore, current research on psychological treatments for anxiety and asthma comorbidity is limited, as the few studies involving treatment of this population have smaller sample sizes. Therefore, more information is needed to understand how these children differ from their peers with only an anxiety diagnosis, specifically from a larger sample of children with asthma and anxiety comorbidity. Furthermore, more research is needed to determine if a more integrated approach is necessary for treatment of anxiety and asthma.

The following study investigated the characteristics of children with asthma and anxiety and how asthma may interact with traditional CBT treatment for anxiety. It was hypothesized that children with asthma and anxiety would have more physical worries, physical symptoms, parental anxiety, panic symptom, generalized anxiety symptoms, and separation anxiety symptoms when compared to children with anxiety but without asthma. Conversely, the comorbid asthma and anxiety group would have less general negative self-talk when compared to children with anxiety without asthma. Additionally, it was hypothesized that asthma would be a moderator for treatment between the comorbid asthma and anxiety group and the nonmedical anxiety group, with the comorbid asthma and anxiety group responding less well to treatment. This study used a larger sample size to address some of the limitations presented in the current research on asthma and anxiety treatment. This study hopefully sheds some light on children with asthma and anxiety comorbidity and how this combination of disorders may affect treatment.

CHAPTER 3: METHODS

The current study employed an archival, quasiexperimental research design to compare characteristics of children with comorbid asthma and anxiety and children with anxiety but without a comorbid medical condition. Specifically, the levels of anxiety severity, negative self-statements, physical symptom presentation, panic, generalized anxiety and separation anxiety symptom presentation, parental anxiety, and theme of worried thoughts were compared. Additionally, this study compared the treatment response of children with comorbid anxiety and asthma to the treatment response of children without comorbid asthma across the four treatment groups.

Participants

Children from ages 7 to 17 years were included in the original data collection process of the Childhood Anxiety Multimodal Study (CAMS; Walkup et al., 2008). Approximately 488 children were assigned to four treatment groups across multiple sites around the United States after initial phone screening and diagnostic assessment. Three treatment groups (i.e., cognitive-behavioral therapy [CBT], sertraline, and a combined CBT/psychopharmacology group) were compared to a placebo psychopharmacology group. Of these participants, 78.9% were white, 49.5% were female, and 74.2% were younger than 13 years old. From the original data of 488 participants, 18.1% (n = 88) answered yes to Question 25 on the medical questionnaire, indicating a history of asthma or asthma-related disorder. These 88 participants were compared to the remaining 400 participants in the nonasthma group.

Inclusion Criteria

All children meeting criteria for at least one anxiety disorder were included in the data collection of the original study. Specifically, children meeting criteria for primarily generalized anxiety disorder (GAD), separation anxiety disorder (SAD), or social phobia were included in the study (Walkup et al., 2008). However, most children received a diagnosis of at least two primary anxiety disorders (78.7%) and at least one secondary diagnosis (55.3%). For this particular study, children who were marked by parents as having asthma were placed in the asthma group, while children whose parents marked "no" on this question were placed in the comparison group.

Exclusion Criteria

Children were excluded from the original study if they were diagnosed with an unstable medical condition, and girls were excluded if pregnant or sexually active without birth control (Walkup et al., 2008). Additionally, children were excluded if they previously were involved in two trials for SSRI but had no response or were treated using CBT. Furthermore, children were excluded if they were receiving any psychiatric drugs other than stimulants or were diagnosed with any psychological disorders that may interfere with anxiety treatment. Children were also excluded if they refused school because of anxiety or presented a risk to themselves or others.

Measures

Demographics

Demographic data regarding age, gender, and ethnicity were collected from parent participants.

Screen for Child Anxiety Related Emotional Disorders (SCARED; Birmaher et al., 1997; Birmaher, Khetarpal, Cully, Brent, &McKenzie, 1999)

The SCARED is a 41-item self-report questionnaire that measures anxiety disorders in children. The SCARED has demonstrated ability to indicate high levels of anxiety in children and to differentiate among specific anxiety disorders (Birmaher et al., 1999). Specifically, this measure screens for panic disorder (PD), generalized anxiety disorder (GAD), school avoidance (SH), social anxiety (SC), and separation anxiety (SP). Children were asked to rate their identification with anxiety statements using a 3-point Likert scale (0 = *not true or hardly ever true of me;* 1 = *somewhat true or sometimes true of me;* 2 = *very true or often true of me*). Children received an overall score indicating their anxiety and five subscores, which were linked to specific anxiety disorders previously mentioned. A total score of 25 or greater on the SCARED indicates a potential anxiety disorder. The SCARED was used to determine severity of anxiety and different anxiety presentations.

The SCARED has previously demonstrated strong overall internal consistency (α = .90) and internal consistency regarding the five subtests of anxiety ranging from α = .78 to α = .87 (Birmaher et al., 1997; Birmaher et al., 1999). The SCARED has also shown sufficient discriminant validity when compared to depression measures (Birmaher et al., 1997; Birmaher et al., 1999). The SCARED also demonstrates sufficient discriminant validity in separating anxiety diagnoses, especially when comparing panic disorder (PD) to other anxiety disorders (Birmaher et al., 1997; Birmaher et al., 1999).

Pediatric Anxiety Rating Scale (PARS; Research Units on Pediatric Psychopharmacology Anxiety Study Group, 2002).

The PARS measures general child and adolescent anxiety severity, and consists of two sections, a symptom checklist and severity scale. The symptom checklist consists of

50 items requiring children, parents, and investigators to indicate whether a specific anxiety symptom had been present within the past week. Symptoms fall into five categories – generalized social interactions or performance situations, separation, specific phobia, acute physical signs and symptoms, and other. The severity scale asks participants to rate the frequency, severity, avoidance, interference, and number associated with anxiety symptoms within the past week. Ratings are done on an 8-point Likert scale from 0 (*none*) to 7 (*extreme*). The severity scale is then totaled; this measure was the primary outcome measure used in the CAMS study. The PARS has demonstrated test-retest reliability (r = .55), internal consistency (α = 0.64), and interrater reliability (r = 0.97; Research Units on Pediatric Psychopharmacology Anxiety Study Group, 2002).

Coping Questionnaire – Child (CQ-C; Kendall & Marrs-Garcia, 1999)

The CQ-C is a 3-item self-report questionnaire that assesses a child's sense of his or her own ability to cope with distressing situations (Kendall & Marrs-Garcia, 1999). The situations are personalized to each child based on parent and child report of worries and anxiety-provoking situations. The questions are rated on a scale of 1 (*not at all able to help myself*) to 7 (*totally able to help myself*). However, for the purpose of this study, the content of the worries was examined. Worries and anxious situations were separated into six categories (i.e., academic/performance concerns, social/evaluation concerns, physical/natural danger, school phobia/refusal, specific fear, and separation concerns). The CQ-C has demonstrated test-retest reliability and is sensitive to treatment (Kendall et al., 1997). Additionally, the CQ-C has demonstrated internal reliability (α = .69), strong parent-youth agreement (r = .46), and concurrent validity with other measures of childhood anxiety (Crane & Kendall, 2018).

Negative Affective Self-Statement Questionnaire (NASSQ; Ronan et al., 1994).

The NASSQ is a self-report measure that asks children to rate the frequency of 57 anxious or depressive self-statements (e.g., "I thought I was going to do something wrong," "I feel like everybody was looking at me and laughing") and 13 positive self-statements (e.g., "I feel good about myself," "Nothing bothers me," "I feel like jumping for joy") within the past week. Ratings are made on a scale from 1 (*not at all*) to 5 (*all the time*). This measure has been shown to demonstrate acceptable internal reliability (α = .89-96) and 2-week test-retest reliability (α = .73 - .96). Additionally, the NASSQ has been shown to respond to cognitive behavioral treatments (Kendall et al., 1997; Ronan et al., 1994; Treadwell & Kendall, 1996). The NASSQ has also shown sufficient discriminant validity between individuals who are nonanxious and individuals who are clinically anxious. For the purpose of this study, the NASSQ was used to determine the frequency of negative self-talk.

Physical Symptoms Checklist (PSC; Emslie et al., 2006)

The PSC is a 46-item self-report measure that reports the number of physical symptoms experienced by children within the past week (Emslie et al., 2006). Each item is rated on a 4-point Likert scale from 0 (*not at all*) to 3 (*very much*). A factor analysis demonstrated eight separate components: sleep, pain, panic, cardiac, upper respiratory, elimination, nausea, and skin (Emslie et al., 2006). The PSC was used to determine frequency of physical symptoms.

State-Trait Anxiety Inventory (STAI; Spielgberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983)

The STAI is a 20-item self-report measure that measures adult state and trait anxiety. State anxiety is the level of anxiety felt in response to anxiety-provoking situations (e.g., public speaking), while trait anxiety is a more chronic level of stress experienced by an individual (Spielberger et al., 1983). Each item is rated on a 4-point Likert scale from 1 (*almost never*) to 4 (*almost always*). The questionnaire asks adults about their general level of anxiety (e.g.," I am tense," "I am a steady person") and anxiety in response to situations (e.g., "I worry too much over something that doesn't really matter"). This measure has been shown to demonstrate acceptable test-retest reliability (α = .65 - .75) and acceptable internal consistency (α = .86 - .95; Spielberger et al., 1983). The STAI has also demonstrated sensitivity to predicting caregiver distress, changing with variations in support system and health (Elliot, Shewchuk, & Richards, 2001; Shewchuk, Richards, & Elliot, 1998).

Medical Questionnaire

Parents were asked to answer yes or no as to whether their children had asthma or another respiratory condition. This question was included in a larger demographic and medical history questionnaire completed by the parents.

Responder vs. Non Responder: The Clinical Global Impressions-Investigator (CGI-I)

The CGI-I (Guy, 1976) is a 7-point, one-item rating scale used by the investigator to assess for improvement in anxiety symptoms. In the original study, children were determined to be a responder to the treatment condition if their CGI-I score was either 1 or 2 (Walkup et al., 2008). If their CGI-I was greater than 2, the child was not considered a responder.

Procedure

Original Study Procedure

Participants were initially recruited through telephone-screening procedures to determine eligibility (Compton et al., 2010). The data from the SCARED, PARS, STAI, CQ-C, NASSQ, and PSC were collected during the pretreatment assessment at a variety of metropolitan sites throughout the United States. Specifically, participants were treated in the following cities: Philadelphia, PA; Los Angeles, CA; New York City, NY; Durham, NC; Baltimore, MD; and Pittsburgh, PA. During pretreatment assessment, researchers obtained informed consent and assent. Along with questionnaires, researchers provided a structured diagnostic interview to determine whether the child met criteria for one or more anxiety disorders. After pretreatment assessment, participants were then randomized into one of four treatment groups: CBT; sertraline; a combination of CBT and sertraline; and a pill placebo. Participants then completed 12 weeks of psychopharmacology treatment or 14 weeks of CBT or combined treatment (Compton et al., 2010). Following treatment, participants again completed a posttreatment assessment.

Current Study Procedures

Data were obtained from the original CAMS database file after obtaining approval from the institutional review board (IRB) and the primary researchers of the original study. Participants were divided into two groups based on their answers to the asthma question on the medical history questionnaire. Children who had experienced asthma at any point in their lives per parental report were placed in one group, whereas children whose parents did not report a history of asthma were the comparison group.

SPSS was used to combine data from the questionnaires mentioned in this section and to run analyses.

CHAPTER 4: RESULTS

Preliminary Analyses

Descriptive statistics were used to calculate demographic information in the specific sample. The data were split to analyze specific demographics between the group with asthma and the group without asthma. Demographic data are presented in Tables 4 and 5. Although a significant difference was found in number of children with asthma compared to children without asthma, no significant group differences occurred in their gender, ethnicity (see Table 6), or age, $t(484) = -.906$, $p = .365$.

Table 4
Demographic Statistics for Asthma vs. Nonasthma Sample

Factor	Children with asthma	Children without asthma
Gender		
Male	33 (37.5%)	134 (33.7%)
Female	55 (62.5%)	264 (66.3%)
Race		
Black	6 (6.8%)	38 (9.5%)
Asian	6 (6.8%)	6 (1/5%)
White	67 (76.1%)	317 (79.6%)
American Indian	2 (2.3%)	4 (1.0%)
Native Hawaiian/Pacific Islander	0 (0%)	2 (0.5%)
Other	7 (8.0%)	31 (7.8%)

Table 5
Means and Standard Deviations (SD) for Children's Age

Factor	Children with asthma	Children without asthma
Age	10.86 (*SD* = 2.87)	10.65 (*SD* = 2.79)

Table 6
Chi-Squared Analyses Comparing Demographics

Factors	X^2	*N*	***df***	Significance
Gender	.469	486	1	.469
Race	10.320	486	5	.067

Means and standard deviations of dependent variables are presented in Table 7. Additionally, frequency data for the Coping Questionnaire – Child (CQ-C) are presented in Table 8. When comparing the groups in terms of treatment response, all children in the asthma group were determined to be responders to treatment.

Table 7
Means and Standard Deviations for Outcome Variables

Measures	Children with asthma	Children without asthma
NASSQ	35.97 (18.19)	31.38 (17.21)
PSC	.35 (.29)	.30 (.24)
SCARED– Panic	4.23 (4.27)	4.38 (4.86)
SCARED – General	6.85 (4.75)	6.05 (4.85)
SCARED -Separation	4.86 (3.99)	4.24 (3.84)
PARS (Pre)	19.14 (4.57)*	19.19 (4.11)*
PARS (Post)	12.07 (5.53)	10.44 (5.27)
STAI	37.28 (7.43)	39.06 (8.56)*

*Indicates score higher than clinical cutoff for this measure
Note. Abbreviation definitions are available in the Measures section.

Table 8
Frequency Results for the Coping-Questionnaire Situations

Situation Domains	Children with asthma	Children without asthma
Academic/Performance Concerns	43 (16.3%)	173 (14.8%)
Social/Evaluation Concerns	113 (48.2%)	452 (38.8%)
Physical/Natural Concerns	29 (11%)	195 (16.7%)
School phobia/Refusal	1 (0.4%)	6 (0.5%)
Specific Fear	17 (6.4%)	73 (6.3%)
Separation Concerns	61 (23.1%)	266 (22.8%)

An independent samples *t* test was conducted to determine whether youth with asthma and youth without asthma differed on pretreatment Pediatric Anxiety Rating Scale (PARS) scores. The independent samples *t* test was found not to be significant, $t(483) = .101$, $p = .919$ ($M = 19.14$, $SD = 4.57$).

Inferential Statistics

Hypothesis 1: Children with comorbid asthma and anxiety would exhibit higher levels of physical symptoms (PSC), panic symptoms (SCARED-Panic),

generalized anxiety symptoms (SCARED-GAD), separation anxiety symptoms (SCARED-Separation), and parental anxiety (STAI), when compared to children without comorbid asthma. A multivariate analysis of variance (MANOVA) was used to determine whether children with asthma would demonstrate higher rates of physical symptoms, parental anxiety, panic symptoms, generalized anxiety symptoms, and separation anxiety symptoms than children without asthma. The Levene's test was found to be significant for physical symptoms; therefore homogeneity of variance was not met for this variable. However, despite adjusting significance for the Physical Symptoms Checklist (PSC; $p < 0.05$), the MANOVA did not demonstrate a statistically significant difference between children with asthma and children without asthma on any of the measures. MANOVA data are presented in Table 9.

Table 9
Multivariate Analyses for Hypothesis 1

Measures	*df*	***F***	Significance
PSC	1	3.314	.069
STAIT-S	1	3.232	.073
SCARED-Panic	1	.009	.926
SCARED-GAD	1	2.008	.157
SCARED-Separation	1	1.879	.171

Note. Abbreviation definitions are available in the Measures section.

Hypothesis 2: Children with comorbid asthma and anxiety would demonstrate less general negative self-talk (NASSQ) than anxious children with anxiety but without asthma. A one-way analysis of variance (ANOVA) was conducted to determine if children with asthma demonstrated lower rates of negative self-talk on the Negative Affectivity Self-Statement Questionnaire (NASSQ) than children without asthma. The Levene's test was not found to be significant ($p = .553$); therefore,

homogeneity of variance could be assumed. The analysis demonstrated a statistically significant difference between groups, $F(1, 484) = 5.019$, $p = .026$; the asthma group demonstrated higher scores on the NASSQ.

Hypothesis 3: Youth with comorbid asthma and anxiety would demonstrate higher occurrences of physical/natural worries (CQ-C) than children with anxiety but without asthma. Three Pearson's chi-squared analyses were performed to examine the relationship between asthma and worry themes. The relationships between these variables were not significant. Chi-squared analyses are presented in Table 10.

Table 10
Chi-Squared Analyses for Worry Content

Factors	X^2	*N*	*df*	Significance
Situation 1	2.404	476	5	.791
Situation 2	3.486	478	5	.626
Situation 3	4.122	476	5	.532

Hypothesis 4: Children with comorbid asthma and anxiety would be less likely to be treatment responders than children with anxiety but without asthma. Alternatively, children with comorbid asthma and anxiety would demonstrate higher levels of anxiety (PARS) in response to the treatment conditions (CBT, Sertraline, Combined CBT and Sertraline, and Placebo) when compared to children with anxiety but without asthma. Initially, a logistical regression was planned to determine whether children with asthma were less likely to respond to CBT treatment than children without asthma. However, descriptive statistics demonstrated that all children in the asthma group were treatment responders. Therefore, a 2 x 4 ANOVA was conducted to examine the effect of asthma on posttreatment anxiety scores (PARS) within the four treatment conditions (i.e., CBT, Sertraline, Combined CBT and Sertraline,

and Placebo). For the pre- and posttreatment PARS scores per group, refer to Table 7. The Levene's test was found to be significant; therefore, homogeneity of variances could not be assumed ($p < .01$). As a result, the p value was increased to .05 to decrease the risk of making a Type I error. The analyses demonstrated a statistically significant main effect for treatment condition, $F(3, 478) = 5.236$, $p = .001$, $\eta_p^2 = .032$, on anxiety scores, but the asthma main effect, $F(1, 478) = 5.733$, $p = .017$, $\eta_p^2 = .012$, and the interaction of asthma and treatment condition were not significant, $F(3, 478) = .997$, $p = .341$. The distribution of each treatment group is presented in Table 11.

Table 11
Distribution of Participants in Treatment Groups

Treatment Groups	Youth with asthma	Youth without asthma
Combined	23 (26.1%)	124 (31.2%)
Sertraline	18 (20.5%)	82 (20.6%)
CBT only	27 (30.6%)	112 (28.1%)
Placebo	20 (22.7%)	80 (20.1%)

Note. CBT stands for Cognitive Behavioral Therapy. The combined group combined CBT treatment with sertraline.

CHAPTER 5: DISCUSSION

This study aimed to determine whether significant differences would be found in the characteristics and presentation of children with comorbid mild-moderate asthma and anxiety disorders when compared to children with anxiety but without asthma. Furthermore, this study investigated whether children with comorbid asthma and anxiety were less likely to respond to traditional cognitive-behavioral therapy (CBT) treatment than children with anxiety but without asthma. While none of the hypotheses in this study were supported, the findings provide important information about the relationship between asthma and anxiety diagnoses in children. Most significantly, findings suggest that traditional CBT protocols designed to treat anxiety may be an effective treatment for youth with asthma and anxiety comorbidity. This population may respond to treatment with some accommodations made for their specific concerns. A large limitation of this study must be addressed before interpreting results. While the overall sample obtained was 486, the number of children with asthma was only 88. This large discrepancy between groups makes determining statistical significance difficult despite the relatively large sample size.

Parental Psychopathology, Anxiety, and Physical Symptoms

Children with comorbid asthma and anxiety did not show significant differences in regard to panic, generalized anxiety, or separation anxiety scores; parental psychopathology; and physical symptoms when compared to children with anxiety but without asthma. These findings suggest that children with asthma and anxiety comorbidity may not have a different profile or presentation of anxiety symptoms and etiological factors from those of children without asthma. In many cases, asthma may not

be as large of a precipitating factor in the development of anxiety disorders than initially hypothesized, at least in the case of mild to moderate levels of asthma.

First, in regard to the presentation of physical symptoms, the finding of no significant difference between children with asthma and anxiety and children with only anxiety may be explained in numerous ways. Children with asthma and anxiety comorbidity may not differ from children with anxiety but without asthma because of the high presentation of somatic complaints in anxiety disorders (Ginsberg, Riddle, & Davies, 2006). Younger children, especially, may be more likely to describe their anxiety symptoms in physical terms, as they may not yet have the vocabulary or cognitive skills to discuss anxious thoughts or cognitions. Children younger than age 9 years are less reliable in verbalizing their psychiatric symptoms than older youth (Edelbrock, Costello, Dulcan, Kalas, & Conover, 1985). Furthermore, not all symptoms on the Physical Symptoms Checklist (PSC) may overlap with asthma symptoms; symptoms associated with gastrointestinal issues (e.g., stomachaches, nausea, butterflies) may not be as prevalent in children with comorbid asthma and anxiety, but are often a common symptom in anxiety disorders.

Second, panic, generalized anxiety, and separation anxiety symptoms may not differ between the two groups because of many different factors. Most children with anxiety do not present with panic symptoms initially; panic disorder is often diagnosed in adolescence (Kessler et al., 2007). This presentation may hold true for children with asthma as well. While children with asthma and anxiety may also feel separation concerns at times as a result of their asthma, these concerns may not significantly interfere with their functioning and may be more adaptive given their medical diagnosis.

The separation anxiety scores for youth with asthma and anxiety were not clinically significant, indicating that their separation concerns were only mild. Mild concerns could also explain the nonsignificant findings with generalized anxiety symptoms. Instead, children with asthma and anxiety may present with a fear of negative evaluation resulting from their medical conditions. Despite their legitimate concerns regarding safety, symptom severity, and separation from parents, social anxiety may be more prevalent in youth with asthma and anxiety comorbidity (Bruzzese, Fisher, Lemp, & Warner, 2009) than youth without asthma. This prevalence has been previously demonstrated in children with other chronic medical conditions (i.e., Type 1 diabetes; Williams, Sharpe, & Mullan, 2012), though more research is needed to understand the relationship between fear of negative evaluation and youth with asthma.

Finally, parental psychopathology may play an equal or similar role in the development of anxiety in children with asthma. The findings of this study are consistent with research that demonstrates parental influence can increase threat interpretation in children with asthma and anxiety (Sicouri et al., 2016; Sicouri et al., 2017b). Specifically, Sicouri et al. (2016) found that children with anxiety showed an interpretation bias toward general threatening situations, while children with asthma exhibited interpretation bias toward- asthma-threatening situations. Similarly, children with comorbid asthma and anxiety did not differ on their threat interpretation in comparison to the asthma alone and anxiety alone groups. Furthermore, parents of children with asthma were more likely to predict that their children would interpret asthma-related situations as threatening when compared to parents of children without asthma.. These results demonstrated that while parents may influence their children's thought patterns regarding different threatening

situations, parents of children with asthma may provide a more adaptive approach for real-life threatening situations. Parents in the current study demonstrated anxiety that was considered clinical in nature; however, the heightened parental anxiety in this case may not be problematic. Instead, it may act as a helpful tool for increasing asthma control.

Negative Self-Talk

Contrary to the initial hypothesis, youth with comorbid asthma and anxiety had significantly higher negative self-talk than youth with anxiety but without asthma. After taking a closer look at the questions in the Negative Affectivity Self-Statement Questionnaire (NASSQ), some may be conceived as fitting anxiety or asthma questions. For example, such items as "I feel like I am going to die" (Ronan et al., 1994) and other questions associated with dying and physical weakness may be positively endorsed by youth with comorbid asthma and anxiety as these items may be more related to realistic consequences of their medical condition. Also, items similar to "I get a nervous feeling like something is going to happen" (Ronan et al., 1994) can also be interpreted by youth with asthma as a medically related item. They may worry about the likelihood of an asthma exacerbation. Given the possible interpretations of NASSQ items, more research should investigate reliability, validity, and potential patterns in youth with comorbid asthma and anxiety. Thus far, scarce research has been conducted on the use of the NASSQ in youth with comorbid medical and psychological illnesses.

Research with adults has demonstrated that the NASSQ may be useful in medical populations. In a study involving adults with congenital heart disease, researchers demonstrated that the NASSQ may be helpful in predicting overall psychological adjustment to the medical diagnosis (Rietveld et al., 2002). Specifically, patients with

higher rates of negative self-talk reported higher rates of psychological distress. Again, research is limited regarding the use of the NASSQ and medical populations. Though the questionnaire was not initially developed with medical comorbidities in mind, further research may determine its usefulness in determining psychological functioning among youth with medical comorbidities.

Given youth with asthma experience increased negative self-talk, this concept may guide treatment, especially in regard to cognitive restructuring. Clinicians should look closely at negative self-talk in youth with asthma and anxiety, understanding the real and potential threat their medical condition may have on their well-being; the negative self-talk may not be negative self-talk at all. Instead, it may act as an adaptive mechanism for controlling their asthma. This negative self-talk may also help guide safe, yet effective exposures for children and adolescents with asthma and anxiety comorbidity (e.g., using an inhaler in front of a peer). Informed of negative self-talk, the clinician may also help the youth problem solve certain anxiety-provoking asthma triggers in an adaptive way for their medical illness (e.g., take their cellphone and inhaler with them where they had previously experienced an asthma exacerbation).

Worry Themes in Youth with Asthma and Anxiety

The current results of this study did not determine a significant relationship between asthma and anxiety comorbidity and specific themes of participants' worries. The profiles of youth with comorbid asthma and anxiety and youth with anxiety only were similar in regard to the themes of their worries. These similarities may demonstrate again that children and adolescents with mild to moderate asthma may have concerns similar to those of their counterparts without asthma. Further, youth with comorbid

asthma and anxiety endorsed social and separation worries most often. While these frequencies were not significant, this data furthers the concept that children and adolescents with medical comorbidities may have increased fears of negative evaluation (Williams et al., 2014).

While panic disorder PD is one of the more common anxiety disorders comorbid with asthma (Dudeney et al., 2016), the prevalence of social-anxiety disorder should not be discredited. The increased social concerns in youth with asthma may be related to the social implications of their illness (Bruzzesse et al., 2009). Youth with asthma are required to take medications regularly, sometimes in public locations. These youth may feel embarrassed about taking this medication because of concerns regarding negative evaluation from their peers. Youth with asthma may also develop anxiety about participating in social activities, especially activities that may increase the likelihood of asthma attacks (e.g., recreational sports, physical exercise). These fears may cause adolescents to avoid social situations.

The increased rate of separation concerns in youth with asthma is consistent with current literature on the comorbidity of anxiety and asthma in youth. Separation anxiety disorder (SAD) is twice as common in children with asthma than in controls without asthma (Dudeney et al., 2016). This concept is in line with Rachman's theory of anxiety acquisition (Rachman, 1977). In addition to classically conditioning to asthma stimuli and the development of an anxiety response to asthma triggers, children may also imitate their parent's anxiety and develop vicarious fears from their parent's anxiety. As a result, these children may learn to associate their parents with safety from asthma-related symptoms. Separation from parents can cue fears of uncertainty in regard to safety in the

event of an asthma exacerbation. Though this worry may be common and important to youth with asthma and anxiety, separation concerns may still be adaptive for their health.

Response to Treatment

Youth with asthma and anxiety did not demonstrate significant differences in regard to treatment response when compared to youth without asthma. In fact, all the youth with asthma and anxiety comorbidity in this sample were treatment responders. These results demonstrate that youth with comorbid asthma and anxiety may benefit from traditional cognitive-behavioral therapy (CBT) and medication treatment for childhood anxiety. These findings have many explanations. Few studies have examined tailored treatment of youth with asthma and anxiety; most of these studies have been pilot trials with small sample sizes and have yet to be replicated (Papneja & Manassis, 2006). Findings from the current study may demonstrate that children and adolescents with asthma and anxiety respond better to all treatment conditions (CBT, sertraline, and combined) than initially hypothesized. The tools introduced through the Coping Cat treatment may generalize to asthma-related anxiety stimuli. Traditional CBT may also address all the concerns present in youth with comorbid asthma and anxiety, including family functioning (Keeton et al., 2013).

Research on treatment for adults has demonstrated limited findings when integrating traditional CBT protocol with asthma interventions (Ross et al., 2005). While CBT treatment with asthma education (CBT-AE) demonstrated reductions in panic, generalized anxiety, and other anxiety characteristics, only reduced panic symptoms were maintained 6 months after follow-up. Furthermore, research with adults has been conducted using only waitlist comparison groups (Lehrer et al., 2008; Ross et al., 2005).

More information is needed in comparing the CBT-AT and CBT without asthma focus to determine if asthma-focused CBT treatment is more effective than traditional CBT.

Flexibility within Fidelity

Within CBT treatment is the concept of flexibility within fidelity (Kendall, Gosch, Furr, & Sood, 2008). This concept emphasizes the importance of adhering to evidence-based practice while also allowing flexibility and individualization of the protocol to meet the needs of the specific patient. Within traditional CBT treatment, flexibility within fidelity allows the clinician to adapt session protocol to the specific needs of the patient (Kendall et al., 2008). Patient interests, specific thoughts (e.g., I'm going to embarrass myself if I have an asthma attack in front of my friends), and specific fears are noted and integrated into the treatment protocol.

Flexibility within fidelity may explain why youth with asthma and anxiety comorbidity were still responsive to traditional CBT treatments. During the treatment protocol, therapists were able to work with the youth to determine most appropriate coping thoughts, exposures, and rewards. This flexibility allowed the therapists the ability to integrate asthma-related fears into the treatment protocol when necessary. For example, if a child's fear was using an inhaler in a public setting, the therapist was able to integrate this exposure into practice.

Medication

These results also demonstrate that youth with asthma and anxiety also responded to medication treatment (sertraline) and combined CBT with medication. Sparse research has been conducted on the use of psychotropic medications in youth with asthma.

Therefore, the current study is one of the first to determine that psychotropic medications may be beneficial in reducing overall anxiety for youth with asthma-related conditions.

Generalizability

These results are not generalizable to all youth with comorbid asthma and anxiety, however. Much is unknown regarding the presentation of asthma in the sample used for this study. Youth were excluded from the original study if they were suffering from a severe medical illness. Therefore, the youth involved in this study likely presented with mild to moderate asthma concerns. In that case, the asthma may not have played as large a role in the development of anxiety as previously thought. Research has demonstrated that children diagnosed with asthma, but who do not currently present with active symptoms, endorsed a positive quality of life (QOL; Annett, Bender, Lapidus, DuHamel, & Lincoln, 2001). Therefore, in the current sample, presenting anxiety may be less related to their medical illness and better treated by traditional cognitive and behavioral methods for childhood anxiety. The initial study was also conducted in outpatient mental-health clinic settings. Participants were recruited from the public, rather than from medical or primary-care settings, and asthma was not a part of recruitment criteria. This sample selection potentially limited the number of children with asthma, especially those with active asthma symptoms, recruited in the initial study.

Limitations

Several limitations are associated with this study. As previously mentioned, the method of measuring asthma diagnosis was limited in providing detail of asthma symptoms. More information, such as severity, length of diagnosis, and asthma adherence, would be beneficial for understanding the sample. Furthermore, as the study

recruits were not drawn from a medical setting, active asthma symptoms could not be assumed. Recruiting the sample from an asthma clinic would provide more information regarding current active symptoms, asthma severity, and treatment protocol for these participants. With a medical sample, future researchers can facilitate collaboration between clinicians and medical professionals to incorporate asthma psychoeducation into treatment and push the boundaries of asthma-related exposures, with the guidance of a medical professional.

Additionally, the content of the specific therapeutic sessions for these children is unknown. Having more information regarding the specific session content could help researchers determine whether asthma was addressed, and to what extent. Asthma might have been considered in treatment and incorporated into key therapeutic components, such as cognitive restructuring, problem solving, and exposures This information could help determine whether addressing asthma in the context of CBT treatment is beneficial to the participant's progress.

Future Directions

Despite the limitations, this study demonstrated that CBT and phytopharmaceuticals may be an effective treatment for comorbid asthma and anxiety disorders. While clinicians should be aware of how asthma may affect anxiety presentation, they should not discount traditional CBT for treatment. Yet, clinicians should also be aware that some techniques may need to be adapted specifically to the reality of asthma. Additionally, previous research has demonstrated that asthma adherence psychoeducation can be an effective complementary treatment to standard CBT for anxiety and asthma; however, more research is needed to demonstrate the

effectiveness of these treatments. Further research should compare traditional CBT to specific asthma-related protocols mentioned previously to determine if these treatments are equally effective or if one may be more beneficial for youth with asthma and anxiety comorbidity. Additionally, researchers should also recruit from medical facilities, including asthma clinics, to determine the severity of asthma, frequency of attacks, and other important diagnostic information that may be relevant to anxiety presentation and treatment.

Further research is also needed to understand asthma as a potential risk factor for developing anxiety disorders. While researchers know what makes children generally more susceptible to anxiety, more information is needed about children specifically with asthma. Does the mortality of their medical condition predispose them to develop anxiety? Do other factors facilitate the development of anxiety disorders in youth with asthma? This information can contribute to the development of specific protocols or adaptation of traditional CBT for treating children with comorbid asthma and anxiety. Differences in temperament and thinking styles may affect treatment responses. Therefore, focusing more treatment sessions on specific characteristics, such as an increase in realistic physical worries, rather than attempting to restructure negative cognitions may be necessary.

REFERENCES

Akinbami, L. J., Moorman, J. E., Garbe, P. L., & Sondik, E. J. (2009). Status of childhood asthma in the United States, 1980-2007. *Pediatrics, 123,* S131-S145. doi: 10.1542/peds.2008.2233C

Al Ghriwati, N., Winter, M. A., Everhart, R. S., & Fiese, B. H. (2017). Family functioning and child asthma severity: A bio-behavioral approach. *Families, Systems, & Health, 35*(4), 439-449.

Albano, A. M., & Kendall, P. C. (2002). Cognitive behavioral therapy for children and adolescents with anxiety disorders: Clinical research advances. *International Review of Psychiatry, 14,* 129-134. doi: 10.1080/09540260220132644

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed). Arlington, VA: American Psychiatric Publishing.

Annett, R. D., Bender, B. G., Lapidus, J., DuHamel, T. R., & Lincoln, A. (2001). Predicting children's quality of life in an asthma clinical trial: What do children's reports tell us? *The Journal of Pediatrics, 139*(6), 854-863.

Anxiety and Depression Association of America. (2017). *Facts & Statistics*. Retrieved from https://adaa.org/about-adaa/press-room/facts-statistics

Arnold, P. D., & Taillefer, S. (2011). Genetics of childhood and adolescent anxiety. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 49-73). New York, NY: Springer.

Asthma and Allergy Foundation of America. (2018, February). Asthma facts and figures. Retrieved from http://www.aafa.org/page/asthma-facts.aspx

Avallone, K. M., McLeish, A. C., Lubero, C. M., & Bernstein, J. A. (2012). Anxiety sensitivity, asthma control, and quality of life in adults with asthma. *Journal of Asthma, 49*(1), 57-62.

Barlow, D. H. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist,* 1247-1263.

Barlow, D. H., Craske, M. G., & Meadows, E. A. (2000). *Mastery of your anxiety and panic.* Graywind Publications.

Beck, A. T. (1967). *Depression – Clinical, experimental and theoretical aspects.* New York, NY: Harper.

Beesdo, K., Knappe, S., & Pine, D. S. (2009). Anxiety and anxiety disorders in children and adolescents: Developmental issues and implications for *DSM-V. Psychiatric Clinics of North America, 32*, 483-524. doi: 10/1016/j.psc.2009.06.002

Birmaher, B., Khetarpal, S., Brent, D., Cully, M., Balach, L., Kaufman, J., … Neer, S. M. (1997). The Screen for Child Anxiety Related Emotional Disorders (SCARED): Scale construction and psychometric characteristics. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(4), 545-553.

Birmaher, B., Khetarpal, S., Cully, M., Brent, D., & McKenzie, S. (1999). Psychometric properties of the Screen for Child Anxiety Related Emotional Disorders (SCARED): A replication study. *Journal of the American Academy of Child & Adolescent Psychiatry, 38,* 1230-1236.

Bruzzese, J. M., Carcone, A. I., Lam, P., Ellis, D. A., & Naar-King, S. (2014). Adherence to asthma medication regimens in urban African American adolescents: Application of self-determination theory. *Health Psychology, 33*(5), 461-464.

Bruzzese, J. M., Fisher, P. H., Lemp, N., & Warner, C. M. (2009). Asthma and social anxiety in adolescents. *The Journal of Pediatrics, 155*(3), 398-403.

Carr, R. E., Lehrer, P. M., Rausch, L. L., & Hochron, S. M. (1994). Anxiety sensitivity and panic attacks in an asthmatic population. *Behaviour Research and Therapy, 32*(4), 411-418.

Centers for Disease Control. (2017). National Current Asthma Prevalence. Retrieved from https://www.cdc.gov/asthma/most_recent_data.htm

Ciriaco, M., Ventrice, P., Russo, G., Scicchitano, M., Mazzitello, G., Scicchitano, F., & Russo, E. (2013). Corticosteroid-related central nervous system side effects. *Journal of Pharmacology & Pharmacotherapeutics, 4*(Suppl1), S94-S98. doi.: 10.4103/0976-500X120975

Craske, M. G., & Barlow, D. H. (2014). Panic disorder and agoraphobia. In D. H. Barlow (Ed.), *Clinical handbook of psychological disorders* (pp. 1-61). New York, NY: The Guilford Press.

Cohen, J., Mychailyszyn, M. P., Settipani, C. A., Crawley, S., & Kendall, P. A. (2011). Issues in differential diagnosis: Considering generalized anxiety disorder, obsessive compulsive disorder, and posttraumatic stress disorder. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 23-35). New York, NY: Springer.

Compton, S. N., Walkup, J. T., Albano, A. M., Piacentini, J. C., Birmaher, B., … March, J. S. (2010). Child/adolescent anxiety multimodal study (CAMS): Rationale, design, and methods. *Child and Adolescent Psychiatry and Mental Health, 4*(1), 1-15.

Crane, M. E., & Kendall, P. C. (2018). Psychometric evaluation of the child and parent version of the Coping Questionnaire. Manuscript in preparation.

Craske, M. G., & Barlow, D. H. (2014). Panic disorder and agoraphobia. In D. H. Barlow (Ed.). *Clinical handbook of psychological disorders* (5th ed., pp. 1-61). New York, NY: Guilford Press.

Crawford, A. M., & Manassis, K. (2001). Familial predictors of treatment outcome in childhood anxiety disorders. *Journal of the American Academy of Child and Adolescent Psychiatry, 40*(10), 1182-1189.

Crowe, K., & McKay, D. (2017). Efficacy of cognitive-behavioral therapy for childhood anxiety and depression. *Journal of Anxiety Disorders, 49,* 76-87.

Crozier, M., Gillihan, S. J., & Powers, M. B. (2011). Issues in differential diagnosis: Phobias and phobic conditions. In D. McKay & E. A. Storch (Eds.), *Handbook of Child and Adolescent Anxiety Disorders* (pp. 7-22). New York, NY: Springer.

De Pauw, S. S., & Mervielde, I. (2010). Temperament, personality and development psychopathology: A review based on the conceptual dimensions underlying childhood traits. *Child Psychiatry and Human Development ,41,* 313-329. doi: 10.1007/s10578-009-0171-8

De Peuter, S., Lemaigre, V., Diest, I. V., & Van den Bergh, O. (2008). Illness-specific catastrophic thinking and overperception in asthma. *Health Psychology, 27*(1), 93-99.

De Peuter, S., Put, C., Lemaigre, V., Demedts, M., Verleden, G., & Van den Bergh, O. (2007). Context-evoked overperception in asthma. *Psychology and Health, 22*(6), 737-748.

Degnan, K. A., Almas, A. N., & Fox, N. A. (2010). Temperament and the environment in the etiology of childhood anxiety. *Journal of Child Psychology and Psychiatry, 5*(4), 497-517.

Dia, D. A., & Bradshaw, W. (2008). Cognitive risk factors to the development of anxiety and depressive disorders in adolescents. *Child and Adolescent Social Work Journal, 25*, 469-481. doi: 10.1007/s10560-008-0156-7

Domjan, M. (2018). *The essentials of conditioning* (4th ed.). Washington, D.C.: American Psychological Association.

Dudney, J., Sharpe, L., Sicouri, G., Lorimer, S., Dear, B. F., Selvadurai, H. C., … Hunt, C. (2017). Attentional bias in children with asthma with and without anxiety disorders. *Journal of Abnormal Child Psychology, 45*(8) 1635-1646. doi.: 10.1007/s10802-017-0261-1

Edelbrock, C., Costello, A. J., Dulcan, M. K., Kalas, R., & Conover, N. C. (1985). Age differences in the reliability of the psychiatric interview of the child. *Child Development, 56*(1), 265-275.

Elliott, T., Shewchuk, R., & Richards, J. S. (2001). Family caregiver problem solving abilities and adjustment during the initial year of the caregiving role. *Journal of Counseling Psychology, 48,* 223-232.

Emslie, G., Kratochvil, C., Vitiello, B., Silva, S., Mayes, T., McNulty, S., … March, J. (2006). Treatment for adolescents with depression study (TADS): Safety results. *Journal of the American Academy of Child and Adolescent Psychiatry, 45*(12), 1440-1455.

Faravelli, C., Lo Sauro, C., Godini, L., Lelli, L., Benni, L., Pietrini, F., … Valdo, R. (2012). Childhood stressful events, HPA axis, and anxiety disorders. *World Journal of Psychiatry*, *2*(1), 13-25. doi: 10.5498/wjp.v2.i1.13

Farrell, L. J., Donovan, C. L., Turner, C., & Walker, J. (2011). Anxiety disorders in children with chronic health problems. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 479-503). New York, NY: Springer.

Feldman, J. M., Matte, L., Interian, A., Lehrer, P. M., Shou-En, L., Scheckner, B., … Shim, C. (2016). Psychological treatment of comorbid asthma and panic disorder in Latino adults: Results from a randomized control trial. *Behavioral Research and Therapy, 87*, 142-154. doi.: 10.1016/j.brat.2016.09.007

Feldman, J. M., Ortega, A. N., Koinis-Mitchell, D., Kuo, A. A., & Canino, G. (2010). Child and family psychiatric and psychological factors associated with child physical health problems. *The Journal of Nervous and Mental Disease, 198*(4), 272-279.

Ginsberg, G. S., Riddle, M. A., & Davies, M. (2006). Somatic symptoms in children and adolescents with anxiety disorders. *Journal of the American Academy of Child & Adolescent Psychiatry, 45*(10), 1179-1187.

Gordon-Hollingsworth, A. T., Becker, E. M., Ginsburg, G. S., Keeton, C., Compton, S. N., Birmaher, B. B., … March, J. S. (2015). Anxiety disorders in Caucasian and African American children: A comparison of clinical characteristics, treatment process variables, and treatment outcomes. *Child Psychiatry and Human Development, 46*, 643-655. doi: 10.1007/s10578-014-0507-x

Gualtieri, C. T., & Morgan, D. W. (2008). The frequency of cognitive impairment in patients with anxiety, depression, and bipolar disorder: An unaccounted source of variance in clinical trials. *Journal of Clinical Psychiatry, 69*(7), 1122-1130.

Guy, W. (1976). *Clinical global impressions ECDEU assessment manual for psychopharmacotherapy.* Rockville, MD: National Institute for Mental Health.

Heimberg, R. G., & Magee, L. (2014). Social anxiety disorder. In D. H. Barlow (Ed.), *Clinical handbook of psychological disorders* (5th ed., pp. 114-154). New York, NY: Guilford Press.

Herndon, J. B., Mattke, S., Cuellar, A. E., Hong, S. Y., & Shenkman, E. A. (2012). Anti-inflammatory medication adherence, healthcare utilization and expenditures among Medicaid and children's health insurance program enrollees with asthma. *PharmoEconomics, 30*(5), 397-412.

Hofflich, S. A., Hughes, A. A., & Kendall, P. C. (2006). Somatic complaints and childhood anxiety disorders. *International Journal of Clinical and Health Psychology, 6*(2), 229-242.

Hofmann, S. G., Asnaani, A., Vonk, I. J., Sawyer, A. T., & Fang, A. (2012). The efficacy of cognitive behavioral therapy: A review of meta-analyses. *Cognitive Therapy Research, 36,* 427-440.

Hong, R. Y., Lee, S. S., Tsai, F. F., & Tan, S. H. (2017). Developmental trajectories and origins of a core cognitive vulnerability to internalizing symptoms in middle childhood. *Clinical Psychological Science, 5*(2), 299-315.

Jacob, M. L., Thomassin, K., Morelen, D., & Suveg, C. (2011). Emotion regulation in childhood anxiety. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 171-185). New York, NY: Springer.

Katon, W., Lozano, P., Russo, J., McCauley, E., Richardson, L., & Bush, T. (2007). The prevalence of *DSM-IV* anxiety and depressive disorders in youth with asthma compared with controls. *Journal of Adolescent Health, 41*, 455-463. doi: 10.1016/j.jadohealth.2007.05.023

Keeton, C. P., Ginsburg, G. S., Drake, K. L., Sakolsky, D., Kendall, P. C., Birmaher, B., … Walkup, J. T. (2013). Benefits of child-focused anxiety treatments for parents and family functioning. *Depression and Anxiety, 30*, 865-872.

Kendall, P. C., Cummings, C. M., Villabø, M. A., Narayanan, M. K., Treadwell, K., Birmaher, B., … Albano, A. M., (2016). Mediators of change in the child/adolescent anxiety multimodal treatment study. *Journal of Consulting and Clinical Psychology, 84*(1), 1-14.

Kendall, P. C., Flannery-Schroeder, E., Panichelli-Mindel, S. M., Southam-Gerow, M., Henin, A., & Warman, M. (1997). Therapy for youths with anxiety disorders: A second randomized clinical trial. *Journal of Consulting and Clinical Psychology, 65*(3), 366-380.

Kendall, P. C., Gosch, E., Furr, J. M., & Sood, E. (2008). Flexibility within fidelity. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*(9), 987-993.

Kendall, P. C., & Hedtke, K. (2006). *Cognitive-behavioral therapy for anxious children: Therapist manual* (3rd ed.). Ardmore, PA: Workbook Publishing.

Kendall, P. C., & Marrs-Garcia, A. (1999). *Psychometric analyses of a therapy-sensitive measure: The Coping Questionnaire (CQ).* Unpublished manuscript, Temple University.

Kendall, P. C., & Treadwell, K. R. (2007). The role of self-statements as a mediator in treatment for youth with anxiety disorders. *Journal of Consulting and Clinical Psychology, 75*(3), 380-389.

Kessler, R. C., Amminger, G. P., Aguilar-Gaxiola, S., Alonso, J., Lee, S., & Ustun, T. B. (2007). Age of onset of mental disorders: A review of recent literature. *Current Opinion in Psychiatry, 20*(4), 359-364.

Larson, M. J., South, M., & Merkley, T. L. (2011). Neuropsychological considerations in child and adolescent anxiety. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 75-89). New York, NY: Springer.

Lebowitz, E. R., Woolston, J., Bar-Haim, Y., Calvocoressi, L., Dauser, C., Warnick, E., … Leckman, J. F. (2013). Family accommodations in pediatric anxiety disorders. *Depression and Anxiety, 30*, 47-54. doi: 10.1002/da.21998

Lehrer, P. M., Karavidas, M. K., Lu, S. E., Feldman, J., Kranitz, L., … Reynolds, R. (2008). Psychological treatment of comorbid asthma and panic disorder: A pilot study. *Journal of Anxiety Disorders, 22*(4), 671-683.

Lind, N., Nordin, M., Palmquist, E., & Nordin, S. (2014). Psychological distress in asthma and allergy: The Västerbotten environmental health study. *Psychology, Health & Medicine, 19*(3), 316-323.

Lowther, H., Newman, E., Sharp, K., & McMurray, A. (2016). Attentional bias to respiratory: An anxiety- related threat in children with asthma. *Cognition and Emotion, 30*(5), 953-967.

Lu, Y., Mak, K. K., van Bever, H. P., Ng, T. P., Mak, A., & Ho, R. C. (2012). Prevalence of anxiety and depressive symptoms in adolescents with asthma: A meta-analysis and meta-regression. *Pediatric Allergy and Immunology, 23*(8), 707-715.

Marshall, T., Jones, D. P., Ramchandani, P. G., Stein, A., & Bass, C. (2007). Intergenerational transmission of health beliefs in somatoform disorder. *British Journal of Psychiatry, 191*, 449-450.

Mayo Clinic. (2019). Asthma. Retrieved from http://www.mayoclinic.org/diseases-condtions/asthma/symptoms-causes/syc-20369653

McLeish, A. C., Zvolensky, M. J., & Luberto, C. M. (2010). The role of anxiety sensitivity in terms of asthma control: A pilot test among young adult asthmatics. *Journal of Health Psychology, 16*(3), 439-444.

McLeod, B. D., Wood, J. J., & Avny, S. B. (2011). Parenting and child anxiety disorders. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 213-228). New York, NY: Springer.

McNally, R. J. (2002). Anxiety sensitivity and panic disorder. *Biological Psychiatry, 52*(10), 938-946.

McQuaid, E. L., & Walders, N. (2003). Pediatric asthma. In M. C. Roberts (Ed.), *Handbook of pediatric psychology* (pp. 269-285). New York, NY: Guilford Press.

Merikangas, K. R., Nakamura, E. F., & Kessler, R. C. (2009). Epidemiology of mental disorders in children and adolescents. *Dialogues in Clinical Neuroscience, 11*(1), 7-20.

Meuret, A. E., Ehrenreich, J. T., Pincus, D. B., & Ritz, T. (2006). Prevalence and correlates of asthma in children with internalizing psychopathology. *Depression and Anxiety, 23*(8), 502-508.

Muris, P., Mayer, B., Freher, N. K., Duncan, S., & van den Hout, A. (2010). Children's internal attributions of anxiety-related physical symptoms: Age-related patterns and the role of cognitive development and anxiety sensitivity. *Child Psychiatry and Human Development, 41,* 535-548. doi: 10.1007/s10578-010-0186-1

Muris, P., Merckelbach, H., Mayer, B., & Snieder, N. (1998). The relationship between anxiety disorder symptoms and negative self-statements in normal children. *Social Behavior and Personality, 26*(3), 307-316.

Murphy, A. C., Proeschal., A., Brightling, C. E., Wardlaw, A. J., Pavord, I., Bradding, P., & Green, R. H. (2012). The relationship between clinical outcomes and medication adherence in difficult-to-control asthma. *Thorax, 67*(8), 751-753.

National Asthma Education and Prevention Program. (2007). *Guidelines for the diagnosis and management of asthma.* Retrieved from http://www.nhlbi.nih.gov/files/docs/guidelines/asthsumm.pdf

National Institute of Health. (2014, September). Asthma. Retrieved from https://www.nhlbi.nih.gov/health-topics/asthma

National Institute of Mental Health. (2017, November). Any anxiety disorder. Retrieved from https://www.nimh.nih.gov/health/statistics/any-anxiety-disorder.shtml

Pahl, K. M., Barrett, P. M., & Gullo, M. J. (2012). Examining potential risk factors for anxiety in early childhood. *Journal of Anxiety Disorders, 26*, 311-320. doi: 10.1016/j.janxdis.2011.12.013

Papneja, T., & Manassis, K. (2006). Characterization and treatment response of anxious children with asthma. *Canadian Journal of Psychiatry, 51*(6), 393-395.

Pearlman, D. N., Zierler, S., Meersman, S., Kim, H. K., Viner-Brown, S. I., & Caron, C. (2006). Race disparities in childhood asthma: Does where you live matter? *Journal of the National Medical Association, 98*(2), 239-247.

Peris, T. S., Compton, S. N., Kendall, P. C., Birmaher, B., Sherrill, J., March, J. … Piacentini, J. (2015). Trajectories of change in youth anxiety during cognitive-behavior therapy. *Journal of Consulting and Clinical Psychology, 83*(2), 239-252.

Pilecki, B., & McKay, D. (2011) Cognitive behavioral models of phobias and pervasive anxiety. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 479-503). New York, NY: Springer.

Rachman, S. (1977). The conditioning theory of fear-acquisition: A critical examination. *Behaviour Research and Therapy, 15*(5), 375-387.

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.

Research Units on Pediatric Psychopharmacology Anxiety Study Group (2002). The pediatric anxiety rating scale (PARS): Developmental and psychometric properties. *Journal of the American Academy of Child & Adolescent Psychiatry, 41*(9), 1061-1069.

Rietveld, S., & Brosschot, J. F. (1999). Current perspectives on symptom perception in asthma: A biomedical and psychological review. *International Journal of Behavioral Medicine, 6*(2), 120-134.

Rietveld, S., Mulder, B. J., M., Van Beest, I., Lubbers, W., Prins, P. J. M., Vioen, S., … Karsdorp, P. (2002). Negative thoughts in adults with congenital heart disease. *International Journal of Cardiology, 89*(1), 19-26.

Rietveld, S., Van Beest, I., & Everaerd, W. (1999). Stress-induced breathlessness in asthma. *Psychological Medicine, 29*(6), 1359-1366.

Roemer, L., & Orsillo, S. M. (2014). An acceptance-based behavioral therapy for generalized anxiety disorder. In D. H. Barlow (Ed.), *Clinical handbook of psychological disorders* (5th ed., pp. 206-236). New York, NY: Guilford Press.

Ronan, K. R., Kendall, P. C., & Rowe, M. (1994). Negative affectivity in children: Development and validation of a self-statement questionnaire. *Cognitive Therapy and Research, 18,* 509-528.

Ross, C. J., Davis, T. M., & Macdonald, F. (2005). Cognitive-behavioral treatment combined with asthma education for adults with asthma and coexisting panic disorder. *Clinical Nursing Research, 14*(2), 131-157.

Roy-Byrne, P. P., Davidson, K. W., Kessler, R. C., Asmundson, G. J., Goodwin, R. D., Kubzansky, L., … Stein, M. B. (2008). Anxiety disorders and comorbid medical illness. *General Hospital Psychiatry, 30*(3), 208-225.

Sales, J., Fivush, R., & Teague, G. W. (2008). The role of parental coping in children with asthma's psychological well-being and asthma-related quality of life. *Journal of Pediatric Psychology, 33*(2), 208-219.

Shewchuk, R., Richards, J. S., & Elliott, T. (1998). Dynamic processes in health outcomes among caregivers of patients with spinal cord injuries. *Health Psychology, 17,* 125-129.

Sicouri, G., Sharpe, L., Hudson, J. L., Dudeney, J., Jaffe, A., & Hunt, C. (2017a). A case series evaluation of a pilot group cognitive behavioral treatment for children with asthma and anxiety. *Behaviour Change, 34*(1), 35-47.

Sicouri, G., Sharpe, L., Hudson, J. L., Dudeny, J., Jaffe, A., Selvadurai, H., & Hunt, C. (2017b). Parent-child interactions in children with asthma and anxiety. *Behavior Research and Therapy, 97,* 242-251.

Sicouri, G., Sharpe, L., Hudson, J. L., Dudeney, J., Jaffe, A., Selvadurai, H., … Hunt, C. (2016). Threat interpretation and parental influences for children with asthma and anxiety. *Behaviour Research and Therapy, 89,* 14-23.

Silk, J. S., Tan, P. Z., Ladouceur, C. D., Meller, S., Siegle, G. J., & McMakin, D. L. (2016). A randomized clinical trial comparing individual cognitive-behavioral therapy and child-centered therapy for child anxiety disorders. *Jounral of Clinical Child & Adolescent Psychology, 47*(4), 542-554.

Silverman, W. K., Goedhart, A. W., Barrett, P., & Turner, C. (2003). The facets of anxiety sensitivity represented in the Childhood Anxiety Sensitivity Index: Confirmatory analyses of factor models from past studies. *Journal of Abnormal Psychology, 112*(3), 364-374.

Sood, E., & Kendall, P. K. (2007). Assessing anxious self-talk in youth: The Negative Affectivity Self-Statement Questionnaire – Anxiety Scale. *Cognitive Therapy and Research, 31*(5), 603-618.

Sperry, L. (2009). Treating patients with asthma: The impact of individual and family dynamics. *The Family Journal, 14*(4), 350-354.

Spiegler, M. D., & Guevremont, D. C. (2010). *Contemporary behavior therapy* (5th ed.). Belmont, CA: Wadsworth/Cengage.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

Thompson-Hollands, J., Kerns, C. E., Pincus, D. B., & Corner, J. S. (2014). Parental accommodation of child anxiety and related symptoms: Range, impact, and correlates. *Journal of Anxiety Disorders, 28,* 765-773. doi: 10.1016/j.janxdis.2014.09.007

Tiggelman, D., van de Ven, M. O., van Schayck, O. C., & Engels, R. C. (2015). Longitudinal associations between asthma control, medication adherence, and quality of life among adolescents: Results from a cross-lagged analysis. *Quality of Life Research, 24,* 2067-2074.

Treadwell, K. R., & Kendall, P. C. (1996). Self-talk in youth with anxiety disorders: Content specificity and treatment outcomes. *Journal of Consulting and Clinical Psychology, 64*(5), 941-950.

Viana, A. G., Kiel, E. J., Alfano, C. A., Dixon, L. J., & Palmer, C. A. (2017). The contribution of temperamental and cognitive factors to childhood anxiety disorder symptoms: A closer look at negative affect, behavioral inhibition, and anxiety sensitivity. *Journal of Child and Family Studies, 26,* 194-204. doi: 10.1007/s10826-016-0553-z

Vila, G., Hayder, R., Bertrand, C., Falissard, B., de Blic, J., Mouren-Simeoni, M. C., … Scheinmann, P. (2003). Psychopathology and quality of life for adolescents with asthma and their parents. *Psychosomatics, 44*, 319-328.

Walkup, J. T., Albano, A. M., Piacentini, J., Birmaher, B., Compton, S. N., Sherrill, J. T., … Kendall, P. C. (2008). Cognitive behavioral therapy, sertraline, or a combination in childhood anxiety. *New England Journal of Medicine, 359*(26), 2753-2766.

Wamboldt, M. Z., Weintraub, P., Krafchik. D., Berce, N., & Wamboldt, F. S. (1995). Links between past parental trauma and the medical and psychological outcome of asthmatic children: A theoretical model. *Family Systems Medicine, 13*, 129-150.

Weems C. F., Silverman, W. K., & La Greca, A. M. (2000). What do youth referred for anxiety problems worry about? Worry and its relation to anxiety and anxiety disorders in children and adolescents. *Journal of Abnormal Child Psychology, 28*(1), 63-72.

Williams, C., Sharpe, L., & Mullan, B. (2014). Developmental challenges of adolescents with type 1 diabetes: The role of eating attitudes, family support and fear of negative evaluation. *Psychology, Health, & Medicine, 19*(3), 324-334.

Wilmhurst, L. (2015). *Essentials of child and adolescent psychopathology* (2nd ed.). Hoboken, NJ: Wiley.

Winter, E. C., & Bienvenu, O. J. (2011). Temperament and anxiety disorders. In D. McKay & E. A. Storch (Eds.), *Handbook of child and adolescent anxiety disorders* (pp. 203-212). New York, NY: Springer.

Wright, K. D., Reiser, S. J., & Delparte, C. A. (2017). The relationship between childhood health anxiety, parent health anxiety, and associated constructs. *Journal of Health Psychology*, *22*(5), 617-626.