The Relationship of Asthma and Anxiety Symptoms in an Urban, Majority African-American, Adolescent Population

by

Sarah McArdell Moore

A dissertation submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
(Counseling Psychology)

At the

University of Wisconsin, Madison

2016

Date of oral examination: September 21, 2015

This dissertation is approved by the following members of the Final Oral Committee:

Stephen M. Quintana, Ph.D. Professor, Counseling Psychology (Chair)

Alberta M. Gloria, Ph.D. Professor, Counseling Psychology

William T. Hoyt, Ph.D. Professor, Counseling Psychology

Bruce E. Wampold, Ph.D. Professor, Counseling Psychology

Melissa A. Rosenkranz, Ph.D. Associate Scientist, Center for Investigating Healthy Minds at the Waisman Center

This research was supported by the National Institute of Nursing Research and uses data collected as part of the Mobile CHESS Research on Emergency Medical Services for Children (M-CHESS) study (grant number 1R01NR010241-01A1). David H. Gustason, Ph.D was the Principal Investigator and Christine A. Sorkness, Pharm.D. was the Co-Investigator on the study. The contents of this document are the responsibility of the author and do not necessarily represent the views of the supporting agency or study investigators.

Abstract

The present study analyzed the longitudinal relationship of asthma and anxiety symptoms in a low-income, predominantly African-American, urban population of adolescents receiving their healthcare through Wisconsin's Medicaid system. Of the 213 youth with asthma participating in the study, 71% reported clinically significant levels of anxiety symptoms during the course of the study, affirming previously published studies reporting elevated rates of anxiety among youth with asthma. Within this population, the symptoms of anxiety and the symptoms of asthma showed significant covariance both within-persons and between-persons indicating a close correspondence that may reflect reciprocal reinforcement of asthma and anxiety symptoms or a common causal factor giving rise to both asthma and anxiety symptoms. Discussion of the study results details possible mechanisms to explain the association of anxiety and asthma symptoms as well as the potential for chronic stress to underlie and exacerbate both conditions, particularly in communities managing multiple systemic stressors. These findings underscore the need for increased attention by psychologists to the impact of chronic conditions such as asthma on the mental health of their clients. They also highlight the need for collaborative care as indicated by the Affordable Care Act's directive to integrate mental health services into primary health care and careful clinical management of comorbid asthma and anxiety symptoms. Future research is needed to understand the impact of chronic stress on asthma and anxiety symptoms and to provide guidance for treatment of comorbid asthma and anxiety symptoms.

Acknowledgements

Thank you to the members of my dissertation committee, Dr. Stephen Quintana, Dr. William T. Hoyt, Dr. Alberta M. Gloria, Dr. Melissa A. Rosenkranz, Dr. Bruce E. Wampold and everyone in Counseling Psychology and at the University of Wisconsin-Madison who have helped me along the way towards becoming a psychologist and completing my dissertation. Dr. Quintana, thank you for becoming my advisor, giving me the support I needed to complete this project and for your understanding and kindness throughout my time in Counseling Psychology. Thank you dearly Dr. Gloria for your generous mentorship, challenge and care that have allowed me to persevere and to grow in this work. Thank you Susan Thideman for helping keep me on track.

Thank you to the entire M-CHESS team, especially to Dr. David Gustafson, Dr. Christine Sorkness and Fiona McTavish. Thank you to the youth and families who opened their homes to us and who shared their time and resources to make this project happen, your faces and your voices are the heart of this work. Thank you to Alice Pulvmacher for helping me to keep it all in perspective.

Thank you to family and friends who have tolerated my absence and cheered me along the way. Thank you to my parents, Jim McArdell and Judy McArdell, for encouraging me and always holding me up with love no matter what adventure I am on.

Brad, thank you for your love, support and infinite patience; it has made this possible. My dear daughters, thank you for being my joy and the inspiration to finish.

Table of Contents

Table of Figures

Table of Tables

Chapter One: Introduction to the Study

Asthma

Asthma is a chronic respiratory illness affecting children, adolescents, and adults worldwide. It is a disorder that inflames and narrows the airways causing recurring periods of coughing, chest tightness, shortness of breath, and wheezing. Chronic diseases such as asthma are associated with higher incidence of psychological distress and disorder (Farrell, Donovan, Turner, & Walker, 2011; Glover et al., 2012). The intermittent nature of asthma exacerbations and cycles of increased and decreased symptom severity can be extremely stressful and confusing for children with asthma and for their caregivers (Jackson, Sykes, Mallia, & Johnston, 2011). Asthma often impacts sleep cycles and the resultant fatigue and irritability can be a barrier to care management as well as a risk factor for psychological distress (Jensen, Gibson, Collins, Hilton, et al., 2013). Researchers have found that youth with asthma suffer higher rates of distress and report diminished results on quality of life assessments (Rietveld, van Beest, & Prins, 2005; Vila, Nollet-Clemençon, de Blic, Mouren-Simeoni, & Scheinmann, 2000)

There is no single cause for the development of asthma. Etiological contributors include heritability, the prenatal environment and across the lifespan exposures to allergens, infections, and pollutants (Beasley, Crane, Lai, & Pearce, 2000; Holgate, 1997). Asthma is sometimes broken down into different "types" based on asthma triggers, the two descriptors most often used are intrinsic and extrinsic asthma. Asthma is described as intrinsic when symptoms are triggered by irritants such as dry air or smoke and other non-allergen related stimuli such as exercise, stress or viruses. Extrinsic asthma is described as asthma where symptoms are triggered by allergens such as pet dander, mold or cockroach feces (Martinez & Helms, 1998)

Standard outpatient treatment for asthma includes use of “Asthma Action Plans.” Educational and behavioral asthma management tools that have been designed to help individuals with asthma recognize when they need to utilize medication and seek medical treatment (Gibson & Powell, 2004). Many asthma action plans encourage avoidance of “strong emotions” that could result in laughing or crying (Yin et al., 2013). The National Heart, Blood, and Lung Institute’s (NHBLI) asthma action plan guide includes a checklist of potential asthma symptom triggers which include allergens such as, dust mites, cockroaches, indoor molds, pollen and outdoor molds, as well as irritants like tobacco smoke, strong odors, cleaning and perfume sprays and other potential sources of reactivity such vacuuming, consuming sulfites, medication use and exposure to cold air or humid air. The NHBLI asthma action plan is found in Appendix A.

Medications indicated on an asthma action plan are likely to include a bronchodilator medication for quick relief of asthma symptoms, (this type of medication is sometimes called a “rescue inhaler") and a “controller medication” designed to decrease symptoms over time, primarily through reducing inflammation in the lungs. The phrase “asthma control” is used by clinicians and researchers specializing in asthma to describe the level of symptoms experienced by an individual or to describe treatment goals. For example, instructing a young person who has exercise sensitive asthma to use their bronchodilator medication before gym class could be described as an intervention to increase asthma control. If this intervention results in fewer asthma attacks, this would also be described as an increase in asthma control. An increase or persistence of asthma symptoms, including asthma attacks where a quick relief medication is needed to restore normal breathing, would indicate that a person’s asthma is poorly controlled. Poor control of asthma places an individual at risk for life threatening complications such as

respiratory failure, lung collapse, and serious infections such as pneumonia (National Heart, Blood, and Lung Institute, 2009).

Diagnostic Increase

In the 1970's the incidence of asthma diagnosis in the United States was 3%, this rate began to increase sharply in the 1980's, leveling off in the late 1990s to arrive at the current estimation of 7-9 % of the United States population or over 16 million people. Approximately 3,500 deaths per year are directly attributed to asthma. Yearly direct healthcare costs related to asthma in the United States are estimated in the billions, with some reports as high as 10.1 billion in direct healthcare costs alone. An additional 8.1 billion is estimated for indirect costs amounting to a yearly total of 18.3 billion dollars. Indirect costs include loss of productivity from missed school and work days (Center for Disease Control and Prevention [CDC], 2009).

Asthma is the most common chronic illness affecting youth. The current rate of asthma in young people is estimated at 9% or 6.7 million (Center for Disease Control and Prevention [CDC], 2009). In 2003, youth missed 12.8 million school days due to asthma related absences (Akinbami, Moorman, Garbe, & Sondik, 2009). Urban populations have higher prevalence of the disease than rural or suburban populations and suffer more severe symptoms and complications (Meuret, Ehrenreich, Pincus, & Ritz, 2006). Adolescent males are 30% more likely to have an asthma diagnosis than females. Youth who are members of a racial/ethnic minority group or come from a low-income household are more likely to develop asthma and for that asthma to be severe (Gillaspy, Hoff, Mullins, Van Pelt, & Chaney, 2002; Rand et al., 2000) Non-Hispanic African-American youth have the highest rates of asthma diagnosis in comparison to all other groups in the US. Adolescents who describe themselves as African-American or Black report more severe symptoms related to asthma and have higher emergency health care

utilization than White adolescents (Ginde, Espinola, & Camargo Jr., 2008; Rand et al., 2000). Additionally, multiple factors such as the physical neighborhood environment, types of housing available and access to clinic and emergency care, compound to disproportionately burden low-income, urban, neighborhoods with high rates of asthma and subsequent quality of life impairment (Armstrong et al., 2013; D'Amato, Liccardi, D'Amato, & Holgate, 2005; Glover et al., 2012; Juhn et al., 2005).

Research Directions

As incidence of asthma increased so did research into the nature of asthma, its prevalence and phenomena in pediatric populations. Because asthma has historically been categorized as a fully or partially psychosomatic illness, studies from multiple disciplines have included general measure of psychological wellbeing (Dhar & Ghoshal, 2011; Graham, Rutter, Yule, & Pless, 1967; Reckless, 1971). Due to the cumulative risk for low-income, racial/ethnic minority youth living in urban environments to develop asthma and to experience significant complications from asthma, multiple studies have focused on the experience of illness in these groups (Ostro, Lipsett, Mann, Braxton-Owens, & White, 2001; Rand et al., 2000; Sarpong, Hamilton, Eggleston, & Adkinson Jr, 1996). Within this diverse body of research, numerous studies have reported that a pediatric asthma diagnosis is associated with increased stress and reduction in psychological well-being (Gillaspy et al., 2002; Surís, Parera, & Puig, 1996; Wright, Rodriguez, & Cohen, 1998). Consequentially, the potential for asthma to be associated with comorbid psychological disorders has emerged as a vital area of research and multiple studies have found an association between an asthma diagnosis and increased anxiety symptoms as well as specific anxiety disorders (Deshmukh, Toelle, Usherwood, O'grady, & Jenkins, 2008; Gershon, Wang, Guan, & To, 2010; Katon et al., 2007; Lu et al., 2012). While chronic diseases

in general are associated with higher rates of psychological distress, diagnosing the potential comorbidity of asthma and anxiety disorder is complicated by shared diagnostic symptomology which increases the difficulty of detecting and treating both conditions appropriately. This in contrast to other concurrent chronic illnesses such as diabetes and depression which have more definable borders (Lin et al., 2004).

Anxiety

Anxiety is an adaptive response to stress provoking stimuli, allowing the body to prepare to respond to a potential threat. However prolonged anxiety or anxiety in the absence of contextual stimuli can lead to substantial distress, impairment and an anxiety disorder diagnosis. Symptoms of anxiety include excessive worry, distress or fear and physical sensations such as chest tightness, shortness of breath, feelings of nausea and lightheadedness. Anxiety symptoms can result in difficulty falling asleep or maintaining sleep, difficulty concentrating and reduced ability to function across multiple settings. Like asthma, likelihood of developing an anxiety disorder is influenced by multiple factors including genetic and environmental contributors. Anxiety symptoms and anxiety disorders can also arise in response to episodic or chronic stressors such natural disasters or exposure to violence and trauma (Barlow, 2000; Brakel, Muris, Bögels, & Thomassen, 2006; Mineka & Zinbarg, 2006). All major subtypes of anxiety have been shown to have significant levels of heritability based on an aggregation of genetic and environmental similarities within families (Hettema et al., 2001; Merikangas et al., 1999).

Adolescents are more vulnerable to anxiety symptoms and anxiety disorders than adults. Behavioral Risk Fact or Surveillance System placed the expected lifetime risk of anxiety disorders for youth between 5.4 and 17.2% (Strine et al., 2008). The National Institute of Mental Health places rate of anxiety disorder for youth aged 13-18 years at 8% and at 10% for all youth

under the age of 18. These estimates are influenced by population sampling, methodological approaches and study defined criteria for anxiety disorder diagnosis. Socioeconomic factors, comfort or stigma related to mental health concerns and differences in expression of symptoms among cultural/racial/ethnic groups substantially influenced the reported rates of symptoms and diagnosis (Farrell et al., 2011, 2011; Katon, Russo, Richardson, McCauley, & Lozano, 2008; Wolitzky-Taylor, Bobova, Zinbarg, Mineka, & Craske, 2012). A recent large scale study assessing for rates of DSM-IV based psychiatric disorders within low-income adolescents in a large urban area, placed the prevalence rate of anxiety disorder at approximately 7%. In the study, 35% of the participants in this sample were African American (Roberts, Roberts, & Xing, 2007).

Anxiety disorders put youth at risk for reduced performance at school, school avoidance and dropping out of school entirely (Murdock, Robinson, Adams, Berz, & Rollock, 2009; Van Ameringen, Mancini, & Farvolden, 2003). Social anxiety in teens has been linked to lower rates of peer connection and higher rates of victimization by peers (Erath, Flanagan, & Bierman, 2007). Anxiety disorders also place adolescents at higher risk for drug and alcohol use and development of a substance abuse disorder (Wolitzky-Taylor et al., 2012). Youth with an anxiety disorder and a comorbid illness have been shown to have higher levels of emotional distress and increased report of symptoms than youth who have a chronic disease but do not have a comorbid anxiety disorder (Chavira, Garland, Daley, & Hough, 2008; McLaughlin, Geissler, & Wan, 2003).

Comorbidity

Definition and treatment of clinically multimorbid conditions is crucial for individual's health and wellbeing. In the case of medical and psychiatric comorbidity, patients and

biomedical practitioners often assume that psychiatric distress will resolve with successful management of the physical chronic condition. However, there are indications that a large part of role impairment (such as missing work and school) comes from the interaction of the chronic illness and the comorbid psychiatric disorder rather than the chronic illness alone and that remission of physical symptoms does not necessarily improve functioning in the absence of treatment for the concurrent psychiatric concern (Kessler, Ormel, Demler, & Stang, 2003).

Comorbidity increases the risk for poor management of illness, negative outcomes and can delay the treatment or identification of multimorbid conditions. The interaction of chronic illnesses with internalizing disorders often results in additional functional impairment and reduced ability to manage either condition successfully (McCauley, Katon, Russo, Richardson, & Lozano, 2007). Taken individually asthma and anxiety have substantial negative impacts on the lives of young people. Untreated anxiety disorders and uncontrolled asthma are both characterized by intermittent exacerbations of symptomology and serious physical and social consequences. A study by Richardson et al. (2006) showed that comorbidity of anxiety and asthma can lead to increased symptom burden for both conditions. People experiencing anxiety often avoid situations and settings that increase their symptoms. A person with anxiety related to a health condition may avoid medical appointments, resist use of medication and avoid other health supporting practices if engaging in these behaviors triggers anxiety (American Psychological Association [APA], 2007). Additionally, caregivers of youth with comorbid anxiety and asthma reported higher levels of interpersonal strain which negatively impacted their ability to seek and support treatment for children in their care (Chavira, Garland, Daley, & Hough, 2008). It has also been proposed that the experience of asthma can predispose people to specific anxiety disorders. Caregivers who have witnessed, and individuals who have

experienced, life threatening asthma attacks have developed Post Traumatic Stress (PTS) and Post Traumatic Stress Disorder (PTSD) in the aftermath of the event. This was shown in turn to compound the difficulty of asthma care management due to the challenges presented by these specific psychiatric conditions (Kean et al., 2006).

Symptoms confusion. Symptoms perception and overlapping symptomology in multimorbid illness can result in symptoms confusion for patients, caregivers, researchers and clinicians. The physical experience of asthma and asthma attacks as significant overlap with many anxiety symptoms and descriptions of some specific anxiety disorders. Additionally many anxiety disorders have overlapping criteria that require professional discernment to determine if an actionable diagnosis is warranted. While there is a substantial body of evidence for the co-occurrence of asthma and anxiety symptoms, the value of this evidence is often limited by a lack of differentiation between the symptoms of asthma and the somatic symptoms of anxiety.

Symptoms confusion can have substantial negative impact on an individual's understanding of their health and ability to manage their illnesses. A panic attack and an asthma attack have similar symptoms, but a bronchodilator inhaler or nebulizer treatment, will not relieve chest tightness or breathlessness stemming from anxiety. Youth who do not get relief when they use their asthma medication during an anxiety related episode may lose confidence in the efficacy of their medications and not utilize them in appropriate situations. If youth and caregivers do not believe the prescribed medications work, they are unlikely to adhere to medication schedules or adhere to other asthma management tools such as asthma action plans or symptom diaries. Fears that medications do not work can in turn increase anxiety. (Gibson & Powell, 2004; Yin et al., 2013). If medications are perceived to lack efficacy, youth and families

are less likely to tolerate side effects such as dry mouth, oral yeast infections, skin sensitivity and bruising (Dahl, 2006).

Diagnostic assessment. Accurate diagnosis in line with the best established practices of care for both asthma and anxiety are vital for treatment of either condition and critical for conjoint management. In the U.S., the standard method of diagnosing asthma is via a physician or other qualified healthcare provider utilizing the National Heart, Lung and Blood Institute (NHLBI) guidelines. The guidelines include taking a patient's history of symptoms experienced in the past year, a Forced Expiratory Volume in One Second test, (FEV_1) and considering reports of healthcare usage and medication adherence. The FEV_1 is a test of lung function that utilizes a spirometry machine to assess airway obstruction, bronchoconstriction or bronchodilatation. Despite this standard, spirometry is often not used in primary care for either initial diagnosis of asthma or confirmatory diagnosis (Kaplan & Stanbrook, 2010).

There are multiple clinically valid approaches to the diagnosis of an anxiety disorder or assessment of anxiety symptoms (Connolly & Bernstein, 2007) Many studies in this body of literature have identified limitations or analysis considerations related to the researcher's perception of etiology and the methods used to establish a diagnosis of asthma and/or anxiety (Katon et al., 2004). No study examining the potential relationship of asthma and anxiety, including those that assessed for panic attacks or "ataque de nervios", which most closely parallel an asthma attack, addressed participants' ability to differentiate between symptoms of asthma and the somatic symptoms of anxiety (Goodwin et al., 2003) Differences in methods of diagnosis, particularly in light of overlapping symptomology between asthma and anxiety, make it difficult to associate findings within a disciplinarily diverse body of literature.

Communities in Focus

In a foundational study investigating the psychosocial characteristics of inner city children with asthma, researchers found that inner city children with asthma faced significant additional burdens related to their illness than peers in suburban and rural areas. Youth in the study had difficulty reducing asthma exacerbations or attacks due to limited asthma management skills such as use of a peak flow meter, asthma action plan or access to their medication when needed. Caregivers in the study reported distrust of medical providers, care directives and underutilization of healthcare resources. The study described "inner city youth" as more likely to be from a low-income family and belong to a racial or ethnic minority group. Additionally, youth in the study were found to have high levels of life stress unrelated to asthma that could put them at risk for non-adherence to asthma management strategies and increased asthma morbidity (Wade et al., 1997)

Subsequent studies affirmed higher rates of asthma diagnosis in urban areas, within defined groups such as African-Americans living in low-income urban areas and the increased contextual challenges of managing asthma and comorbid mental health challenges in low-income communities (Andrew Aligne, Auinger, Byrd, & Weitzman, 2000; Beasley et al., 2000; Bender Berz, Murdock, & Koinis Mitchell, 2005; Rand et al., 2000). A recent meta-analysis investigating the comorbidity of asthma and anxiety based on studies comparing youth with asthma to youth without asthma or any other chronic disease found that the likelihood of youth with asthma having an anxiety disorder was significantly higher than in peers without asthma (Lu et al., 2012).

Urban environments have multiple physical and social environmental factors that contribute to the prevalence of asthma. Living in a high traffic urban area increases a child's risk

for an asthma related, emergency hospital admission by 300% and increases the weekly experience of asthma symptoms by 80% , in comparison to children with asthma living in low vehicle traffic areas (Meng, Rull, Wilhelm, Ritz, & English, 2006). Rates of air pollution are higher in urban areas in general but are highest in low-income areas (Ostro et al., 2001). While the effects of industrial and traffic related air pollution has the most negative impact on lung development in infants and very young children, living in high traffic areas is also associated with reduction in lung function for youth aged 10-18 years, as measured by spirometry. Reduction in lung function as measured by spirometry is a critical clinical criteria for an asthma evaluation because gradual loss of lung capacity due to inflammation often limits an individual's ability to accurately perceive their level of impairment (Gauderman et al., 2004). Low-income and subsidized housing are more likely to be located in areas of current or historic industrial pollution and in high density vehicle traffic areas (Brauer et al., 2002; Neidell, 2004). Low-income youth in urban areas are more likely to live in apartment buildings, apartment buildings are associated with lower levels of indoor air quality due to greater presence of significant asthma triggers such as cockroach, dust mites and various rodents (Phipatanakul, 2002; Sarpong et al., 1996; Wallace et al., 2003). Disrepair and deteriorating conditions in apartment buildings, increase the level of risk for poor air quality, asthma impairment and other respiratory complications (Rauh, Chew, & Garfinkel, 2002).

Many of these same environmental factors can be associated with increased prevalence of anxiety symptoms such tension, worry, fear, panic, difficulties in relaxing, and restlessness (Lewis, Byrd, & Ollendick, 2012). A study examining the experience of African-Americans living in public housing showed that that persons in this community are more likely to experience higher rates of psychiatric disorders and mental health challenges than those living

outside public housing. Anxiety symptoms and anxiety disorder rates are higher than in the non-public housing population even when controlling for chronic health conditions such as asthma (Simning, Wijngaarden, & Conwell, 2010) Being a member of lower socioeconomic status group and living in a low-income neighborhood are associated with higher levels of anxiety across racial/ethnic groups (Santiago, Wadsworth, & Stump, 2011). Green spaces and mature trees benefit people with asthma by improving air quality; a lack of green space has been shown to increase overall stress levels in urban areas (Ward Thompson et al., 2012). This multitude of overlapping and discrete risk factors for development of asthma and anxiety symptoms has led to significant research interest in the prevalence and relationship of these two conditions in low-income areas, particularly in low-income, predominantly African-American communities (Bender Berz et al., 2005; Handelman, Rich, Bridgemohan, & Schneider, 2004; Morrison Gutman, McLoyd, & Tokoyawa, 2005; Ostro et al., 2001; Rand et al., 2000).

Statement of the Problem

Asthma and anxiety are two of the most common conditions affecting youth in the United States. Independently an asthma diagnosis and persistence of anxiety symptoms have significant negative effects on the health and well-being of young people and conjointly these effects are increased. Comorbid symptoms of asthma and anxiety in youth presents a substantial challenge that can negatively impact the ability to treat either condition. Current research reports that youth living in urban areas, particularly low-income African-American youth, suffer higher rates of asthma, increased morbidity and have significant rates of comorbid asthma and anxiety symptoms.

To date, there are no published longitudinal studies investigating the relationship of asthma and anxiety symptoms or differentiating the within and between individual variance of

symptoms. Studies relying on single point measures gathered from a group of individuals can only provide information about the between person relationship of asthma and anxiety symptoms at the moment of measurement and can result in the group's results being inappropriately generalized to the individual. Establishing whether asthma and anxiety covary over time and if so, between and/or within individuals can provide a necessary step towards conceptualizing the nature of the relationship and the progression of each illness independently and conjointly as appropriate. Additionally, while there is strong support for the comorbidity of asthma and anxiety symptoms, multiple studies do not adequately account for the possibility that overlapping somatic symptoms shared between the two conditions could result in inaccurate accounting of prevalence rates. Research using measures of anxiety and asthma symptoms selected to reduce the potential for association based upon somatic symptoms confusion is needed. Finally, given the high rates of asthma and anxiety reported in low-income, urban, African-American communities, it is critical to consider how the relationship of asthma and anxiety may be influenced by the biopsychosocial environments in these communities.

The Current Study

The current study sought to extend the literature investigating the comorbidity of asthma and anxiety through a longitudinal study design and analysis using multilevel modeling. In order to minimize results attributable to symptoms confusion, the study measures were selected to exclude questions that could describe both asthma and anxiety symptoms. This study used the anxiety specific subscale from the Hospital Anxiety and Depression Scale (HADS-A) to measure asthma symptoms and the Asthma Control Test (ACT) to measure asthma symptoms. The HADS does not screen for specific anxiety disorders but rather general symptoms of anxiety common to multiple anxiety disorders. The HADS was selected because it was designed to assess symptoms

of anxiety and depression in the context of medical illness by excluding somatic symptoms (Bambauer, Locke, Aupont, Mullan, & McLaughlin, 2005; Olssøn, Mykletun, & Dahl, 2005). Lastly, this research utilized an ecological systems perspective to consider the potential impact of sociodemographic and structural factors on the study results and to describe the participants in the study.

Data source

The current study analyzed data collected as part of the Mobile CHESS Research on Emergency Medical Services for Children (M-CHESS) study supported by the National Institute of Nursing Research. The study was a randomized control trial for which the primary aims were to test whether an asthma care management system (M-CHESS) delivered via a smartphone could support low-income teenagers (ages 12-18) with significant asthma to improve their asthma control (i.e., reduce asthma symptoms) and reduce asthma-related emergency or urgent care visits and hospitalizations. Secondary aims included testing whether the M-CHESS system increased adherence to medication used for long term control of asthma symptoms and reduced absenteeism from school, work or an event they wanted to attend. This study is described more fully as part of Chapter Three: Methods.

Procedures in brief

For the current study, 219 adolescents aged 12-17 years reported their asthma symptom control and anxiety symptoms at five time points over the course of a year. To be eligible for the study, youth had to have a pre-existing asthma diagnosis, reside in Milwaukee County and access healthcare through Wisconsin's state run Medicaid program providing health care to low-income children and families. Identification of asthma diagnosis for participants was based on the National Heart, Lung, and Blood Institute (NHLBI) guidelines. NHLBI guidelines for diagnosis

include measurement of symptoms experienced in the past year, spirometry FEV_1 baseline and reports of medication adherence. Participants were required to have had a hospital or urgent care visit related to asthma and to have filled a prescription for asthma medication within the 12 months preceding enrollment.

Prior to enrollment in the study, participants were visited in their homes, given information about the study and invited to ask questions directly to study staff. If interested, potential participants were then invited to a study intake located within their geographic area. Transportation services were provided. At intake, a registered nurse established height, weight and body mass index (BMI) followed by administration of spirometry, a test of lung function that measures the forced expiratory volume of the lungs in one second (FEV1). From the FEV1 results the participant was designated as having high or low levels of asthma severity based on lung obstruction. Following this process, adolescents received a smart phone, a tutorial on how to use the device and completed the first round of study measures to assess asthma symptoms and anxiety symptoms using an application located on phone. Participants were prompted to complete the Hospital Anxiety and Depression Scale (HADS) and the Asthma Control Test (ACT) in this same way throughout their time on study. Some participants completed an exit process that included a second spirometry measure.

Community

The disproportionately high rates of morbidity and mortality for low-income, African-American youth provided the basis for the M-CHESS intervention study to focus on this group of young people living in Milwaukee, Wisconsin. Milwaukee is listed as one of the top ten cities in American where air pollution and industrial pollution is concentrated in low-income, racial and ethnic minority neighborhoods (Bergquist, 2009). In 2013, the poverty rate for White

persons in Wisconsin was 7% while the poverty rate for Black persons in Wisconsin was 39%. Approximately, 69% of Wisconsin's African-American population lives in Milwaukee County. Only zip codes within Milwaukee County were selected for the research study. The Milwaukee Public School system is the largest in Wisconsin, serving over 78,000 students during the 2013-2014 school year. In the Milwaukee Public School system, 87% of students identify themselves as students of color with 56% identifying as African-American. Nearly 80% of the school population is eligible for free and reduced lunch, which served as a proxy indicator of eligibility to receive their healthcare through Medicaid.

The city of Milwaukee experiences higher rates of asthma diagnosis than surrounding suburban and rural areas. Asthma is the number one cause of school absenteeism for children in Milwaukee County and is the number one cause of pediatric hospitalization. In 1999, there were 2,245 individuals hospitalized in Milwaukee County with a primary diagnosis of asthma, resulting in $11,718,955 in hospital based medical expenses. The asthma hospitalization rate for children in Milwaukee County is 4.49/1000, four times the Healthy People 2010 goal of 1.0/1000. Although African Americans make up less than one third of the County's population, they account for over two-thirds of asthma hospitalizations (White, & Geddes, 2003).
Using US census designate categories, study participants are predominantly youth of color and African -American youth account for 73% of the study's population.

Measures

The measures for this study included the Asthma Control Test (ACT) and the Hospital Anxiety and Depression Scale (HADS). The ACT is a five item self-administered survey tool that has been validated in cross-sectional and longitudinal studies (Nathan et al., 2004; Schatz et al., 2006, 2006). A copy of the ACT can be found in Appendix B. Anxiety symptoms were

measured using the Hospital Anxiety and Depression Scale (HADS). The HADS is a 14 item self-report survey that has been repeatedly validated and widely used to assess for symptoms of anxiety and depression in adolescents and adults. Study analysis utilized the HADS-A (anxiety) subscale. A copy of the HADS can be found in Appendix C.

Table 1.1 Comparison of HADS-A and ACT items

Hospital Anxiety and Depression Scale - A	**Asthma Control Test**
1. I feel tense or 'wound up‘ 2. I get a sort of frightened feeling as if something awful is about to happen 3. Worrying thoughts go through my mind 4. I can sit at ease and feel relaxed 5. I get a sort of frightened feeling like 'butterflies' in the stomach 6. I feel restless as I have to be on the move *7.* I get sudden feelings of panic	1. How much of the time did your asthma keep you from getting as much done at work, school or at home? 2. How often have you had shortness of breath? 3. How often did your asthma symptoms …wake you up at night or earlier than usual in the morning? 4. How often have you used your rescue inhaler or nebulizer medication (such as albuterol)? *5.* How would you rate your asthma control *...?*

Note: Adapted from (Schatz et al., 2006; Snaith & Zigmond, 1986)

Research Questions

This study investigated the longitudinal relationship between self-reported asthma and anxiety symptoms among participants in an adolescent asthma intervention. The purpose of the research was to investigate a potential relationship between asthma and anxiety symptoms by determining if asthma and anxiety symptoms co-varied within individuals and between individuals over time. Secondarily, the study investigated whether several individual level moderators impacted asthma or anxiety symptoms either within-persons or between-persons. To this end the current studies research questions are:

1. Is there a relationship between asthma and anxiety over time?
2. Does smoking, race/ethnicity, Body Mass Index (BMI) or gender, moderate any relationship between asthma and anxiety?

Chapter Two: Literature Review

The following review of literature includes the theoretical basis for the research, the current context for investigating the comorbidity of asthma and anxiety and the challenge of defining and assessing comorbidity for researchers, clinicians, caregivers and individuals with anxiety and/or asthma.

Theoretical Basis

This study proceeds from the belief that biological, psychological and social factors contribute to the comorbidity of asthma and anxiety. This Biopsychosocial perspective is further explicated through Ecological Systems Theory and allows for the existing body of research to be considered as only part of the broader context encompassing the lived experience of youth. The young people in this study were invited to participate not only because they have asthma but because they have biopsychosocial characteristics which previous studies have shown place them at higher risk for an asthma diagnosis: poverty, urban residence and for the majority, belonging to a racial or ethnic minority group (Andrew Aligne et al., 2000; Forno & Celedón, 2009). These same combination of characteristics have been identified as contributing to anxiety and emotional distress (Evans & Kim, 2013; Goosby, 2007; Morrison Gutman et al., 2005). The current study does not investigate the impact of these shared characteristic upon the expression of asthma or anxiety symptoms but rather seeks information about the relationship of these two conditions within the participants' shared context.

Biopsychosocial model

In 1977, George Engel's essay "The need for a New Medical Model: A Challenge for Biomedicine," he described the limits of the biomedical model to impact the health of individuals and populations. He critiqued the standard biomedical model which emphasizes direct biological

cause and effect relationships between an action or agent on the body and disease or the impairment of health. The biomedical model emphasizes elimination or suppression of these causes with the expectation that this will restore the body to health (G. L. Engel, 1977; Wade & Halligan, 2004). In place of the biomedical model, Engel's proposed the Biopsychosocial model, where illness is best understood in the interaction between the biological, psychological and sociological environments. The biomedical perspective places the responsibility to define and prescribe treatment in the hands of the healthcare provider and places on the individual, or caregiver of an individual, the responsibility to comply with treatment directives. In contrast, the Biopsychosocial model acknowledges influence of multiple spheres upon the individual. For example, the two person interaction between patient and doctor or client and psychologist, is influenced by internal systems such as the nervous system at work upon the body and external systems such as each member of the dyad's family beliefs (George L. Engel, 1981) . A psychiatrist, Engel was able to speak to the psychological aspects of medical disease and the importance of relationship and understanding between those providing care and those receiving care.

Despite increased consideration for biopsychosocial perspectives, the biomedical model remains a dominant model of health care conceptualization, research and service delivery in the United States. Multiple perspectives on the etiology of asthma mark out a vast array of overlapping investigatory paths influenced by the theoretical perspective of the researcher team. These efforts range from biopsychosocially influenced investigation of asthma as a condition with high rates of psychological distress influenced by multiple contextual factors to more biomedically influenced efforts investigating asthma as a highly heritable biological condition disproportionately affecting specific populations (Lilly, 2005; McGrady et al., 2010; Van

Lieshout & Macqueen, 2012). Anxiety in and of itself and in the context of an asthma diagnosis is approached with a similar diversity of perspective seeking to separate, delineate or integrate the genetic epidemiology of anxiety disorders and the more contextually and environmentally bound conceptualizations of etiology (Hettema, Neale, & Kendler, 2001)

From a biopsychosocial perspective, hypotheses that locate the development and progression of asthma and anxiety solely within the body do not properly account for the psychological and social factors that could influence the expression of asthma in the body, development of anxiety and substantially influence the progression of symptomology in low-income youth of color living in urban environments. Racial and ethnic minority youth and their families are more likely to experience discrimination and report negative interactions with health care providers (Armstrong et al., 2013; Williams & Williams-Morris, 2000). Youth with asthma who receive their healthcare through Medicaid are less likely to use controller medications and more likely to report dissatisfaction with their level of care (Finkelstein JA, Lozano P, Farber HJ, Miroshnik I, & Lieu TA, 2002; Weech-Maldonado, Morales, Spritzer, Elliott, & Hays, 2001). Youth eligible to receive mental healthcare through Medicaid are unlikely to receive services even if those services are available due to difficulty managing and understanding complex care systems(Harrison, McKay, & Bannon, 2004). This dissatisfaction with care and difficulty in accessing care for youth using Medicaid may increase the severity of asthma symptoms due to under treatment and increase the potential for life threatening exacerbations and death (Persky et al., 1998). Perception of a biological predisposition toward asthma could bias clinicians towards a diagnosis of asthma when symptoms could be attributed to a temporary respiratory inflammation (Gergen, 1996).

In a study of school children in Philadelphia, Black youth were more likely to be given a diagnosis of asthma than White youth with the same symptoms presentation (Cunningham, Dockery, & Speizer, 1996). Factors in the physical environment are also likely to contribute to the development or expression of asthma among low-income youth of color. Low-income housing and housing utilized by persons of color is often clustered in areas of historical or current environmental pollution which could impact the development of asthma and increase symptomology (Gauderman et al., 2004; Neidell, 2004; Yu, Sheppard, Lumley, Koenig, & Shapiro, 2000). Poor indoor air quality that could trigger asthma exacerbation is also more likely in low-income housing to due to construction design and the condition of the housing itself via the presence of rodent and cockroach allergens. Indoor air quality is also diminished by keeping windows closed, which may be a necessity to avoid exposure to particulate matter triggers in outdoor air (Phipatanakul, 2002; Rauh et al., 2002; Wallace et al., 2003). All of these challenges to managing asthma symptoms and to obtaining supportive and appropriate care for asthma could contribute to subsequent development of anxiety and anxiety disorders, which are reported at high levels within communities living in subsidized housing (Simning et al., 2010). It is also possible that the chronic stress of poverty and systemic racism could in and of itself contribute to development of anxiety and anxiety disorders separately from the development of asthma but co-existing with asthma at elevated rates (Evans & Kim, 2013; Goosby, 2007; Lewis et al., 2012; Williams & Williams-Morris, 2000).

It is possible that trait based psychological and biological factors contribute to the comorbidity observed in this study and to the high rates of association found in other studies investigating the phenomena (Gershon et al., 2010; Katon et al., 2007; Lu et al., 2012). It is also likely that the burden of managing a life threatening chronic illness increases anxiety symptoms

among young people (Surís et al., 1996). Symptoms of anxiety and the stress placed upon the body by an anxiety disorder could in turn increase the inflammatory responses thought to be responsible for an increase in some types of asthma symptoms (Veres, Rochlitzer, & Braun, 2009).

Ecological systems theory

Contemporaneous to Engel's development of the Biopsychosocial model, Urie Bronfenbrenner created the Ecological theory of human development which proposed that individual's development was impacted by the surrounding environment and divided the environment into five systems. The current study conceptualizes the psychosocial aspect of Engel's Biopsychosocial model through Bronfenbrenner's systems affecting development: Microsystem, Mesosystem, Exosystem, Macrosystem and the Chronosystem (Bronfenbrenner, 1986; Wright et al., 1998). In this model, the individual and their body is placed within concentric spheres of influence that are bidirectional. These spheres take into account the various ways in which a young person's environment can impact the development and treatment of conditions such as asthma and anxiety. For example, a young person may have access to mental health services that could provide treatment for anxiety which should provide resolution within a medical model, however the biopsychosocial model considers that barriers to care could include perception of need by individuals and families, copay requirements, logistical challenges of accessing care and dependency on employment that does not offer paid leave to accommodate care (Asnaani, Richey, Dimaite, Hinton, & Hofmann, 2010; Hunter & Schmidt, 2010; Williams & Williams-Morris, 2000). These challenges come from different systems affecting development but interact to increase the difficulty of accessing care.

At the center of these systems is the individual. The mental and physical health predispositions of an individual would be contained within the inner circle of the individual and would include a child's innate risk for development of asthma and/or anxiety. Immediately proximal to the Individual is the Microsystem, made up of the institutions and groups that are most directly influence a child's development. Microsystem examples include families, networks of caregivers, peers and potentially health care providers. In the case of asthma and anxiety, caregiver's beliefs have a significant impact on treatment. Families who cannot afford all of their child's prescribed asthma medications are more likely to purchase quick relief or rescue medicines rather than medications designed for long term control of asthma symptoms. The lack of controller medication increases the need for rescue medications, resulting in increased asthma symptoms such as asthma attacks which reinforces the prioritization of rescue medications and increases stress for both the affected youth and their families (Ungar, MacDonald, & Cousins, 2005). Similarly, a family's beliefs about mental health and ability to recognize symptoms of anxiety in need of treatment would play a substantive role in whether a young person receives care. This system also includes the impact of disruptions to the family such as incidents of domestic violence, which are associated with higher incidence of both asthma and anxiety symptoms (Graham-Bermann, 1996; Wright et al., 2004).

The Mesosystem is the space of interactions between microsystem agents. It can include the relationship between families and the school system, between families and friend groups and between families and healthcare providers. It can also represent interactions between microsystem agencies such as intimately involved social service agencies and schools. While the biomedical model privileges the in the moment relationship between providers and clients, a biopsychosocial perspective would expand thinking about that relationship to encompass the

historical and lived experiences of discrimination and disrespect which could impact the relationship between mental and medical health providers and low-income families of color. For example, despite having high rates of emergency department use, low-income African-Americans report less use of clinical medical resources and more distrust of health service agencies. Members of this group also report the highest rates of racial based discrimination within healthcare environments. (Armstrong et al., 2013; Law, Oraka, & Mannino, 2011; Voils et al., 2004) Using a standard medical model, high rates of emergency department usage is often used as a proxy for uncontrolled or poorly managed asthma however from an ecological systems perspective; this pattern could additionally represent inaccessibility of clinic care or desire to avoid negative interactions with health care systems. Interactions between systems play a significant role in obfuscating or facilitating care for asthma and anxiety. For example, a successful program treating anxiety symptoms in African-American youth offered within a school system would represent coordination in the Mesosystem which could mediate a challenge in the Microsystem such as difficulty accessing care due to transportation issues (Ginsburg & Drake, 2002).

An adolescent is most directly connected to the Microsystem; the Exosystem involves more distal systems which might not be as evident to young people. --primarily their caregiver's networks of social contacts, employment or agencies engaged in providing services to the caregivers and their families. While the Affordable Care Act has brought significant changes to the US system of health care, access to medical and mental healthcare and perception of access to care is closely tied to socioeconomic status. People may receive healthcare insurance through their employer, by purchasing private insurance or through a government program available to qualifying individuals or they might have no health care insurance and be responsible for all

treatment costs. In the US, low-income racial and ethnic minority youth are less likely to have a primary care physician and more likely to utilize emergency department services. Research shows that financial concerns related to purchase of asthma medications and costs for medical services increased family stress and contributed to inconsistent and underutilization of medication (Ginde et al., 2008; Law et al., 2011; Rand et al., 2000). Additionally a caregiver's social support network can be critical to their ability or difficulty in providing for their child's chronic care management. For example, the apartment building or neighborhood a child lives in may have substantial asthma trigger risks but relocation would require unacceptable changes in the Exosystem, the loss of social support, job or access to affordable housing (Mansour, Lanphear, & DeWitt, 2000).

The Macrosystem encompasses the cultural environment, asking what roles do factors such as ethnicity, race, socioeconomic status, gender and many other group level identities play in the life of the individual. While the bidirectional nature of the ecological systems model demonstrates the interconnectedness of these factors across system, this level describes how factors common to groups can impact individuals. Cultural understandings of illness can have substantial impact on how directives for care are implemented. Caregivers often modify asthma care plans unintentionally or because they prefer to rely on methods of care that are familiar to them such as teas or topical ointments. Caregivers from across multiple socioeconomic and ethnic groups share fears that medications are too strong, too numerous or might not be available when needed (Horne & Weinman, 2002; Mansour et al., 2000; Sleath et al., 2012). The description of symptoms related to distress is often tightly bound with cultural understandings of illness. In a case study examining cultural competency in diagnosis and treatment of comorbid asthma and anxiety, researchers described a situation where a family moved from Japan to the

United States and sought treatment for what they perceived to be their son's increased asthma symptoms. As negative side effects from the medications, particularly overuse of his bronchodilator medication, increased, the treating physician urged the parents to consider the possibility of a comorbid anxiety disorder. Only through addressing the parent's culturally based concerns about the potential stigma of a mental health diagnosis could the health care practitioner find an optimal balance of treatment for the young man's comorbid asthma and anxiety (Horikawa, Udaka, Crow, Takayama, & Stein, 2014).

For African-Americans concerns related to stigma from receiving mental health care or a mental health diagnosis could make an asthma diagnosis more acceptable than an anxiety diagnosis. Researchers Hunter and Schmidt proposed a sociocultural model of understanding anxiety diagnosis in African-American communities that describes how awareness of racism, coupled with stigma related to mental illness and an orientation towards treating physical illness as more salient than mental illness likely results in under-diagnosis of anxiety disorders (Hunter & Schmidt, 2010). Additionally a cultural-familial understanding of mental illness can contribute to whether an individual seeks services for an illness and this understanding is passed down generationally as described by Bronfenbrenner's model of the Exosystem (Bronfenbrenner, 1986; Lindsey, Joe, & Nebbitt, 2010). For example, if shortness of breath, which can result from a multitude of intrinsic and extrinsic causes, is understood within a family to be the result of asthma then the family will seek to have it treated as asthma and present it to others asthma.

The last system is the Chronosystem describing the how time, the experiences over the life course impact, normative events such as aging and non-normative events such as specific illness impact an individual overtime. It is also possible to conceptualize institutional and intergenerational memory within the Chronosystem. While medical practitioners may perceive

their contemporary practice to be divorced from previous abuses of individuals and communities, these past abuses may present salient barriers to care for those connected to that experience through intergenerational and cultural memory (Brandon, Isaac, & LaVeist, 2005; McKenzie & Bhui, 2007).

Both anxiety and asthma have critical influence on the development of a young person's ability to function within their systems. Asthma management strategies often focus on the individual's ability and responsibility to control the course of their illness through medication adherence and the use of an asthma action plan to develop awareness of their asthma symptom (Bhogal, Zemek, & Ducharme, 1996; Gibson & Powell, 2004; Yin et al., 2013) . However, for youth who are already experiencing high levels of life stress and uncontrollable contextual stressors, these types of interventions have been shown to cause increased levels of anxiety. Asthma has a wide range of triggers and reactivity to triggers can be intermittent. The expectation that youth could use an asthma action plan or other awareness based intervention to control their asthma presented an additional burden of expectation and stress rather than empowering youth to believe they could affect positive change in their health status (Murdock et al., 2010).

The current study population was selected based on previous research suggesting that low-income African-American youth living in urban areas, as a group, suffer from some of the highest rates of asthma diagnosis in the United States, and are likely to have elevated rates of anxiety symptoms in comparison to peers without asthma. By investigating if there is a relationship between asthma and anxiety longitudinally for the group and longitudinally within individuals in the group, this research seeks to gain insight into the progression of anxiety and asthma and thereby expand the research field and provide basis to conceptualizing treatment.

Using an ecological systems perspective to approach this work allows the researched, lived experiences of African-American youth as a group to contextualize the study results and thereby provide an opportunity to consider what systemic factors may impact the outcomes.

Research Context

The historic increase in asthma prevalence among youth, coupled with evidence of an association with anxiety symptoms prompted diverse researcher efforts examining multiple facets of the relationship between these two conditions and the impact of their comorbidity on young people. (Goodwin et al., 2003; Goodwin, Messineo, Bregante, Hoven, & Kairam, 2005; Katon et al., 2007; Lu et al., 2012; McCauley et al., 2007; McLaughlin, Geissler, & Wan, 2003; Meuret et al., 2006; Wolitzky-Taylor et al., 2012). A summary sample of reviewed studies' results and methods used to define the presence of asthma and anxiety is provided in Appendix D and Appendix E. These studies were selected because they represented literature focusing on the comorbidity of asthma and anxiety symptoms in youth populations and/or a focus on racial and ethnic minority (REM) populations, low-income youth or youth in urban areas. Considering these studies as a group allowed several common areas of challenge and focus to emerge and informed the current study's methodology and analysis. The most significant challenges to researching the relationship of asthma and anxiety symptoms are defining comorbidity, somatic symptoms overlap between asthma and anxiety and the ability of clinicians and individuals to discern between symptoms of anxiety and asthma. Areas of focus include diagnostic criteria used to determine the presence of anxiety and asthma symptoms, studies related to risk factors and studies investigating a possible association between asthma and specific anxiety disorders.

Comorbidity

While there is substantive historical, quantitative and qualitative evidence for the co-occurrence of asthma and anxiety symptoms, additional research is needed to clarify the nature of this relationship, including the progression and persistence of symptoms, in order to determine if the relationship constitutes an expected and proactively managed comorbidity. There are three major challenges to substantiating a comorbid relationship between asthma and anxiety. First, comorbidity has multiple definitions which can include etiological and contextual descriptors as well as consideration of illness progression. Second, there are substantial overlaps in the symptoms used as diagnostic indicators for asthma and anxiety, and medications prescribed for relief from asthma can cause and increased symptoms of anxiety. Finally, symptoms perception of either condition is influenced by multiple contextual and cultural factors including the ability to perceive and report symptoms and the relationship between the client and clinician.

In any investigation regarding the co-occurrence of asthma and anxiety, how a study defines comorbidity impacts its reporting of results. For example, Goodwin et al. (2004) analyzed the association of asthma and anxiety, as well as other internalizing disorders, in a birth cohort of 1053 from an urban region of New Zealand. To assess for an internalizing disorder, the Composite International Diagnostic Interview was administered by a trained lay person to each participant at ages 18 and 21. In the interview, youth were asked to recall internalizing symptoms over the past three years. Asthma diagnosis was determined by participant self-report of diagnosis, occurrence of asthma symptoms, frequency of symptoms, medication use, medical consultation and frequency of asthma attacks in the three years preceding the interview.

Based on the 16 to 18 year time period, 17% of youth with asthma met the studies DSM-IV diagnostic criteria for an anxiety disorder. The second wave of the study, based on the 18 to

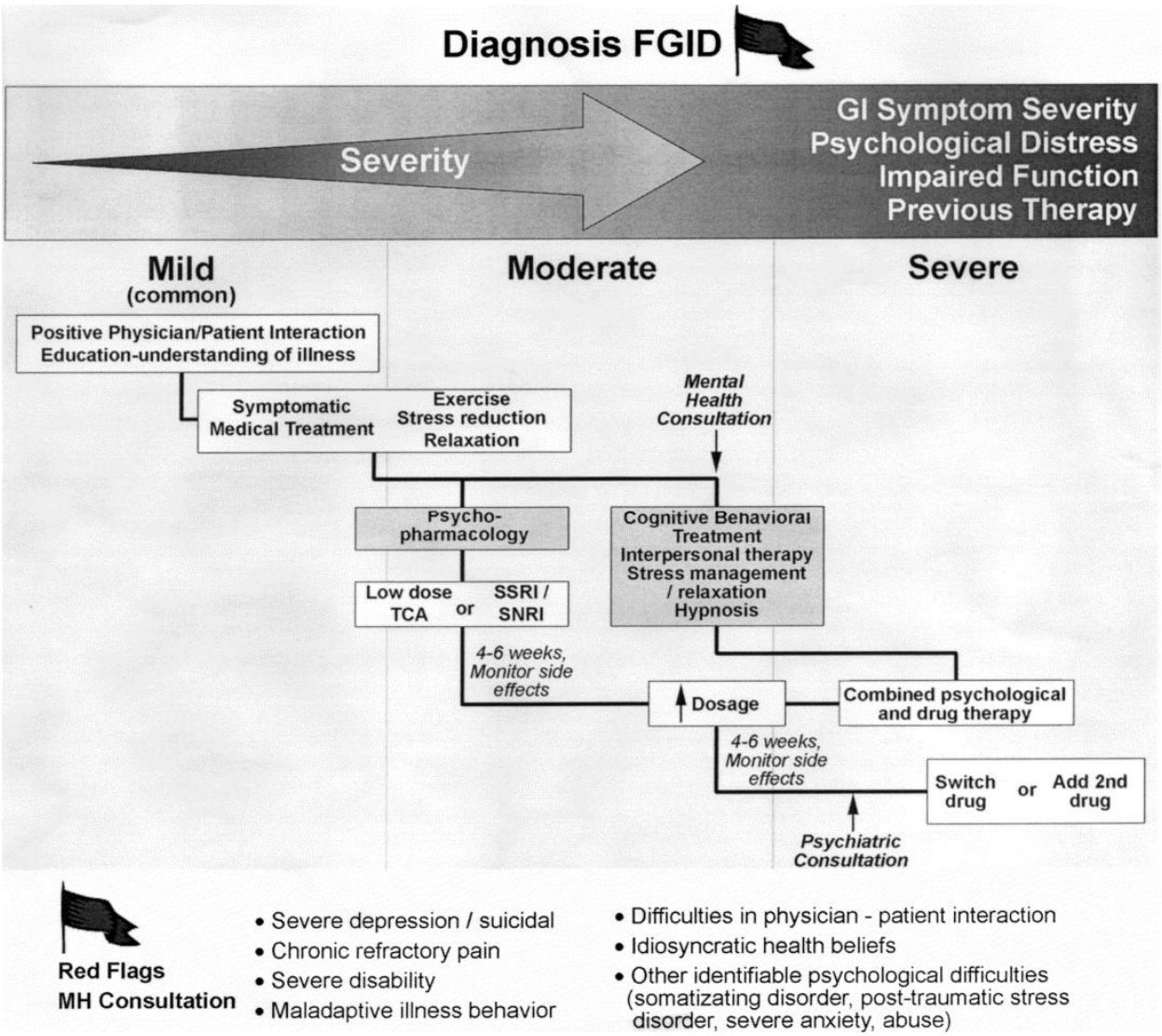
21 year time period, 12.9% of youth with asthma met criteria for an anxiety disorder. These rates constitute higher rates of anxiety disorder than that expected in a general population sample and does not include youth experiencing symptoms of anxiety that did not reach the diagnostic thresholds set by the researchers. The study used a fixed effects regression model and determined that, in this population, there was no significant association between asthma and panic attacks, anxiety disorders, or depression. Researchers found a co-occurrence between asthma and anxiety but rejected it as comorbidity by their definition. Researchers' used a study specific measurement, the Child Adversity Index, to assess for socio-economic adversity, measures of parental change and conflict, measures of child abuse exposure, and measures of parental adjustment. Goodwin et al. attributed high rates of comorbidity in cross-sectional studies to over reporting of symptoms singular symptoms as both asthma and anxiety symptoms on self-report instruments and symptoms confusion by both patients and clinicians involved in research (Goodwin et al., 2005) . Discussion of this study's results highlights the need for clear terminology with regards to comorbidity, while the researchers did find a co-occurrence of asthma and anxiety it did not meet their definition of comorbidity. Using the broadest definition of comorbidity – the co-occurrence of two conditions – all of the research in the present studies review of literature found that anxiety symptoms and anxiety disorders are more likely to be present in among persons with asthma than among those without asthma.

Defining comorbidity. A challenge to discussing this body of multidisciplinary literature is the variety of definitions accompanying the terms comorbid, concurrent, multimorbid and co-occurent. Comorbidity models typically focus on the dependence and independence of risk factors as well as the causal interaction of the conditions. (Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009). The current study's longitudinal design and analysis seek information that

could allow the relationship of asthma and anxiety to be more clearly defined through use of multiple measurements and separating the relationship within individuals from the relationship observed at the group level.

Difficulty defining comorbidity in the asthma/anxiety dyad is consistent with other literatures examining comorbid relationships such as diabetes and separation anxiety, irritable bowel syndrome with depression and anxiety and thyroid disease with depression (Morrison, Dashiff, Abdullatif, & Moreland, 2011; van de Ven et al., 2012; Whitehead, Palsson, & Jones, 2002). Clear understanding of the relationship between comorbid illnesses provides valuable resources to guide treatment. In response to research showing an association between functional gastrointestinal disorders (FGIDs), such as irritable bowel syndrome (IBS,) and psychological distress, depression and suicidality, treatment protocols were designed to help physicians anticipate and effectively treat this potential comorbidity (Fond et al., 2014). Included were suggestions for stress reduction, psychotherapy and psychopharmaceutical intervention (Riedl et al., 2008) Research into the comorbidity of psychiatric disorders with FGIDs were estimated to be as high as 94% (Whitehead et al., 2002).

Figure 2.1 Assessment and treatment protocol for comorbid FGID and Psychological Distress



Note: Figure appeared in (Riedl et al., 2008)

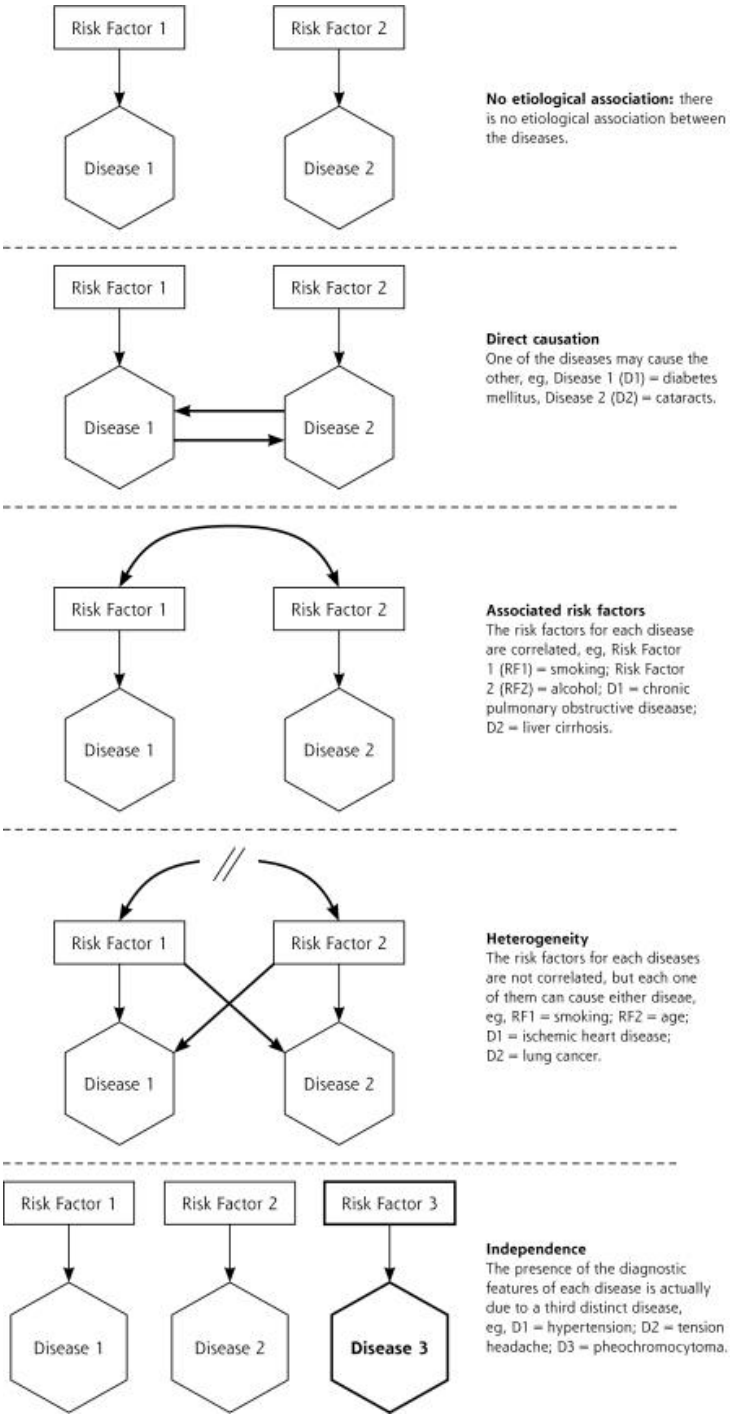
The current study conceptualized the potential relationship between asthma and anxiety using the definition system pictured below in figure 2.2**.** This system was proposed by Vaderas et al., (2009) to assist health service providers in assessment and treatment of comorbid conditions (Valderas et al., 2009). The system describes five different types of comorbidity, 1) no etiological association, 2) direct causation, 3) associate risk factors, 4) heterogeneity and 5) independence. In the first case, describing comorbidity with no etiological association, asthma

and anxiety would co-occur without any association of risk factors in the same way that an individual could have a broken leg and an allergy to peanuts. Their correlation would not be greater than that expected by chance. In the second, direct causation, asthma or anxiety could directly cause the occurrence of the other condition. This comorbidity would describe the development of post-traumatic stress disorder subsequent to trauma from a life threatening asthma attack (Kean et al., 2006). Direct causal comorbidity could also describe a hypothesis that neurological functioning related to asthma subsequently predisposes the development of anxiety. While less likely, it could also describe a path of causation where stress placed on the body via anxiety would make an individual more likely to express their predisposition towards the development of asthma.

Conditions arising from associated risk factors is the definition of comorbidity most often proposed by researchers investigating the relationship between asthma and anxiety. It describes a wide range of conceptualizations relative to the etiology and concurrence of asthma and anxiety including that individuals who are biologically predisposed to develop asthma are biologically predisposed to develop anxiety. It could also describe a relationship where the neuro-immune response thought to trigger the inflammatory disregulation of asthma also triggers anxiety symptoms and eventual development of an anxiety disorder (Veres et al., 2009). While not a synonymous representation, a broad reading of associated factors comorbidity could include associated contextual risk factors such as socio-economic status and housing type that could account for the presence of both asthma and anxiety. This describes the type of comorbidity most often used to explain the co-occurrence of asthma and anxiety among low-income youth living in urban areas (Deshmukh et al., 2008; Forno & Celedón, 2009; Mehnert & Koch, 2008)

In a comorbidity of heterogeneity, the risk factors for the two conditions are not associated but both risk factors are present and either one could cause both diseases. In this scenario two non-associated risk factors could cause either disease and the challenge is pinpointing the causal factor. Lastly, a comorbidity of independence describes a situation where the presence of the first two conditions of interest is explained by a third unidentified condition such as symptoms of cardiovascular failure being attributed as diagnostic features of asthma and anxiety. While some comorbid relationships might be best described by these categories singularly, it is certainly possible for a relationship between conditions to be better understood as the integration of two or more types of comorbidity. While this taxonomy was developed primarily to describe discrete medical diagnosis it is nonetheless helpful in describing research finding relative to asthma and anxiety disorders or symptoms when there is disagreement about what type of co-occurrence warrants the language of comorbidity.

Figure 2.2 Proposed Definitions of Comorbidity



Note: Figure appeared in (Valderas et al., 2009)

Overlapping symptomology

Multimorbid conditions are particularly difficult to diagnose and treat when there is overlapping symptomology. Existing evidence for the comorbidity of asthma and anxiety should be considered in light of potential symptoms confusion by clinicians and clients given the overlapping symptomology between asthma and anxiety, as well as common use of anxiogenic medications in treatment of severe asthma exacerbations. The symptoms of an asthma attack, anxiety symptoms, and the side effects of common corticosteroids such as prednisone have significant overlap (Koinis–Mitchell et al., 2009) Increased report of asthma symptoms has been shown to result in increased dosage levels of controller medications and increased likelihood of corticosteroid use. These medications have anxiogenic effects and side effects that can in turn increase feelings of anxiety which could be reported as a lack of symptom remission and continue a cycle of increased medication without relief from symptoms of asthma (Romero-Frais et al., 2005). Understanding and assessing the symptoms of asthma and anxiety in young people is a complicated matrix of symptoms recognition and attribution. While asthma and anxiety, in general, share common symptomology such as shortness of breath and chest tightness, the signs of an asthma exacerbation (attack) and a panic attack share substantially more overlap. In addition to symptoms of asthma that youth are asked to identify for themselves, caregivers are given additional indicators to monitor. As previously stated, side effects of medications given to control asthma symptoms can, in turn increase anxiety symptoms. The table below compares the symptoms of an asthma attack, warning signs for caregivers, panic attack criteria and the side effects of prednisone, a corticosteroid used to treat poorly controlled asthma. In addition to the side effects listed in the table below, prednisone use has been associated with increased levels of fear, anxiety and psychopathology (Romero-Frais et al., 2005).

Table 2.1 Symptoms Comparison Chart

Symptoms of Asthma Attack	Asthma Attack Warning Signs for Parents	Prednisone Side Effects	Panic Attack Symptoms	Generalized Anxiety Disorder Symptoms
Severe shortness of breath, chest tightness or pain, and coughing or wheezing	Chest tightness	Dry, hacking cough	Chest pain or discomfort	Muscle tension
The inability to speak more than short phrases due to shortness of breath	Shortness of breath	Difficulty breathing or swallowing	Feeling of choking	Restlessness or feeling keyed up or on edge
Severe breathlessness or wheezing, especially at night or in the early morning	Wheezing	Shortness of breath, especially during the night	Sensations of shortness of breath or smothering	Sleep disturbance (difficulty falling or staying asleep, or restless unsatisfying sleep
Worsening symptoms despite use of a quick-relief (rescue) inhaler	Coughing	Numbness, burning, or tingling in the face, arms, legs, feet, or hands	Numbness or tingling sensations (paresthesias)	Difficulty concentrating or mind going blank
Low peak flow readings when you use a peak flow meter	Vomiting	Upset stomach, vomiting	Nausea or abdominal distress	Being easily fatigued
	Unusual paleness or sweating	Increased sweating	Sweating	Irritability
	Anxious or scared look	Shaking of the hands that you cannot control	Fear of losing control or going crazy	
	Fatigue and breathlessness	Depression	Fear of dying	
	Hunched-over body posture	Swelling or pain in the stomach	Trembling or shaking	
	Restlessness during sleep	Weak muscles	Chills or hot flashes	
	Fast breathing	Lightheadedness	Feeling dizzy, unsteady, lightheaded, or faint	
		Irregular heartbeat	Palpitations, pounding heart, or accelerated heart rate	
		Confusion	Feelings of unreality (derealization) or being detached from oneself (depersonalization)	

Note: Table based on (Romero-Frais et al., 2005)American Lung Association, 2007, DSM-IV-TR, 2000, National institute of health: Medline: Prednisone.2008)

There is overlap among all five categories explicated above. However, there is substantial overlap between the warning signs of an asthma attack for parents, the side effects of prednisone and symptoms of panic attack. The similarity of these groups of symptoms can make it difficult to discern appropriate diagnosis and treatment if the possibility of comorbid symptomology is not considered. These overlapping symptoms highlight the importance of using NHLB guidelines for diagnosis in research and clinical settings and the importance of integrating mental health services into primary care. To date there is no proposed or validated measure designed to help clinicians or youth with asthma distinguish between symptoms of anxiety and symptoms of an asthma exacerbation or attack. No study, even those that assessed for panic attacks or disorder, attempted by any means to discern if participants were able to differentiate between the experience of asthma symptoms and symptoms of a panic attack.

In this light, it is important to note that there is less likelihood of symptoms overlap leading to symptoms confusion when comparing the symptoms an asthma attack and symptoms of generalized anxiety disorder (GAD). These two lists of symptoms are similar to the symptoms reports elicited by the ACT and HADS measurements. While the HADS does not specifically screen for GAD, the instruments focus on non-somatic general symptoms of anxiety such as worry and restlessness aids in separating the symptoms of asthma and anxiety to allow for meaningful analysis.

Symptoms perception

The addition to overlapping symptoms, a substantial challenge to investigating the comorbidity of asthma and anxiety is symptoms perception. Symptom perception includes an individual's ability to identify and report symptoms, caregiver's recognition of symptomology I their children and clinician's ability to understand and discern their client's experience of illness.

Often, youth with asthma do not know the extent of their lung impairment and their ability to report meaningfully on their health status is limited. Inhaled methacholine simulates bronchoconstriction experienced during an asthma attack. In a study by Chen et al. (2006) youth with the most severe asthma based on biological based measures taken before a methacholine challenge test reported high levels of asthma control indicating low levels of asthma symptomology. In youth with asthma and anxiety, higher levels of somatic symptoms were reported, even when their asthma was deemed mild and expected to result in few symptoms based on biological measures and methacholine challenge results (Chen, Hermann, Rodgers, Oliver-Welker, & Strunk, 2006). Additionally, caregiver reports of internalizing and asthma symptoms have been shown to have rates of inaccuracy up to 30% (Yoos, Kitzman, McMullen, & Sidora, 2003).

In a study investigating the role of cognitive and psychological factors in symptoms perception judgments made by youth with asthma, Koinis-Mitchell et al. (2009), attempted to determine which factors were related to congruence between self-report of asthma symptoms and biological measures of lung obstruction and reactivity. Researchers found that accurate perception was related to a child's ability to pay attention to their bodies rather than cognitive or psychosocial variables often targeted by active asthma management strategies (Yin et al., 2013) Accurate reporting of symptoms is important because it substantially defines a healthcare providers treatment recommendations and choice of pharmaceutical intervention. If individuals with asthma have an undiagnosed anxiety disorder and are being treated only for asthma, their asthma might be well controlled by their current medication but they could still present to their health care practitioner symptoms that would be consistent with uncontrolled asthma such as muscle tightness or wakefulness at night. Higher self-report of symptoms was related to

increased prescription of anxiogenic oral corticosteroids which in turn could contributes to a cycle of increased medication and increased symptom reporting (Romero-Frais et al., 2005).

Another complicating factor in symptoms perception and differentiation is an increase in anxiety symptoms can be part of a learned response to an individual's known asthma triggers such as cigarette smoke, grass clippings or dust. If persons are aware that cigarette smoke is a trigger for them they can become conditioned to respond physically in anticipation of encountering their trigger or when they believe the trigger is present. In a study by De Pueter et al., (2005), participants reported distress and increased physical symptoms which they attributed to asthma when they expected to interact with an asthma exacerbating agent despite treatment with placebo (De Peuter et al., 2005). Additionally, people with asthma have described a cycle where fear of having an asthma attack in response to an expected trigger seems to intensify physical symptoms or even trigger an attack in the absence of the expected stimuli (Dhar & Ghoshal, 2011). It is possible that when an individual's asthma triggers are identified they become reinforced through a process of associative learning, effectively activating a classical conditioned response to the stimuli via anxiety that is inconsistent with current respiratory status (Lehrer, 1998). For example, when asthma is well controlled cigarette smoke might not trigger an asthma attack but if someone has a lung inflammation related to cold or flu, is under medicated or has not been taking their controller medication the smoke might trigger an asthma attack. If an attack has happened multiple times in response to cigarette smoke, a person's fear or anxiety response could trigger symptoms that could be viewed as consistent with an asthma attack. This type of response adds to the difficulty of separating the primary driver of symptomology as some may be driven by asthma, some by anxiety and some in combination of conditions.

Both individual and caregiver's ability to perceive an accurate level of asthma symptoms is in doubt. Multiple studies have shown disagreement between biological measures of asthma and patient report, between youth and caregivers and between clinical assessment and self-report assessment. Under-reporting is reporting high levels of symptom control in contrast to clinical assessment which may include spirometry; over-reporting is the opposite configuration. Caregivers often under report their child's asthma symptoms and over report their adherence to asthma management protocols and daily controller use. Parents and other caregivers are also likely to underestimate the amount of lung obstruction and the severity of asthma impairment, resulting in under-treatment of asthma (Carroll, Wildhaber, & Brand, 2012; Feldman et al., 2013) In contrast, over-reporting of symptoms has also been reported, particularly in response to unpleasant or anxiety provoking contexts (Bogaerts et al., 2005). Still other investigations have proposed that under reporting and over reporting are representative of a general tendency among people with asthma to have difficulty noticing what is happing in their body and to accurately perceive their level of lung impairment due to asthma (Janssens, Verleden, De Peuter, Van Diest, & Van den Bergh, 2009).

Obesity. Young people whose height and weight relationship places them in the obese category are presented with an additional challenge to symptoms perception. Because obesity can cause breathing difficulties due to the restriction of lung expansion, young people who have asthma and a BMI in the obese range have two separate conditions impacting their ability to breathe. It is unlikely that clinicians could differentiate between difficulty breathing due to lung obstruction from asthma versus lung restriction from obesity in the absence of a biologic based metric (Hakala, Stenius-Aarniala, & Sovijärvi, 2000; Jensen, Gibson, Collins, & Wood, 2013).While spirometry can differentiate between lung obstruction due to asthma and lung

restriction due to obesity it is unlikely that an individual would be able to parse the driver of their symptoms (Chang VW & Lauderdale DS, 2005). Difficulties in symptoms perception due to obesity are particularly challenging because obesity in youth has seen increases similar to that of youth with asthma over the last 20 years. Several studies have found an association between obesity and asthma in pediatric populations (Brenner, Kelly, Wenger, Brich, & Morrow, 2001; Ford, 2005) . Overweight and obese youth were more likely to report higher levels of asthma symptoms (reduced asthma control) as measured by the ACT than peers defined by BMI charts as normal weight, despite comparable levels of lung obstruction. In addition to challenges related to differentiation between asthma and obesity related breathing problems, obesity independently is associated with higher rates of anxiety symptoms and anxiety disorders compounding the challenge of identify and treating the causes of distress (Gariepy, Nitka, & Schmitz, 2010) Since youth with asthma who are obese are more likely to report higher levels of asthma symptoms and obesity is more common in low-income urban populations, it is possible that obesity could moderate the between-person impact of asthma, anxiety or the relationship between these two conditions (Chang VW & Lauderdale DS, 2005). The current study utilizes a measurement of anxiety symptoms that excludes somatic symptoms of anxiety such as chest tightness and breathlessness in an effort to differentiate between participants report of asthma and anxiety symptoms.

Focus on diagnostic criteria

Existing studies utilized a range of assessment for asthma diagnosis including simple self-report by a participant or caregiver and medical claims data. These studies typically treated asthma as the primary target area of interest and anxiety symptoms or anxiety disorders as a secondary area of interest. This may explain why assessment of anxiety symptoms or even of

specific anxiety disorders were typically not done by a mental health clinician but instead relied principally upon self-report instruments and assessment by trained lay practitioners. In terms of diagnostic specificity, one study stood out within this body of literature because it employed high standards of diagnosis for both asthma and anxiety. Asthma was diagnosed by a physician based on the National Heart, Lung, and Blood Institute (NHLBI) guidelines. Anxiety disorders were diagnosed by an experienced child psychologist who administered the K-SADS-R, modified for DSM-IV and the Anxiety and Fears Behavioral Scale a validated self-report measure. In this study, Vila et al. found that there were differences between the rates of anxiety disorder in youth with asthma and those youth without asthma; however these differences were not substantive. They found that 35 percent of youth with asthma met the DSM-IV criteria for an anxiety disorder while 33.8 percent of the comparison group was found to have an anxiety disorder. Researchers also administered the Anxiety and Fears Behavioral Scale, which indicated a 43% prevalence rate for anxiety disorders in youth with asthma which was significantly higher than in the study participants without asthma (Vila et al., 2000). This study excluded asthmatic youth who were receiving uninterrupted corticosteroids, meaning they were using corticosteroids as a daily controller medication rather than to reverse an exacerbation. This treatment is known to have anxiogenic effects (Romero-Frais et al., 2005). It is possible this exclusion accounts for the similarity of results between both groups who were administered the Anxiety and Fears Behavioral Scale.

Vila et al. (2000) was the only study to examine agreement in diagnosis of an anxiety disorder. Thirty-seven youth were identified by either a clinician, a caregiver or by themselves as having an anxiety or affective disorder. Twenty of the youth identified by a clinician with an anxiety or depressive disorder also identified themselves as having a disorder, seventeen

clinician identified youth also had parent identification, but only 13 participants had diagnostic agreement between parent, clinician, and youth. It is possible this result is consistent with other studies showing parents and caregivers are less able to identify internalizing symptoms such as those associated with anxiety disorder or to discern them from symptoms of asthma (Rockhill et al., 2007).

Focus on risk factors

Several studies sought to identify risk factors that would explain higher rates of asthma or anxiety symptoms within designated populations. In an effort to determine association of risk for comorbid anxiety and asthma, Katon, Russo, Richardson, McCauley, and Lozano, (2007) attempted to determine if select sociodemographic characteristics were associated with internalizing disorders in youth with asthma. They also investigated the impact of asthma severity on anxiety symptoms. In their study, 16.3 percent of youth with asthma compared with 8.6 percent of youth without asthma met DSM-IV criteria for one or more anxiety and depressive disorders. Levels of asthma severity were not associated with increased levels of anxiety disorder prevalence, this is in contrast to studies hypothesizing higher levels of asthma severity and incidence of severe asthma attacks could result in PTSD (Kean et al., 2006) Researchers found that low levels of parental education, being part of a single-parent family, having lower median neighborhood and household income as well as receiving their healthcare Medicaid were significantly associated with diagnosis of one or more anxiety or depressive disorder for all youth in the study not only those with asthma (Katon et al., 2007). This result indicates that while sociodemographic factors can play an important role in the development of an anxiety disorder, asthma remains an additional risk factor.

Focus on populations at risk

In response to high rates of asthma diagnosis among urban low-income youth in general and urban African-American youth in particular, several studies focused their research on these groups. Rates of asthma diagnosis increased faster among low-income children and children of color than among long income white children or children with higher family income. Severe asthma is twice as prevalent in low-income communities and Black children have an estimated 20 % higher rate of asthma prevalence than White children (*CDC, 2001).* Researchers Gillaspy et al. (2002), attempted to consider the comorbidity of asthma and anxiety in the context of the multiple anxiety provoking stressors effecting low-income and/or racial and ethnic minority youth. They surveyed a matched sample of youth enrolled in a Midwestern Job Corps program. Job Corps is a residential education & vocational program for youth whose household income is below their state poverty line. The study defined, "at risk" as having 1) a history of educational or vocational difficulties and 2) being from a low-income household 3) being from a racial minority group. Twenty-five youth with asthma were matched with 25 youth without asthma based on sex, race/ethnicity, aged within 16 months and education level within one year. Asthma status was determined by participant self-report of having asthma. As an anxiety measure, youth completed the Beck Anxiety Index (BAI). Study results showed that 24% of youth without asthma and 32% of youth with asthma fell into the "moderate" or "severe" categories on the BAI. While rates of moderate or severe anxiety symptoms was higher for both groups was higher than age range averages, the difference suggests asthma was a contributing factor in ratings of anxiety symptoms (Gillaspy et al., 2002). Another potential explanation was that the BAI uses both cognitive and physical symptoms of anxiety in its assessment, and several of the assessment questions used to define anxiety are extremely similar to symptoms of

an asthma exacerbation (Creamer, Foran, & Bell, 1995; Fydrich, Dowdall, & Chambless, 1992) It is possible participants with asthma reported higher rates of anxiety because they were reporting their asthma symptoms as symptoms of anxiety.

Puerto Ricans in the U.S. mainland and in Puerto Rico also have a very high prevalence of asthma relative to other U.S. populations. Puerto Ricans had a prevalence rate of asthma 125% higher than non-Latino/a Caucasians and 80% higher than non-Latino/a African Americans (Ortega, McQuaid, Canino, Goodwin, & Fritz, 2004). An investigation by Ortega et al., study sought to determine rates of DSM-IV symptoms and/or diagnosis among asthmatic and non-asthmatic study participants. Spanish version of the Diagnostic Interview Schedule for Children DSM-IV (DISC: DSM-IV) was administered to a community sample of 1,871 youth and caregivers. The participants were evaluated twice and the second wave interviewers were different from the first wave and blind to previous results. Youth aged 11 to 18 were interviewed directly while assessment of younger youth relied on parental report. Researchers found that 612 participants or 32% had caregiver reports of an asthma diagnosis and 416 participants or 22% had a lifetime report of an asthma attack. Researchers found the strongest predictors of asthma attack were descriptive variables. Of youth with a history of asthma attacks, 81% resided in urban areas and 68% were from low-income families. This result is similar to other studies that have shown low-income youth and youth from urban areas to be at increased risk for an asthma diagnosis. In terms of comorbidity with internalizing disorders, the researchers' found an association between parental report of asthma diagnosis and depressive symptoms, while parental report of an asthma attack was associated with symptoms of separation anxiety. Overall, they found that children with a history of asthma attacks were likely to have increased but not diagnostically significant symptoms of separation anxiety. Researchers proposed that worry

related to having an asthma attack or using their medication could contribute to this result (Ortega et al., 2004).

In discussion of these findings, Feldman et al., proposed that high rates of asthma diagnosis among Puerto Rican children might be the result of overlap between asthma symptoms and ataques de nervios" (Feldman, Ortega, McQuaid, & Canino, 2006; Lewis-Fernández et al., 2002). The symptoms of "ataques de nervios" are similar to but distinct from panic disorder (*Diagnostic and Statistical Manual of Mental Disorders-IV-TR,* 2000). Researchers proposed that Puerto Rican caregivers understanding of "ataque" might lead them to conflate "ataques de nervios", "un ataque de asma" and anxiety symptoms such as those used to define separation anxiety resulting in higher overall rates of asthma diagnosis and anxiety related internalizing disorders (Feldman et al., 2006). With this analysis, Feldman et al. draws attention to how important specificity and cultural considerations are when analyzing prevalence rates in populations.

In the follow-up study by Feldman et al., anxiety and depression were collapsed into a single category of internalizing disorder. In the study youth with asthma had higher rates of internalizing disorders than youth without asthma. However, this study found that diagnosis of an internalizing disorder in the first wave was not predictive of an internalizing disorder in the second wave. This result raises the possibility that groups of youth with asthma may have an elevated risk of for anxiety symptoms but that these symptoms may not co-occur longitudinally.

Focus on specific anxiety disorders

Several reviewed studies attempted to determine if comorbid anxiety symptoms were indicative of specific anxiety disorders which could be more likely to co-occur with asthma. Goodwin et al. (2005) looked at probable anxiety disorder and depression diagnosis in the

patients of an inner city asthma clinic. For their study, 74 inner city racial and ethnic minority youth aged five to 11 were recruited from a specialty clinic for asthma located in the Bronx, NY. The study found an 18% rate of probable anxiety disorder. Broken down by disorder the results indicated: GAD 4.1%, Panic 14.9%, Agoraphobia 5.4%, and separation anxiety disorder at a rate of 8.1%.(Goodwin et al., 2005) Researchers did not propose any explanation for why these specific disorders were observed in the population. It is possible the high rates of panic disorder could relate to an overlap between symptoms of a panic attack and symptoms of an asthma attack and agoraphobia could be related to avoidance of allergens related to outdoor air quality.

A study by Kean et al. (2006) assessed post-traumatic stress (PTS) symptoms in youth with asthma, their caregivers and youth without asthma. For the study, 200 adolescents with an average age of 14 were divided into three groups. Kean and colleagues differentiated between youth with asthma who had experienced a life threatening asthma exacerbation after age five and youth with less severe asthma who took at least one controller medication , a third group did not have asthma or any other chronic illness. Researchers cited a comparison rate for PTS symptoms in the community at 2-6%. Youth that had experienced a life threatening asthma event had a PTS symptom rate of 28%, the asthma comparison group had a rate of 11% and youth without chronic disease had a rate of 8%. One hundred percent of caregivers in the life threatening asthma group reported an event related to their child's asthma that they viewed as traumatic. Rates of PTS symptoms for caregivers were 29% of in the life threatening asthma group as compared to 14% in the less severe group and 2% of comparison group participants (Kean et al., 2006). While this study strongly supports a relationship between asthma and PTSD given a life threatening asthma related event, the relationship is located within the life threatening event which is a prerequisite to diagnosis of PTSD and therefore it would be difficult to conclude that

an asthma diagnosis in and off itself predisposes an individual or their caretakers to PTSD. The current research does not assess for any specific anxiety disorder and instead seeks to establish if anxiety symptoms common to a broad category of anxiety disorders such as restlessness, worry and fright occur and persist in a specific population of youth with asthma.

Conclusion

The current body of literature provides guidance for the methodology used in the current study and for conceptualizing the potential meaning of the analysis. In order to investigate the possibility that asthma and anxiety symptoms are comorbid in a clinically significant fashion a longitudinal design investigating both within and between person covariance was used. To reduce the possibility that symptoms confusion could be the primary mechanism of potential covariance, a measure of anxiety symptoms rather than specific anxiety disorders such as panic attack disorder was used for the research. Lastly, literature describing risk factors and challenges to care potentially experienced by study participants in their biopsychosocial environments provides the basis for discussing the study results.

Chapter Three: Research Method

This chapter describes the methodology used to study the longitudinal relationship between self-reported asthma and anxiety symptoms among participants in an adolescent asthma intervention. This study uses data collected by the University of Wisconsin-Madison's Center for Health Enhancement Systems Studies protocol *Mobile CHESS Research on Emergency Medical Services for Children (M-CHESS)*. The M-CHESS study was a randomized controlled trial where the primary aim was to test a smartphone based intervention designed to improve asthma control and reduce asthma related emergency care. The M-CHESS intervention was designed for youth expected to be the most negatively impacted by an asthma diagnosis. All study participants were low-income as defined by Medicaid guidelines and receive their health care through Badgercare, Wisconsin's Medicaid program (Wisconsin Department of Health Services, n.d.). The current limit for a family of four living in Wisconsin is $24,250or $2,220 per month maximum. All participants live in a well-defined urban environment with substantive risks for asthma exacerbation. A total of 95% of the study participants identify as youth of color and 73% identified as African-American.

Participants

A total of 219 adolescents living in Milwaukee, Wisconsin were recruited from two managed care organizations (MCOs) serving families who receive Medicaid benefits through Wisconsin's Medicaid program, BadgerCare. While the M-CHESS study did not recruit African-American youth specifically based on the demographics of the counties selected for recruitment, researchers expected a majority African-American population to enroll.

Eligibility

To be considered for the study, youth met the following eligibility criteria:

- Age 12 to 17 at the time of the data extract
- Current MCO member
- Medicaid recipient at intake
- Resident of Milwaukee area zip code

Additionally, specific International Classification of Disease (ICD-9) codes or evidence of asthma medication use were required:

- Asthma-related (ICD9 = 493.xxx or 786.07) hospital admission in the 12 months prior to the extract date, OR,
- Asthma-related (ICD9 = 493.xxx or 786.07) emergency room visit in the 12 months prior to the extract date, OR,
- Asthma-related (ICD9 = 493.xxx or 786.07) urgent care visit in the 12 months prior to the extract date, OR,
- Filled prescription for oral steroid in the 12 months prior to the extract date
- One or more filled prescriptions for asthma medication (i.e., Short-acting beta agonist, Oral corticosteroid, Inhaled or nebulized corticosteroid, Long-acting beta agonist, Xanthine, Leukotriene modifier, Mast cell stabilizer) in the 12 months prior to the extract date.

Potential participants were excluded if they had asthma and a second medical condition affecting lung function. That is, researchers required that there be no evidence of pulmonary disorders (based on ICD-9 codes for any claim in the 12 months prior to the extract date), including chronic bronchitis (ICD-9 codes 490.xxx, 491, 491.1, 491.2, 491.20, 491.21, 491.8, 491.9, or V81.3) and bronchopulmonary dysplasia (ICD-9 code 770.7). To be eligible for the study participants could not have a diagnosis of developmental, cognitive, or sensory disabilities on any managed care organization's insurance claim records during the 12 months prior to the extract date. This requirement was enacted based on the expectation that it would allow youth to utilize the intervention unassisted by a caregiver and that they would be able to respond to the study measures on their own. No anxiety related criteria was used to determine eligibility.

Recruitment

The two partnering health management organizations reviewed claims data to identify adolescents aged 12 to 17 living in Milwaukee County who had an asthma related emergency or hospital visit in the last twelve months and received their health care through Medicaid. Caregivers of the potentially eligible adolescents received a letter from the MCO briefly introducing the study, explaining that unless they opted out via the included, self-addressed, stamped opt out postcard, a study representative would contact them to explain the study and opportunities to participate.

Each managed care plan designated a recruiter to telephone caregivers and inform them that their child had been randomly selected for an invitation to consider this study. If interest was confirmed, an appointment was scheduled for the family to participate in a baseline visit to explain the study more fully and allow families to ask questions in advance of participation in an intake.

A rolling intake procedure was used because intake for each participant required approximately three hours and it would not have been feasible to complete intake for participants in a single session. This process also allowed for recruitment and intake procedures to occur across multiple community sites, increasing convenience for participants and the likelihood that they would participate in the study.

Data collection process

Intake and exit processes were conducted at community sites and transportation was provided for participants. When the M-CHESS study was discontinued, participants (a) did not participate in an exit process and (b) returned their smartphones via arrangements made by the researchers

such as returning the phones by mail. The following subset of data and measurement were collected at the intake by registered nurses who were members of the research team:

1) Participant age, race/ethnicity and sex.
2) Height, weight and body mass index (BMI).
3) Spirometry

Participants filled out a form to record their age, race/ethnicity and sex. Height and weight were physically measured by the nurses and spirometry was conducted in accordance with NHLB guidelines. All participants were given a smartphone to complete the study measures. At the intake, youth received a tutorial about their phones and the study measures from a member of the research study's technical support team. Youth completed the first ACT and HADS on their smartphones before leaving the intake. After the intake, participants were prompted to complete the measures electronically using the device. Participants were directed to complete the ACT monthly for all twelve months of enrollment. They were directed to complete the HADS at three month intervals for all twelve months of the study. Only ACT measurements taken at the same time as the HADS were included in the current study.

Caregivers were interviewed to assess their attitudes and beliefs about asthma. One question was whether their child smoked tobacco. In order to minimize risk, since smoking marijuana is illegal in Wisconsin and smoking tobacco is illegal for minors, researchers limited the question to smoking tobacco and advised caregivers that they could choose not to answer.

Data Collection Challenges. The M-CHESS study experienced expected and unexpected challenges to data collection. M-CHESS researchers expected a 20% dropout rate based on previous studies conducted by the research team with similar populations – primarily low-income, racial and ethnic minorities living in urban areas of Wisconsin (D. Gustafson et al.,

2012; D. H. Gustafson et al., 1999; Wise et al., 2007). In addition to this expected data loss, multiple survey points were missed due to technology related issues. Over 50% of the phones used in the study had to be replaced because they were lost, stolen or broken, in total 330 phones were given out. Participants often missed response windows while waiting for a phone to be replaced and service restored. Teens also encountered problems accessing the surveys and completing them on the device. Lastly, due to concerns regarding adolescents' inappropriate use of the smartphones, the study enrollment was stopped by the M-CHESS team resulting in a significantly smaller data set than anticipated. Before stopping the study, researchers and caregivers expressed concerns that the study devices were facilitating relationships between participants outside those envisioned by the study and about the smartphones capacity to take and send photographs.

Incentives

A smartphone and monthly service plan was provided throughout the study. Anecdotally, youth stated that their primary incentive to participate in the study was having a phone that could text and access the internet. Prior to the study, youth reported not having consistent access to phone service and wanting the study phones to text and e-mail friends. They expressed disappointment that the phones only had capacity to call 911 and could not make any other phone calls. Service was discontinued and the phones returned at the end of the study.

Additionally, each participant and their caregiver were given $20 in cash for their time at intake. Participants earned an additional $20 cash for completing measures at set monthly and quarterly marks throughout the study. Each participant and their caregiver received $20 cash for their time at their exit interview. In total caregivers could receive up to $40 in cash throughout

the course of the study and youth could receive up to $140 in gift cards throughout the course of the study.

Measures

Asthma Control Test (ACT). The ACT is a five item self-administered tool that has been validated both in cross-sectional and longitudinal studies (Nathan et al., 2004; Schatz et al., 2006, 2006). Asthma control is a term used to describe of how well asthma symptoms are being minimized by therapeutic interventions. Report of increased asthma control is synonymous with a reduction in asthma symptoms. While there are multiple measures to assess asthma control in research and clinical settings, the ACT was selected as the primary asthma control outcome for National Institute of Allergy and Infectious Disease (NIAID) sponsored intervention trials, and the National Heart, Lung, and Blood Institute (NHLBI) sponsored Childhood Asthma Research and Education Network trials.

Hospital Anxiety and Depression Scale. The Hospital Anxiety and Depression Scale (HADS) is a 14 item self-report survey that has been repeatedly validated and widely used to assess for symptoms of anxiety and depression in adolescents and adults. Because it excludes somatic symptoms of depression and anxiety which could overlap with medical conditions of interest, the HADS is widely used in research investigating mental health in the context of a comorbid medical diagnosis (Bambauer et al., 2005; Bjelland, Dahl, Haug, & Neckelmann, 2002; Snaith & Zigmond, 1986; White, Leach, Sims, Atkinson, & Cottrell, 1999). Study analysis utilized the HADS-A (anxiety) subscale.

Longitudinal Multilevel Modeling

Longitudinal Multilevel Modeling (MLM) was used in this study to assess the change in participant's asthma and anxiety scores of participants over time. It utilizes a nested structure with Level-1 as time (the five potential measurement points throughout the study) and Level-2 as the individual study participants. The variables of interest are asthma symptoms as measured by the ACT and anxiety symptoms as measured by the HADS-A. The ACT is a measure of asthma control, meaning an increase in participant scores indicates a reduction in asthma symptoms. For the HADS an increase in scores indicates an increase in anxiety symptoms. The relationship between variables is assumed to be linear. MLM allows for change to be modeled accurately when some individuals have missing data and the missing data is assumed to be random. MLM allows also for inclusion of different data structures and unbalanced collection periods, such as in the current study which utilized rolling intake procedures and had an unexpected termination date (Todd, Allen, & Javdani, 2012). In this study, missing data is assumed to be the result of expected rates of attrition, technological challenges collecting data and stopping data collection prematurely. These conditions are unlikely to have influenced the reporting or non-reporting of asthma or anxiety symptoms by study participants. (Snijders & Bosker, 2012) Including more measurement occasions allows for better description of the form of change and inclusion of more individuals to help estimate within and between person effects (Hoffman, 2007).

MLM also allows for analysis of both the within-person and between-person effects on covariation. This discernment of within-person from between-person effects is critical for interpreting the possible meaning of potential covariance. In order to disaggregate between-person and within-person effects the study analysis was conducted using recommendations from Curran and Bauer (2011), detailing the use of multilevel mixed models to avoid errors of

inference misattributing group level results to individuals within the group (Curran & Bauer, 2011). Because the study purposefully integrates time into them model in order to investigate the potential for covariance over time, rather than control for the effect of time the data was not detrended (Wang & Maxwell, 2015).

Chapter Four: Results

The following chapter includes the preliminary and primary analysis for the current study. The preliminary analysis describes the study data, the population's demographic characteristics and description of relevant statistics for the study measures. The primary analysis describes the research questions and outcomes.

Preliminary Analysis

Participant Data

The study had 219 participants, only those participants having at least two of five ACT measurements were included in the decomposed within and between person ACT calculations (n=174). Similarly, only participants with at least two of five HADS-A measurements were included in the decomposed within and between person ACT calculations (n=185). For analysis including both the HADS and the ACT, participants had to have two measurements of each survey. Figure 3.1 describes the number of ACT and HADS measurements completed during the yearlong study. The mode for the ACT was 3 measurements completed and 4 measurements for the HADS-A.

Table 4.1 Distribution of ACT and HADS-A Measurements

ACT Measurements	Totals	HADS-A Measurements	Totals
5	34	5	42
4	47	4	71
3	55	3	39
2	39	2	36
1	40	1	28
0	4	0	3
	219		219

As discussed in the methods section, missing data is assumed to be random and unrelated to the study constructs, resulting from expected attrition rates, technological challenges related to data collection and the early termination of the study protocol.

Measures

Asthma Control Test (ACT). Longitudinal validation of the ACT has shown it to be reliable, valid and responsive to changes in asthma symptoms. Internal consistency based on Cronbach's alpha in multiple validation studies places the ACT's reliability at approximately 0.85 (Schatz et al., 2006, 2007; Vega et al., 2007; Xin Zhou, 2007). Correlation between clinical asthma specialist's ratings of asthma symptoms and ACT scores establish criterion validity ($r = 0.52$, $P < .001$). Cronbach's alpha for ACT scores within the study sample was good, 0.87. Responsiveness of the ACT to changes in asthma symptoms representing changes in lung function was demonstrated with significant correlations between changes in ACT scores and changes in s clinical asthma specialists' ratings ($r = 0.44$, $P < .001$) (Schatz et al., 2006). Descriptive statistics for the ACT are presented below in Table 4.2.

Table 4.2 Descriptive Statistics for ACT

ACT	
Mean (0-25)	19.04
Standard Deviation	4.03
Reliability	α=0.87
Sample	641

The mean ACT score for the 641 measure sample was 19.04. Scores on the ACT range from 0-25 with a score of 19 or lower indicating poor asthma control and a recommendation to seek clinical help to reduce asthma symptoms and increase asthma control. For example, someone with a score of 19 would likely have reported that their school performance or attendance was impacted by their asthma, they had experience shortness of breath, that their sleep was impacted

by coughing or wheezing and that they had used their rescue medication in response to an asthma attack.

Hospital Anxiety and Depression Scale. The HADS-A has been validated in multiple environments and the internal consistency of the Anxiety subscale of the HADS is good. (Cronbach's a=0.8463-0.85) (Andersson, Kaldo-Sandström, Ström, & Strömgren, 2003). Cronbach's alpha for HADS-A scores within the study was excellent, .90. The HADS-A subscale has a score ranging from 0-21. Items are rated on a 4-point Likert-type scale ranging from 0-3. For ease of interpretation the HADS is traditionally divided by 7 to reduce a 21 point scale to a 3 point scale for analysis (Bjelland et al., 2002). Descriptive statistics for the HADS-A are presented below in Table 4.3.

Table 4.3 Descriptive Statistics for HADS-A

HADS-A	
Mean (0-3)	1.10
Standard Deviation	0.61
Reliability	α=0.90
Sample	711

The HADS-A defined a score of 8 or more points as indicating clinically significant anxiety symptoms (sensitivity 0.89, specificity 0.75). Multiplying the mean of 1.10 by 7 results in a back converted score of 7.7 slightly below the cut off for clinical significance (Olssøn et al., 2005).

Demographics

Participants in the study were low-income youth aged 12-17 years, diagnosed with asthma and receiving their healthcare through Medicaid. All of the participants lived in Milwaukee County, Wisconsin. Male or female were the two options presented by the M-CHESS study in singular gender/sex binary classification. M-CHESS researchers did not anticipate study enrollment to be disproportionately female or male. More female participants

than male participants were enrolled in the study although the difference was not substantial. As previously described, the current study used data from a randomized control trial designed to test whether an asthma care management system (M-CHESS) delivered via a smartphone could support low-income teenagers (ages 12-18) with significant asthma to improve their asthma control (i.e., reduce asthma symptoms) and reduce asthma-related emergency or urgent care visits and hospitalizations. Enrollment in the study was anticipated to be primarily African-American based on high rates of asthma prevalence among low-income African-American youth living in Milwaukee County and based on enrollment in the Center's previous asthma related research. Educational materials were designed to appeal to this group of youth, for example, the animated asthma education videos featured African-American teenagers designed and voiced by African-American University of Wisconsin-Madison students who themselves had asthma. Demographic statistics are presented below in Table 4.4.

Table 4.4 Demographic Statistics

Self-Reported Characteristics		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	95	43.4	43.6	43.6
	Female	123	56.2	56.4	100.0
Total		218	99.5	100.0	
System		1	.5		
Total		219	100.0		
Race/Ethnicity	Asian	2	.9	.9	.9
	African-American or Black	159	72.6	72.9	73.9
	Hispanic/Latino or Hispanic/Latino & White	21	9.6	9.6	83.5
	Native American	1	.5	.5	83.9
	White or Caucasian	10	4.6	4.6	88.5
	Other	5	2.3	2.3	90.8
	Multi-Racial	20	9.1	9.2	100.0
Total		218	99.5	100.0	
System		1	.5		
Total		219	100.0		

In the M-CHESS study, potential differences in outcomes related to the racial/ethnic identity of youth were not an area of focus, therefor data collected with regard to the racial/ethnic identity of participants is difficult to use because it exhibits a monoracial bias by allowing youth to only identify themselves in one category. The study included the categories of Multi-Racial and Other without further clarifying information such as “Multi-Racial: Black, Native American and White” or “Other: Bangladeshi”. Further, the study collapsed all participants identifying as Hispanic/Latino into a single group potentially combining Latinos who identify as White and Latinos who identify as Black into one group. By directing participants to select only one category with which to identify it is unknown if the 25 participants who selected Other, Multi-Racial or any of the other available categories, would also have identified as African-American

or Black and therefore potentially been exposed to some or many of the same risk factors such as systemic racism as those in the study who identified as Black or African American. Because of this lack of clarity around racial/ethnic identity, the current study chose to examine whether endorsing a racial or ethnic minority status was a significant moderator in contrast to those endorsing a White racial or ethnic status. Because all of the participants are members of a low-income group and residents of an urban area, this analysis could provide insight into role of racial or ethnic minority identity as a predictor of asthma and anxiety. When collapsing all participants who did not choose White as a singular descriptor, it is important to note that the Racial or Ethnic Minority category is predominantly African-American at a rate of 76% African-American. It is also important to note that the analysis will be limited by the small number of White participants, 10 individuals or ~5% of the valid study population.

Primary Analysis

The statistical analysis for this project was conducted using Hierarchical Linear and Nonlinear Modeling 7 (HLM 7), created by Raudenback, Bryk, and Congdon (2010) and distributed by Scientific Software International, Inc. Research question one asks: Is there a relationship between asthma and anxiety over time? To answer this question, the primary analysis investigates the covariance of asthma and anxiety within-persons and between persons using Curran and Bauer's model of variance partitioning (Curran & Bauer, 2011).

Questions One

The first multilevel mixed model tested covariance between anxiety and asthma symptoms by decomposing longitudinal ratings of ACT symptoms into between-person and within-person predictors of HADS-A scores. As opposed to latent growth models, variance partitioning of longitudinal data allows for the test of within- and between-person effects (Curran

& Bauer, 2011). In order to test for the relationship between asthma and anxiety symptoms, the within-person ACT component was entered as a Level-1 predictor, and the between-person ACT component was entered as a Level-2 predictor of a person's anxiety symptoms. No moderators of this relationship were entered.

HADS-A Within-Persons and Between-Persons Model. The Level-1 model was:

$$\text{HADS-A}_{ij} = \beta_{0j} + \beta_{1j}*(\text{Within-person ACT}_{ij}) + r_{ij}$$

Where β_{0j} is the intercept, β_{1j} is the association between HADS-A scores and the within-person ACT component, and r_{ij} is the error term and indicates that the Level-1 random component was allowed to vary across time. The Level-2 model was:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(\text{Between-person ACT}_{j}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Where β_{0j} is the intercept, γ_0 is the association between HADS-A scores and the between-person ACT component, and u_{0j} represents the error terms and indicate that the Level-2 random component was allowed to vary across persons.

The above two level model was combined and analyzed as a mixed model:

$$HADS\text{-}A_{ij} = \gamma_{00} + \gamma_{01}*BP\_ACT_j$$

$$+ \gamma_{10}*WP\_ACT_{ij} + u_{0j} + u_{1j}*WP\_ACT_{ij} + r_{ij}$$

Results are reported below in Table 4.5.

Table 4.5 Final estimation of fixed effects (with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	1.091138	0.032084	34.009	211	<0.001
BP_ACT, γ_{01}	-0.075467	0.009370	-8.054	211	<0.001
For WP_ACT slope, β_1					
INTRCPT2, γ_{10}	-0.030470	0.008107	-3.758	212	<0.001

The final estimation of fixed effects with robust standard errors demonstrated a significant covariance between HADS-A and ACT scores both between-persons (γ_{00} = -0.08, *SE* = 0.01, *t* = -8.05, *df* = 211, *p* <.001) and within-persons (γ_{10} =-0.03, *SE* = 0.01, *t* = -3.76, *df* = 211, *p* <.001). The within-person effect suggests that when persons report higher anxiety symptoms than they do on average, they also report a statistically significant increase in asthma symptoms. Asthma symptom increase is marked by a decrease in ACT scores because ACT is measure of asthma symptom control. More specifically, individuals' anxiety symptoms significantly increased, by 0.03, for every one unit increase from their average level of asthma symptoms. The between-person effect suggests that after controlling for within-person effects, when persons report higher levels of asthma symptoms compared to others, they report higher levels of anxiety. Meaning, individuals who experience greater asthma symptoms by one unit compared to other individuals, report higher amount of anxiety symptoms by 0.08. This result is consistent with literatures describing higher rates of internalizing symptoms in relation to chronic illness.

After controlling for within- and between-patient effects, the final estimation of variance components indicated significant between-patient variability in HADS-A scores (χ^2 = 942.98, *df* = 165, *p* <.001).

4.6 Final Estimation of Variance Components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	0.41011	0.16819	165	942.98123	<0.001
WP_ACT slope, u_1	0.05126	0.00263	166	226.47383	0.001
Level-1, *r*	0.34986	0.12240			

This result can be interpreted cautiously as an indicator that the HADS-A and ACT are successfully measuring different constructs and that symptoms confusion is less likely to explain the covariance between HADS-A and ACT scores.

ACT Within-Persons and Between-Persons Model. The second multilevel mixed model repeats the procedures used in the HADS Within-Persons and Between-Persons Model. The ACT model tested covariance between anxiety and asthma symptoms by decomposing longitudinal ratings of HADS-A symptoms into between-person and within-person predictors of ACT scores. In order to test the relationship between asthma and anxiety symptoms, the within-person HADS-A component was entered as a Level-1 predictor, and the between-person HADS-A component was entered as a Level-2 predictor of a person's anxiety symptoms. As in the previous analysis, no moderators of this relationship were entered. It is important to note that there are some redundancies in analyzing the same set of variables where the predictor and criterion variables are reversed. The Level-1 model was:

$$ACT_{ij} = \beta_{0j} + \beta_{1j}*(WP\_HADS\text{-}A_{ij}) + r_{ij}$$

Where β_{0j} is the intercept, β_{1j} is the association between ACT scores and the within-person HADS-A component, and r_{ij} is the error term and indicates that the Level-1 random component was allowed to vary across time**.** The Level-2 Model was:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(BP\_HADS\text{-}A_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + u_{1j}$$

Where β_{0j} is the intercept, γ_0 is the association between ACT scores and the between-person HADS-A component, and u_{0j} and represent the error terms and indicate that the Level-2 random component was allowed to vary across persons.

The two level model was combined and analyzed as a mixed model:

$$ACT_{ij} = \gamma_{00} + \gamma_{01}*BP\_HADS\text{-}A_j$$

$$+ \gamma_{10}*WP\_HADS\text{-}A_{ij} + u_{0j} + u_{1j}*WP\_HADS\text{-}A_{ij} + r_{ij}$$

Results are reported below in Table 4.7

Table 4.7 Final estimation of fixed effects (with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	18.792435	0.201142	93.428	211	<0.001
BP_HADS-A, γ_{01}	-2.966110	0.407999	-7.270	211	<0.001
For WP_HADS-A slope, β_1					
INTRCPT2, γ_{10}	-1.537559	0.439032	-3.502	212	<0.001

The final estimation of fixed effects with robust standard errors demonstrated a significant covariance between ACT and HADS-A scores both between-persons (γ_{00} = -2.97, *SE* = 0.41, *t* = -7.27, *df* = 211, *p* <.001) and within-persons (γ_{10} =-1.54, *SE* = 0.44, *t* = -3.50, *df* = 211, *p* <.001). The within-person effect suggests that when persons report higher anxiety symptoms than they do on average, they also report a statistically significant increase in asthma symptoms. More specifically, individuals' asthma symptoms increased by 1.54 for every one unit increase from their average level of anxiety symptoms. The between-person effect suggests that after controlling for within-person effects, when individuals reported higher levels of anxiety symptoms compared to others, they reported higher levels of asthma symptoms. Specifically, persons' who experience greater anxiety symptoms by one unit compared to other persons, report

a higher score in asthma symptoms by 1.53. This result provides additional evidence of covariance between asthma and anxiety symptoms.

While the implications of adjunctive psychosocial treatment for youth with asthma and anxiety symptoms is explicated in the proceeding discussion section, it is important to note here that as part of analysis rationale that perception of medical symptoms as psychiatric or psychosomatic has the potential decrease adherence to treatment. Therefore calculating the effect size for the HADS-A within-persons and between-persons covariance was critical in advance of any recommendations for treatment. In order to allow for interpretation of effect size, the coefficients from the HADS-A within-persons and between-persons model were converted to z scores in order to calculate the standardized gamma co-efficient. The within-persons effect had a standardized gamma of -.21, interpreted as a significant small effect size (γ_{01} = -0.03, β = -0.21 SE = 0.01, t-ratio = -3.76, p <.001). The between-persons effect had a standardized gamma of -.41, interpreted as a significant medium effect size (γ_{01} = -0.08, β = -0.41, SE = 0.01, t-ratio = -8.05, p <.001).

After controlling for within- and between-person effects, the final estimation of variance components indicated significant between-person variability in ACT scores (χ^2 = 587.15, *df* = 162, *p* <.001).

Table 4.8 Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	2.35725	5.55663	162	585.15427	<0.001
WP_HADS-A slope, u_1	2.41218	5.81859	163	198.51751	0.030
Level-1, *r*	2.69224	7.24815			

This result could be interpreted as an additional indicator that the ACT and HADS-A are successfully measuring different constructs.

Moderator Analysis

Question Two

After establishing a statistically significant covariance between asthma and anxiety symptoms, research question two investigated whether several individual level variables know to potentially impact asthma and/or anxiety symptoms would moderate this covariance. The current study included several moderators known to potentially impact either asthma or anxiety symptom. Research questions two asked: Does smoking, gender, race/ethnicity or Body Mass Index moderate the relationship between asthma and anxiety? Smoking is most common among individuals whose income is below the federal poverty level and exposure to smoke is associated with increased asthma symptoms (Forno & Celedón, 2009). Having an African-American racial or ethnic identity is associated with higher diagnostic rates for asthma and increased symptoms severity. Individuals with asthma who have BMI levels consistent with obesity report higher levels of asthma symptoms that peers whose weight is in the normal or overweight range for BMI. Currently there is no known published data examining the symptomology of individuals with asthma who also have BMI's in the underweight category. Teenage females are more likely to report anxiety symptoms than teenage males. Descriptive statistics for the potential moderators appear below in Table 4.9.

Table 4.9 Moderator Variables

Moderator		Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	95	43.4	43.6	43.6
	Female	123	56.2	56.4	100.0
Total		218	99.5	100.0	
System		1	.5		
Total		219	100.0		
Race/Ethnicity	Racial/Ethnic Minority	208	95	95.4	95.4
	White or Caucasian	10	4.6	4.6	100.0
Total		218	99.5	100.0	
System		1	.5		
Total		219	100.0		
BMI	BMI	217	99.1	100.0	100.0
Total		217	99.1	100.0	
System		3	.9		
Total		219	100.0		
Smoking Status	No	210	95.9	97.2	97.2
	Yes	6	2.7	2.8	100.0
Total		216	98.6	100.0	
System		3	1.4		
Total		219	100.0		

Smoking. Smoking by participants was considered as a potential moderator because youth who smoke have higher rates of asthma symptoms and exposure to smoke is a common asthma trigger. Smoking has also been associated with anxiety as a response to anxiety triggers and with relief of anxiety symptoms. Of the 216 caregivers that answered the question only 6 reported that their teenager smoked. Caregiver report of an unexpectedly low frequency of participant's smoking behaviors is unlikely to be accurate and therefore this variable was excluded from analysis.

After excluding Smoking as a potential moderator, Gender, BMI, and Race/Ethnicity as assessed at intake were modeled as time-invariant, individual characteristics for the moderator analyses (Wang & Maxwell, 2015). To determine its interaction effect on the relationship

between ACT and HADS-A scores both within- and between-persons, each moderator variable was run using the formula described in the HADS-A Within-Persons and Between-Persons Gender Interaction Model found below. Racial/Ethnic identity, BMI, and Gender did not significantly moderate the within-person or between-person covariance between ACT and HADS-A. However, there was a significant main effect between gender and an individual's reported level of anxiety (γ_{01} = 0.22, *SE* = 0.06, *t*-ratio = 3.41, *p* <.001). Specifically, in the current sample, women reported anxiety levels 0.22 units higher than men. This model is reported below:

HADS-A Within-Persons and Between-Persons Gender Interaction Model.

The Level-1 Model was:

$$HADS\text{-}A_{ij} = \beta_{0j} + \beta_{1j}*(WP\_ACT_{ij}) + r_{ij}$$

In the model above, HADS-A_{ij} is the dependent variable. B_{0j} is the intercept for the overall mean for HADS-A scores indicating the average level of anxiety for participants in the study. B_{1j}*(WP_ACT_{ij}) is the slope for the within-persons ACT effect and was entered as a Level-1 predictor of HADS-A scores. Meaning variation in a person's asthma symptoms compared to their average level of asthma symptoms predicted changes in their anxiety symptoms. R_{ij} is the Level 1 residual. The Level-2 Model was:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}*(GENDER_j) + \gamma_{02}*(BP\_ACT_j) + \gamma_{03}*(ACT\_GEND_j) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}*(GENDER_j) + u_{1j}$$

At Level-2, in the model above, gender was entered as a cross-level moderator of the within-person relationship, this is represented by $\beta_{1j.}$ At Level-1, β_{1j} represents the within-person effect and then at Level-2 gender is a predictor of $\beta_{1j.}$ (ACT_GEND_j) is the interaction term of the between-person variable and the gender variable. This tests whether gender moderates the

between-person relationship of ACT and HADS-A scores. GENDER, γ_{11} tests whether gender moderates the within-person relationship of ACT and HADS-A.

The two levels were combined and analyzed as a mixed model:

$$HADS\text{-}A_{ij} = \gamma_{00} + \gamma_{01}*GENDER_j + \gamma_{02}*BP\_ACT_j + \gamma_{03}*ACT\_GEND_j$$

$$+ \gamma_{10}*WP\_ACT_{ij} + \gamma_{11}*GENDER_j*WP\_ACT_{ij}$$

$$+ u_{0j} + u_{1j}*WP\_ACT_{ij} + r_{ij}$$

For the model above, γ_{00} represents the intercept or average HADS-A score across individuals, γ_{01} represents the effect of an individual's gender on their reported anxiety score (i.e., HADS-A), γ_{02} represents the between-person relationship between ACT and HADS-A, γ_{03} represents the interaction effect between an individual's gender and the between-person relationship between ACT and HADS-A, γ_{10} represents the within-person relationship between ACT and HADS-A, γ_{11} represents the interaction effect between an individual's gender and the within-person relationship between ACT and HADS-A, and u_{0j}, u_{1j}, r_{ij} represent the Level-1 and Level-2 random components. Results are reported below in Table 4.10:

Table 4.10 Final estimation of fixed effects (with robust standard errors)

Fixed Effect	Coefficient	Standard error	*t*-ratio	Approx. *d.f.*	*p*-value
For INTRCPT1, β_0					
INTRCPT2, γ_{00}	0.967667	0.047421	20.406	209	<0.001
GENDER, γ_{01}	0.216352	0.063521	3.406	209	<0.001
BP_ACT, γ_{02}	-0.069235	0.016085	-4.304	209	<0.001
ACT_GEND, γ_{03}	-0.001650	0.019744	-0.084	209	0.933
For WP_ACT slope, β_1					
INTRCPT2, γ_{10}	-0.036815	0.012174	-3.024	211	0.003
GENDER, γ_{11}	0.010691	0.016235	0.659	211	0.511

The final estimation of fixed effects with robust standard errors demonstrated a small but significant effect for gender on an individual's reported HADS-A score, (γ_{01} = 0.22, *SE* = 0.06, *t*-ratio = 3.41, *df* = 209, p <.001) meaning that females in the study reported a slightly higher level

of anxiety than males. However, results indicated that gender did not significantly moderate the between-person relationship between ACT and HADS-A scores (γ_{03} = -0.002, *SE* = 0.02, *t*-ratio = -0.08, *df* = 209, *p* = .933) or the within-person relationship between ACT and HADS-A (γ_{11} = 0.01, *SE* = 0.02, *t*-ratio = 0.66, *df* = 211, *p* = .511).

Table 4.11 Final estimation of variance components

Random Effect	Standard Deviation	Variance Component	*d.f.*	χ^2	*p*-value
INTRCPT1, u_0	0.39930	0.15944	163	901.75352	<0.001
WP_ACT slope, u_1	0.05140	0.00264	165	225.31196	0.001
Level-1, *r*	0.34986	0.12240			

According to the final estimation of the variance components, after accounting for gender, the within- and between-person ACT effects and the interaction between gender and the within- and between-person ACT effects, anxiety scores significantly varied between persons (χ^2 = 901.75, *df* = 163, *p*-value <.001), meaning that gender did not account for all of the variance in anxiety scores.

Discussion

Asthma is a life threatening illness that negatively impacts the daily lives of millions of young people. In the United States this burden of asthma is disproportionately carried by low-income youth living in large urban areas, particularly African-American youth (Law et al., 2011; Rand et al., 2000). Anxiety disorders, intermittent anxiety and anxiety symptoms related to chronic stress reduce the quality of life for young people and present additional challenges to the treatment of concurrent chronic illness such as asthma (Chavira et al., 2008; Lewis et al., 2012; McLaughlin et al., 2003). The results from the current study present evidence for a relationship between asthma and anxiety symptoms based on significant covariance of the within-person and between-person HADS and ACT scores and the ability of a change in one variable to predict a change in the other. That a change in anxiety symptoms can predict a change in asthma symptoms is particularly interesting from a psychological perspective because it may indicate that one way to potentially reduce asthma symptoms in some individuals is through psychosocial treatments aimed at reducing anxiety. None of the selected moderators had an impact on the covariance between asthma and anxiety. The following discussion section examines these findings in the context of relevant extant literatures, proposes possible explanatory mechanisms for the results and describes in brief clinical implications for mental and medical health practitioners.

Primary Results

Covariance of Asthma and Anxiety

The current study presented evidence that asthma and anxiety symptoms were significantly correlated within individuals and between individuals overtime. An increase in anxiety symptoms was associated with an increase in asthma symptoms and vice versa. To the

best of the researcher's knowledge, the current project is the first longitudinal study to examine the persistence of comorbidity in asthma and anxiety symptoms and allow for differentiation of within and between individual variance. Establishing that these two conditions covaried over time between-persons affirms existing literature reported evidence for comorbid symptomology based on cross-sectional designs using single point estimates (Gillaspy et al., 2002; Kean et al., 2006; Vila et al., 2000). The finding of covariance within-persons expands the literature to include evidence that a relationship between asthma and anxiety symptoms persists overtime for individuals. This evidence is critical for conceptualizing what the comorbid relationship of symptoms might be in the progression of both conditions. Additionally, within-person variability suggests that a single point assessment may not be sufficient for determining if an individual has a comorbid condition. For example, utilizing screening tools to assess for anxiety symptoms only when asthma is initially diagnosed or once during treatment in primary care may not sufficient to identify and properly treat comorbid anxiety symptoms or monitor for development of an anxiety disorder. Similarly, psychologists who elicit physical health information only at intake could be unaware of their client's potential for increased anxiety symptoms due to changes in medication, an initial asthma diagnosis or asthma exacerbation.

Differentiating between individual and group level comorbidity is important for defining continuing research efforts and for the development of treatment strategies. The current study indicates that there was significant covariance of asthma and anxiety within and between individuals suggesting that interventions tailored to both the individual and the group are needed to reduce the burden of comorbidity among low-income youth of color living in urban areas. For example an individual with asthma who is identified as having comorbid anxiety symptoms could benefit from an individual level intervention such as psychotherapy and from interventions

designed for groups, such as psychoeducation provided to all youth with asthma about the potential for psychological distress in relation to an asthma attack or diagnosis of asthma.

Research designed to develop and test protocols for diagnosis and treatment of comorbid asthma and anxiety symptoms could provide guidance for practitioners and aid in reducing the burden of these conditions on young people. Irritable Bowel Syndrome (IBS) shares some experiential similarities with asthma in that symptomology can be experienced intermittently and unpredictably and that an increase in symptoms can impair the ability of an individual to participate in desired activities. Because IBS has been shown to correlate with psychological distress research based protocols have been developed to address this comorbidity. In Figure 2.1, the protocol for medical practitioners described the assessment and treatment of the expected comorbidity between functional gastrointestinal disorders (FGIDS) such as IBS and psychological distress. This model was developed based on evidence of general psychological distress evidenced on the between-persons level and the potential for within-persons persistence of psychological distress leading to mental health diagnosis, most commonly depression (Fond et al., 2014; Jones, Latinovic, Charlton, & Gulliford, 2006; Riedl et al., 2008; Whitehead et al., 2002). As in the case of FGID and psychological distress, the results of the present study indicate that asthma symptoms and anxiety symptom covary on the individual and group level. Further research is needed to develop and test whether a similar protocol anticipating the comorbidity of anxiety and asthma symptoms among low-income youth of color living in urban areas could benefit from treatment. However, because this covariance was demonstrated within a population of young people already deemed likely to experience high rates of asthma and anxiety symptoms based on previous research efforts, this evidence of comorbidity is limited in its generalizability and additional research is needed to ascertain if this covariance persists in

samples consistent with US population distribution and in other populations at notable risk for high occurrence of asthma such as Puerto Ricans.

Interdependence of Symptoms

The significant covariance of asthma and anxiety symptoms within and between persons longitudinally suggests the possibility that the relationships between asthma and anxiety may be interdependent and not simple co-occurrence of symptomology. While a change in anxiety symptoms was a particularly strong predictor of asthma symptoms, a change in asthma symptoms also predicted a change in anxiety symptoms. It is possible these changes within and between persons are indicative of an interdependent cycle of symptom reinforcement where increase and decrease of symptomology for either asthma or anxiety can becomes a feedback loop impacting the progression of both conditions. For example, psychological distress resulting in increased in anxiety symptoms could lead an individual to reduce their use of asthma control medications leading to increased asthma symptoms, these asthma symptoms could in turn increase psychological distress leading to subsequent increase in anxiety symptoms. Anxiogenic medication use for increased asthma symptoms is associated with higher anxiety symptoms and increased anxiety is associated with prescription of prednisone which can in turn cause anxiety (Horikawa et al., 2014). In order to examine potential explanations of the study results using a biopsychosocial framework the following sections describe: 1) how asthma symptoms could cause anxiety symptoms, 2) how anxiety symptoms could cause asthma symptoms, 3) confabulation of symptoms and 4) the possibility that chronic stress might be the underlying cause of both sets of symptoms.

Impact of Asthma on Anxiety

A significant relationship was found between the HADS-A and ACT scores both between-persons and within-persons. In this study population, when an individual reported higher anxiety symptoms than they did, on average, they also reported a statistically significant increase in asthma symptoms. Additionally, after controlling for the significant within-person effects, when participants reported higher levels of asthma symptoms compared to others in the group, they also reported higher levels of anxiety. There are numerous pathways from which to propose an explanation for the impact of asthma symptoms on anxiety symptoms. Based on the current study's previous review of literature, the following discussion focuses on three primary paths: 1) the nature of chronic disease, 2) the experience of asthma as an illness and 3) medication use. The experience of illness is limited primarily to asthma because while all of the youth in the study have a highly reliable diagnosis of asthma it is unknown if any youth in the study have been diagnosed with an anxiety disorder.

Chronic disease. Managing serious chronic illness is likely to increase psychological distress and potentially increase anxiety (Farrell et al., 2011; Glover et al., 2012; Lin et al., 2004; Lin & Korff, 2008; Surís et al., 1996). Asthma is a chronic disease often requiring increased levels of medical intervention and that poses a risk of serious complications requiring hospitalization and sometimes leading to death. Understandably, a diagnosis of asthma as a chronic disease and the management of asthma have been associated with increased distress, increased rates of psychological symptoms and increased diagnosis of psychological disorders (Bender Berz et al., 2005; McGrady et al., 2010; Van Lieshout & Macqueen, 2012). Youth's beliefs about their health, future potential and internalization of themselves as a "sick" person can increase the burden placed upon them by their diagnosis and experience of symptomology.

High rates of interfamilial asthma and within a young person's community make it likely that even if they have not suffered significant complications or life threatening attacks, they know someone who has and may know someone whose death was caused by asthma (Glover et al., 2012; Surís et al., 1996). It is possible that the burden of managing asthma predisposes individuals to increased levels of anxiety when asthma symptoms increase because negative beliefs and worries about their chronic disease are activated.

Experience of illness. Asthma is characterized by intermittent symptomology and asthma attacks can be triggered unexpectedly by unavoidable stimuli. While asthma action plans are intended to help youth monitor their asthma symptoms in order to reduce the occurrence of asthma attacks and increase asthma control, for some young people this expectation that they may have to take steps to "control" their asthma can create additional stress and anxiety (Gibson & Powell, 2004; Yin et al., 2013). Ideally, an asthma action plan decreases anxiety because individuals are better able recognize and appropriately treat their asthma symptoms and recognize their asthma triggers to avoid asthma attacks or exacerbation. However for some young people this creates the idea that they should be able to "control" asthma and thereby avoid experiences related to the illness of asthma, such as becoming sick, needing inconveniently obtainable medication or being hospitalized, this could cause an increase in anxiety symptoms when an increase in asthma symptoms reminds them of their vulnerability (Rank, Volcheck, Li, Patel, & Lim, 2008). Similarly, if an individual has experienced a life threatening or traumatic event related to asthma, an increase in asthma symptoms could subsequently increase their reported anxiety symptoms due to worry that the could suffer these same consequences (Feldman, Siddique, Thompson, & Lehrer, 2009). For example, a question from the HADS-A "I get a sort of frightened feeling as if something awful is about to happen." could be related in the

view of the individual participant to a question on the ACT, "How often have you had shortness of breath?"(Schatz et al., 2006; White et al., 1999). If an individual had difficulty breathing and they are anxious that because of this difficulty breathing something awful is about to happen, scores for asthma symptoms and anxiety symptoms would increase and when breathing is restored both sets of symptoms could be subsequently reduced.

From an ecological systems perspective, the experience of asthma as an illness would also include the impact on significant others in a young person's connected systems. An increase in asthma symptoms could cause anxiety related to worries about the cost of medications and the impact of this cost on the family, that they will miss school and disappoint a teacher or classmate or even worry that their caregiver will be angry with them for "getting sick" or needing emergency health care (Murdock et al., 2010; Rand et al., 2000; Surís et al., 1996). Reduced asthma symptoms could lessen these concerns and symptoms of anxiety related to these concerns would be lessened in turn.

Medication use. Medication for increased asthma symptoms could increase anxiety symptoms in multiple ways including concern about the availability of medications, beliefs about how medication use is viewed by others and by anxiogenic effects of both inhaled and ingested corticosteroids used to reduce asthma symptoms.

Obtaining medications for asthma can be a challenge for families both logistically and financially (Bender, 2002; Mansour et al., 2000). If a young person's asthma symptoms have increased, it could necessitate an emergency department visit, health care appointment or addition of a new medication. The increased need for treatment could subsequently increase their anxiety due to the worry about obtaining the care they need and about the difficulty this

could present to their family. It could mean a parent missing work, difficulty affording medication or lack of a convenient pharmacy to have the prescriptions filled.

An increase in symptoms of asthma could also remind individuals and caregivers of the need for youth to adhere to treatment protocols which typically include having a rescue (bronchodilator) inhaler available at all times. Many schools do not allow students to carry their rescue medication with them. Their caregivers are expected to register the medication with the school and for it to be dispensed by the school's designate, often not a trained medical professional and who has other primary job duties. Additionally, medications are typically kept in a locked location. These practices are inconsistent with standard medical advice for the treatment of asthma which states that if a bronchodilator medication has been prescribed it should always be available and that adolescents capable of using the medication independently should have it with them at all times. School policies restricting access to asthma medications have contributed to several deaths within schools (Allen, Henselman, Laird, Quiñones, & Reutzel, 2012; McCarthy, Kelly, & Reed, 2000). An increase in awareness of the need to carry their rescue medication and the possibility that they may need to use it at school could increase anxiety symptoms both through worry that the medication would not be available when they need it or that they could be subject to disciplinary procedures if were found to be carrying their rescue medication.

Increased need for medication use due to increased asthma symptoms could also have social consequences that subsequently increase anxiety. If a young person has a negative self-concept associated with having asthma, carrying medication and the possibility of needing to use their medication in front of peers could increase anxiety symptoms. This could in turn lead to social isolation and withdrawal from preferred activities or school avoidance which could also

increase anxiety symptoms (Barlow, 2000; Bruzzese, Fisher, Lemp, & Warner, 2009; Horne & Weinman, 2002)

Asthma medications can also have anxiogenic side effects. Both inhaled corticosteroids used for long term asthma control and ingested corticosteroids such as prednisone which is used for treatment of substantial increase in asthma symptoms are associated with increased anxiety (Boushey et al., 2005; Dahl, 2006; Romero-Frais et al., 2005) A brief course of prednisone prescribed for increased asthma symptoms could account for both the increase in reported anxiety symptoms and the subsequent decrease in anxiety symptoms when the treatment is completed. Adherence to all types of asthma medications is highest when symptoms are elevated and the anxiogenic effects of these medications could explain the concomitant increase in anxiety symptoms.

The burden of chronic illness, challenges of managing asthma and the potential results of anxiogenic medication use all present likely scenarios that could explain the role of asthma symptoms on anxiety symptoms, however additional possibilities such as symptoms confusion which could have a role in increased report of anxiety or asthma symptoms will be discussed in a later section.

The Role of Anxiety Symptoms on Asthma Symptoms

A significant relationship was found between ACT and HADS-A scores both between-persons and within-persons The within-person effect suggests that when youth in the study reported higher anxiety symptoms than they did on average, they also reported a statistically significant increase in asthma symptoms. The between-person effect suggested that after controlling for within-person effects, participants who reported higher levels of anxiety symptoms compared to others in the study also reported higher levels of asthma symptoms.

Based on current research examining the impact of anxiety on asthma, the most likely explanations for these results are: 1) anxiety is a "strong emotion" one that numerous asthma action plans encourage youth to avoid and is often identified as an asthma symptom trigger and 2) increased anxiety may limit an individual's ability to manage and appropriately treat their asthma resulting in poorer asthma control and increased report of asthma symptoms. As in the previous section discussing the potential impact of asthma symptoms on anxiety symptoms, the proceeding section focuses on anxiety symptoms impacting asthma symptoms in the same unidirectional fashion. It is unlikely that any or only one of these potential mechanisms accounts for the covariance of asthma and anxiety symptoms, however it is important to define the potential unidirectional impact of symptoms before discussing reciprocal and confabulated effects. This acts to delineate for consideration what are most likely a confluence of multiple reciprocal influences.

Emotional Intensity. Elevations in anxiety could predict increased asthma scores through the concept of "strong emotions". Youth with asthma are often advised to avoid "strong emotions" because changes within the body, such as a change in breathing patterns, could lead to an asthma attack (Bhogal et al., 1996; Yin et al., 2013). Recurrent feelings of panic and breathlessness could also explain the impact of anxiety on asthma symptoms if these feelings were strong enough to trigger increased asthma attacks which would subsequently increase the report of asthma symptom (Hasler et al., 2005; Lewis-Fernández et al., 2002)

Asthma management. Anxiety symptoms negatively impact the ability of young people to manage chronic illness (Farrell et al., 2011). Youth who are experiencing psychological stress are less likely to take their asthma medications and monitor their asthma symptoms which could lead to a subsequent increase in asthma exacerbation and report of reduced asthma control.

Remission of their anxiety symptoms could allow youth to improve the asthma management practices including resuming use of both long term controller medications and avoidance of asthma triggers which could subsequently result in fewer reported asthma symptoms (Cluley & Cochrane, 2001)

Anxiety limits asthma management in other ways as well, young people experiencing increased anxiety related to social situations and peer relationships may avoid use of their asthma medications in general and, particularly in the presence of others (Bruzzese et al., 2009; Horne & Weinman, 2002) Reduction in medication use could account for increased asthma symptoms as a result of increased anxiety symptoms. For example, anxiety symptoms may lead a young person to choose not to use their inhaler before exercise in gym class because they do not want people to know they have asthma or see them using medication. If exercise then triggered an asthma attack this could be explained as anxiety impairing treatment adherence and thereby contributing to asthma exacerbation.

Confabulation of Asthma and Anxiety symptoms

The previous sections described pathways that could account for the role of either asthma or anxiety symptoms on the other variable. However there are explanatory pathways that could impact the role of both asthma and anxiety. Confabulation of symptoms describes how unconscious processes such as those involved in symptoms perception and associated learning could explain or impact the association of asthma and anxiety symptoms.

Symptoms perception. While a diagnosis of asthma was well established in the present study, it is unknown whether participants had undiagnosed or diagnosed anxiety disorders. As discussed previously, the symptoms of panic attack and symptoms of an asthma attack have substantial overlap. The current study sought to reduce the likelihood that asthma symptoms

would be perceived or reported as anxiety symptoms and vice versa by examining the relationship between asthma symptoms and non-somatic anxiety symptoms. The HADS-A was designed to be used to screen for anxiety and depression in populations with a medical illness such as cancer and to exclude somatic symptoms of anxiety such as chest tightness or shortness of breath that could be indicative of either panic attack or an asthma attack (Andersson et al., 2003; Bambauer et al., 2005; Singer et al., 2009). Despite this it is possible symptoms perception could have impacted the report of covariance of asthma and anxiety symptoms both within-persons and between persons.

Symptoms perception remains a significant challenge to researching and treating comorbid anxiety and asthma symptoms. Consider the following exchange, an adult says "How are you feeling?", and an adolescent says "I feel like a fish out of water". Depending on the adult's thinking, cultural identity, training, role in the child's life and the context of the statement, the words could be understood to mean difficulty breathing, flopping around and feeling agitated, being in an environment that is unsuitable and any number of other interpretations. If the adolescent has been brought to a therapist for treatment, a social interpretation is more likely while the same adolescent making the same statement during a medical check-up would more likely be understood as describing physical sensations potentially attributable to a breathing problem such as asthma or a respiratory infection. However, awareness of the potential for comorbidity of asthma and anxiety symptoms by medical and mental health practitioners could mediate the challenge of symptoms confusion through expanded inquiry relative to symptomology and collaborative care.

Associated learning. Individuals learned responses could also account for the covariance between asthma or anxiety symptoms found in the current study. It is possible for a person's self-

identified asthma triggers to activate a physical asthmatic response in the presence of placebo. An individual's belief that they are being exposed to a substance they believe to be an asthma trigger will experience a physical response consistent with exposure to that harmful substance (Chen et al., 2006; De Peuter et al., 2005). The proposed mechanism for this effect is associated learning resulting in a classical conditioning response. Classical conditioning is also proposed as a factor in the maintenance of anxiety symptoms and anxiety disorders due to beliefs that certain situation will always trigger anxiety symptoms (Mineka & Oehlberg, 2008). It is possible that beliefs about the effects of exposure to asthma triggers such as smoke, road construction fumes and grass could cause elevation of both asthma and anxiety symptoms.

Chronic Stress

The present study's results reported significant evidence for a within and between person relationship between asthma and anxiety symptoms; however it is possible that unmeasured or uninvestigated factors better accounts for these results. Based on review of the literature for this study, and the biopsychosocial environmental factors likely to be shared by the study population of low-income youth living in an urban area, the most likely unmeasured factor underlying the covariance of asthma and anxiety symptoms is the effect of chronic stress and subsequent immune suppression leading to increased illness and respiratory infections (Segerstrom & Miller, 2004) Chronic stress is generally associated with the management of chronic illness and high rates of chronic stress have been documented in youth with asthma (Baum, Garofalo, & Yali, 1999; Evans & Kim, 2013; Farrell et al., 2011; Glover et al., 2012; Surís et al., 1996). In previous studies investigating the relationship between asthma and anxiety multiple researchers suggested that the biopsychosocial environment of young people of color living in urban areas can result in intermittent and chronic stress which could contribute to the development of both

conditions. (Goodwin, Fergusson, & Horwood, 2004; Goodwin et al., 2005; Mansour et al., 2000; Ostro et al., 2001; Rand et al., 2000). All of the participants in the current study qualified for healthcare services through Medicaid, a proxy measurement indicating a low-income socioeconomic status. Poverty presents numerous challenges contributing to chronic stress including potential for housing instability, neighborhood violence, family dysfunction and unemployment and increased psychological distress (Baum et al., 1999; Evans & Kim, 2013; Steptoe & Feldman, 2001) Additionally the overwhelming majority of study participants endorsed a racial or ethnic minority (REM) identity. Having a REM identity is associated with higher rates of discrimination in healthcare which contributes to chronic stress (Armstrong et al., 2013; Williams, Neighbors, & Jackson, 2003). For African-Americans, particularly low-income African-Americans, systemic racism and experiences of discrimination contribute to chronic stress pervasively across multiple spheres of the ecological systems model (Clark, Anderson, Clark, & Williams, 1999; McKenzie & Bhui, 2007; Williams & Williams-Morris, 2000). Therefore it is likely that the study population experiences chronic stress due to a confirmed asthma diagnosis, lower socioeconomic status and for the majority, identification with an African-American identity.

It is possible that chronic stress related to asthma predisposes the relationship of asthma and anxiety symptoms and that when an individual's level of chronic stresses increases, asthma and anxiety symptoms are both impacted simultaneously. Further, chronic stress suppresses the immune system and makes individuals more susceptible to transitory illnesses such as cold and flu. Respiratory infections are proposed to have a role in the development of asthma and are the most cited cause of asthma exacerbation (Busse, Lemanske Jr, & Gern, 2010). It is possible that the experience of a respiratory infection could also simultaneously impact asthma and anxiety

symptoms. Asthma symptoms through exacerbation and anxiety symptoms through the increased stress of being sick, missing anticipated events and not being able to participate in desired activities. The potential relationship between chronic stress, infection, anxiety and asthma, particularly in communities highly impacted by asthma morbidity and mortality is an important area of continued research. Further research attempting to ascertain the generalizability of the significant covariance between asthma and anxiety symptoms implicated by the current study's findings should also consider incorporating measures of chronic stress into their investigations.

Clinical Implications

The comorbidity of asthma and anxiety symptoms and the reciprocal nature of this relationship reported in this study have substantial implications for clinical practice on the part of both mental health practitioners and medical health practitioners. For medical health practitioners, the primary recommendation is increased adherence to existing recommendations for assessment of mental health in primary care, particularly in the context of chronic illness. For mental health practitioners, the primary recommendation is collaboration with medical health practitioners to provide adjunctive therapy for youth with asthma. Research recommendations for the respective disciplines are also included.

Medical Health Practitioners

Medical health practitioners need to be aware of the potential for asthma symptoms to be accompanied by comorbid anxiety symptoms in order to avoid over prescription of medication, particularly medication that could increase symptoms of an unrecognized anxiety disorder (Horikawa et al., 2014). Even when medical health practitioners are cognizant of the potential for psychological symptoms to accompany chronic disease they may not recognize the need to refer their patients for psychological services. Research exploring the impact of psychological

and physiological comorbidity found that the majority of medical practitioners expected that resolution or management of the physical complaint would resolve the comorbid psychological distress. However, this same research showed that psychological symptoms often persisted in the absence of treatment even if the comorbid chronic complaint was considered resolved or controlled (Kessler et al., 2003).

Increased openness is needed on the part of asthma specialists to discuss the potential for psychological comorbidity with their patients and their patient's caregivers. In keeping with recommendations for increased use of mental health screeners in primary care, incorporating a psychological measure such as the HADS into treatment as usual for youth with asthma could provide practitioners with an opportunity to discuss the potential impact of anxiety on their child's asthma symptoms (Cairney, Veldhuizen, Wade, Kurdyak, & Streiner, 2007; Colton & Manderscheid, 2006). Mental health provisions in the Affordable Care Act provides opportunities for increased collaboration between mental health practitioners and medical health practitioners, particularly for people receiving health care through Medicaid. Medical health practitioner's awareness of the comorbidity of asthma and anxiety and of increased access to psychological services could result in more willingness to refer patients with asthma for further assessment and treatment of anxiety based on results from a mental health screener or interview by medical practitioner. This collaboration would be further supported by integration of mental health consultation into primary care services (Pomerantz, Cole, Watts, & Weeks, 2008).

Developing and testing protocols designed to discern between asthma and anxiety in clinical settings could assist in raising awareness of the comorbidity and in providing guidance for specialists. To date there is no proposed or validated measure designed to help clinicians or

youth with asthma distinguish between symptoms of anxiety and symptoms of an asthma exacerbation or attack.

Mental Health Practitioners

Due to increasing evidence and attention on the impact that chronic illness has on mental health, therapists need to incorporate awareness of these factors into their treatment practices. Assessment of a client's physical health status is critical to providing comprehensive care especially in instances where there is an established comorbidity between a client's chronic condition and psychiatric distress. Understanding the reinforcing and reciprocal nature of asthma and anxiety could help practitioners conceptualize treatment that included attending to the intermittent nature of asthma symptoms and the burden of managing a chronic illness.

Additionally, mental health practitioners are well suited to support discernment between asthma and anxiety symptoms and to provide consultation and direct service for anxiety related barriers to asthma treatment. Further a mental health practitioner's awareness of the anxiogenic nature of some asthma medications could prevent over treatment or over medication of anxiety symptoms based in exacerbation of asthma symptoms. For example, providing brief intervention for a sharp increase in anxiety that could be accounted for by temporary use of prednisone. In general, increased awareness of the comorbidity between asthma and anxiety necessitates increased collaboration between medical and mental health practitioners in order to ensure the best treatment for young people. In addition to collaborative care that integrates treatment for asthma and anxiety, youth may benefit from validated mental health treatments designed to reduce stress and treat anxiety.

Research Directions: Opportunity and Caution

Results from the initial and effect size calculation for the HADS-A within-persons and between-persons covariance indicate that one way to potentially reduce asthma symptoms could be through psychosocial treatments aimed at reducing anxiety. The within-persons effect had a standardized gamma of -.21, interpreted as a significant small effect size (γ_{01} = -0.03, β = -0.21 SE = 0.01, t-ratio = -3.76, p <.001) and the between-persons effect had a standardized gamma of -.41, interpreted as a significant medium effect size (γ_{01} = -0.08, β = -0.41, SE = 0.01, t-ratio = -8.05, p <.001). While this result presents the potential for mental health practitioners to reduce asthma symptoms through successful interventions targeting anxiety symptoms, these results and consideration of potential treatment based on these results should be interpreted with extreme caution. Asthma has historically been treated as a fully or partially psychosomatic illness and it is possible that interventions increasing awareness of the role of anxiety on increasing asthma symptoms within and between individuals could re-activate beliefs that asthma does not require medical intervention and reduce treatment compliance (Ackerknecht, 1982; Bruce Pearson, 1958; French, 1939; Lehrer, 1998). Research is needed to develop adjunctive interventions that could provide relief for anxiety symptoms, potentially reducing asthma symptoms, while maintaining engagement with best medical practices for asthma management including use of an asthma action plan and appropriate medication. Caution is particularly warranted when an individual or community is identified as being at-risk for underutilizing medical services and consequently experiencing high rates of complication and death directly related to asthma.

While caution is warranted, research by psychologists is critically needed in these same areas because how people understand and communicate their symptomology fundamentally underlies what treatment they receive. Psychologists cognizant of how these understandings are

constructed in the biopsychosocial context have the opportunity to develop methods of symptoms differentiation between asthma and anxiety as well as other closely aligned conditions. For example, analysis of the multiple ways young people describe their experiences of asthma or anxiety compared with how young people with asthma and anxiety describe their experiences could reveal differences that could help identify discrete or comorbid conditions. Population specific research by psychologists could also aid in identifying and navigating the role of cultural understanding in treatment and diagnosis. Population specific research could focus on differentiating between "ataque de nervios" and asthma attacks, a challenge proposed to partially account for high rates of asthma diagnosis in Puerto Rican communities. Psychologist researching comorbid mental and physical conditions are poised to make substantial impacts on medical practice through development of tools and protocols to assist in treatment of psychological distress related to medical diagnosis and to assist healthcare providers in understanding that psychosocial treatments have the possibility to reduce the occurrence and report of physical symptoms.

Conclusion

The present study results provided evidence that asthma and anxiety symptoms covary within individuals and between individuals; meaning that a change in one variable predicts a change in the other. As the results are limited to the study population, research efforts are needed to investigate whether this relationship is generalizable. Increased access to mental health services via health parity laws and the Affordable Care Act encourages increased collaboration between primary care coordinators and mental health practitioners. However, studies focused on intervention are needed to provide valuable guidance for clinical treatment of comorbid asthma and anxiety, especially with regard to maintaining medical treatment while encouraging mental

health treatment. Of particular interest to mental health practitioners is the possibility that symptoms of asthma could be reduced by treatments successfully reducing anxiety in youth. Comorbid asthma and anxiety presents a substantial challenge to the quality of life for young people, especially young people already managing contextual stressors that may contribute to the development, persistence and exacerbation of comorbid symptomology. These findings indicate increased need for clinical attention and intervention to decrease the burden of asthma and anxiety on low-income youth of color living in urban areas.

References

Ackerknecht, E. H. (1982). The history of psychosomatic medicine. *Psychological Medicine, 12*(01), 17–24. http://doi.org/10.1017/S0033291700043245

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*(Supplement), S131–S145. http://doi.org/10.1542/peds.2008-2233C

Allen, K., Henselman, K., Laird, B., Quiñones, A., & Reutzel, T. (2012). Potential Life-Threatening Events in Schools Involving Rescue Inhalers, Epinephrine Autoinjectors, and Glucagon Delivery Devices: Reports From School Nurses. *The Journal of School Nursing*, *28*(1), 47–55. http://doi.org/10.1177/1059840511420726

Andersson, G., Kaldo-Sandström, V., Ström, L., & Strömgren, T. (2003). Internet administration of the Hospital Anxiety and Depression Scale in a sample of tinnitus patients. *Journal of Psychosomatic Research*, *55*(3), 259–262. http://doi.org/10.1016/S0022-3999(02)00575-5

Andrew Aligne, C., Auinger, P., Byrd, R. S., & Weitzman, M. (2000). Risk factors for pediatric asthma. *American Journal of Respiratory and Critical Care Medicine*, *162*(3), 873–877. http://doi.org/10.1164/ajrccm.162.3.9908085

Armstrong, K., Putt, M., Halbert, C. H., Grande, D., Schwartz, J. S., Liao, K., … Shea, J. A. (2013). Prior experiences of racial discrimination and racial differences in health care system distrust. *Medical Care*, *51*(2), 144–150. http://doi.org/10.1097/MLR.0b013e31827310a1

Bambauer, K. Z., Locke, S. E., Aupont, O., Mullan, M. G., & McLaughlin, T. J. (2005). Using the Hospital Anxiety and Depression Scale to screen for depression in cardiac patients.

General Hospital Psychiatry, *27*(4), 275–284. http://doi.org/10.1016/j.genhosppsych.2005.03.002

Barlow, D. H. (2000). Unraveling the mysteries of anxiety and its disorders from the perspective of emotion theory. *American Psychologist*, *55*(11), 1247–1263. http://doi.org/10.1037/0003-066X.55.11.1247

Baum, A., Garofalo, J. P., & Yali, A. M. (1999). Socioeconomic Status and Chronic Stress: Does Stress Account for SES Effects on Health? *Annals of the New York Academy of Sciences*, *896*(1), 131–144. http://doi.org/10.1111/j.1749-6632.1999.tb08111.x

Beasley, R., Crane, J., Lai, C. K. W., & Pearce, N. (2000). Prevalence and etiology of asthma. *Journal of Allergy and Clinical Immunology*, *105*(2, Part 2), S466–S472. http://doi.org/10.1016/S0091-6749(00)90044-7

Bender Berz, J., Murdock, K. K., & Koinis Mitchell, D. (2005). Children's asthma, internalizing problems, and social functioning: an urban perspective. *Journal of Child and Adolescent Psychiatric Nursing: Official Publication of the Association of Child and Adolescent Psychiatric Nurses, Inc*, *18*(4), 181–197. http://doi.org/10.1111/j.1744-6171.2005.00026.x

Bender, B. G. (2002). Overcoming barriers to nonadherence in asthma treatment. *Journal of Allergy and Clinical Immunology*, *109*(6, Supplement), S554–S559. http://doi.org/10.1067/mai.2002.124570

Bergquist, L. (2009). Minority areas more polluted. Retrieved from http://www.jsonline.com/news/milwaukee/43931942.html

Bhogal, S. K., Zemek, R. L., & Ducharme, F. (1996). Written action plans for asthma in children. In *Cochrane Database of Systematic Reviews*. John Wiley & Sons, Ltd.

Retrieved from http://onlinelibrary.wiley.com.ezproxy.library.wisc.edu/doi/10.1002/14651858.CD005306.pub2/abstract

Bjelland, I., Dahl, A. A., Haug, T. T., & Neckelmann, D. (2002). The validity of the Hospital Anxiety and Depression Scale: An updated literature review. *Journal of Psychosomatic Research*, *52*(2), 69–77. http://doi.org/10.1016/S0022-3999(01)00296-3

Bogaerts, K., Notebaert, K., Van Diest, I., Devriese, S., De Peuter, S., & Van den Bergh, O. (2005). Accuracy of respiratory symptom perception in different affective contexts. *Journal of Psychosomatic Research*, *58*(6), 537–543. http://doi.org/10.1016/j.jpsychores.2004.12.005

Boushey, H. A., Sorkness, C. A., King, T. S., Sullivan, S. D., Fahy, J. V., Lazarus, S. C., … Israel, E. (2005). Daily versus As-Needed Corticosteroids for Mild Persistent Asthma. *New England Journal of Medicine*, *352*(15), 1519–1528. http://doi.org/10.1056/NEJMoa042552

Brakel, A. M. L. van, Muris, P., Bögels, S. M., & Thomassen, C. (2006). A multifactorial model for the etiology of anxiety in non-clinical adolescents: Main and interactive effects of behavioral inhibition, attachment and parental rearing. *Journal of Child and Family Studies*, *15*(5), 568–578. http://doi.org/10.1007/s10826-006-9061-x

Brenner, J. S., Kelly, C. S., Wenger, A. D., Brich, S. M., & Morrow, A. L. (2001). Asthma and obesity in adolescents: is there an association? *Journal of Asthma*, *38*(6), 509–515. http://doi.org/10.1081/JAS-100105872

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, *22*(6), 723–742. http://doi.org/10.1037/0012-1649.22.6.723

Bruce Pearson, R. S. (1958). Natural History of Asthma. *Allergy*, *12*(4-5), 277–294. http://doi.org/10.1111/j.1398-9995.1958.tb03084.x

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.

Busse, W. W., Lemanske Jr, R. F., & Gern, J. E. (2010). Role of viral respiratory infections in asthma and asthma exacerbations. *The Lancet*, *376*(9743), 826–834. http://doi.org/10.1016/S0140-6736(10)61380-3

Cairney, J., Veldhuizen, S., Wade, T. J., Kurdyak, P., & Streiner, D. L. (2007). Evaluation of 2 Measures of Psychological Distress as Screeners for Depression in the General Population. *Canadian Journal of Psychiatry*, *52*(2), 111–20.

Carroll, W. D., Wildhaber, J., & Brand, P. L. P. (2012). Parent misperception of control in childhood/adolescent asthma: the Room to Breathe survey. *European Respiratory Journal*, *39*(1), 90–96. http://doi.org/10.1183/09031936.00048911

Chang VW, & Lauderdale DS. (2005). Income disparities in body mass index and obesity in the united states, 1971-2002. *Archives of Internal Medicine*, *165*(18), 2122–2128. http://doi.org/10.1001/archinte.165.18.2122

Chavira, D. A., Garland, A. F., Daley, S., & Hough, R. (2008). The impact of medical comorbidity on mental health and functional health outcomes among children with anxiety disorders. *Journal of Developmental and Behavioral Pediatrics: JDBP*, *29*(5), 394–402. http://doi.org/10.1097/DBP.0b013e3181836a5b

Chen, E., Hermann, C., Rodgers, D., Oliver-Welker, T., & Strunk, R. C. (2006). Symptom perception in childhood asthma: The role of anxiety and asthma severity. *Health Psychology*, *25*(3), 389–395. http://doi.org/10.1037/0278-6133.25.3.389

Clark, R., Anderson, N. B., Clark, V. R., & Williams, D. R. (1999). Racism as a stressor for African Americans: A biopsychosocial model. *American Psychologist*, *54*(10), 805–816. http://doi.org/10.1037/0003-066X.54.10.805

Cluley, S., & Cochrane, G. M. (2001). Psychological disorder in asthma is associated with poor control and poor adherence to inhaled steroids. *Respiratory Medicine*, *95*(1), 37–39. http://doi.org/10.1053/rmed.2000.0968

Colton, C. W., & Manderscheid, R. W. (2006). Congruencies in Increased Mortality Rates, Years of Potential Life Lost, and Causes of Death Among Public Mental Health Clients in Eight States. *Preventing Chronic Disease*, *3*(2). Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1563985/

Connolly, S. D., & Bernstein, G. A. (2007). Practice Parameter for the Assessment and Treatment of Children and Adolescents With Anxiety Disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*(2), 267–283. http://doi.org/10.1097/01.chi.0000246070.23695.06

Creamer, M., Foran, J., & Bell, R. (1995). The Beck Anxiety Inventory in a non-clinical sample. *Behaviour Research and Therapy*, *33*(4), 477–485. http://doi.org/10.1016/0005-7967(94)00082-U

Cunningham, J., Dockery, D. W., & Speizer, F. E. (1996). Race, asthma, and persistent wheeze in Philadelphia schoolchildren. *American Journal of Public Health*, *86*(10), 1406–1409. http://doi.org/10.2105/AJPH.86.10.1406

Curran, P. J., & Bauer, D. J. (2011). The Disaggregation of Within-Person and Between-Person Effects in Longitudinal Models of Change. *Annual Review of Psychology*, *62*, 583–619. http://doi.org/10.1146/annurev.psych.093008.100356

Dahl, R. (2006). Systemic side effects of inhaled corticosteroids in patients with asthma. *Respiratory Medicine*, *100*(8), 1307–1317. http://doi.org/10.1016/j.rmed.2005.11.020

D'Amato, G., Liccardi, G., D'Amato, M., & Holgate, S. (2005). Environmental risk factors and allergic bronchial asthma. *Clinical & Experimental Allergy*, *35*(9), 1113–1124. http://doi.org/10.1111/j.1365-2222.2005.02328.x

De Peuter, S., Van Diest, I., Lemaigre, V., Li, W., Verleden, G., Demedts, M., & Van den Bergh, O. (2005). Can subjective asthma symptoms be learned? *Psychosomatic Medicine*, *67*(3), 454–461.

Deshmukh, V. M., Toelle, B. G., Usherwood, T., O'grady, B., & Jenkins, C. R. (2008). The association of comorbid anxiety and depression with asthma-related quality of life and symptom perception in adults. *Respirology*, *13*(5), 695–702. http://doi.org/10.1111/j.1440-1843.2008.01310.x

Dhar, R., & Ghoshal, A. (2011). Psychosomatic trends in asthma: prevalence and attitudes. *Chest*, *140*(4_MeetingAbstracts), 862A–862A. http://doi.org/10.1378/chest.1119421

Engel, G. L. (1977). The need for a new medical model: a challenge for biomedicine. *Science*, *196*(4286), 129–136. http://doi.org/10.1126/science.847460

Engel, G. L. (1981). The clinical application of the biopsychosocial model. *Journal of Medicine and Philosophy*, *6*(2), 101–124. http://doi.org/10.1093/jmp/6.2.101

Erath, S. A., Flanagan, K. S., & Bierman, K. L. (2007). Social anxiety and peer relations in early adolescence: behavioral and cognitive factors. *Journal of Abnormal Child Psychology, 35*(3), 405–416. http://doi.org/10.1007/s10802-007-9099-2

Evans, G. W., & Kim, P. (2013). Childhood poverty, chronic stress, self-regulation, and coping. *Child Development Perspectives*, *7*(1), 43–48. http://doi.org/10.1111/cdep.12013

Farrell, L. J., Donovan, C., Turner, C. M., & Walker, J. R. (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). Springer New York. Retrieved from http://link.springer.com.ezproxy.library.wisc.edu/chapter/10.1007/978-1-4419-7784-7_32

Feldman, J. M., Ortega, A. N., McQuaid, E. L., & Canino, G. (2006). Comorbidity between asthma attacks and internalizing disorders among Puerto Rican children at one-year follow-up. *Psychosomatics*, *47*(4), 333–339. http://doi.org/10.1176/appi.psy.47.4.333

Feldman, J. M., Siddique, M. I., Morales, E., Kaminski, B., Lu, S.-E., & Lehrer, P. M. (2005). Psychiatric disorders and asthma outcomes among high-risk inner-city patients. *Psychosomatic Medicine November/December 2005, 67*(6), 989–996.

Feldman, J. M., Siddique, M. I., Thompson, N. S., & Lehrer, P. M. (2009). The role of panic-fear in comorbid asthma and panic disorder. *Journal of Anxiety Disorders*, *23*(2), 178–184.

Feldman, J. M., Steinberg, D., Kutner, H., Eisenberg, N., Hottinger, K., Sidora-Arcoleo, K., … Serebrisky, D. (2013). Perception of pulmonary function and asthma control: The differential role of child versus caregiver anxiety and depression. *Journal of Pediatric Psychology*, *38*(10), 1091–1100.

Finkelstein JA, Lozano P, Farber HJ, Miroshnik I, & Lieu TA. (2002). Underuse of controller medications among medicaid-insured children with asthma. *Archives of Pediatrics & Adolescent Medicine*, *156*(6), 562–567. http://doi.org/10.1001/archpedi.156.6.562

Fond, G., Loundou, A., Hamdani, N., Boukouaci, W., Dargel, A., Oliveira, J., … Boyer, L. (2014). Anxiety and depression comorbidities in irritable bowel syndrome (IBS): a systematic review and meta-analysis. *European Archives of Psychiatry and Clinical Neuroscience*, 1–10. http://doi.org/10.1007/s00406-014-0502-z

Ford, E. S. (2005). The epidemiology of obesity and asthma. *Journal of Allergy and Clinical Immunology*, *115*(5), 897–909. http://doi.org/10.1016/j.jaci.2004.11.050

Forno, E., & Celedón, J. C. (2009). Asthma and ethnic minorities: socioeconomic status and beyond. *Current Opinion in Allergy and Clinical Immunology*, *9*(2), 154–160.

French, T. M. (1939). PSYCHOGENIC FACTORS IN ASTHMA. *American Journal of Psychiatry*, *96*(1), 87–101.

Fydrich, T., Dowdall, D., & Chambless, D. L. (1992). Reliability and validity of the beck anxiety inventory. *Journal of Anxiety Disorders*, *6*(1), 55–61. http://doi.org/10.1016/0887-6185(92)90026-4

Gariepy, G., Nitka, D., & Schmitz, N. (2010). The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. *International Journal of Obesity*, *34*(3), 407–419. http://doi.org/10.1038/ijo.2009.252

Gauderman, W. J., Avol, E., Gilliland, F., Vora, H., Thomas, D., Berhane, K., … Peters, J. (2004). The effect of air pollution on lung development from 10 to 18 years of age. *New England Journal of Medicine*, *351*(11), 1057–1067. http://doi.org/10.1056/NEJMoa040610

Gergen, P. (1996). Social class and asthma--distinguishing between the disease and the diagnosis. *American Journal of Public Health*, *86*(10), 1361–1362.

Gershon, A. S., Wang, C., Guan, J., & To, T. (2010). Burden of comorbidity in individuals with asthma. *Thorax*, *65*(7), 612–618. http://doi.org/10.1136/thx.2009.131078

Gibson, P. G., & Powell, H. (2004). Written action plans for asthma: an evidence-based review of the key components. *Thorax*, *59*(2), 94–99. http://doi.org/10.1136/thorax.2003.011858

Gillaspy, S. R., Hoff, A. L., Mullins, L. L., Van Pelt, J. C., & Chaney, J. M. (2002). Psychological distress in high-risk youth with asthma. *Journal of Pediatric Psychology*, *27*(4), 363–371.

Ginde, A. A., Espinola, J. A., & Camargo Jr., C. A. (2008). Improved overall trends but persistent racial disparities in emergency department visits for acute asthma, 1993-2005. *Journal of Allergy and Clinical Immunology*, *122*(2), 313–318. http://doi.org/10.1016/j.jaci.2008.04.024

Ginsburg, G. S., & Drake, K. L. (2002). School-Based Treatment for Anxious African-American Adolescents: A Controlled Pilot Study. *Journal of the American Academy of Child & Adolescent Psychiatry*, *41*(7), 768–775. http://doi.org/10.1097/00004583-200207000-00007

Glover, S., Elder, K., Xirasagar, S., Baek, J.-D., Piper, C., & Campbell, D. (2012). Disparities in mental health utilization among persons with chronic diseases. *Journal of Health Disparities Research and Practice*, *1*(3). Retrieved from http://digitalscholarship.unlv.edu/jhdrp/vol1/iss3/5

Goodwin, R. D., Fergusson, D. M., & Horwood, L. J. (2004). Asthma and depressive and anxiety disorders among young persons in the community. *Psychological Medicine*, *34*(8), 1465–1474.

Goodwin, R. D., Messineo, K., Bregante, A., Hoven, C. W., & Kairam, R. (2005). Prevalence of probable mental disorders among pediatric asthma patients in an inner-city clinic. *Journal of Asthma*, *42*(8), 643–647.

Goodwin, R. D., Olfson, M., Shea, S., Lantigua, R. A., Carrasquilo, O., Gameroff, M. J., & Weissman, M. M. (2003). Asthma and mental disorders in primary care. *General Hospital Psychiatry*, *25*(6), 479–483. http://doi.org/10.1016/S0163-8343(03)00071-9

Goosby, B. J. (2007). Poverty duration, maternal psychological resources, and adolescent socioemotional outcomes. *Journal of Family Issues*, *28*(8), 1113–1134. http://doi.org/10.1177/0192513X07300712

Graham-Bermann, S. A. (1996). Family Worries: Assessment of Interpersonal Anxiety in Children From Violent and Nonviolent Families. *Journal of Clinical Child Psychology*, *25*(3), 280–287. http://doi.org/10.1207/s15374424jccp2503_4

Graham, P. J., Rutter, M. L., Yule, W., & Pless, I. B. (1967). Childhood asthma: a psychosomatic disorder? Some epidemiological considerations. *British Journal of Preventive & Social Medicine*, *21*(2), 78–85.

Gustafson, D. H., McTavish, F. M., Boberg, E., Owens, B. H., Sherbeck, C., Wise, M., … Hawkins, R. P. (1999). Empowering patients using computer based health support systems. *Quality in Health Care : QHC*, *8*(1), 49–56.

Gustafson, D., Wise, M., Bhattacharya, A., Pulvermacher, A., Shanovich, K., Phillips, B., … Kim, J.-S. (2012). The effects of combining web-based eHealth With telephone nurse

case management for pediatric asthma control: a randomized controlled trial. *Journal of Medical Internet Research*, *14*(4). http://doi.org/10.2196/jmir.1964

Hakala, K., Stenius-Aarniala, B., & Sovijärvi, A. (2000). Effects of weight loss on peak flow variability, airways obstruction, and lung volumes in obese patients with asthma*. *Chest*, *118*(5), 1315–1321. http://doi.org/10.1378/chest.118.5.1315

Handelman, L., Rich, M., Bridgemohan, C. F., & Schneider, L. (2004). Understanding Pediatric Inner-City Asthma: An Explanatory Model Approach. *Journal of Asthma*, *41*(2), 167–177. http://doi.org/10.1081/JAS-120026074

Harrison, M. E., McKay, M. M., & Bannon, W. M. (2004). Inner-City Child Mental Health Service Use: The Real Question Is Why Youth and Families Do Not Use Services. *Community Mental Health Journal*, *40*(2), 119–131. http://doi.org/10.1023/B:COMH.0000022732.80714.8b

Hasler, G., Gergen, P. J., Kleinbaum, D. G., Ajdacic, V., Gamma, A., Eich, D., … Angst, J. (2005). Asthma and Panic in Young Adults. *American Journal of Respiratory and Critical Care Medicine*, *171*(11), 1224–1230. http://doi.org/10.1164/rccm.200412-1669OC

Hettema, J. M., Neale, M. C., & Kendler, K. S. (2001). A review and meta-analysis of the genetic epidemiology of anxiety disorders. *The American Journal of Psychiatry*, *158*(10), 1568–78.

Hoffman, L. (2007). Multilevel models for examining individual differences in within-person variation and covariation over time. *Multivariate Behavioral Research*, *42*(4), 609–629. http://doi.org/10.1080/00273170701710072

Holgate, S. T. (1997). The cellular and mediator basis of asthma in relation in relation to natural history. *The Lancet,* SII5–9.

Horikawa, Y. T., Udaka, T. Y., Crow, J. K., Takayama, J. I., & Stein, M. T. (2014). "Anxiety associated with asthma exacerbations and overuse of medication: The role of cultural competency": Erratum. *Journal of Developmental and Behavioral Pediatrics*, *35*(3), 227–227.

Horne, R., & Weinman, J. (2002). Self-regulation and self-management in asthma: exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. *Psychology & Health*, *17*(1), 17.

Hunter, L. R., & Schmidt, N. B. (2010). Anxiety psychopathology in African American adults: Literature review and development of an empirically informed sociocultural model. *Psychological Bulletin*, *136*(2), 211–235. http://doi.org/10.1037/a0018133

Jackson, D. J., Sykes, A., Mallia, P., & Johnston, S. L. (2011). Asthma exacerbations: Origin, effect, and prevention. *Journal of Allergy and Clinical Immunology*, *128*(6), 1165–1174. http://doi.org/10.1016/j.jaci.2011.10.024

Janssens, T., Verleden, G., De Peuter, S., Van Diest, I., & Van den Bergh, O. (2009). Inaccurate perception of asthma symptoms: A cognitive–affective framework and implications for asthma treatment. *Clinical Psychology Review*, *29*(4), 317–327.

Jensen, M. E., Gibson, P. G., Collins, C. E., Hilton, J. M., Latham-Smith, F., & Wood, L. G. (2013). Increased sleep latency and reduced sleep duration in children with asthma. *Sleep and Breathing*, *17*(1), 281–287. http://doi.org/10.1007/s11325-012-0687-1

Jensen, M. E., Gibson, P. G., Collins, C. E., & Wood, L. G. (2013). Airway and systemic inflammation in obese children with asthma. *European Respiratory Journal*, *42*(4), 1012–1019. http://doi.org/10.1183/09031936.00124912

Jones, R., Latinovic, R., Charlton, J., & Gulliford, M. (2006). Physical and psychological co-morbidity in irritable bowel syndrome: a matched cohort study using the General Practice Research Database. *Alimentary Pharmacology & Therapeutics*, *24*(5), 879–886. http://doi.org/10.1111/j.1365-2036.2006.03044.x

Juhn, Y. J., Sauver, J. S., Katusic, S., Vargas, D., Weaver, A., & Yunginger, J. (2005). The influence of neighborhood environment on the incidence of childhood asthma: a multilevel approach. *Social Science & Medicine*, *60*(11), 2453–2464. http://doi.org/10.1016/j.socscimed.2004.11.034

Kaplan, A., & Stanbrook, M. (2010). Must family physicians use spirometry in managing asthma patients? *Canadian Family Physician*, *56*(2), 126–128.

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*(5), 455–463. http://doi.org/10.1016/j.jadohealth.2007.05.023

Katon, W., Russo, J., Richardson, L., McCauley, E., & Lozano, P. (2008). Anxiety and depression screening for youth in a primary care population. *Ambulatory Pediatrics*, *8*(3), 182–188. http://doi.org/10.1016/j.ambp.2008.01.003

Kean, E. M., Kelsay, K., Wamboldt, F., & Wamboldt, M. Z. (2006). Posttraumatic stress in adolescents with asthma and their parents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *45*(1), 78–86. http://doi.org/10.1097/01.chi.0000186400.67346.02

Kessler, R. C., Ormel, J., Demler, O., & Stang, P. E. (2003). Comorbid mental disorders account for the role impairment of commonly occurring chronic physical disorders: Results from the national comorbidity survey. *Journal of Occupational, 45*(12), 1257–1266.

Koinis–Mitchell, D., McQuaid, E. L., Seifer, R., Kopel, S. J., Nassau, J. H., Klein, R. B., … Fritz, G. K. (2009). Symptom perception in children with asthma: Cognitive and psychological factors. *Health Psychology*, *28*(2), 226–237. http://doi.org/10.1037/a0013169

Law, H.-Z., Oraka, E., & Mannino, D. M. (2011). The role of income in reducing racial and ethnic disparities in emergency room and urgent care center visits for asthma—United States, 2001–2009. *Journal of Asthma*, *48*(4), 405–413. http://doi.org/10.3109/02770903.2011.565849

Lehrer, P. M. (1998). Emotionally Triggered Asthma: A Review of Research Literature and Some Hypotheses for Self-Regulation Therapies. *Applied Psychophysiology and Biofeedback*, *23*(1), 13–41. http://doi.org/10.1023/A:1022170028979

Lewis-Fernández, R., Guarnaccia, P. J., Martínez, I. E., Salmán, E., Schmidt, A., & Liebowitz, M. (2002). Comparative phenomenology of ataques de nervios, panic attacks, and panic disorder. *Culture, Medicine and Psychiatry*, *26*(2), 199–223. http://doi.org/10.1023/A:1016349624867

Lewis, K. M., Byrd, D. A., & Ollendick, T. H. (2012). Anxiety symptoms in African-American and Caucasian youth: Relations to negative life events, social support, and coping. *Journal of Anxiety Disorders*, *26*(1), 32–39. http://doi.org/10.1016/j.janxdis.2011.08.007

Lilly, C. M. (2005). Diversity of asthma: Evolving concepts of pathophysiology and lessons from genetics. *Journal of Allergy and Clinical Immunology*, *115*(4, Supplement), S526–S531. http://doi.org/10.1016/j.jaci.2005.01.028

Lindsey, M. A., Joe, S., & Nebbitt, V. (2010). Family matters: The role of mental health stigma and social support on depressive symptoms and subsequent help seeking among African American boys. *Journal of Black Psychology*. http://doi.org/10.1177/0095798409355796

Lin, E. H. B., Katon, W., Korff, M. V., Rutter, C., Simon, G. E., Oliver, M., … Young, B. (2004). Relationship of Depression and Diabetes Self-Care, Medication Adherence, and Preventive Care. *Diabetes Care*, *27*(9), 2154–2160. http://doi.org/10.2337/diacare.27.9.2154

Lin, E. H. B., & Korff, M. V. (2008). Mental disorders among persons with diabetes—Results from the World Mental Health Surveys. *Journal of Psychosomatic Research*, *65*(6), 571–580. http://doi.org/10.1016/j.jpsychores.2008.06.007

Lu, Y., Mak, K.-K., van Bever, H. P. S., Ng, T. P., Mak, A., & Ho, R. C.-M. (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. http://doi.org/10.1111/pai.12000

Mansour, M. E., Lanphear, B. P., & DeWitt, T. G. (2000). Barriers to asthma care in urban children: Parent perspectives. *Pediatrics*, *106*(3), 512–519. http://doi.org/10.1542/peds.106.3.512

Martinez, F. D., & Helms, P. J. (1998). Types of asthma and wheezing. *The European Respiratory Journal. Supplement*, *27*, 3s–8s.

McCarthy, A. M., Kelly, M. W., & Reed, D. (2000). Medication Administration Practices of School Nurses. *Journal of School Health, 70*(9), 371–376. http://doi.org/10.1111/j.1746-1561.2000.tb07277.x

McCauley, E., Katon, W., Russo, J., Richardson, L., & Lozano, P. (2007). Impact of anxiety and depression on functional impairment in adolescents with asthma. *General Hospital Psychiatry, 29*(3), 214–222.

McGrady, M. E., Cotton, S., Rosenthal, S. L., Roberts, Y. H., Britto, M., & Yi, M. S. (2010). Anxiety and asthma symptoms in urban adolescents with asthma: The mediating role of illness perceptions. *Journal of Clinical Psychology in Medical Settings*, *17*(4), 349–356.

McKenzie, K., & Bhui, K. (2007). Institutional racism in mental health care. *BMJ : British Medical Journal*, *334*(7595), 649–650. http://doi.org/10.1136/bmj.39163.395972.80

McLaughlin, T., Geissler, E. C., & Wan, G. J. (2003). Comorbidities and associated treatment charges in patients with anxiety disorders. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*, *23*(10), 1251–1256. http://doi.org/10.1592/phco.23.12.1251.32700

Mehnert, A., & Koch, U. (2008). Psychological comorbidity and health-related quality of life and its association with awareness, utilization, and need for psychosocial support in a cancer register-based sample of long-term breast cancer survivors. *Journal of Psychosomatic Research*, *64*(4), 383–391. http://doi.org/10.1016/j.jpsychores.2007.12.005

Meng, Y.-Y., Rull, R. P., Wilhelm, M., Ritz, B., & English, P. (2006). Living near heavy traffic increases asthma severity. *UCLA Center for Health Policy Research*. Retrieved from http://escholarship.org/uc/item/5t52w95d

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. http://doi.org/10.1002/da.20205

Mineka, S., & Oehlberg, K. (2008). The relevance of recent developments in classical conditioning to understanding the etiology and maintenance of anxiety disorders. *Acta Psychologica*, *127*(3), 567–580. http://doi.org/10.1016/j.actpsy.2007.11.007

Mineka, S., & Zinbarg, R. (2006). A contemporary learning theory perspective on the etiology of anxiety disorders: It's not what you thought it was. *American Psychologist*, *61*(1), 10–26. http://doi.org/10.1037/0003-066X.61.1.10

Morrison Gutman, L., McLoyd, V. C., & Tokoyawa, T. (2005). Financial strain, neighborhood stress, parenting behaviors, and adolescent adjustment in urban African American families. *Journal of Research on Adolescence, 15*(4), 425–449. http://doi.org/10.1111/j.1532-7795.2005.00106.x

Morrison, S., Dashiff, C., Abdullatif, H., & Moreland, E. (2011). Parental separation anxiety and diabetes self-management of older adolescents: a pilot study. *Pediatric Nursing, 38*(2), 88–95.

Murdock, K. K., Greene, C., Adams, S. K., Hartmann, W., Bittinger, S., & Will, K. (2010). The puzzle of problem-solving efficacy: Understanding anxiety among urban children coping with asthma-related and life stress. *Anxiety, Stress & Coping: An International Journal*, *23*(4), 383–398.

Murdock, K. K., Robinson, E. M., Adams, S. K., Berz, J., & Rollock, M. J. D. (2009). Family—school connections and internalizing problems among children living with asthma in

urban, low-income neighborhoods. *Journal of Child Health Care*, *13*(3), 275–294. http://doi.org/10.1177/1367493509336682

Nathan, R. A., Sorkness, C. A., Kosinski, M., Schatz, M., Li, J. T., Marcus, P., … Pendergraft, T. B. (2004). Development of the asthma control test: A survey for assessing asthma control. *Journal of Allergy and Clinical Immunology*, *113*(1), 59–65. http://doi.org/10.1016/j.jaci.2003.09.008

Neidell, M. J. (2004). Air pollution, health, and socio-economic status: the effect of outdoor air quality on childhood asthma. *Journal of Health Economics*, *23*(6), 1209–1236. http://doi.org/10.1016/j.jhealeco.2004.05.002

Olssøn, I., Mykletun, A., & Dahl, A. A. (2005). The hospital anxiety and depression rating scale: A cross-sectional study of psychometrics and case finding abilities in general practice. *BMC Psychiatry*, *5*, 46–7. http://doi.org/10.1186/1471-244X-5-46

Ortega, A. N., McQuaid, E. L., Canino, G., Goodwin, R. D., & Fritz, G. K. (2004). Comorbidity of asthma and anxiety and depression in Puerto Rican children. *Psychosomatics*, *45*(2), 93–99. http://doi.org/10.1176/appi.psy.45.2.93

Ostro, B., Lipsett, M., Mann, J., Braxton-Owens, H., & White, M. (2001). Air Pollution and Exacerbation of Asthma in African-American Children in Los Angeles. *Epidemiology*, *12*(2), 200–208.

Persky, V. W., Slezak, J., Contreras, A., Becker, L., Hernandez, E., Ramakrishnan, V., & Piorkowski, J. (1998). Relationships of race and socioeconomic status with prevalence, severity, and symptoms of asthma in Chicago school children. *Annals of Allergy, Asthma & Immunology*, *81*(3), 266–271. http://doi.org/10.1016/S1081-1206(10)62824-4

Phipatanakul, W. (2002). Rodent allergens. *Current Allergy and Asthma Reports*, *2*(5), 412–416. http://doi.org/10.1007/s11882-002-0075-1

Pomerantz, A., Cole, B. H., Watts, B. V., & Weeks, W. B. (2008). Improving efficiency and access to mental health care: combining integrated care and advanced access. *General Hospital Psychiatry*, *30*(6), 546–551. http://doi.org/10.1016/j.genhosppsych.2008.09.004

Rand, C. S., Butz, A. M., Kolodner, K., Huss, K., Eggleston, P., & Malveaux, F. (2000). Emergency department visits by urban African American children with asthma. *Journal of Allergy and Clinical Immunology*, *105*(1, Part 1), 83–90. http://doi.org/10.1016/S0091-6749(00)90182-9

Rank, M. A., Volcheck, G. W., Li, J. T. C., Patel, A. M., & Lim, K. G. (2008). Formulating an Effective and Efficient Written Asthma Action Plan. *Mayo Clinic Proceedings*, *83*(11), 1263–1270. http://doi.org/10.4065/83.11.1263

Rauh, V. A., Chew, G. R., & Garfinkel, R. S. (2002). Deteriorated housing contributes to high cockroach allergen levels in inner-city households. *Environmental Health Perspectives*, *110*(Suppl 2), 323–327.

Reckless, J. B. (1971). A behavioral treatment of bronchial asthma in modified group therapy. *Psychosomatics*, *12*(3), 168–173. http://doi.org/10.1016/S0033-3182(71)71530-8

Riedl, A., Schmidtmann, M., Stengel, A., Goebel, M., Wisser, A.-S., Klapp, B. F., & Mönnikes, H. (2008). Somatic comorbidities of irritable bowel syndrome: A systematic analysis. *Journal of Psychosomatic Research*, *64*(6), 573–582. http://doi.org/10.1016/j.jpsychores.2008.02.021

Rietveld, S., van Beest, I., & Prins, P. J. M. (2005). The relationship between specific anxiety syndromes and somatic symptoms in adolescents with asthma and other chronic diseases. *Journal of Asthma*, *42*(9), 725–730. http://doi.org/10.1080/02770900500306472

Roberts, R. E., Roberts, C. R., & Xing, Y. (2007). Rates of DSM-IV psychiatric disorders among adolescents in a large metropolitan area. *Journal of Psychiatric Research*, *41*(11), 959–967. http://doi.org/10.1016/j.jpsychires.2006.09.006

Rockhill, C. M., Russo, J. E., McCauley, E., Katon, W. J., Richardson, L. P., & Lozano, P. (2007). Agreement between parents and children regarding anxiety and depression diagnoses in children with asthma: *The Journal of Nervous and Mental Disease*, *195*(11), 897–904. http://doi.org/10.1097/NMD.0b013e318159289c

Romero-Frais, E., Vázquez, M. I., Sández, E., Blanco-Aparicio, M., Otero, I., & Verea, H. (2005). Prescription of oral corticosteroids in near-fatal asthma patients: Relationship with panic-fear, anxiety and depression. *Scandinavian Journal of Psychology*, *46*(5), 459–465. http://doi.org/10.1111/j.1467-9450.2005.00477.x

Ross, C. J. M., Davis, T. M. A., & Hogg, D. Y. (2007). Screening and assessing adolescent asthmatics for anxiety disorders. *Clinical Nursing Research*, *16*(1), 5–24. http://doi.org/10.1177/1054773806295235

Santiago, C. D., Wadsworth, M. E., & Stump, J. (2011). Socioeconomic status, neighborhood disadvantage, and poverty-related stress: Prospective effects on psychological syndromes among diverse low-income families. *Journal of Economic Psychology*, *32*(2), 218–230. http://doi.org/10.1016/j.joep.2009.10.008

Sarpong, S. B., Hamilton, R. G., Eggleston, P. A., & Adkinson Jr, N. F. (1996). Socioeconomic status and race as risk factors for cockroach allergen exposure and sensitization in

children with asthma. *Journal of Allergy and Clinical Immunology*, *97*(6), 1393–1401. http://doi.org/10.1016/S0091-6749(96)70209-9

Schatz, M., Mosen, D., Kosinski, M., Vollmer, W., Magid, D., O'Connor, E., & Zeiger, R. (2007). Validity of the asthma control test completed at home. *American Journal of Managed Care*, *13*(12), 661–667.

Schatz, M., Sorkness, C. A., Li, J. T., Marcus, P., Murray, J. J., Nathan, R. A., … Jhingran, P. (2006). Asthma Control Test: Reliability, validity, and responsiveness in patients not previously followed by asthma specialists. *Journal of Allergy and Clinical Immunology*, *117*(3), 549–556. http://doi.org/10.1016/j.jaci.2006.01.011

Segerstrom, S. C., & Miller, G. E. (2004). Psychological Stress and the Human Immune System: A Meta-Analytic Study of 30 Years of Inquiry. *Psychological Bulletin*, *130*(4), 601–630. http://doi.org/10.1037/0033-2909.130.4.601

Simning, A., Wijngaarden, E. van, & Conwell, Y. (2010). Anxiety, mood, and substance use disorders in United States African-American public housing residents. *Social Psychiatry and Psychiatric Epidemiology*, *46*(10), 983–992. http://doi.org/10.1007/s00127-010-0267-2

Singer, S., Kuhnt, S., Götze, H., Hauss, J., Hinz, A., Liebmann, A., … Schwarz, R. (2009). Hospital anxiety and depression scale cutoff scores for cancer patients in acute care. *British Journal of Cancer*, *100*(6), 908–912. http://doi.org/10.1038/sj.bjc.6604952

Sleath, B., Carpenter, D. M., Slota, C., Williams, D., Tudor, G., Yeatts, K., … Ayala, G. X. (2012). Communication during pediatric asthma visits and self-reported asthma medication adherence. *Pediatrics*, *130*(4), 627–633. http://doi.org/10.1542/peds.2012-0913

Snaith, R. P., & Zigmond, A. S. (1986). The hospital anxiety and depression scale. *British Medical Journal (Clinical Research Ed.)*, *292*(6516), 344.

Steptoe, A., & Feldman, P. J. (2001). Neighborhood problems as sources of chronic stress: Development of a measure of neighborhood problems, and associations with socioeconomic status and health. *Annals of Behavioral Medicine*, *23*(3), 177–185. http://doi.org/10.1207/S15324796ABM2303_5

Strine, M. P. H., Tara, Mokdad, P. D., Ali, Balluz, M. P. H., Sc. D. ,Lina, Gonzalez, P. D., Olinda, Crider, P. D., Raquel, Berry, P. D., Joyce, & Kroenke, M. D., Kurt. (2008). Depression and anxiety in the United States: Findings from the 2006 behavioral risk factor surveillance system. *Psychiatric Services*, *59*(12), 1383–1390. http://doi.org/10.1176/appi.ps.59.12.1383

Surís, J.-C., Parera, N., & Puig, C. (1996). Chronic illness and emotional distress in adolescence. *Journal of Adolescent Health*, *19*(2), 153–156. http://doi.org/10.1016/1054-139X(95)00231-G

Todd, N. R., Allen, N. E., & Javdani, S. (2012). Multilevel modeling: Method and application for community-based research. In L. Jason & D. Glenwick (Eds.), *Methodological approaches to community-based research.* (pp. 167–185). Washington: American Psychological Association. Retrieved from http://content.apa.org/books/13492-010

Ungar, W. J., MacDonald, T., & Cousins, M. (2005). Better breathing or better living? A qualitative analysis of the impact of asthma medication acquisition on standard of living and quality of life in low-income families of children with asthma. *Journal of Pediatric Health Care*, *19*(6), 354–362. http://doi.org/10.1016/j.pedhc.2005.06.004

Valderas, J. M., Starfield, B., Sibbald, B., Salisbury, C., & Roland, M. (2009). Defining comorbidity: Implications for understanding health and health services. *Annals of Family Medicine, 7*(4), 357–363. http://doi.org/10.1370/afm.983

Van Ameringen, M., Mancini, C., & Farvolden, P. (2003). The impact of anxiety disorders on educational achievement. *Journal of Anxiety Disorders*, *17*(5), 561–571. http://doi.org/10.1016/S0887-6185(02)00228-1

van de Ven, A. C., Muntjewerff, J.-W., Netea-Maier, R. T., de Vegt, F., Ross, H. A., Sweep, F. C. G. J., … Janzing, J. G. E. (2012). Association between thyroid function, thyroid autoimmunity, and state and trait factors of depression. *Acta Psychiatrica Scandinavica*, *126*(5), 377–384. http://doi.org/10.1111/j.1600-0447.2012.01870.x

Van Lieshout, R. J., & Macqueen, G. M. (2012). Relations between asthma and psychological distress: an old idea revisited. *Chemical Immunology and Allergy*, *98*, 1–13. http://doi.org/10.1159/000336493

Vega, J. M., Badia, X., Badiola, C., López-Viña, A., Olaguíbel, J. M., Picado, C., … Dal-Ré, R. (2007). Validation of the Spanish Version of the Asthma Control Test (ACT). *Journal of Asthma, 44*(10), 867–872. http://doi.org/10.1080/02770900701752615

Veres, T. Z., Rochlitzer, S., & Braun, A. (2009). The role of neuro-immune cross-talk in the regulation of inflammation and remodelling in asthma. *Pharmacology & Therapeutics*, *122*(2), 203–214. http://doi.org/10.1016/j.pharmthera.2009.02.007

Vila, G., Nollet-Clemençon, C., de Blic, J., Mouren-Simeoni, M.-C., & Scheinmann, P. (2000). Prevalence of DSM IV anxiety and affective disorders in a pediatric population of asthmatic children and adolescents. *Journal of Affective Disorders*, *58*(3), 223–231. http://doi.org/10.1016/S0165-0327(99)00110-X

Voils, C. I., Oddone, E. Z., Weinfurt, K. P., Friedman, J. Y., Schulman, K. Y., & Bosworth, H. B. (2004). Who trusts healthcare institutions? Results from a community-based sample. *Ethnicity & Disease*, *15*(1), 97–103.

Wade, D. T., & Halligan, P. W. (2004). Do biomedical models of illness make for good healthcare systems? *BMJ : British Medical Journal*, *329*(7479), 1398–1401.

Wallace, L. A., Mitchell, H., O'Connor, G. T., Neas, L., Lippmann, M., Kattan, M., … Liu, L.-J. S. (2003). Particle concentrations in inner-city homes of children with asthma: the effect of smoking, cooking, and outdoor pollution. *Environmental Health Perspectives*, *111*(9), 1265–1272.

Wang, L. P., & Maxwell, S. E. (2015). On disaggregating between-person and within-person effects with longitudinal data using multilevel models. *Psychological Methods*, *20*(1), 63–83. http://doi.org/10.1037/met0000030

Weech-Maldonado, R., Morales, L. S., Spritzer, K., Elliott, M., & Hays, R. D. (2001). Racial and ethnic differences in parents' assessments of pediatric care in Medicaid managed care. *Health Services Research*, *36*(3), 575–594.

White, D., Leach, C., Sims, R., Atkinson, M., & Cottrell, D. (1999). Validation of the Hospital Anxiety and Depression Scale for use with adolescents. *The British Journal of Psychiatry*, *175*(5), 452–454. http://doi.org/10.1192/bjp.175.5.452

Whitehead, W. E., Palsson, O., & Jones, K. R. (2002). Systematic review of the comorbidity of irritable bowel syndrome with other disorders: What are the causes and implications? *Gastroenterology*, *122*(4), 1140–1156. http://doi.org/10.1053/gast.2002.32392

Williams, D. R., Neighbors, H. W., & Jackson, J. S. (2003). Racial/Ethnic Discrimination and Health: Findings From Community Studies. *American Journal of Public Health*, *93*(2), 200–208. http://doi.org/10.2105/AJPH.93.2.200

Williams, D. R., & Williams-Morris, R. (2000). Racism and mental health: The African American experience. *Ethnicity & Health*, *5*(3-4), 243–268. http://doi.org/10.1080/713667453

Wisconsin Department of Health Services. (n.d.). Federal Poverty Level Guidelines. Retrieved May 17, 2015, from https://www.dhs.wisconsin.gov/medicaid/fpl.htm

Wise, M., Gustafson, D. H., Sorkness, C. A., Molfenter, T., Staresinic, A., Meis, T., … Walker, N. P. (2007). Internet telehealth for pediatric asthma case management: Integrating computerized and case manager features for tailoring a web-based asthma education program. *Health Promotion Practice*, *8*(3), 282–291. http://doi.org/10.1177/1524839906289983

Wolitzky-Taylor, K., Bobova, L., Zinbarg, R. E., Mineka, S., & Craske, M. G. (2012). Longitudinal investigation of the impact of anxiety and mood disorders in adolescence on subsequent substance use disorder onset and vice versa. *Addictive Behaviors*, *37*(8), 982–985. http://doi.org/10.1016/j.addbeh.2012.03.026

Wright, R. J., Mitchell, H., Visness, C. M., Cohen, S., Stout, J., Evans, R., & Gold, D. R. (2004). Community Violence and Asthma Morbidity: The Inner-City Asthma Study. *American Journal of Public Health*, *94*(4), 625–632. http://doi.org/10.2105/AJPH.94.4.625

Wright, R. J., Rodriguez, M., & Cohen, S. (1998). Review of psychosocial stress and asthma: an integrated biopsychosocial approach. *Thorax*, *53*(12), 1066–1074. http://doi.org/10.1136/thx.53.12.1066

Xin Zhou, F.-M. D. (2007). Validity of Asthma Control Test in Chinese patients. *Chinese Medical Journal*, *120*(12), 1037–41.

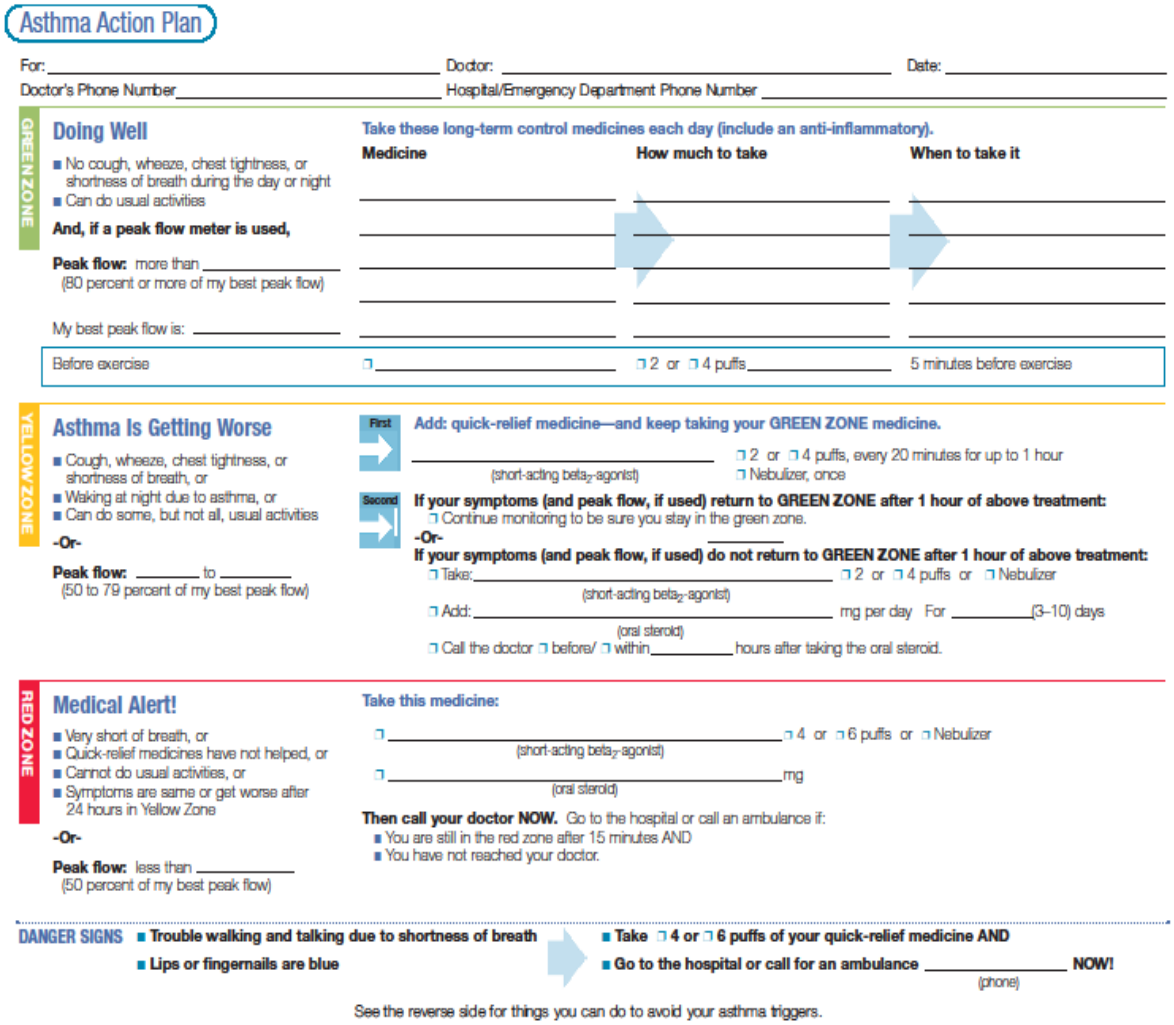
Yin, H. S., Gupta, R. S., Tomopoulos, S., Wolf, M. S., Mendelsohn, A. L., Antler, L., … Dreyer, B. P. (2013). Readability, suitability, and characteristics of asthma action plans: Examination of factors that may impair understanding. *Pediatrics*, *131*(1), e116–e126. http://doi.org/10.1542/peds.2012-0612

Yoos, H. L., Kitzman, H., McMullen, A., & Sidora, K. (2003). Symptom perception in childhood asthma: How accurate are children and their parents? *Journal of Asthma*, *40*(1), 27–39. http://doi.org/10.1081/JAS-120017204

Yu, O., Sheppard, L., Lumley, T., Koenig, J. Q., & Shapiro, G. G. (2000). Effects of ambient air pollution on symptoms of asthma in Seattle-area children enrolled in the CAMP study. *Environmental Health Perspectives*, *108*(12), 1209–1214.

Appendix A

National Heart Lung and Blood Institutes Asthma Action Plan



Asthma Action Plan

For: _____ Doctor: _____ Date: _____

Doctor's Phone Number _____ Hospital/Emergency Department Phone Number _____

GREEN ZONE

Doing Well

- No cough, wheeze, chest tightness, or shortness of breath during the day or night
- Can do usual activities

And, if a peak flow meter is used,

Peak flow: more than _____
(80 percent or more of my best peak flow)

My best peak flow is: _____

Take these long-term control medicines each day (include an anti-inflammatory).

Medicine	How much to take	When to take it
Before exercise	❒ _____	❒ 2 or ❒ 4 puffs _____	5 minutes before exercise

YELLOW ZONE

Asthma Is Getting Worse

- Cough, wheeze, chest tightness, or shortness of breath, or
- Waking at night due to asthma, or
- Can do some, but not all, usual activities

-Or-

Peak flow: _____ to _____
(50 to 79 percent of my best peak flow)

First

Add: quick-relief medicine—and keep taking your GREEN ZONE medicine.

_____ (short-acting beta$_2$-agonist)
❒ 2 or ❒ 4 puffs, every 20 minutes for up to 1 hour
❒ Nebulizer, once

Second

If your symptoms (and peak flow, if used) return to GREEN ZONE after 1 hour of above treatment:
❒ Continue monitoring to be sure you stay in the green zone.

-Or-

If your symptoms (and peak flow, if used) do not return to GREEN ZONE after 1 hour of above treatment:
❒ Take: _____ (short-acting beta$_2$-agonist) ❒ 2 or ❒ 4 puffs or ❒ Nebulizer
❒ Add: _____ (oral steroid) mg per day For _____ (3–10) days
❒ Call the doctor ❒ before/ ❒ within _____ hours after taking the oral steroid.

RED ZONE

Medical Alert!

- Very short of breath, or
- Quick-relief medicines have not helped, or
- Cannot do usual activities, or
- Symptoms are same or get worse after 24 hours in Yellow Zone

-Or-

Peak flow: less than _____
(50 percent of my best peak flow)

Take this medicine:

❒ _____ (short-acting beta$_2$-agonist) ❒ 4 or ❒ 6 puffs or ❒ Nebulizer

❒ _____ (oral steroid) mg

Then call your doctor NOW. Go to the hospital or call an ambulance if:
- You are still in the red zone after 15 minutes AND
- You have not reached your doctor.

DANGER SIGNS
- **Trouble walking and talking due to shortness of breath**
- **Lips or fingernails are blue**

- **Take ❒ 4 or ❒ 6 puffs of your quick-relief medicine AND**
- **Go to the hospital or call for an ambulance _____ (phone) NOW!**

See the reverse side for things you can do to avoid your asthma triggers.

Appendix B

Today's Date: _____

Patient's Name: _____

FOR PATIENTS:

Take the Asthma Control Test™ (ACT) for people 12 yrs and older.

Know your score. Share your results with your doctor.

Step 1 Write the number of each answer in the score box provided.

Step 2 Add the score boxes for your total.

Step 3 Take the test to the doctor to talk about your score.

						SCORE
1. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home?	All of the time 1	Most of the time 2	Some of the time 3	A little of the time 4	None of the time 5	
2. During the past **4 weeks**, how often have you had shortness of breath?	More than once a day 1	Once a day 2	3 to 6 times a week 3	Once or twice a week 4	Not at all 5	
3. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?	4 or more nights a week 1	2 or 3 nights a week 2	Once a week 3	Once or twice 4	Not at all 5	
4. During the past **4 weeks**, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?	3 or more times per day 1	1 or 2 times per day 2	2 or 3 times per week 3	Once a week or less 4	Not at all 5	
5. How would you rate your **asthma** control during the **past 4 weeks**?	Not controlled at all 1	Poorly controlled 2	Somewhat controlled 3	Well controlled 4	Completely controlled 5	
						TOTAL

Copyright 2002, by QualityMetric Incorporated.
Asthma Control Test is a trademark of QualityMetric Incorporated.

If your score is 19 or less, your asthma may not be controlled as well as it could be. Talk to your doctor.

FOR PHYSICIANS:

The ACT is:

- A simple, 5-question tool that is self-administered by the patient
- Clinically validated by specialist assessment and spirometry[1]
- Recognized by the National Institutes of Health

Reference: 1. Nathan RA et al. *J Allergy Clin Immunol*. 2004;113:59-65.

Appendix C

Hospital Anxiety and Depression Scale (HADS)

Tick the box beside the reply that is closest to how you have been feeling in the past week.
Don't take too long over you replies: your immediate is best.

D	A		D	A	
		I feel tense or 'wound up':			**I feel as if I am slowed down:**
	3	Most of the time	3		Nearly all the time
	2	A lot of the time	2		Very often
	1	From time to time, occasionally	1		Sometimes
	0	Not at all	0		Not at all
		I still enjoy the things I used to enjoy:			**I get a sort of frightened feeling like 'butterflies' in the stomach:**
0		Definitely as much		0	Not at all
1		Not quite so much		1	Occasionally
2		Only a little		2	Quite Often
3		Hardly at all		3	Very Often
		I get a sort of frightened feeling as if something awful is about to happen:			**I have lost interest in my appearance:**
	3	Very definitely and quite badly	3		Definitely
	2	Yes, but not too badly	2		I don't take as much care as I should
	1	A little, but it doesn't worry me	1		I may not take quite as much care
	0	Not at all	0		I take just as much care as ever
		I can laugh and see the funny side of things:			**I feel restless as I have to be on the move:**
0		As much as I always could		3	Very much indeed
1		Not quite so much now		2	Quite a lot
2		Definitely not so much now		1	Not very much
3		Not at all		0	Not at all
		Worrying thoughts go through my mind:			**I look forward with enjoyment to things:**
	3	A great deal of the time	0		As much as I ever did
	2	A lot of the time	1		Rather less than I used to
	1	From time to time, but not too often	2		Definitely less than I used to
	0	Only occasionally	3		Hardly at all
		I feel cheerful:			**I get sudden feelings of panic:**
3		Not at all		3	Very often indeed
2		Not often		2	Quite often
1		Sometimes		1	Not very often
0		Most of the time		0	Not at all
		I can sit at ease and feel relaxed:			**I can enjoy a good book or radio or TV program:**
	0	Definitely	0		Often
	1	Usually	1		Sometimes
	2	Not Often	2		Not often
	3	Not at all	3		Very seldom

Please check you have answered all the questions

Scoring:
Total score: Depression (D) _____ Anxiety (A) _____
0-7 = Normal
8-10 = Borderline abnormal (borderline case)
11-21 = Abnormal (case)

Appendix D
Comparison of Diagnostic Measures

Author	Population Brief	Diagnosis of Asthma	Anxiety	Result Brief
Vila et al. 2000	164, ages 8-15, 2 groups, one from specialty clinic in Paris & community sample for comparison.	Physician based: NHLBI guidelines.	DSM-IV	Youth with Asthma: 35% met DSM-IV criteria for an anxiety disorder, 29% for GAD, 42.5% using DSM-III criteria
Gillaspy et al. 2002	50, 2 groups of matched Job Corps participants from the US Midwest, average age 18.5.	Self-report of asthma diagnosis.	Anxiety level	Statistically significant levels of anxiety over non asthmatic peers
Goodwin et al. 2004	1053, ages 18 and 21, community sample in urban region of New Zealand.	Self-report of diagnosis, symptoms, asthma attacks & medication use.	DSM-IV	Prevalence of anxiety disorder: 17% (16-18), 12.9% (18-21) GAD, Social & specific phobia and agoraphobia
Reitveld et al. 2005	111, ages 11-16, community sample in the Netherlands	Self-report of diagnosis	DSM-IV	Both asthma group & chronic disease group had higher rates of panic attack with asthma slightly but significantly higher.
Goodwin et al. 2005	74, ages 5-11, specialty clinic, in the Bronx, NY.	Physician based: diagnosis by a pediatric pulmonologist.	Probable DSM-IV diagnosis	Probable diagnosis: GAD 4.1%, Panic 14.9%, Agoraphobia 5.4 & separation anxiety disorder 8.1%
Kean et al. 2006	200 youth under 18, in the US. Average age 14. Life Threatening Asthma (LTA), Asthma Control (AC) & No Chronic illness (NC).	Physician based: NHLBI guidelines	DSM IV	Any anxiety diagnosis: Youth: 20% LTA, 11% AC, 8% NC Caregivers: 29% LTA, 14% AC, 2% NC
Ortega et al. 2004	1,871, ages 4-17, community sample in Puerto Rico.	Parental report of either diagnosis or attack	DSM-IV	In all anxiety disorder categories, higher percentages for participants who reported an asthma attack.
Feldman et al. 2006	1,789, ages 5-18, community sample in Puerto Rico.	Parental report of either diagnosis or attack.	DSM-IV	31% of youth with asthma attack history had internalizing disorders. In both waves of the study. 24% of youth without asthma had an internalizing disorder.
Ross et al. 2007	53 youth ages 12-18, Canada.	Physician based: Medical claims data & Canadian consensus guidelines.	DSM-IV	40% met DSM-IV criteria for an anxiety disorder. PTSD 6%, GAD 23%, Social Phobia 3%, Specific phobia 6%, Separation anxiety 2%. 30%, 16%
Katon et al. 2007	781 youth aged 11–17 years with asthma and 598 similarly aged youth, Seattle, WA.	Physician based: Diagnosis, medication, and healthcare data records from HMO.	DSM-IV	Youth with asthma had almost twice the rate of DSM-IV criteria for either depressive or anxiety disorders.

Appendix E
Measures used to Assess Anxiety

Author	Measure	Recipient	Type/Administration	Environment
Vila et al. 2000	Anxiety and Fears Behavioral Scale for DSM-III	Youth	Self-report : assessed on a day when participant did not have an asthma crisis	Clinical
	Kiddie Schedule for Affective Disorders and Schizophrenia, modified for DSM-IV	Youth	Interview: experienced child psychologist trained for instrument	Clinical
Gillaspy et al. 2002	The Beck Anxiety Inventory	Youth	Self-report	Institutional
Goodwin 2004	Composite International Diagnostic Interview	Youth	Interview by trained layperson	In-home
	Study specific interview for Panic Disorder	Youth	Interview by trained layperson	In-home
Reitveld 2005	Spence Children's Anxiety Scale	Youth	Self-report	Clinical
	Spielberger State-Trait Anxiety Inventory for children.	Youth	Self-report	Clinical
Goodwin 2005	Diagnostic Interview Schedule for Children-IV: Predictive scale 5-8 with caregiver assistance 9-11 direct interview	Youth	Interview by trained psychiatric interviewer with minimum degree of associate	Clinic waiting room
Kean et al. 2006	PTSD-React ion Index for DSM-IV	Youth	Open ended self-report , coded by clinician	Clinical
	Follow up asthma related panic measure given only to youth with asthma	Youth	Open ended self-report , coded by clinician	Clinical
	Multidimensional Anxiety Scale for Children	Youth	Self-report	Clinical
Ortega et al. 2004	Diagnostic Interview Schedule for Children-IV	Youth	Interview by lay person	In-home
Feldmen et al. 2006 (wave 2)	Diagnostic Interview Schedule for Children-IV	Caregiver	Interview by lay person	In-home
Ross et al. 2007	Anxiety Disorders Interview Schedule-IV Parent Version	Caregiver	Interview by nurse trained to administer	No Info
	Anxiety Disorders Interview Schedule-IV Child Version	Youth	Interview by nurse trained to administer	No info
	State-Trait Anxiety Inventory for Children: Trait Scale	Youth	Self-report	No info
	Multidimensional Anxiety Scale for Children	Youth	Self-report	No info
Katon et al. 2007	Diagnostic Interview Schedule for Children-IV	Youth	Self-report via Telephone	Choice
	Childhood Anxiety Sensitivity Index	Youth	Self-report via Telephone	Choice
	The Mood and Feelings Questionnaire (short form)	Youth	Self-report via Telephone	Choice