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Assessing Asthma-Specific Health-Related Quality of Life in Children With an Ecological Systems Approach

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This is to certify that the doctoral dissertation by

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2018

Abstract

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by

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MPH, Texas A&M School of Public Health, 2009

BS, North Carolina Central University, 2006

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Public Health

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Abstract

Despite initiatives and management efforts to minimize exacerbation and adverse outcomes, asthma remains a leading cause of childhood chronic disease in the United States. Environmental, personal, and social factors have been associated with an increase of asthma morbidity. However, little is known about how they cumulatively affect children's quality of life. This study applied a multifactorial conceptual model grounded by the ecological systems theory framework to ascertain which environmental, personal, and social factors were cumulatively associated with adverse health-related quality of life (HRQoL) in children with asthma ages 5-17 years. A national, cross-sectional survey, the Behavioral Risk Factor Surveillance System Asthma Call-back Survey, of 2,968 (unweighted) participants were used to identify the association between the factors and HRQoL outcomes, symptom-free days, missed school, and activity limitations. Multiple linear regression and cumulative regression models for complex survey data were used to assess the associations. Factors associated with the HRQoL outcomes included cost barriers to asthma medications and primary care physicians, insurance status, having an insurance gap, the type of health insurance, the presence of mold in the school, the guardian's diminished mental health, and environmental tobacco smoke. Understanding which factors influence asthma HRQoL may foster positive social change by enlightening and empowering the child, caregivers, health care professionals, and other stakeholders to become active participants in the asthma management process. Therefore, quality of life is optimized by all participants taking an active role in the asthma management process through conversations and developing synergistic strategies.

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Dedication

I dedicate this to my best friend and sister, Lotoshea Clark. After suffering from a myocardial infarction at the age of 29 secondary to type I diabetes, she spent the next couple of years fighting to regain normalcy. Unfortunately, she lost her battle in 2012. Witnessing her journey encouraged me to persevere with completing my dissertation and to never give up despite the obstacles I face.

Acknowledgments

I cannot thank my family, especially my mother, and friends for their ongoing support throughout this process. In addition, I would like to thank my committee and committee chair, Dr. Angela Prehn, for your guidance.

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Chapter 1: Introduction to the Study

Introduction

Extensive research on childhood asthma has contributed to what is currently known about the disease and how it is treated. Although the etiology is inconclusive, multiple factors have been identified that exacerbate the disease (Briones, Lustik, & Lalone, 2010; Subbarao, Mandhane, & Sears 2009; Valerio, Andreski, Schoeni, & McGonagle, 2010). In addition, prioritizing asthma management has been the result of previous asthma research (National Asthma Education and Prevention Program Coordinating Committee, 2007). Despite the breadth of research, the effect the disease has on a child's quality of life is not fully understood. Understanding the factors affecting quality of life will inspire positive social change by encouraging children with asthma, their caregivers, and medical professionals to adhere to management strategies to avoid adverse outcomes. In addition, findings from this research can inspire health professionals to ensure that children with asthma have a unique plan of care to meet their needs. Moreover, this research will encourage dialogue between the child and all members that are involved with their asthma care.

Composed of five chapters, in this exploratory research, I focus on how asthma affects children's quality of life including school attendance, daily activities, and days they were free of symptoms. Beginning with Chapter 1, I provide an overview of the study. Within Chapter 1, the introduction of this research describes the relevance of this study and social implications. In Chapter 1, I also highlight the prevalence, morbidity and mortality indices of childhood asthma in the background. Content from the

background provides the foundation of the study's research problem. My purpose in this study details how to address the problem. Moreover, to solve the problem, I note research questions and their supporting hypotheses (i.e., the null and alternative hypotheses). I explain the theoretical framework and nature of the study that grounds this research. I describe terms and variables used throughout the study in the definitions section of this chapter. Aspects of the study that are believed but cannot be confirmed are explained in the assumptions section of the chapter. Afterwards, I describe the study's scope, delimitations, and limitations prior to concluding Chapter 1with the study's significance and the summary.

In subsequent chapters, I focus on several main elements of the research. In Chapter 2, I discuss how the conceptual framework shapes the overall study and serves as the foundation of the literature review thus identifying where the gap in research and knowledge exists. In the following chapter, I explain the design and methodology of the research in further detail. In Chapter 4, I present the results of the research, thereby answering the research questions. Concluding the study, in Chapter 5, I discuss the findings and proposed recommendations.

Background

Asthma is one of the most common chronic ailments and the leading cause of disability for children in the United States (Akinbami, 2006). Reports from the 2012 National Health Interview Survey showed that 6.8 million children (9%) in the United States have asthma (Bloom, Jones, & Freeman, 2013). Furthermore, the prevalence of childhood asthma increased by 1.4% per year between 2001 and 2010 (Moorman,

Akinbami, Bailey et al., 2012). Specifically, Moorman et al. (2012) noted the prevalence of asthma in children ages 0 to 17 years was 8.7% in 2001 and increased to 9.3% in 2010. The burden of asthma disproportionately affects boys, non-Hispanic black children, and children from socioeconomically disadvantaged families (Bloom et al., 2013; Centers for Disease Control [CDC], 2010). In addition to understanding the magnitude and disparities of asthma, it is essential to focus on other challenges surrounding the disease.

Asthma is a disease with no cure, and literature suggests the etiology is multicausal, which subsequently makes treatment difficult (Briones et al., 2010; Subbarao, Mandhane, & Sears, 2009; Valerio et al., 2010). Asthma exacerbation (acute or subacute episodes of progressively worsening shortness of breath, cough, wheezing, and chest tightness), a result of poor management, is a primary side effect of the disease (Dougherty & Fahy, 2009). More important, the exacerbation has an adverse effect on the child, which can subsequently alter various areas in their life. As a multidimensional concept that includes domains related to one's physical, mental, emotional, and social functioning, health-related quality of lie (HRQoL) is an important element to assess that reflects how the disease affects a child (CDC, 2011). HRQoL is a multidimensional concept that includes domains related to physical, mental, emotional, and social functioning (CDC, 2011). An emphasis on studying the association between asthma control and quality of life has been recommended (National Heart, Lung, and Blood Institute, 2014). However, despite the recommendation, little is known regarding if cumulative asthma symptoms, triggers, and management factors are associated with quality of life in children with asthma.

Problem Statement

Asthma research has been plentiful, resulting in a better understanding about asthma's etiology and factors associated with the disease's morbidity and mortality. Moreover, previous asthma research has primarily focused on symptom control (Shedd et al., 2007). However, children with asthma are still burdened by the disease, resulting in frequent emergency room visits and hospitalizations for them (O'Connor, Saville, Hartert, & Arnold, 2014). The frequent medical attention contributes to the $3.2 billion annual direct cost of pediatric asthma (Bhaumik et al., 2013). In addition, approximately one-third of U.S. residents have controlled asthma, a figure that could be lower for children (Gold et al., 2013). When the disease is not controlled, asthma can subsequently impair a child's quality of life as it has been found to increase symptomatic days, missed school, acute care visits, and rescue inhaler use (Carpenter et al., 2013; Dean, Calimlim, Kindermann, Khandker, & Tinkelman, 2009; Nguyen, Boulay, & Peng, 2011).

HRQoL for people with asthma has primarily been assessed in clinical and interventional studies (Cicutto, To, Murphy, 2013; Cui, Zack, Zaharan, 2015; Sullivan, Smith, Ghushchyan, Globe, Lin, & Globe, 2013). Those studies pose limitations as participants were selected from certain geographic areas (Fagnano, Bayer, Isensee, Hernandez, & Halterman, 2011; Margellos-Anast, Guitierrez, & Whitman, 2012) or affiliated with specific medical centers (Bhaumik et al., 2013; Gandhi et al., 2013; Gerald et al., 2012). The difference in the populations could result in various conclusions, which could affect treatment. Additional research has assessed the association between childhood asthma and their caregiver's HRQoL, which does not accurately reflect how

the disease affects effects the child (Takaro, Krieger, Song, Sharify, & Beaudet, 2011). However, existing literature has not fully explained how asthma affects children's HRQoL from a population perspective. Moreover, previous literature has not assessed the association between multiple factors and HRQoL simultaneously.

Purpose of the Study

My purpose in this quantitative study was to explore how the HRQoL of children with asthma was individually and cumulatively affected by environmental, personal, and social factors in a nationally representative sample. Environmental factors that I assessed included pets at home and school, mold in the home and school, and children's exposure to cigarette smoke. Personal factors consisted of the child having an asthma action plan at home and school and cost barriers to seeing a primary care physician or asthma specialist and to accessing asthma medication. Social factors that I explored included the presence of stress for the parent or guardian, the child's insurance status and type, and the presence of lapsed health insurance.

Research Questions

In this study, I answered the following three overarching questions:

Research Question 1: Which personal factors are associated with asthma HRQoL?

Research Question 1a: Which personal factors of a child are associated with asthma HRQoL, as measured by the number of symptom-free days?

$H_0$1a: No personal factors are associated with symptom-free days in children with asthma.

H_a1a: One or more personal factors are associated with symptom-free days in children with asthma.

Research Question 1b: Which personal factors of a child are associated with asthma HRQoL as measured by activity limitations?

$H_0$1b: No personal factors are associated with activity limitations for children with asthma.

H_a1b: One or more personal factors are associated with activity limitations for children with asthma.

Research Question 1c: Which personal factors of a child are associated with asthma HRQoL as measured by the number of missed school days?

$H_0$1c: No personal factors are associated with missed school for children with asthma.

H_a1c: One or more personal factors are associated with missed school for children with asthma.

Research Question 2: Which environmental factors are associated with asthma HRQoL in children, as measured by the number of symptom-free days?

$H_0$2a: No environmental factors are associated with asthma HRQoL in children as measured by the number of symptom-free days in children with asthma.

H_a2a: One or more environmental factors are associated with symptom-free days in children with asthma.

Research Question 2b: Which environmental factors are associated with asthma HRQoL in children, as measured by activity limitations?

$H_0$2b: No environmental factors are associated with activity limitations for children with asthma.

H_a2b: One or more environmental factors are associated with activity limitations for children with asthma.

Research Question 2c: Which environmental factors are associated with asthma HRQoL in children, as measured by the number of missed school days?

$H_0$2c: No environmental factors are associated with missed school for children with asthma.

H_a2c: One or more environmental factors are associated with missed school for children with asthma.

Research Question 3: Which social factors are associated with asthma HRQoL?

Research Question 3a: Which social factors are associated with asthma HRQoL in children, as measured by the number of symptom-free days?

$H_0$3a: No social factors, as measured by adult perceived stress, insurance status and type, and socioeconomic status are associated with symptom-free days in children with asthma.

H_a3a: One or more social factors are associated with symptom-free days in children with asthma.

Research Question 3b: Which social factors are associated with asthma HRQoL in children, as measured by activity limitations?

$H_0$3b: No social factors are associated with activity limitations for children with asthma.

H_a3b: One or more social factors are associated with activity limitations for children with asthma.

Research Question 3c: Which social factors are associated with asthma HRQoL in children, as measured by the number of missed school days?

$H_0$3c: No social factors are associated with missed school for children with asthma.

H_a3c: One or more social factors are associated with missed school for children with asthma.

Conceptual Framework

A conceptual model grounded by Brofenbrenner's ecological systems theory (EST) framework was used for these analyses. The model conceptualizes a child's HRQoL as they develop. Moreover, the EST depicts how asthma exacerbation triggers and management strategies children encounter influences their quality of life. Given that HRQoL is associated with various factors, the EST was ideal to use because the systems it is composed of reflected where the children engaged in those factors. The EST is composed of layers including the microsystem, mesosystem, exosystem, macrosystem, and chronosystem that extend outward from the individual (Brofenbrenner, 1979).

The *microsystem* is defined as a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics (Brofenbrenner, 1979). A child's microsystem would consist of their home and school (Brofenbrenner, 1994). Extending outward is the *mesosystem*, which involves interrelations among two or more microsystems in which the developing person actively participates (Brofenbrenner, 1979). For example, asthma management strategies used while the child is at home could be reinforced while the child is at school, thus the joining of the two microsystems. The next setting in which the child interacts with is the exosystem. The *exosystem* refers to one or more settings that do not involve the developing person as an active participant, but in which events occur that affect, or are affected by, what happens in the setting containing the developing person (Brofenbrenner, 1979). An exosystem could consist of medical settings or their parent's workplace. The final setting is the *macrosystem*, which refers to consistencies regarding functionality in lower-order systems (micro-, meso-, and exo-) that exist, or could exist, at the level of the subculture or the culture as a whole, along with any belief systems or ideology underlying such consistencies (Brofenbrenner, 1979). The macrosystem can be complex as many factors are intertwined. Those factors could include such things as the child's socioeconomic status, cultural or ethnic values, or the government's influence, all of which can have a negative or positive affect on the child and can ultimately increase or diminish asthma exacerbation (Brofenbrenner, 1979).

The first four levels of the EST apply directly in this study. Asthma triggers that I studied included those observed in the child's microsystem. The relationship between a

child's school and doctor is a representation of the interaction between HRQoL and the mesosystem because asthma action plans obtained from the physician should be on file at the child's school. As a confounding factor of this study, a child's socioeconomic status is a representation of their exosystem. An interaction between a child's macrosystem and HRQoL is represented by whether a child takes his or her prescribed medication, which can be influenced by his or her beliefs. The chronosystem was not studied. As a cross-sectional study, this research does not follow up with children through time to assess any changes that can influence their HRQoL, which would be reflected in their chronosystem. Further explanation of this framework is described in Chapter 2.

Nature of Study

This study was a quantitative, cross-sectional design. The decision for the specified design is because my research explores how various factors effects HRQoL, which reflects the premise of a cross-sectional study, measuring the exposure and outcome simultaneously. Independent variables of the study consist of factors grouped as environmental, personal or social. These variables are studied to understand their effect on HRQoL outcomes including symptom-free days, missed school, and activity limitations. Covariate variables assessed in this study included the child's gender, age, and race/ethnicity.

Definitions

Terms and abbreviations found throughout the research are listed and defined:

Activity limitation. A long-term reduction in a person's capacity to the usual kind or amount of activities associated with age group as a result of a chronic condition (Akinbami, Moorman, & Liu, 2011).

Asthma. A chronic lung disease that inflames and narrows the airways resulting in wheezing, chest tightness, shortness of breath, and coughing (National Heart, Lung, and Blood Institute, 2014).

Asthma action plan. Instructions both for daily actions to keep asthma controlled and for actions to adjust treatment when symptoms or exacerbations occur (National Asthma Education and Prevention Program Coordinating Committee, 2007).

Asthma Call Back Survey (ACBS). Survey that captures information pertaining to the health and experiences of persons with asthma and provides data at the state and local level (CDC, 2014).

Asthma diagnosis. A diagnosis is based on medical and family history, a physical exam, and test results including a spirometry (Kim & Mazza, 2011; National Heart, Lung, and Blood Institute, 2014).

Asthma exacerbation. Acute or subacute episodes of progressively worsening shortness of breath, coughing, wheezing, and chest tightness or any combination thereof (Carlos, Rachekefsky, Schatz, 2009; Dougherty & Fahy, 2009).

Behavior Risk Factor Surveillance System (BRFSS). Health survey that collects state data about U.S. residents regarding their health-related risk

behaviors and events, chronic health conditions, and use of preventive services (CDC, 2013).

Environmental Tobacco Smoke (ETS). The combination of "side-stream" smoke given off by a burning tobacco product and "mainstream" smoke exhaled by the smoker (U.S. Department of Health and Human Services, 2006).

Health-Related Quality of Life (HRQoL). Multidimensional concept that includes domains related to physical, mental, emotional, and social functioning (CDC, 2011; Cui et al., 2015).

Symptom-free. No coughing, wheezing, or other symptoms of asthma. (CDC, 2015).

Assumptions

I made several assumptions in this study. Primary assumptions pertain to the administration of the survey. First, I assumed that this was a generalizable study because the prevalence of conditions obtained from the BRFSS ACBS has been found to be comparable to others (Shen & Oraka, 2012). In addition, the CDC noted that despite many households without telephones, estimates of characteristics for the total population are unlikely to be affected (CDC, 2012). I also assumed that that participants answered the questions truthfully. I made this assumption because participants are reassured their personal information remains confidential, and some identifiers obtained during the interview are not released in the public data files (CDC, 2012). An additional assumption pertained to data integrity. For instance, I assumed that information provided was

accurate for the child. I assumed this because the parent or guardian is the data source, responding on the child's behalf.

Scope and Delimitations

Data that I used were those that were collected between 2012 and 2014. A 3-year period ensured an adequate sample size by increasing the number of completed surveys. Also, permitting the use of data collected from both cell and landline phones could increase the sample size as telephone surveys have been found to have low coverage rates (CDC, 2012). Eligible participants of this research were school-age children between the ages of 5 and 17 years whose parent or guardian completed the BRFSS. Children between these ages are chosen because those younger are known to have confounding respiratory conditions, which makes it difficult to establish an asthma diagnosis (Hartman & O'Connor, 2009; NHLBI, 2007). Parents or guardians with a completed BRFSS survey are integral to collecting information on the child's behalf. For instance, socioeconomic factors collected for the adult are acceptable to be used as a proxy for their child (Flores et al., 2009). Overall, these delimitations make this study more likely to be generalized to similar populations.

Aside from delimitations regarding the population chosen, another involves the methodology. For instance, literature outside of the United States and Canada was omitted from being reviewed. The decision to limit prior studies to those two areas ensued from the likelihood of similar asthma outcomes and management practices (Rowe, Bota, Clark, & Camargo, 2007; Myers, 2008). In addition, current literature within the last 10 years was used. A narrowed study period captured updated asthma

practices as they aligned with current standards. This time frame was also relevant as asthma HRQoL for children is a newer study interest.

Limitations

Limitations of a study are inevitable despite measures taken. Caveats of this research were primarily due to the study's design and the survey instrument that was used. The study's design was cross-sectional, which could be advantageous for describing participants and the magnitude and distribution of the disease and for the use of secondary data, BRFSS ACBS, which was used in this study. BRFSS ACBS was chosen as it was administered nationally, and it would have been impossible for this study to collect or obtain data at this level otherwise. In addition, the survey collected a child's information pertinent to exposure and disease history simultaneously, which was a benefit of a cross-sectional study. Despite the benefits of the study's design and data source, limitations were still possible.

Cross-sectional designs are limited in nature for several reasons. First, it is unknown whether the disease or exposure came first, which further complicates studying childhood asthma given that it is multiclausal (Shen & Oraka, 2012). Understanding the exposure-disease temporality could be integral in improving quality of life of a child with asthma. The inability to provide an explanation of the findings in a cross-sectional study is also a limitation of its use (Mann, 2003). Another limitation of this study design is that disease etiology cannot be ascertained (Mann, 2003). This is unfortunate because the cause of asthma is unknown, but determining a cause would be a paramount discovery. Nonetheless, acquiring some information on the disease is still beneficial.

The ACBS is a newer component of the BRFSS survey that was implemented in 2006 (Winer, Qin, Harrington, Moorman, & Zahran, 2012). Administering this survey is costly and optional, so some states have opted out of conducting it or limited it to only adults (CDC, 2012). Moreover, the cost could be a reason why it has been slowly implemented. Therefore, the results are only generalizable to children in participating states (Shen & Oraka, 2012). Since 2006, more states participated in conducting the surveys, increasing from 25 areas during that year to 41 in 2013 (CDC, 2015). However, although states may have included the asthma module for children, data are not always included in the public dataset (CDC, 2015). Consequently, this limits the number of participants. Despite the limitation, aggregating data for multiple years ensures an adequate sample size, which has been done in previous literature (Zahran, Bailey, Qin, & Moorman, 2014).

Another limitation with the BRFSS ACBS is that it can be administered at various times during a year, which could lead to information bias (CDC, 2012). For instance, asthma worsens during certain seasons and a respondent may remember a child's asthma attack if the survey was administered at another point. A similar scenario applies to adult's responses to the BRFSS survey. For example, an individual may be more likely to remember specific details if the problem recently occurred. Although it is unlikely to avoid these potential occurrences, a stringent and consistent data collection methodology helps to minimize these types of biases. An additional issue of recall bias is that the information provided by the adult is a proxy for the child (CDC, 2013). As a result, this could pose a concern for data accuracy.

Another potential form of bias is similar to that of loss to follow up. BRFSS and ACBS are not conducted simultaneously. The BRFSS survey is conducted first followed by the ACBS if the person is eligible. The ACBS is administered by the respective state within approximately 2 weeks after the BRFSS survey (Winer, Qin, Harrington, Moorman, & Zahran, 2012). Therefore, the delay in conducting the ACBS may result in the person not being available. However, study staff make several attempts to contact the participant before they are considered lost to follow-up (CDC, 2013). Response rates for the ACBS vary across states. In 2012, total weighted ACBS response rates for participating states that had more than 75 records (i.e., median completion, cooperation, refusal, and The Council of American Survey Research Organization [CASRO] rates) for child landline and cell phone surveys were 88.2%, 52.3%, 40.5%, and 44.3% respectively (CDC, 2014). For 2013, all response rates increased (CDC, 2015). For instance, the median completion, cooperation, and CASRO rates were 93.9%, 55.0%, and 44.6%, respectively, for participating states that had more than 75 records (CDC, 2015). Similar response rates to those in 2013 were observed for the survey administered in 2014. Median completion, cooperation, and CASRO rates for 2014 were 92.39%, 57.10%, 45.94 (CDC,2016). The median refusal rate for 2013 and 2014 were favorable compared to that in 2012 in which a decrease to 35.4% 34.5%, respectively, was observed.

Literature has shown that the BRFSS survey administered by landline phones compared to those conducted via cellular phones have a low response rate (Gundersen, ZuWallack, Dayton, Echeverria, & Delnevo, 2014; Qayad et al., 2013). This is a reflection of response rates for 2012 and 2013 in which those for landlines were higher

than the combined data including landline and cellular phones (CDC 2014, 2015). For instance, weighted median responses for 2012 landline surveys were 96.2%, 56.5%, 32.2%, and 46.0 respectively. Similarly, median response rates in 2013 for landline surveys were 96.3%, 56.5%, 33.8%, and 45.0%, respectively. Similar results identified between 2012 and 2013 were observed in 2014 with the exception of completion rate in which it dropped to 92.4% (CDC, 2016). In general, the response rates for the ACBS align with those found in previous research for the BRFSS surveys (Gundersen, ZuWallack, Dayton, Echeverria, & Delnevo, 2014; Qayad et al., 2013).

Significance

Dramatic improvements to asthma management have been made through the years. However, the fact that asthma remains a leading chronic disease in children shows that more work is necessary (Akinbami, 2006; Valerio et al., 2010). Asthma should not be a barrier to a positive quality of life for children. Asthma and acute repercussions of the disease when it's exacerbated can have lasting consequences on the child, their family and communities. Those adverse outcomes are known to interfere with children's daily activities (Moonie, Sterling, Figgs, & Castro, 2006; Stevens, Pickering, & Laqui, 2010), pose barriers on families (Flores et al., 2009), and financially burden health care systems (Barnett & Nurmagambetov, 2011). Therefore this study is essential in broadening the knowledge base of childhood asthma. Assessing the association between HRQoL of children with asthma and environmental, personal and social factors not only benefits the child but also their support team, including family, health professionals, and teachers.

Results of this study may improve asthma treatment by incorporating the child's network (i.e., family, school, and health care professional) into management plans and equipping them with the knowledge necessary to minimize asthma morbidities that subsequently affect HRQoL. Moreover, previous studies have not analyzed how factors associated with a child's school affects HRQoL (Permaul et al., 2012). In addition, current measures can be enhanced with the results from this study. For instance, factors to affect asthma-related HRQoL that may not have been explored in previous research may be identified in this study.

Summary

Asthma is a leading chronic condition in children. Extensive research has provided the basis of childhood asthma's etiology, pathophysiology, and epidemiology. However, a lack of studies exist regarding asthma HRQoL conducted from a large population perspective. This study focuses on environmental, personal and social factors and their association with asthma HRQoL for children. Assessing the association between the factors and HRQoL is necessary to reduce the burden asthma has on children, their families and communities.

In Chapter 1, I provided the context of this research and how it adds to existing bodies of knowledge. Moreover, the background of the study, problem statement and the purpose of the study were explained in this chapter. In addition, I discussed the assumptions, scope and delimitations, and limitations in this chapter. In Chapter 1, I concluded with the significance of this study and the implications it has for positive social change. In Chapter 2, I present the review of the literature, which supports the

research topic by identifying the existing gap. I also provide a comprehensive basis of the theoretical foundation and a review of the study's methodology.

Chapter 2: Literature Review

Introduction

In 2009, childhood asthma prevalence in the United States was 9.6%, or approximately 7 million children aged 0 to 17 years old, who were living with the disease (Akinbami et al., 2011). An increase was observed between 2001 and 2009 in which the prevalence rose from 8.7% to 9.6% (CDC, 2011). Although a statistically significant difference in the prevalence of asthma was observed between 2012 and 2013 (i.e., 9.3% in 2012 versus 8.3% in 2013), the overall prevalence of asthma has plateaued (Akinbami, Simon, & Rossen, 2016). Asthma prevalence varies across genders, geographical locations, age, and race/ethnicities, which is constantly reflected in literature. For instance, the northeastern region of the country was found to have higher rates than other regions (Akinbami, 2006). Akinbami (2006) found that boys were also reported to have a higher prevalence (11.3%) rates than girls (7.9%), which has also been observed elsewhere (Ahmad et al., 2009; Lin, Kielb, Chen, & Hwang, 2005; Nicholas et al., 2005; Shalowitz, Sadowski, Kumar, Weiss, & Shannon, 2007). In addition, non-Hispanic Black, Hispanic, and Puerto Rican children have been found to have higher asthma prevalence than others (Akinbami, 2006; McDaniel, Paxson. & Waldfogel, 2006; Moorman et al., 2012; Shalowitz, Sadowski, Kumar, Weiss, & Shannon, 2007). This has further been observed in national data in which the prevalence increased from 11.4% to 17.0% in non-Hispanic black children (CDC, 2011). The increase of asthma prevalence and the disproportionate effect on certain groups is further reason why the child's quality of life should be explored.

Despite what is known about who is affected by childhood asthma, sparse literature is available to explain how the disease influence children's lives nationally. Research that has focused on asthma HRQoL does not exist outside of clinical studies for children; population-level data are not readily available. This gap in the literature supported my purpose in this study, to explore the association between HRQoL for children with asthma and environmental, personal and social factors. In doing so, additional knowledge could be added to the current body of literature that exists, which may improve childhood asthma management and outcomes.

In Chapter 2, I review the literature that was identified and synthesized pertaining to factors associated with asthma HRQoL. Divided into five sections, the chapter begins with a synopsis of current literature thus identifying the gap and need for research. To identify relevant articles, the second section details the process. Following the methods is the review of literature that was identified, which is categorized by the factors that exacerbate asthma including environmental conditions, personal risk factors and social constraints. Chapter 2 ends with a summary and transitions to the following chapter.

Literature Search Strategy

The systematic review allowed for an exhaustive search of the literature about childhood asthma HRQoL. Overall, the review identified what previous studies had been conducted and supported the reason for my research. The process consisted of multiple steps including a database search, establishment of an inclusion and exclusion criteria, and data extraction. I explain each section in further detail.

Database Search

I applied two methods to identify journal articles in the literature review. First, I obtained articles using keywords in Academic Search Complete, CINAHL Plus with Full Text, and MEDLINE with Full Text all via EBSCOhost. Keywords for each database included *asthma* AND *quality of life* AND child; *asthma* AND *health related quality of life* AND *child*; *childhood asthma* AND *missed school; asthma* AND *child* AND *activity limitation; asthma* AND *child* AND *symptoms; asthma* AND *child* AND *sleep; asthma* AND *asthma action plan; asthma* AND *child* AND *quality of life* AND *environment; asthma* AND *mold; asthma* AND *child* AND *cigarette smoke; asthma* AND *child* AND *pets; asthma* AND *child* AND insurance*; Asthma Call-back Survey*; *Ecological Systems Theory* AND *asthma.* A second method applied to identify articles was through cited reference searching, the process of locating current research based on earlier research by following a particular cited reference, or cited author, forward in time to find more current articles that have also cited that author or work (Ithaca College Library, n.d.).

Inclusion/Exclusion Criteria

I applied a predefined criterion upon reviewing an article. Each article must have been peer-reviewed, research conducted in North America, and published in the English language. A publication date between 2010 and 2018 was ideal, but I included older literature due to the narrowed research topic and stringent inclusion criteria. Articles were eliminated if they included: results for other illnesses or chronic conditions in addition to asthma such as seasonal colds, respiratory infections or cystic fibrosis; reported results based on genetic components of asthma; solely discussed asthma

morbidity in adults; systematic literature reviews; and assessed specific drug interactions with asthma.

Data Extraction

I classified articles into three overarching themes for organizational purposes. The three themes included environment, personal, and social factors. Within each theme, independent variables explored in this study. Upon the identification of a relevant article, key components were identified and documented in a matrix for each category. Data obtained from the articles consisted of the study's objective, study population, methodology, type of study (e.g., cross-sectional, cohort, case control), major findings from the study, strengths and limitations, and recommendations. Where applicable, strengths, limitations and/or recommendations were inferred when author(s) failed to note them.

Ecological Systems Theory

A conceptual model grounded by Brofenbrenner's EST serves as the construct of my research. A conceptual model was chosen because it can stand in for formal theories to provide an inventory of concepts, relations, and propositions that can be linked to data (Linder & Sexton, 2011). In addition, Linder and Sexton (2011) suggested that in the grand scheme of theoretical frameworks, this construct can model and estimate cumulative health risks, which supports the basis of my research. The EST provides the framework to show the interaction of the concepts. For example, starting at the individual level and extending outward, the EST is composed of different settings in which individuals exist including the micro, meso, exo, and macro systems

(Brofenbrenner, 1979). Furthermore, those interactions have been shown to influence asthma outcomes in previous conceptual models.

Brofenbrenner (1979) described microsystems as patterns of activities, roles, and interpersonal relations experienced by the developing person in a given setting with particular physical and material characteristics. Specifically, a child's microsystem could consist of interactions within their home and school. Various conceptual models have illustrated how familial interactions can affect childhood asthma. For example, family-centered management strategies can reduce asthma exacerbation (Zimmerman, Bonner, Evans, & Mellins, 1999). In addition to asthma management within a child's home, a different conceptual model provided a discrete simulation of exposure to household risk factors and found a high incidence of asthma episodes and severe asthma events in children with decreased lung function (Fabian et al., 2012). In this study factors assessed at the microsystem for a child with asthma include home ownership, the guardian's marital status, exposure to pets and mold at home and school, and contact with secondhand smoke. The effect of these factors on the child's microsystem can subsequently affect their quality of life in a positive or negative way.

Schools are also considered to be in a child's microsystem and integral to their quality of life primarily as a source for the child to access resources that help control their asthma (Cicutto, To, & Murphy, 2013). Furthermore, schools have primarily been the only other location to implement asthma management strategies besides the home. Schools are advantageous for asthma education programs because they are equipped with

resources to support health education programs and are an ideal setting for children to practice self-management skills (Cicutto, To, & Murphy, 2013; Clark et al., 2009).

Mesosystems of the EST are interrelations among two or more microsystems in which the person actively participates. In a conceptual model that assessed how family support affected asthma outcomes determined negative perceptions about medication use and the health care provider was reduced with family support (Rhee, Belyea, Brasch, 2010). This example shows how a child with asthma quality of life is affected by the interaction of their two microsystems, home and doctor's office. A separate model that also found similar results explained how a high-quality relationship between the parent and provider can result in better medication compliance (Sidora-Arcoleo, Feldman, Serebrisky, Spray, 2012).

Contrary to the first two systems that directly involve the child, *exosystems* refers to one or more settings that do not involve the person as an active participant. However, the individual is affected by the events that occur in those settings. As seen in some conceptual models, direct actions are not necessary for subsequent effects on a child's asthma condition. For example, an asthma intervention implemented at the state level can be adopted by schools to improve asthma outcomes such as better asthma control among the child, improved quality of life for the child and parent, and a better environment within the school (Hester et al., 2013). In another study, also focused on interventions, a conceptual model was proposed to improve asthma control in inner city children with the use of community asthma coalitions (Herman, 2010). As opposed to developing interventions, conceptual models have also been used to improve health care

practices. For instance, a tree model was developed from a retrospective study of children with asthma to predict the severity of asthma exacerbations at the time of ER visits (Farion, Michalowski, Wilk, O'Sullivan, & Matwin, 2010). The results from that study can aide medical staff adopting standards guidelines on treating patients with asthma in the ED.

The last of component of the EST, macrosystems are the consistencies regarding functionality in lower-order systems that exist or could exist at the level of the subculture or the culture as a whole, along with any belief systems or ideology underlying such consistencies. This part of the system can be complex as many factors are intertwined. Factors can include one's socioeconomic status, cultural or ethnic values, or the government's influence (Brofenbrenner, 1979). As seen in one study, a community health worker intervention model was found to be effective in improving asthma control for children when a worker was recruited from the community (Margellos-Anast, Gutierrez, & Whitman, 2012). It was found that the community health worker was well-received by the family as they were familiar with the community. This shows that asthma management extends beyond the individual level, including one's own beliefs.

Ecological Systems Theory has been highly applied in previous research for childhood asthma. The systems that this theory encompasses make it appropriate for this study. Unlike other theories or health models used in public health that address one aspect of a disease such as one's beliefs or behavior, this model takes into consideration several components. For instance, as the micro, meso, exo and macro systems shape a child's life, so do the various factors of asthma. Moreover, the environmental, personal

and social factors that were explored in this study could be classified into one of the systems and can ultimately have an effect on a child with asthma quality of life

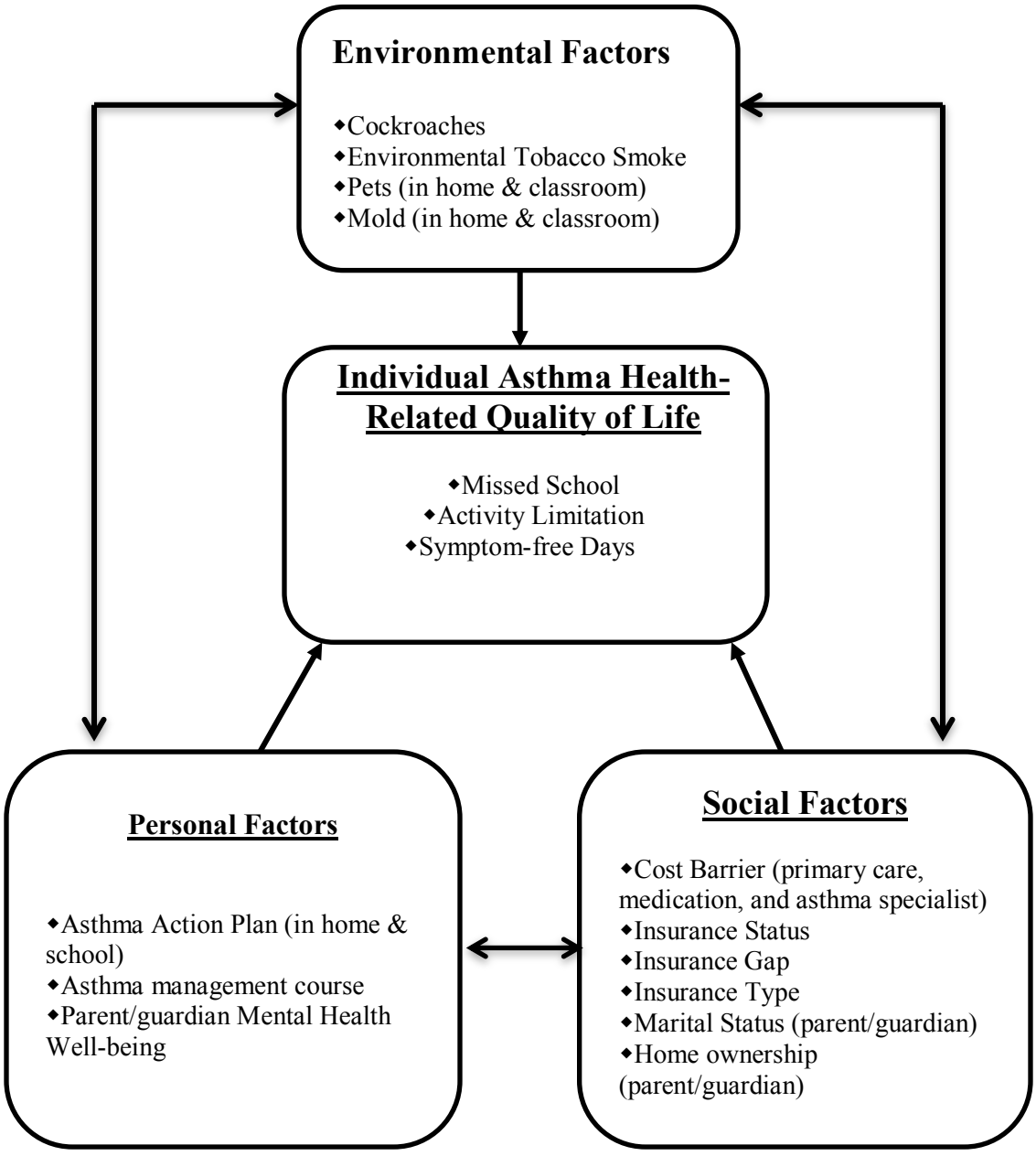

Figure 1. Application of ecological systems theory for childhood asthma HRQoL.

Asthma Burden on Health-Related Quality of Life

Understanding the interaction between asthma and HRQoL provides insight from the individual's perspective about the effect of the disease and treatment on health-related function and well-being (Sullivan et al., 2013). Adverse HRQoL has been found to be associated with poorly controlled asthma (Dean et al., 2010; Guilbert et al., 2011). For instance, in a national internet study, Dean et al. (2010), found that children aged 6 to 12 years old surveyed with uncontrolled asthma had significantly worse HRQoL for: (1) role/social limitations-emotional/behavioral; (2) role/social limitations-physical, bodily pain/discomfort; (3) behavior; (4) mental health; and (5) self-esteem, when compared to children with controlled asthma. In addition, increased HRQoL has been observed to decrease costs of health care utilization (Wade & Guo, 2010).

Assessing HRQoL for children with asthma can be subjective and previous literature has demonstrated the use of different metrics to analyze the association. For example, in a multifaceted, school-based asthma program, physical, emotional, and social impairments experienced by children with asthma were measured to assess their quality of life (Cicutto, To, & Murphy, 2013). However, the affect asthma has on quality of life was assessed by asthma-related visits to the ED, visits to a physician, missed days of school, rescue inhaler use, and symptom-free days in another study (Nguyen, Boulay, & Peng, 2011). These various measurements demonstrate the lack of standardization in assessing asthma HRQoL in children. Accordingly, this study could serve as the foundation of standardizing how asthma HRQoL is measured in a national sample.

HRQoL Outcomes

Missed School

Assessing the affect asthma has on school attendance is a common measure in asthma research and is well defined (Akinbami et al., 2011). Previous research has shown that children with asthma miss more school than those without the disease (Moonie et al., 2006; Stevens, Pickering, & Laqui, 2010). In 2008, approximately 14.4 million lost school days for children were contributed by asthma (American Lung Association, 2012). Moreover, children 5-17 years old that reported having at least one asthma attack in the previous year missed 10.5 million school days in the past year (Akinbami et al., 2011). Stevens et al. (2010) observed in the 2007 National Survey of Children's Health (NSCH) that children with asthma repeat grades more than children without the disease, which further confirms that missing school effects the child's performance in school. Overall, missed school can effect one's quality of life by resulting in reduced academic performance, a disruption in the learning process, and subsequently contribute to achievement gaps (Bach, 2011).

The severity of one's asthma condition has been shown to be an important factor of school absenteeism (Moonie et al., 2006; Dean et al., 2009; Flores et al., 2009; Wu, Cabana, Hilton, Ly, 2011; Dean et al., 2010; Hsu, Qin, Beavers, Mirabelli, 2016). For instance, Moonie et al. (2006) discovered that children from a predominantly African American school in St. Louis, Missouri with asthma severity greater than mild intermittent were absent on average 4.3 days per school year more than students without asthma. Similarly, Dean et al. (2009) found that a median of six school days per school

year were missed in children aged 6-12 years with uncontrolled asthma, as opposed to four missed days in children with controlled asthma. Flores et al. (2009) reported similar numbers of missed school days in children with asthma aged 2-18 years they studied from a Milwaukee, Wisconsin children's hospital. The increased number of missed school days in the Flores study could be due to the fact that students had an average of two asthma attacks and twelve daytime and night time symptoms in the past month. Although Wu et al. (2011) did not quantify the number of days, it was still determined that asthma severity was statistically associated with missed school days in the past year for children they studied in the Hawaiian BRFSS ACBS. Similar to Wu et al. (2011), Hsu et al. (2016) also used the BRFSS ACBS to assess school absenteeism, but of all children participating in the survey (i.e., respondents of 35 participating states and territories). Hsu et al. (2016) found that children who missed at least one day of school because of asthma were more likely to have at least one asthma attack, sought acute or emergency care for asthma symptoms and were hospitalized for asthma compared to children with asthma that had not missed school.

Overall, previous research supports that asthma has an effect on school attendance and why it should be a measure of HRQoL in children. However, with the exception of Hsu et al. (2016) study, these study populations only focus on specific groups, thus limiting their results and further supporting the need for additional analysis. For instance, although Stevens' et al. (2010) study used data from a national study, the survey was only administered for one year and the response rate was less than 50%. Therefore, the results are limited and do not fully assess how asthma affects school attendance. Similar to

Stevens et al. (2010), Moonie et al. (2006) administered a United States-based survey, but of adult Internet users that were guardians of children with asthma. Unfortunately, that study would not capture data from individuals not listed in the registry of users therefore making the results less generalizable (Moonie et al., 2006). Wu et al. (2011) study would be similar to this study, but instead of using the BRFSS ACBS that includes all participating states and territories, their study only used the survey administered in Hawaii. Hsu et al. (2016) study is the only one that is comparable to this study. However, their study population only consisted of those that were contacted via a landline phone (Hsu, Qin, Beavers, Mirabelli, 2016). My study incorporates both landline and cell phones.

In addition to differences in populations studied in prior research, asthma severity was studied as a sole contributing factor (Moonie et al., 2006; Dean et al., 2009; Wu, Cabana, Hilton, Ly, 2011; Dean et al., 2010). Asthma severity can be influenced by several factors, so it is imperative to know the interactions they have. As a result, my study goes beyond the assessment of asthma severity to look at combinations of factors and their effects on HRQoL.

Activity Limitations

Activity limitations are also a measure of HRQoL. Similar to other outcomes, activity limitations on exercising, running, and walking have been observed to be common in children with asthma and also among children in which the disease is uncontrolled (Tsai, Ward, Lentz, & Kieckhefer, 2012; Dean et al., 2010; Maier, Arrighi, Morray, Llewllyn, & Redding, 1998). In addition, activity limitations have improved in

prior studies as a result of an intervention (Takaro et al., 2011). For instance, Takaro et al. (2011) found that for children living in the Breathe-Easy Homes (i.e., housing units modified to reduce asthma exacerbation), activity limitations improved after a year of living in the home. Takaro et al. (2011) findings would need to be corroborated in other communities for them to be generalizable.

Only one study identified was conducted on a national level that assessed asthma and activity limitations (Cui et al., 2015). Unlike the studies that showed an association between asthma management and activity limitations, Cui et al. (2015) concluded in their study of adolescents aged 12-17 years that the HRQoL measure was not statistically different between the asthma status groups (i.e., no asthma, asthma without symptoms and asthma with symptoms). Although Cui et al. (2015) study is similar to mine, the difference between them is the fact that their study was administered directly to the child as opposed to the parent/guardian. It could be argued that a parent may have the ability to account for some of their child's asthma symptoms (Decker, Meyer, Littlefield, &Thompson, 2008; Wittich, Li, Gerald, 2006). Overall, unlike previous research that focused on associations between asthma control and activity limitations, my study will specifically address activity limitations in children with asthma despite their control status. The significance of a broader assessment that includes other factors is because conflicting results have been apparent as observed between Cui et al. (2015) and Takaro et al. (2011) studies with regards to whether activity limitations are associated with asthma management. Therefore, it could be assumed that asthma control is not the only issue that affects activity limitations in children with asthma.

Symptom-Free Days

Asthma symptom-free days is a measure of quality of life as symptoms such as coughing, wheezing, and shortness of breath are assessed (Takaro et al., 2011; Dean et al., 2010). However, symptom-free days have been measured in various ways in previous research. In addition, the findings of those studies have been inconsistent. For instance, instead of researching symptom-free days as a HRQoL outcome, Dean et al. (2011) used the factor to group their study population's asthma severity while other outcomes grouped as psychosocial and physical factors were the outcomes of interest. Dean et al. (2010) found that children with uncontrolled asthma fared worse body pain/discomfort, self-esteem, mental health and physical and emotional social limitations than children with controlled asthma. The findings of Dean et al. (2010) study could pose limitations as they even noted that definitions of asthma severity are not consistently used. Therefore, it may be necessary to research HRQoL in a broader context. Similar to my study, symptom-free days have been an outcome of interest for HRQoL in children with asthma. In a separate study focusing on an asthma communication intervention for inner-city children aged 6-12 years in Baltimore, Maryland, it was found that in-home educational intervention provided by a health care provider did not decrease symptom days (Butz et al., 2010). These results could have been based on the fact that the intervention was geared towards the caregiver instead of the child (Butz et al., 2010). This idea is supported by an earlier study with the same intervention where there was a discrepancy in the information parents reported for their children, in which 63% of parents reported activity limitations for their child, but only 30% of the parents stated that

their child's asthma was not controlled (Butz, Walker, Land & Vibbert, 2007). Conversely, Takaro et al. (2011) observed in their interventional study of a similar population that living in the asthma-friendly home improved children with asthma symptom-free days. Moreover Takaro et al. (2011) concluded that during a previous two-week time frame, children living in the new home saw an increase in symptom-free days of 12.4 versus an average of 8.6 in their old home. The fact that these studies methodologies were different could explain the conflicting results (Butz et al., 2010; Butz et al., 2007; Takaro et al., 2011). Moreover, it is indicative that further analysis is necessary to assess symptom-free days as an asthma-specific HRQoL outcome in children with asthma as there could be various factors that are not considered in existing literature.

Environmental Factors and HRQoL

The environment is a broad term that encompasses multiple factors that can affect health (WHO, 2006). Furthermore, quantifying the amount of time spent in a particular environment can be challenging or almost impossible with humans, especially children, who spend time in numerous places for various amounts of time. A primary example of this point is how children spend a considerable amount of time at home, school, or other places for extended childcare or extracurricular activities. Places children spend their time, including inside and outside, exposes them to asthma triggers and can subsequently exacerbate the disease (Jayawardene, YoussefAgha, Lohrmann, El Afandi, 2013). Literature has linked exposures to roaches, pets, dust mites, exposure to secondhand smoke, mold, and poor ventilation to adverse asthma outcomes (NCBI, 2011; Lamb,

Ervice, Lorensen, Prentice, & White, 2011; Subbarao, Mandhane, & Sears, 2009; Environmental Protection Agency (EPA), 2012).

Although the literature has supported which environmental factors exacerbates asthma conditions, previous literature is limited on how the environment is associated with asthma-specific HRQoL (Shedd et al., 2007). An intervention study including low-income, middle school-age children from Detroit, Michigan determined that neither of the educational programs (i.e. Open Airways curriculum only and Open Airways curriculum with peer education) improved participants' symptoms or quality of life at two different time periods, twelve and twenty-four months, respectively (Clark, Shah, & Little, 2010). A different study of low-income children 4-17 years old in Boston, MA enrolled in the Healthy Public Housing Initiative intervention found that participants' respiratory symptoms were associated with asthma-related quality of life (Levy et al., 2004). Despite the differences in the results of Levy et al. (2004) and Clark et al., (2010) studies, the findings would not be generalizable to other populations as both focused on low-income populations, they had small sample sizes, and were conducted in different areas of the United States. The limitations of the existing literature illustrate why my study is necessary. Furthermore, my study will expand the existing literature pertinent to the association between environmental factors and asthma-specific HRQoL in a national population.

Cigarette Smoke

Exposure to environmental tobacco smoke (ETS) can cause adverse reactions in anyone, but it is extremely harmful for children with asthma as it can exacerbate

symptoms (Akinbami, 2013). Unlike many adults that know the effects of secondhand smoke and can minimize their exposure, children unfortunately may not know, and in many instances, be unable to avoid the situation when the smoker is a household member. Nevertheless, the association between exposure to secondhand smoke and asthma exacerbation has had mixed findings in previous research.

Secondhand smoke was observed to cause an increase in school absenteeism, health care visits, activity limitations and wheezing in asthmatic children ages 6-11 years old who participated in the National Health and Nutrition Examination Survey (NHANES) compared to study participants between the ages of 12-19 years (Akinbami, Kit, & Simon, 2013). However, in other studies, despite exposure to high levels of ETS, no association was observed with asthma morbidity or decreased activity days, (Butz et al., 2011; Wu, Cabana, Hilton, & Ly, 2011). For instance, in Butz et al. (2011) study, inner-city children 6-12 years old with asthma and living in a home with a smoker were found to have a correlation between increased cotinine concentrations and symptom days and activity limitations, but the findings were not statistically significant. Similar findings were observed in another study where ETS was not associated with HRQoL in children 4-17 years old that lived in one of three public housing communities in Boston, Massachusetts (Levy et al., 2004).

A potential explanation in the discrepancies could be the populations that were studied. For instance, Akinbami et al. (2013), Butz et al. (2011) and Levy et al. (2004) studies focused on low-income populations while Wu et al. (2011) was not. In addition, several of the studies focused on specific geographical regions, which could affect the

findings. Wu et al. (2011) was a state-based study done exclusively in Hawaii while Butz et al. (2011) was done in a community in Baltimore, Maryland and Levy et al. (2004) was done in three communities in Boston. The overall findings of these studies support why a study at a national level including all age groups is necessary.

Allergens

Another realm of environmental factors pertains to indoor air quality that children are exposed to within their home and school. Exposure to indoor allergens has been found to exacerbate asthma and is well documented (Permaul et al., 2012; Degar et al, 2010; McCormack et al., 2009; NCBI, 2011; Lamb, Ervice, Lorensen, Prentice, & White, 2011; Subbarao, Mandhane, & Sears, 2009; Environmental Protection Agency (EPA), 2012). However, limited research has been done to identify the relationship between allergens and HRQoL. Of the existing literature, indoor allergens vary, which is reflected in the diverse body of literature. Overall, similar to other studies that focused on factors to affect asthma HRQoL, the results vary.

Despite children having reduced HRQoL (i.e. median scores of 4.5 for children seven years old and younger and 4.6 for those between eight and seventeen years old on a seven-point asthma-specific questionnaire), the outcome was not associated with allergies, including those to roaches and dust mites (Levy et al., 2004). In a separate clinical trial study including children 12 months- 17 years old from Washington DC or Maryland counties, HRQoL was not independently associated with exposures to household allergens (Teach, Crain, Quint, Hylan, & Joseph, 2006). However, Teach et al. (2006) did conclude that exposure to cockroaches was associated with HRQoL (i.e.

functional limitations and nighttime symptoms) in the presence of ETS. Contrary to Teach et al. (2006) and Levy et al. (2004) findings, underserved children in South Central Texas that participated in an asthma management clinical trial, the use of dust mite covers were associated with an increase in the Paediatric Asthma Quality of Life Questionnaire Emotional subscale (Shedd et al., 2007).

Allergens in children's schools are another microsystem element that is necessary to study as it may affects a child's HRQoL. A study that compared indoor allergens in homes to those in twelve northeastern, urban, elementary schools of children with asthma did not ascertain how those allergens affected asthma HRQoL, but the results are an asset to the literature as they provide insight on alternate environments in which children spend their time (Permaul et al., 2012). For example, Permaul et al. (2012) reported that collected air and dust samples in various areas of the twelve schools including children's classrooms, cafeterias, and gymnasiums were different than those found in homes. Moreover, the levels of mouse, cat, and dog settled dust allergens were found to be 545%, 198%, and 144%, respectively, higher in schools than in homes (Permaul et al., 2012). In addition, Permaul et al., (2012) found that homes, on the other hand, had higher dust mite settled allergens than schools.

Pets

Pet allergens have been identified in both the home and school, but assessing the presence of pets in the home or classroom and the association with asthma-specific HRQoL has been minimally researched. Only one study was identified that researched this environmental factor and the specific association with asthma HRQoL (Shedd et al.,

2007). Despite Shedd et al. (2007) finding a relationship between using a dust mite cover and a reduction of cockroaches, no association was observed between having a cat in the home and asthma-specific quality of life. Research should have assessed the association between the presence other household pets and HRQoL instead of solely cats.

Personal Factors and HRQoL

Asthma Action Plan

Asthma action plans are imperative for adequate disease management. Furthermore, they are used to prevent asthma exacerbation. Literature aimed at specifically identifying a relationship between the use of asthma action plans and HRQoL is minimal. However, findings from previous studies have varied in the evidence showing the effectiveness of asthma action plans. In a study focused on urban minority children, those with an action plan had a mean reduction of ten asthma exacerbations in the previous year than children without plans (Flores et al., 2009). Contrary to Flores et al. (2009) findings, a significant difference was not observed between the prevalence in the use of an asthma action plans between children with and without impaired asthma (Wu, Cabana, Hilton, & Ly, 2011). The contradiction in these findings supports the need for further exploration of the use of asthma action plans and HRQoL.

Of the existing studies, a positive association was identified in children over five years old that were selected from four New York medical centers that participated in a prospective study (Sheares, Mellins, Dimango, Serebrisky, & Zhang, 2015). Sheares (2015) concluded that the use of a written asthma action plan increased mean scores on the Pediatric Asthma Caregivers Quality of Life Questionnaire for activity limitations and

emotional function subgroups from baseline to the twelve-month follow-up period. The likelihood of these results being replicated are questionable because the overall study included adults up to eighty years old and patients were identified from specialty clinics. In a different study, the use of a written asthma action plan was part of a larger intervention for children eighteen years and younger that sought out to determine if measures to control asthma effected HRQoL outcomes (Polivka, Chaudry, Crawford, Bouton & Sweet, 2011). Overall, Polivka et al. (2011) found that the intervention improved HRQoL outcomes including, reducing symptom days, nights, activity limitations, and missed school. The conflicting results from previous studies warrant the need of further exploration regarding how the implementation of written asthma action plans effects HRQoL.

Social Factors and HRQoL

As one's physical environment is complex to understand, the same applies to their social surroundings. Understanding the foundation of social environment is imperative to determining how it shapes health. In addition to individual factors and a person's physical environment, a social environment can shape an individual's behavior (McNeil, Wyrwich, Brownson, Clark, & Kreuter, 2006). A social environment can shape a person's behavior by influencing their norms, enforcing patterns of social control, providing or preventing environmental opportunities to engage in certain behaviors, and reduce or produce stress (Berkman & Kawachi, 2000). Social environments can be influenced by a host of issues including socioeconomic issues, safety, and demographics of the people living in the community. Therefore, these factors can affect a child with

asthma HRQoL by influencing their access to health care or predisposing them to adverse living conditions, which can subsequently exacerbate their asthma.

Demographic Influences

Demographics of individuals or a community can be used as a proxy to provide a profile, thus potentially explaining issues that might increase asthma exacerbation and influence one's life such as adherence to medication use. In return, a child can experience more symptomatic days or nights, activity limitations and missed school if their asthma is exacerbated or their medication is not properly taken. Variables used in prior literature to analyze the effect of demographic features include one's socioeconomic status (SES), parent's level of education, home and car ownership, census tract data, and a child's insurance status (Beck, Simmons, Huang, & Khan, 2012). SES is a prominent social factor that has been linked to adverse asthma outcomes in children including HRQoL. SES can influence asthma HRQoL in various ways including the lack of access to asthma medication, the inability for the child's family to make changes within their home to meet asthma standards, or the lack of specialized services to help the child with asthma management (Zahran, Bailey, Qin, & Moorman, 2015; Laster, Holsey, Shendell, McCarty, & Celano, 2009). It has been found that children with asthma from poor families have worse HRQoL than children with asthma from families with a higher SES (Horner, Brown, & Walker, 2012). Moreover, a population based study conducted in the United States found that cost barriers to health care and a household income less than $15,000 were associated with uncontrolled asthma in children. In interventional studies that have been aimed at low-income families of children with asthma, providing

them with resources have minimized the child's asthma morbidity while improving their HRQoL (Polivka, Chaudry, Crawford, Bouton & Sweet, 2011; Margellos-Anast, Gutierrez, & Whitman, 2012). Urbanity or inner city can be a proxy of one's SES and research has found associations between living in or attending school in these areas with HRQoL. For instance, urban children with moderate/severe nighttime asthma symptoms aged 4-10 years old enrolled in a clinical trial in Rochester, NY were found to have fewer nights of sleep and overall worse sleep scores on a sleep questionnaire than children in the same study with intermittent and mild persistent nighttime symptoms (Fagnano et al., 2011).

Similar to SES, race/ethnicity has been linked to asthma HRQoL. Moreover, it has been found that white children with asthma have better HRQoL than black and Hispanics (Horner, Brown, & Walker, 2012; Evans et al., 2009). In a study by Horner et al. (2012), Hispanic children had worse emotional functioning (i.e., feeling angry, worried, concerned or troubled because of their asthma or feeling frightened by an asthma attack) than non-Hispanic white and black children with asthma. Evans et al., (2009) found that of children aged 8-14 years old with asthma in Chicago, IL, white children had two to three fewer days and nighttime symptoms than black and Hispanic children. Even after adjusting for SES, Evans et al. (2009) found a 38% and 11% gap in the HRQoL outcomes between white and black and white and Hispanic children, respectively.

A child's form of insurance or the lack thereof could be an indicator that influences asthma and HRQoL. It is expected that children without insurance or

underinsured would have an issue controlling their asthma and subsequently poorer asthma-specific HRQoL. For example, of children diagnosed with asthma, an association was found with the lack of insurance and not having prescribed medicine for asthma (Clark, Dodge, Shah, Thomas, Andridge, & Awad, 2010). In some instances, even children with insurance still have problems managing their asthma (Bloomberg et al., 2009). A possibility for this logic is that certain insurances do not provide coverage for specialized services or resources such as an asthma specialist. This was observed in a study where only 11% of the participants had ever seen an asthma specialist (Clark et. al, 2010). In another study, children with Medicaid insurance were 5.3 more times to have impaired asthma control (Wu, Cabana, Hilton, & Ly, 2011).

Findings from previous literature have shown direct and indirect relationships between social factors and HRQoL outcomes. One's SES can influence several HRQoL living outcomes including resources to control a child's asthma and living conditions. In addition, having insurance can be a means to access of care for children to treat their asthma. In general, although the literature has supported how social factors affect asthma HRQoL, the findings could be inconclusive to the general public as the studies have been conducted in subpopulations. Therefore, conducting this study on a national level can potentially corroborate others' findings.

Asthma Call-back Survey

The BRFSS ACBS is newer questionnaire compared to the standard BRFSS questionnaire. Minimal research using the BRFSS ACBS for childhood asthma has been conducted. Aside from states using the data to publish fact sheets regarding asthma

prevalence in their respective jurisdiction, a primary use of the data has been pertinent to asthma in adults and the prevalence of work-related asthma. Of the remaining literature using the survey, only six articles pertain to children (Zahran, et al, 2012; Zahran et al., 2014; Shen & Oraka, 2012; Winer, Qin, Harrington, Moorman, & Zahran, 2012; Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012; Wu, Cabana, Hilton, & Ly, 2011).

Previous research using the BRFSS ACBS for childhood asthma has varied in topic, but none of them have specifically focused on asthma HRQOL in children. A predominant use of the data has been descriptive in reporting the incidence and prevalence of childhood asthma nationally (Zahran et al., 2014; Winer et al., 2012). For example, Zahran et al. (2014) assessed asthma prevalence and severity and concluded that the prevalence of asthma was higher in children aged 0-4 years. Winer et al. (2012) solely determined asthma incidence and found that childhood asthma was also higher in the same age group compared to other children. Despite the high incidence and prevalence of childhood asthma in that young age group, it is possible that older children could have a diminished HRQoL than 0-4 year olds because the disease may affect their daily activities. Therefore, this further supports why HRQoL should be explored among school-age children. Unlike Zahran et al. (2014) and Winer et al. (2012), another study specifically researched children with asthma in Hawaii to assess whether race was associated with impaired asthma control in a predominate Hawaiian and Pacific Islander population (N=247) (Wu, Cabana, Hilton, & Ly, 2011). Race was not found to be a predictor of impaired asthma control, which has been a similar finding in other studies.

However, one significant finding of the study that had not been reported elsewhere was that children with Medicaid insurance were 5.3 times more likely than those with private insurance to have impaired asthma control (Wu, Cabana, Hilton, & Ly, 2011). In addition to that finding, Wu et al. (2011) concluded a higher prevalence of ER and urgent care visits, the use of asthma medications (i.e. inhaled corticosteroids and short-acting $beta_2$ agonists (SABA)), missed school, and some asthma management strategies (i.e. taught to recognize symptoms of an attack, taken an asthma course, and shown how to use an inhaler) in children with impaired asthma control.

The economic crisis that affected the United States between 2007 and 2009 was studied to determine its effect on the prevalence of poorly controlled asthma in children using the BRFSS ACBS (Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012). Pearlman et al. (2012) determined that poorly controlled asthma was associated with a low household income, a parent indicating their diminished mental health and an insurance gap for the child. The association between poorly controlled asthma and an insurance gap contradicts Wu et al. (2011) study that did not find one. Also, an association observed between asthma severity and a child's household income contradicts Zahran et al. (2014), which did not find one. This contradiction could have resulted in the way both research studies classified asthma severity. For example, although both studies referred to the National Heart, Lung, Blood Institute (NHLBI) Expert Report 3, Pearlman et al. (2012) used the number of weekly symptoms, nighttime awakenings, interference with normal activities, and the use of short acting asthma medications to describe asthma severity as well or poorly controlled. However, Zahran et al. (2014)

defined intermittent or persistent asthma by the use of long-term medications. In addition, the classification of asthma severity depended on the child's age. For instance, the guidelines Pearlman et al. (2012) used were specifically for children at least two years old. Therefore, that would not have been applicable for Zahran's research because his study population included infants.

Another use of the BRFSS ACBS pertains to asthma management (Shen & Oraka, 2012; Zahran, Person, Bailey & Moorman, 2012). Shen and Oraka (2012) described the use of complementary and alternative medicine (CAM) while Zahran et al. (2012) focused on education for asthma management. Shen and Oraka (2012) found that the use of CAM was associated with multiple factors including gender, race/ethnicity, age, health insurance coverage, cost barrier, and the severity of a child's asthma. Furthermore, boys were less likely than girls to use CAM. However, children identified as other/non-Hispanic, aged twelve years or older, had public insurance or uninsured, perceived asthma care as a cost barrier and those with uncontrolled asthma were more likely to use CAM. Similar to Shen et al. (2012), Zahran et al. (2012) determined that older children (12-17 years old) were more likely than younger children to receive asthma management. For instance, older children were 1.3 times more likely to report that they received peak flow meter (PFM) and inhaler instructions. Another similarity in both studies related to asthma management strategies was observed with having cost as a barrier for health care. For instance, Zahran et al. (2012) found that inhaler instructions were associated with having cost as a barrier for care. Aside from the similarities in both studies, Zahran et al. (2012) also concluded that other asthma strategies including receiving instructions for

signs of asthma attacks and symptoms, how one is to respond to an asthma attack, and having an action plan, taking an asthma management course were all associated with adverse outcomes.

The previous studies have shown how the BRFSS ACBS has been used to describe the burden of childhood asthma and associated risk factors in which some of those risk factors were assessed in this study. However, asthma HRQoL has not been researched using the BRFSS ACBS for children. Wu et al. (2011) study was the only one close to assessing asthma HRQoL in children. However, its findings were limited because it specifically focused on Hawaii. Therefore, the results could not apply to other states. The only study that has specifically looked at asthma HRQoL was in an adult population, which focused on work-related asthma (Knoeller, Mazurek, & Moormal, 2013). Overall, the failure to assess asthma HRQoL for children was a noticeable limitation of those studies and justifies the importance of this study.

Review of Methodology

Structure of the methodology is standard in the literature and is a key component of it. Overall, the methodology explained how the study was executed. In addition, this information provided the framework to replicate the study. Methodologies contain imperative information such as the type of study, data source and collection, information about the participants and the data analysis strategy. This section highlighted previous methods in the literature by comparing their major components.

I observed the use of several study designs in the literature including randomized controlled trials, and cohort and cross-sectional designs, but majority were cross-

sectional. Controlled trials and cohort studies were predominantly those that had direct contact with children instead of soliciting information from the parent (Bruzzese et al., 2012; Evans et al., 2009; Milam et al., 2008). On the other hand, cross-sectional studies addressed exploratory research, such as seeking information about certain factors interaction with childhood asthma (McDaniel, Paxson, & Waldfogel, 2006; Quinn, Kaufman, Siddiqi, & Yeatts, 2010).

Study participants were mostly children. However, there were instances where adults were included to serve as the proxy for the child or to provide supplemental information for the child (Dean et al., 2010; Butz et al. 2010). Participants were recruited for participation through various ways. For example, participants were randomly selected from households in National surveys (Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012; Winer, Qin, Harrington, Moorman, Zahran, 2012). Participants were also selected to participate in studies from schools (Milam et al., 2008). Convenience sampling was also used, where children were identified after seeking medical care from a physician's office or hospital (Bloomberg et al., 2009).

Data used in prior studies were either primary or secondary. Primary data would include that which researchers collect during their study either through questionnaires or observations. Secondary data came from a wide range of sources. For instance, data from national surveys were used to assess the burden of asthma throughout the United States (Goodwin & Cowles, 2008; McDaniel, Paxson, & Waldfogel, 2006; Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012; Winer et al., 2012; Valerio et al., 2010; Stevens, Pickering, & Laqui, 2010). Additional secondary data sources can come from

previous studies (Quinn, Kaufman, Siddiqi, & Yeatts, 2010; Wu et al., 2011). Another source of secondary data that provides clinical information and does not rely on self-reported information came from medical records or hospital discharge data (Claudio, Stingone, & Godbold, 2006).

Data analysis is the last component of the methodology. This section described the tests that were conducted and the software that used. Some common analytic processes observed in the literature consisted of regression models, which can be used to test associations, one-way analysis of variance (ANOVA) to examine the differences in means and standard deviations, t-test statistic to determine if the means of two groups are statistically different and chi-square test that assesses whether the distributions of categorical variables differ from one another. Overall the analysis for this study was dependent on each research question to ascertain how environmental, personal and social factors affected childhood HRQoL. Furthermore, descriptive statistics and multivariable modeling were employed in this study.

Summary and Transition

In this chapter, I have provided a synopsis of the factors associated with childhood asthma. The purpose of the literature review was to critically review current literature and identify gaps in the literature. The process for identifying articles encompassed a database search. Articles were identified based on a defined inclusion and exclusion criteria. After articles were identified, the review was summarized in categories including environmental, personal and social factors.

A significant portion of literature was found surrounding childhood asthma by an exhaustive search using keywords in Academic Search Complete, CINAHL Plus with Full Text, and MEDLINE with Full Text all via EBSCOhost. I found personal, environmental, and social factors that affected children's asthma HRQoL. However, within the articles that were identified, variations in the outcomes were apparent, which can provide conflicting information when treating children with asthma. Differences observed in the literature could be contributed to the study populations, methods of the studies, and confounding factors. Despite this, the literature strengthens the knowledge of childhood asthma, but lacks evidence showing how environmental, personal, and social factors affect HRQoL in a nationally representative sample, thus supporting the need for my proposed research.

In Chapter 3, I present the methodology and research approach in detail. Key areas of Chapter 3 includes: an introduction and overview, the research design and rationale, sample and setting, instrument used, methods for data collection, the proposed statistical analysis ethical considerations, the study's limitations, and summary. Overall, the next chapter will present the specific procedures for conducting the research.

Chapter 3: Research Method

Introduction

My purpose in this study was to explore how HRQoL of children with asthma was cumulatively affected by environmental, personal, and social factors. In Chapter 3, I describe the methodology that explains how the study was performed. The process is discussed in two major sections including the Methods and Instrumentation and Materials. In the Methods section of the chapter, I discuss the research design and rationale, sampling method used, participants of the study, and power analysis. Instrumentation and Materials reviewed variables under study, threats to validity, the proposed data analysis and ethical considerations. I conclude Chapter 3 concluded with a summary.

Research Design and Rationale

The dependent variable of this study was HRQoL in children with asthma. I measured HRQoL by missed school, activity limitations, and symptom-free days. Independent variables that were assessed consisted of three overarching groups: environmental, personal and social factors. Specific environmental factors included exposure to cockroaches, ETS, pets, and mold. Personal factors consisted of the presence of having an asthma action plan, access to medications, and the parent or guardian's mental health status. Independent variables classified as social factors were cost barriers, one's insurance status, insurance type, and a gap in insurance coverage. To address the possibility of confounding factors, covariates in this study were the child's age gender, ethnicity, and race.

To explore environmental, personal, and social factors' influence on the incidence of HRQoL in children, I used a quantitative, cross-sectional design. Quantitative, cross-sectional research tests objective theories by examining and describing the relationship among variables (Creswell, 2009; Frankfort-Nachmias & Nachmias, 2008). Furthermore, according to Creswell (2009), the relationships studied are quantified unlike a qualitative design, which, in general, analyzes themes. In addition, strategies of inquiry for a quantitative design can be descriptive, which reflects a cross-sectional plan. The chosen design was also appropriate for the research as the data used for analysis were from archived datasets including the Asthma Call-back Survey (ACBS), which was linked with a parent or guardian's responses to the BRFSS. This further supported the notion that survey research is often applied in a quantitative, cross-sectional design unlike a qualitative one, which collects data through observations or interviews.

Determining the research design included a recognition of advantages and disadvantages. Some of the known disadvantages of a cross-sectional study, such as inability to determine disease etiology and questionable usefulness for diseases of low frequencies, poses few problems on the research since prior research confirmed asthma's linkage to multiple factors and its high prevalence. However, the limitation of a cross-sectional study's inability to determine causation because it is descriptive in nature is unfortunate (Friis & Sellers, 2004). Distinctively, the degree of specificity in independent variables differs as opposed to other studies, so it is unknown whether the disease or exposures occurred first, such as is with case-control and cohort studies, respectively. (Frankfort-Nachmias & Nachmias, 2008; Sellers, 2004).

Using survey data about the quantitative component is a significant advantage as opposed to developing a new survey, piloting it to establish validity, and administering it or conducting interviews—all of which require a considerable amount of resources. The use of these data also gathers information on a large scale, thus making generalized inferences permissible. Another advantage is the fact that others can easily replicate the research. However, there are caveats associated with using secondary data for research including the inability to provide input into the research questions compared to developing a new instrument. In addition, any issues arising during the administration of the survey may be unknown.

Participants

Participation in the ACBS is based on one's eligibility determined by responses from the BRFSS (Winer, Qin, Harrington, Moorman & Zahran, 2012). An eligible participant for the ACBS is one with an asthma diagnosis, recruited and granted permission to participate in the ACBS (CDC, 2015). However, several instances existed where a child is ineligible to participate such as an erroneous asthma diagnosis (CDC, 2015). In addition, a child cannot participate if the adult in the home was selected to participate in the adult ACBS (CDC, 2015; Zahran et al., 2014). Another instance is if the respondent of the BRFSS is not the parent or guardian of the child initially selected for the child ACBS (Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012). Other reasons to disqualify a participant from participating pertain to exclusionary measures taken by the state such as meeting a pre-specified quota for ACBS interviews, budgetary constraints, or limited resources. A child is also ineligible if the adult respondent

partially completes the BRFSS (CDC, 2015). The number of participants for the ACBS and participating states and territories that conducted it for children varied yearly resulting in 1,100 records from ten states in 2012 (CDC, 2014), 953 records in ten states in 2013 (CDC, 2015), and 1,257 records in 2014 (CDC, 2016).

For this study, children between the ages of 5 and 17 years were considered for analysis. Literature has shown that an asthma diagnosis in younger children is difficult to establish due to other childhood conditions (Hartman & O'Connor, 2009; NHLBI, 2007). Therefore, this age group included children who were older, which increased the likelihood of a true asthma diagnosis. In addition, the age group focused on school age children, which could enhance inquiry about how asthma affected their quality of life.

Sampling Method

Prior to 2011, the BRFSS ACBS was random-digit-dialed survey only administered via land-line telephones (Zahran et al., 2014). However, subsequent years of data collection included those from both land-line and cellular phones (CDC, 2013). The sampling method of the BRFSS survey consisted of two designs, one for each mode of data collection. Except for Guam and Puerto Rico that used a simple random-sample design, participants selected to participate in the survey via land-line phones were selected by disproportionate stratified sampling (DSS) (CDC, 2014). Random sampling was applied to select participants for surveys administered by cellular phones (CDC, 2014; CDC, 2013).

According to the CDC (2013), DSS sampled two groups of telephone numbers that were classified into densities to obtain the probability of all households with

telephones. Moreover, the determination was based on the number of listed household numbers in a hundred block (a set of one hundred telephone numbers with the same area code, prefix, and first two digits of the suffix and all possible combinations of the last two digits). It was assumed that high and medium density groups belonged to mostly households (CDC, 2013).

Within the random sample method, every element had the same probability of selection. Moreover, samples were based on confirmed area codes and prefix combinations (CDC, 2013). To help states obtain their targeted number of participants, the CDC provided each state with an additional sample of potential respondents (CDC, 2013). In total, states were expected to administer the BRFSS approximately 20% of their targeted sample via cell phones (CDC, 2013).

In addition to the sampling methods applied to the modes of data collection, the CDC also applied iterative proportional fitting (raking) method to weight the data (Pierannunzi, Town, Garvin, Shaw, & Balluz (2012). This method was necessary once data collection via cellular phones was implemented. Moreover, the method reduced bias by adjusting the data by various demographic characteristics including, but not limited to age categories by gender, race and ethnicity, education level, telephone source, and home ownership status (CDC, 2013). In addition, the raking method ensures the weights are a representation of the population (Pierannunzi, Town, Garvin, Shaw, & Balluz (2012).

Sampling for the ACBS depended on the response to the BRFSS. More specifically, a child's eligibility was dependent upon the state's decision to include children in the BRFSS. A child's eligibility subsequently depended on if he or she was

randomly selected and had been diagnosed with asthma. Only one person was eligible to participate in the ACBS in the event both a child and an adult in the home had asthma. Ideally 4,000 interviews should have be conducted for each state. A 1:5:1 sampling ratio was the standard for determining the sample size. Therefore, samples were selected from the listed 1+ block numbers at 1.5 times the rate that is sampled from the not listed 1+ block numbers. An additional criterion for selecting the sample was applied geographically. For instance, telephone numbers were randomly selected by region as opposed from the entire state.

Power Analysis

A priori power analysis was performed to ensure that there is an adequate sample size for this study using the software, G*Power3 (Faul, Erdfelder, & Buchner, 2009). According to Faul et al. (2009), sample size (N) is computed as function of the power (1-β), significance level and the population effect size in a priori power analysis. To assess the relationship between factors (i.e., environmental, personal and social), activity limitations, the number of missed school, and symptom-free days, a multiple logistic regression and multiple linear regression model, respectively, are proposed statistical tests to answer these questions. F-tests were chosen as the test family and linear multiple regression: fixed model, R^2 increase was the desired statistical test. Conventional power and α, 0.8 and 0.05, respectively, was used (Hazra & Gogtay, 2016). With 17 predictor variables, a sample size of 1,085 participants for a small effect size of 0.02 was needed. Using the same parameters, 160 and 79 participants were required for a medium and large effect size of 0.15 and 0.35 respectively. In addition to the estimated sample sizes

using G*Power, the CDC generated required sample sizes for sublevel analysis based on specific levels of precision using an effect size of 1.5 and an estimated risk factor prevalence of 50%. Furthermore, a sample size 3600, 900, 400, 225, 144, 64, and 36 participants were required for a precision of 2%, 4%, 6%, 8%, 10%, 15%, and 20%, respectively (CDC, 2015).

Instrumentation and Materials

Instrumentation and Operationalization of Constructs

The BRFSS ACBS are nationally administered, self-report, telephone surveys. Conducted separately, the primary survey, BRFSS, collects information pertinent to health care access, practices and behaviors while the ACBS explicitly collects data pertinent to asthma (CDC, 2013; CDC, 2015). Established in 1984 by the Centers for Disease Control and Prevention (CDC) Division of Community Health, BRFSS surveys were developed to compare surveillance data across states (CDC, 2013). During its initial use in 1984, BRFSS surveys were administered in only fifteen states while it has expanded to all states, the District of Columbia and three territories (Garbe & Balluz, 2012). Contrary to the BRFSS survey, the ACBS, developed by the Air Pollution and Respiratory Health Branch (APRHB) in the National Center for Environmental Health (NCEH), is relatively new as it was first piloted in 2005 in three states and expanded in subsequent years (Garbe & Balluz, 2012; CDC, 2014).

The ACBS was used to operationalize asthma exacerbation among children and the magnitude asthma has on children. The ACBS was combined with a participant's BRFSS survey. All data was publicly accessible and archived on the CDC's website for

each year. Therefore, permission from the developer to use the data was not necessary. The BRFSS ACBS data has valuable uses including, but not limited to the identification and comprehension of population health problems, provide justification for program development or implementation, and elucidate behaviors that affect health (CDC, 2015; Zahran et al., 2014).

BRFSS survey has a long-standing history of assessing the prevalence of behavioral risks among adults. Given the extensive use of its data, history and high participation rates, previous use of the survey has shown it to be highly reliable and valid especially for chronic diseases (Nelson, Holtzman, Bolen, Stanwyck, & Mack, 2001). For example, when the BRFSS was compared to another national survey, the National Health Interview Survey (NHIS), risk factors for chronic diseases including current smoker, body mass index (BMI), average number of drinks per occasion, and lack of health insurance and diabetes (a chronic disease), had statistically significant similar estimates (Fahimi, Link, Schwartz, Levy, & Mokdad, 2008). When compared to a similar survey that was administered through mail as opposed to random-digit-dialing, the BRFSS prevalence estimates were still comparable to the mailed survey for chronic diseases including asthma and diabetes (Link, Battaglia, Frankel, Osborn, &Mokdad, 2006).

The ACBS is gaining wide usage in efforts to estimate asthma incidence and to explore additional factors that may affect the disease. Reliability and validity of the ACBS has not extensively been explained in previous literature. However, it is known that the small sample size of the ACBS makes the reliability for subgroups such as data

for a single year or geographic areas problematic (National Asthma Control Program, 2012; Winer, Qin, Harrington, Moorman, Zahran, 2012). However, Winer et al. (2012) stated additional years of ACBS data will increase the sample sizes thus increase power and reliability of data. The majority of the research that does exist primarily pertains to adults. For instance, ACBS has shown to be reliable and valid in measuring occupational asthma (Mazurek, Knoeller, Moorman, & Storey, 2013; Knoeller, Mazurek, Moorman, 2012; Knoeller, Mazurek, & Moorman, 2013). Aside from being used for occupational asthma research, the ACBS is the only national survey that calculates the incidence of asthma. The only other national survey that has ever calculated the asthma incidence was the National Health Interview Survey (NHIS) between 1980 and 1996 (Rudd & Moorman, 2007).

Data Collection

The BRFSS ACBS is a state-based, cross-sectional archival data and it is publicly accessible by individual years from the Center for Disease Control and Prevention (CDC) (Winer, Qin, Harrington, Moorman & Zahran, 2012). Surveys are only administered in the United States, including DC, and territories Puerto Rico, Guam, and the Virgin Islands (Zahran et al., 2014; Winer et al., 2012). Administered to non-institutionalized adults 18 years and older, one participant per household is permissible. Data collection for BRFSS ACBS may be obtained by either a state's health department or a contractor. Data collection for both surveys consists of multiple steps.

Approximately two weeks after the BRFSS is administered, the ACBS is conducted (Zahran, Bailey, Qin, Moorman, 2014). Contrary to the BRFSS, a state's

participation for the ACBS is voluntary, which causes the response rates to vary by years (Zahran et al., 2014). Prior to the start of the survey, the person that completed the BRFSS is identified. The parent, guardian or another knowledgeable person can complete the survey in which the interviewer will document the relationship to the child (Winer et al., 2012; Zahran et al., 2012). Although a requirement of the ACBS was to have reported the selected child had asthma, confirmation of one's asthma status is done to ensure their eligibility (Winer et al., 2012; Zahran et al., 2012). A final step of data collection for the ACBS is to get permission to combine the answers of the survey with those of the BRFSS.

Due to its public accessibility, the Public Use Data Files (PUDF) for the BRFSS ACBS was downloaded directly from the CDC's website for each year (2012, 2013, and 2014) for surveys administered via cell phones and landlines. Data collected for 2012 included surveys administered in California, Hawaii, Michigan, Mississippi, Nebraska, New Mexico, Ohio, Pennsylvania, Texas and Washington (CDC, 2015). For 2013, some states with available data in the previous year (i.e., California, Hawaii, New Mexico, Ohio, and Pennsylvania) were omitted. However, Connecticut, Indiana, and, Utah newly added states for 2013 (CDC, 2015). Data for 2014 consisted of data collected from Georgia, Indiana, Kentucky, Maryland, Michigan, Nebraska, New Jersey, Pennsylvania, Puerto Rico, Texas and Utah. All PUDFs contained data for the adult interviewed in the BRFSS and child represented in the ACBS.

Variables

Variables for this research consisted of three types including covariate, independent and dependent. Covariates for the child were used for adjustment in the analysis (Table 1). Independent variables for children were classified into three categories, personal (Table 2), environmental (Table 4) and social factors (Table 5). Although this study focused on children, the advantage of adult data from the BRFSS combined with the child's ACBS enhanced the research. Furthermore, some of the responses from the adult in the household were used as a proxy for the child. The personal independent variable for adults is presented in Table 3. All independent variables were analyzed to assess their association on the following dependent variables (Table 6): missed schools, activity limitations, and symptom-free days.

Despite some of the data categorization upon receipt, some variables were recoded. For instance, the child's age was obtained during the survey, but there were instances in which the age was missing, but an imputed age was available. As a result, the new variables were based on either the actual age reported or the imputed age. For demographic variables, gender, race and ethnicity, the failure to provide a response resulted in a missing value. An adult's employment status was categorized as binary in which an individual that was employed for wages or self-employed were classified as employed and anyone out of work for any reason were considered unemployed. An adult's annual income was recoded into four categories: *< $35,000, $35,000-<$50,000, $50,000-<$75,000 and ≥$75,000*. Classifying incomes into those categories aligned with previous literature (Bloom, Jones, & Freeman, 2012). Similar to collapsing the various

income groups, adult's education status was recoded. One's education status was classified as less than high school if the person did not have a diploma or GED, high school graduate if they had a diploma or GED, some college if the person completed one to three years, and college graduate if they attended four years or more of college. An adult's smoking status became binary, so a respondent that smoked *Every day* or *Some days* were re-coded as *yes* while an individual that did not smoke was coded as *no*. A response of *Some are/some aren't* to the question that asks whether there was a pet in the bedroom was coded as *yes*. Therefore, the responses to the question became binary. If *No current asthma* was answered for either cost being a barrier to a child seeing their primary care physician or an asthma specialist then the response was set to missing. Should the respondent provide a response of *No insurance at the time of interview*, the child was considered as not having insurance. For all questions in which a response to a question was *Don't Know/Not Sure*, *Refused*, or missing were considered missing.

The dependent variable, missed school, retained its existing data values. Similarly, symptom-free days retained their values except of responses *Don't* know, *Refused*, or *No current asthma*. A response of None was recoded as 0, indicating that the child did not have any days free of symptoms. A number response ranging from 1-29 retained its value and the response, *Every day*, was recoded as 30. As a result, the numeric values represented the number of days without being symptom-free. Activity limitations with responses, *A little*, *A moderate amount"* or *A lot*, retained their responses. However, those with a response of *Don't know*, *Refused*, or *No current asthma, nothing happened in past year* were set to missing. On the contrary, the

response, *Not at all*, was categorized as *None*. For the outcome, missed school, a response of *Don't know*, *No current asthma*, *Not old enough for school*, *No school in past year* was recoded to missing. A child that did not miss school was set to 0 and a response of *Every day* was recoded as 30 to account for all days. Therefore, the number of days ranged from 0-30.

Table 1

Child Covariates

Variable	Data type	Survey question	Data values or units
Age	Ratio	What is the month and year of the age of the child?	Month, years
Gender	Nominal	Is the child a boy or girl?	Boy, girl, refused
Hispanic ethnicity	Nominal	Is the child Hispanic or Latino?	Yes, no, don't know/ not sure, refused
Race	Nominal	Which one or more of the following would you say is the race of your child?	White, Black or African American, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, Other

Table 2

Child Independent Variables for Personal Factors

Variable	Data type	Survey question	Data values or units
Asthma action plan	Nominal	Has a doctor or other health professional EVER given you or [child's name] an asthma action plan?	Yes, no, don't know, refused
Asthma action plan in school	Nominal	Does [child's name] have a written asthma action plan or asthma management plan on file at school?	Yes, no, don't know, refused
Asthma management course	Nominal	Have you or [child's name] ever taken a course or class on how to manage [his/her] asthma?	Yes, no, don't know, refused

Table 3

Adult Independent Variables for Personal Risk Factors

Variables	Data type	Survey question	Data values or units
Mental health well-being	Ratio	Now thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?	Number of days, none, don't know/ not sure, refused

Table 4

Child Independent Variables for Environmental Factors

Variable	Data type	Survey question	Data values or units
Cockroaches	Nominal	In the past 30 days, has anyone seen a cockroach inside [child's name]'s home?	Yes, No, Don't Know, Refused
Indoor pets	Nominal	Does [child's name] home have pets such as dogs, cats, hamsters, birds, or other feathered or furry pets that spend time indoors?	Yes, No, Don't Know, Refused
Pets in bedroom	Nominal	Is the pet allowed in {his/her} bedroom?	Yes, No, Don't Know, Refused
Pets in classroom	Nominal	Are there any pets such as dogs, cats, hamsters, birds or other feathered or furry pets in [his/her] classroom?	Yes, No, Don't Know, Refused
Mold	Nominal	In the past 30 days, has anyone seen or smelled mold or a musty odor inside [his/her] home? Do not include mold on food.	Yes, No, Don't Know, Refused
Mold in classroom	Nominal	Are you aware of any mold problems in [child's name]'s school?	Yes, No, Don't Know, Refused
Exposure to ETS	Nominal	In the past week, has anyone smoked inside [his/her] home?	Yes, No, Don't Know, Refused

Table 5

Child Independent Variables for Social Factors

Variable	Data Type	Survey Question	Data Values or Units
Cost Barrier for Primary Care	Nominal	Was there a time in the past 12 months when [child's name] needed to see his/her primary care doctor for asthma but could not because of the cost?	Yes, No, No Current Asthma, Don't Know
Cost Barrier for Asthma Specialist	Nominal	Was there a time in the past 12 months when you were referred to a specialist for [his/her] asthma care but could not go because of the cost?	Yes, No, No Current Asthma, Don't Know
Cost Barrier for Medication	Nominal	Was there a time in the past 12 months when [he/she] needed medication for [his/her] asthma, but you could not buy it because of cost?	Yes, No, No Current Asthma, Don't Know
Insurance	Nominal	Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare or Medicaid?	Yes, No, Don't Know, Refused
Insurance Gap	Nominal	During the past 12 months, was there any time that [he/she] did not have any health insurance or coverage	Yes, No, No Insurance at Time of Interview, Don't Know, Refused
Types of Insurance	Nominal	What kind of health care coverage does [child's name] have? Is it paid through the parent's employer, or is it Medicaid, Medicare, Children's Health Insurance Program (CHIP), or some other type of insurance?	Parent's Employer, Medicaid/Medicare, CHIP, Other, Don't Know, Refused

Table 6

Dependent Variables

Variable	Data type	Survey question	Data values or units
Activity limitations	Ordinal	During the past 12 months, would you say [child's name] limited [his/her] usual activities due to asthma not at all, a little, a moderate amount, or a lot?	Not at all, A Little, A Moderate Amount, A Lot, Don't Know, Refused
Missed school	Ratio	During the past 12 months, about how many days of school did [he/she] miss because of [his/her] asthma?	Number of Days, Zero, Don't Know, Refused
Symptom-free days	Ratio	During the past 14 days, on how many days was [child's name] completely symptom-free, that is no coughing, wheezing, or other symptoms of asthma?	Days/Nights, Don't Know, None

Data Analysis

All statistical analyses were performed using survey analysis procedures for complex survey data in SAS 9.4 (Cary, NC). Descriptive analysis, including means and standard deviations, were performed first to document the characteristics of children and their caregivers. Combining multiple years of data for analysis required the stability of the prevalence estimates to be computed first. Per the CDC (2015), it was critical to ensure the data did not significantly change between years when combining data. As a result, I used the method suggested by the CDC to observe the differences. First, I computed the prevalence for the risk factors (environmental, personal and social) for each period using the sampling weights. Next, I ranked the estimates from low to high followed by applying the appropriate statistical test based on the type of data to compare the lowest and highest estimates at the 5% level of significance.

Three primary research questions were answered in this study. The three questions assessed the association between HRQoL outcomes and the personal, environmental and social factors individually. Therefore, questions were composed of a total of three subquestions reflecting the outcomes of interest.

Research Question 1: Which personal factors are associated with asthma HRQoL?

Research Question 1a: Which personal factors of a child are associated with asthma HRQoL, as measured by the number of symptom-free days?

$H_0$1a: No personal factors are associated with symptom-free days in children with asthma.

H_a1a: One or more personal factors are associated with symptom-free days in children with asthma.

Research Question 1b: Which personal factors of a child are associated with asthma HRQoL as measured by activity limitations?

$H_0$1b: No personal factors are associated with activity limitations for children with asthma.

H_a1b: One or more personal factors are associated with activity limitations for children with asthma.

Research Question 1c: Which personal factors of a child are associated with asthma HRQoL as measured by the number of missed school days?

$H_0$1c: No personal factors are associated with missed school for children with asthma.

H_a1c: One or more personal factors are associated with missed school for children with asthma.

Research Question 2: Which environmental factors are associated with asthma HRQoL?

Research Question 2a: Which environmental factors are associated with asthma HRQoL in children, as measured by the number of symptom-free days?

$H_0$2a: No environmental factors are associated with asthma HRQoL in children as measured by the number of symptom-free days in children with asthma.

H_a2a: One or more environmental factors are associated with symptom-free days in children with asthma.

Research Question 2b: Which environmental factors are associated with asthma HRQoL in children, as measured by activity limitations?

$H_0$2b: No environmental factors are associated with activity limitations for children with asthma.

H_a2b: One or more environmental factors are associated with activity limitations for children with asthma.

Research Question 2c: Which environmental factors are associated with asthma health-related quality of life in children, as measured by the number of missed school days?

$H_0$2c: No environmental factors are associated with missed school for children with asthma.

H_a2c: One or more environmental factors are associated with missed school for children with asthma.

Research Question 3: Which social factors are associated with asthma HRQoL?

Research Question 3a: Which social factors are associated with asthma HRQoL in children, as measured by the number of symptom-free days?

$H_0$3a: No social factors, as measured by adult perceived stress, insurance status and type, and socioeconomic status are associated with symptom-free days in children with asthma.

H_a3a: One or more social factors are associated with symptom-free days in children with asthma.

Research Question 3b: Which social factors are associated with asthma HRQoL in children, as measured by activity limitations?

$H_0$3b: No social factors are associated with activity limitations for children with asthma.

H_a3b: One or more social factors are associated with activity limitations for children with asthma.

Research Question 3c: Which social factors are associated with asthma HRQoL in children, as measured by the number of missed school days?

$H_0$3c: No social factors are associated with missed school for children with asthma.

H_a3c: One or more social factors are associated with missed school for children with asthma.

Statistical Analysis

Research questions were answered by performing either multiple linear regression models or ordinal logistic regression models. For instance, a multiple linear regression model is applicable for dependent variables that are continuous (i.e., number of missed school days and symptom-free days) and the independent variables are categorical. Ordinal logistic regression models are performed for the HRQoL outcome, activity limitations, because the variable consists of ranked categories. However, due to the complexity of the survey data, a cumulative logistic regression model for ordinal outcomes was performed. To carry out each type of statistical test, several steps were taken to ensure assumptions were met, and these steps are detailed in the following paragraphs.

Unlike the standard assumptions for multiple linear regression models, not all are applicable for my study due to the complex survey design (Berglund, 2014). Moreover, Berglund (2014) noted that the assumptions of independence of observations and equal probabilities of selection may not hold true for this type of survey design. The assumption of linearity was assessed by scatter plots between each dependent and independent variables. Multicollinearity was also tested to see if independent variables were correlated with each other. Within SAS, several steps were performed beginning with a procedure to test for correlation (i.e., proc corr). It was assumed that a correlation exceeding .8 was indicative of multicollinearity. Second, an iterative process of including one of the independent variables in the dependent field and all remaining variables in the independent field was done to assess the individual variance inflationary

factor (VIF) values. A VIF that exceeded 10 indicated the presence of multicollinearity. Necessary steps to address multicollinearity included to either exclude one of the variables from analysis, combine the correlated variables, or not take any action. Checking for extreme outliers was conducted as values out of range could adversely affect conclusions. A final check of the residuals was performed to test whether they were normally distributed, which was done by a Normal Q-Q plot.

Similar to multiple linear regression analysis, several assumptions are required for ordinal logistic regression. First, it was assumed that the dependent variable was ordinal. In my study, the variable for activity limitations was ordinal as a respondent could answer whether asthma had limited their activities a little, a moderate amount, a lot, or not at all. Therefore, this assumption was met. A second assumption was that one or more of the independent variables studied was continuous, ordinal, or categorical. In my study, all independent variables met this assumption. Another assumption that was confirmed for ordinal logistic regression models was the lack of multicollinearity. Given that multicollinearity was already assessed for multiple linear regression, it was not repeated. Another assumption for an ordinal logistic regression model is to test for proportional odds. This test was done within SAS by performing a logistic procedure.

Analysis Plan for Questions

Three broad research questions analyze the relationship between HRQoL and environmental, personal, and social factors. Furthermore, the sub-research questions relate to the three asthma HRQoL measures including the number of symptom-free days, missed school days, and activity limitations. The first two sub questions required a

multiple linear regression model for complex survey data because they are ratio outcomes. An *F*-test determined how well all the independent variables predicted the HRQoL outcomes. Results from the F-test indicated if a linear relationship between the variables existed if $p < 0.05$. In addition, a *t* test and beta coefficients are presented. The *t*-test explained the significance of each independent factor and the beta coefficients provided the magnitude of prediction for each independent variable.

The sub-research question that explored the relationship between the HRQoL outcome, activity limitations, and the independent factors required a cumulative regression model. Wald coefficients are provided to assess the individual factors. In addition to the Wald coefficients, odds ratios (OR) are presented for the predicted probabilities. An OR greater than one indicated that the independent factor was more likely to predict activity limitations by. Conversely, ORs less than one indicated a negative association between activity limitations and the independent variable. An OR that equaled one represented no association.

Model selection was dependent upon the bivariate analysis. The bivariate analysis was performed by performing a logistic test among each independent and dependent variable. Statistical significance for entry into the model was based on a *p*-value $\leq .20$. Afterwards, all significant independent variables were entered into the final regression model.

Threats to Validity

Validity in research encompasses several types. My research discussed the following types of validity; construct, external, internal and statistical conclusion, and threats that exist within each type.

Construct validity pertains to whether the variable is adequately defined and accurately measured by the instrument (Parker, 1993). This research exemplified construct validity in several ways. First, the ACBS specifically assessed the burden of childhood asthma and no other conditions. There are also specific questions asked in the survey that allow the outcomes to be studied. For example, the questions: *During the past 12 months, would you say [child's name] limited [his/her] usual activities due to asthma not at all, a little, a moderate amount, or a lot? During the past 12 months, has [he/she] had an episode of asthma or an asthma attack? During the past 12 months, about how many days of school did [he/she] miss because of [his/her] asthma? How long has it been since [he/she] had any symptoms of asthma?* measured activity limitations, asthma exacerbation and missed school, respectively.

External validity measures the generalizability of the findings from the study population to the target population (Friis & Sellers, 2004). The BRFSS ACBS was intended to be generalizable although samples of the population are surveyed. Weighting the responses for the surveys allowed generalizations to be made of people with asthma in states that participated (Zahran, Bailey, & Moorman, 2015; Zahran, et al., 2014). Consequently, potential threats that existed for this form of validity included confounding factors, interaction of history with outcome, interaction of setting with outcome, and

interaction of selection with outcome (Parker, 1993). A potential threat of external validity for my research was the possibility for confounding factors. Suspected confounding factors included the race/ethnicity of the child, their age, and gender.

Internal validity measures the extent to which differences in an outcome between or among groups in a study can be attributed to the hypothesized effects of an exposure being investigated (Friis & Sellers, 2004). Moreover, internal validity refers to the extent to which extraneous variables are controlled (Parker, 1993). This form of validity consists of nine threats including history, maturation, testing, instrumentation, statistical regression, selection, mortality, interactions with selection, and ambiguity about the direction of causal influence (Parker, 1993). Since this is a cross-sectional study, ambiguity about the direction of causal influence was highly likely because causality could not be determined in this type of study. Therefore, internal validity was not relevant in this study. However, since internal validity could be threatened by measurement error, wouldn't that be relevant?

Statistical conclusions validity is that which statements about the association of two variables can be made based on statistical tests (Parker, 1993). Threats of this type of validity are low statistical power, violated assumptions of statistical tests, fishing and error rate problem, reliability of measures, reliability of treatment implementation, random irrelevancies in the experimental setting and random heterogeneity of respondents. Conducting a power analysis to ensure the sample size was adequate was performed to address the possibility of low statistical power. To test the assumption of normal distribution (of the data), skewness and kurtosis was measured. In instances

where data was not normally distributed, additional methods such as correlation, least-squares regression, and logistic regression can be applied when normality violations are present.

Ethical Considerations

Children are considered a vulnerable population according to the National Institutes of Health (Welch et al., 2015). Therefore, precautionary measures must be taken in research involving them. Research on children falls into several risk classifications including: (1) no greater than minimal risk; (2) greater than minimal risk with prospect of direct benefit; (3) greater than minimal risk with no prospect of direct benefit; and (4) any other research (Welch et al., 2015). Within each risk category, requirements have been established to protect the wellbeing of child participants. However, these guidelines are not applicable to this research as the parent or guardian will serve as the proxy for the child therefore preventing risk to the child.

My research and the version of the ACBS I used focused on children. However, a parent or guardian answered questions on the child's behalf and an institutionalized child was not considered for participation, which significantly reduces the risk of harm to the child or fails to take advantage of a vulnerable group. Consent was obtained from the parent or guardian of the eligible child on two occasions, at the end of administering the BRFSS and prior to conducting the ACBS (CDC, 2015). During the BRFSS the adult was asked, "Would it be all right if we call back at a later time to ask additional questions about your child's asthma?" At that time, parents had the option to permit or refuse a future callback. The correct child and adult were identified based on their first name,

initials, or nickname before the start of the ACBS, which was obtained during BRFSS. Informed consent was ascertained in which the administrators read a short statement allowing the respondent to quit at any time or refuse to answer a question.

In addition to an adult's consent for their participation in the ACBS, some states required respondents to provide it to have their BRFSS responses linked with the child's ACBS (CDC, 2015). If applicable, the respondent was asked during the ACBS, "May we combine your answers to this survey with your answers from the survey you did a few weeks ago?" Per the CDC (2015), respondents that do not agree to link their surveys are ineligible to continue the ACBS.

Confidentiality is another consideration in the research. This was done on several accords. First, the ACBS data does not contain any identifiable information. Also, any variables with less than fifty respondents were suppressed (CDC, 2015). Data aggregation for multiple years and the use of data from a National survey will reduce the likelihood of identifying a respondent. A final measure to ensure confidentiality was to keep the data secure. I retained the data on an external hard drive that was not accessible to anyone else. Furthermore, access to the files required a unique password. Data will be destroyed 5 years after conclusion of this research (i.e. after defending the dissertation).

Approval from Walden University's Institutional Review Board (IRB) was obtained prior to conducting the research. This process certified that my research did not pose any ethical issues. IRB approval required a detailed outline of my research noting the scope of it and the study participants involved. In addition, IRB approval required proof of completing a human subjects' protection in research course.

Measures taken to prevent adverse ethical issues were minimized in my research. This was extremely important as the data involved pertained to children, which are deemed as a vulnerable population. Actions taken to prevent harm to study participants were employed through various ways including participation consent, approval from an ethics committee, a methodical data collection process, and safely storing the data.

Summary

The methodology for conducting the research was outlined in this chapter. Several elements make up the research methodology including the research design, sampling method, description of the participants, power analysis, instrumentation that was used, validity, data analysis, and ethical considerations. A quantitative cross-sectional study was chosen as the research design based on the data type and source. Moreover, a national telephone survey, ACBS, was selected to serve as the data source for the research. The sample method and description of the instrumentation discussed was that described by the CDC. Although the ACBS is for children, participants of my research were between the ages 5-17 years. A priori analysis was selected to calculate the power analysis. The process for executing the regression models to analyze the data was discussed as another component of the research methodology. A final step discussed in this chapter was that on ethical considerations, which noted actions taken to ensure the participants were free from harm.

Overall, this chapter discussed the process to answer the three research questions pertaining to the environmental, personal, and social factors that are associated with HRQoL as measured by missed school days, activity limitations, and symptom-free days.

The following chapter will discuss the results of the research. Furthermore, it will present the findings based on the methods and research questions discussed in this chapter.

Chapter 4: Results

Introduction

This study aimed to explore individual and cumulative relationships between the HRQoL of children with asthma and environmental, personal, and social factors in a nationally representative sample. Environmental, personal, and social factors were three overarching themes of this study, but each one was composed of individual indicators. Environmental factors that were assessed included pets at home and school, mold in the home and school, and children's exposure to cigarette smoke. Personal factors consisted of the child having an asthma action plan at home and school and required medications. Social factors that were explored consisted of the presence of stress for the parent or guardian, the child's insurance status and type, a lapse in the child's health insurance, and socioeconomic status. Similar to the three groups of independent variables, the research questions were also grouped accordingly.

This study answered the following three overarching questions:

Research Question 1: Which personal factors are associated with asthma HRQoL?

Research Question 1a: Which personal factors of a child are associated with asthma HRQoL, as measured by the number of symptom-free days?

$H_0$1a: No personal factors are associated with symptom-free days in children with asthma.

H_a1a: One or more personal factors are associated with symptom-free days in children with asthma.

Research Question 1b: Which personal factors of a child are associated with asthma HRQoL as measured by activity limitations?

$H_0$1b: No personal factors are associated with activity limitations for children with asthma.

H_a1b: One or more personal factors are associated with activity limitations for children with asthma.

Research Question 1c: Which personal factors of a child are associated with asthma HRQoL as measured by the number of missed school days?

$H_0$1c: No personal factors are associated with missed school for children with asthma.

H_a1c: One or more personal factors are associated with missed school for children with asthma.

Research Question 2: Which environmental factors are associated with asthma HRQoL?

Research Question 2a: Which environmental factors are associated with asthma HRQoL in children, as measured by the number of symptom-free days?

$H_0$2a: No environmental factors are associated with asthma HRQoL in children as measured by the number of symptom-free days in children with asthma.

H_a2a: One or more environmental factors are associated with symptom-free days in children with asthma.

Research Question 2b: Which environmental factors are associated with asthma HRQoL in children, as measured by activity limitations?

$H_0$2b: No environmental factors are associated with activity limitations for children with asthma.

H_a2b: One or more environmental factors are associated with activity limitations for children with asthma.

Research Question 2c: Which environmental factors are associated with asthma HRQoL in children, as measured by the number of missed school days?

$H_0$2c: No environmental factors are associated with missed school for children with asthma.

H_a2c: One or more environmental factors are associated with missed school for children with asthma.

Research Question 3: Which social factors are associated with asthma HRQoL?

Research Question 3a: Which social factors are associated with asthma HRQoL in children, as measured by the number of symptom-free days?

$H_0$3a: No social factors, as measured by adult perceived stress, insurance status and type, and socioeconomic status are associated with symptom-free days in children with asthma.

H_a3a: One or more social factors are associated with symptom-free days in children with asthma.

Research Question 3b: Which social factors are associated with asthma HRQoL in children, as measured by activity limitations?

$H_0$3b: No social factors are associated with activity limitations for children with asthma.

H_a3b: One or more social factors are associated with activity limitations for children with asthma.

Research Question 3c: Which social factors are associated with asthma HRQoL in children, as measured by the number of missed school days?

$H_0$3c: No social factors are associated with missed school for children with asthma.

H_a3c: One or more social factors are associated with missed school for children with asthma.

Chapter 4 presents the findings of this study. First, the data collection process will be described in which the characteristics of the population will be presented. Another component of this chapter are the results of the study in which the three research questions will be answered. To conclude the chapter, the findings from the study will be summarized.

Data Collection

Approval from Walden University's Institutional Review Board (IRB) was obtained prior to conducting the research (Approval # 08-30-17-0200358). After approval, ACBS data from surveys conducted between 2012 and 2014 were downloaded from the Center for Disease Control and Prevention's (CDC) website. Datasets for three years included all eligible study participants and the guardians' responses from the BRFSS. As a result, the removal of variables irrelevant to the study and observations of ineligible participants were required.

After excluding children that did not meet the age inclusion criterion, 2,968 (89.7%) records remained viable for this study. Exclusion of data from surveys for children outside of age inclusion criterion for aggregate years required re-weighting. The method for re-weighting the data was a multistep process, which used the previous weight for each state, sample size for each year, and took into consideration the number of years data was available. The previous weight was retained for states with only one year of data. In instances where there were several years, the existing weight was multiplied by the total sample size and then divided by the sum for all years for the respective state.

Several variables required re-categorizing due to skip-patterns in which a response of "*no*" resulted in skipping subsequent questions. For instance, if a child did not have a pet then the question pertaining to whether the animal was permitted in their room was skipped. Also, if a child did not currently have asthma and/or had not seen a doctor for their asthma, had not taken asthma medication or did not have asthma symptoms within the past year then the following questions were skipped: activity limitations, missed school, and barriers to a primary care physician, asthma specialist, and asthma medication. In addition to the previous criteria, a response to having an asthma action plan on file at school and the presence of a class pet and mold required that the child attend school outside of their home. Therefore, homeschooled children were skipped. Children that last had symptoms over three months were skipped for symptom-free days. Instead, values were retained for symptom-free days if they responded to last having symptoms: within the past three months, don't know, or refused. Questions

pertaining to the presence of an insurance gap or the type of insurance were only answered if the child did have insurance. Otherwise, the questions were skipped.

Tables 7 and 8 describes the prevalence of asthma among the eligible population unweighted and weighted for each year and for the 3-year period. Of the three years, 2014 had a higher proportion of surveys followed by 2012 and 2013 (37.6%, 33.7%, and 28.7% respectively). There was a total of 4,479,285 children that had ever been diagnosed with asthma after combining and re-weighting the three years of data. While the BRFSS ACBS was only generalizable to the participating states, the prevalence of children ever diagnosed with asthma for this study was approximately 8.3% during the study period. Overall, the prevalence rates are similar to previously reported rates for asthmatic children 0-17 years (Moorman et al., 2012).

Table 7

Unweighted Asthma Call-Back Survey (ACBS) Responses, 2012-2014

Characteristic	2012-2014 Sample (*N*)	2012 Sample (*n*)	2013 Sample (*n*)	2014 Sample (*n*)
Ever diagnosed with asthma	2,968	999	852	1,117

Table 8

Weighted Asthma Call-Back Survey (ACBS) responses, 2012-2014

Characteristic	2012-2014 Weighted *N* (thousands)	2012 Weighted % [95% CI]	2013 Weighted % [95% CI]	2014 Weighted % [95% CI]
Ever diagnosed with asthma	4,479	52.7 [48.55 – 56.86]	15.2 [13.06 – 17.42]	32.1 [28.75 – 35.35]

CI, Confidence Interval

Study Results

Descriptive Statistics

Sampling weights, stratum identifier, and primary sampling units were used to generate all analyses, including descriptive analysis. Continuous study variables (i.e. age and days mental health not good for guardians) were summarized using descriptive statistics including, mean, median, and standard error. Categorical or ordinal study variables (e.g. age, race, household income, and parent's education) were described using frequency distributions, including counts and percentages. Percentages were calculated with the denominator being the weighted total number of participants during the 3-year period.

Table 9 provides the demographic characteristics of children with a prevalence of asthma (i.e. ever diagnosed with asthma). The median age of study participants was 11.0 years and majority were boys (58.7%). Some diversity among the children was observed in the study, but three-fourths (75.9%) were white. Over half of the children (67.5%) were non-Hispanic.

Table 9

Characteristics of Asthma Call-Back Survey for Children 5-17 Years, 2012-2014

Characteristics	2012-2014 Sample*† (*N*)	Weighted *N* (in thousands)	Weighted % [95% CI]
Sex			
Boy	1,781	2,627	58.7 [54.62 – 62.72]
Girl	1,185	1,851	41.3 [37.28 – 45.38]
Age group			
5-11 years	1,201	2,283	51.0 [46.78 – 55.17]
12-17 years	1,767	2,196	49.0 [44.82 – 53.22]
Ethnicity			
Hispanic	505	1,445	32.5 [28.11 – 36.81]
Not Hispanic	2436	3,006	67.5 [63.19 – 71.89]
Race			
White	2,223	3,154	75.9 [72.38 – 79.43]
Black or African American	326	571	13.7 [11.33 – 16.16]
Other**	102	142	3.4 [2.40 – 4.44]
Asian	80	182	4.4 [2.17 – 6.59]
American Indian or Alaskan Native	51	106	2.5 [1.05 – 4.04]

CI, Confidence Interval
*Unweighted count
†Counts for characteristics may not sum to total due to non-responses
**Include participants that indicated their race as *Other* and Native Hawaiian or Other Pacific Islander

Characteristics of adult respondents from the BRFSS survey are presented in Table 10. The majority of the adults (69.5%) reported that they were married, did not have a history of asthma (85.9%), and (87.3%) were at least high school graduates. The high school graduation rate was similar to that of the national estimate, 86.3% (U.S. Census Bureau, 2010-2014). Over 60% of adults reported being employed, which includes individuals that reported being self-employed. The employment rate was slightly higher than the reported rate of 57.7%, but it was comparable to the estimated 63.9% of Americans in the workforce (U.S. Census Bureau, 2010-2014). Home ownership was observed in 66.0% of the adults whereas almost one-third reported living

in a rental home (31.2%). Similar responses were observed among adults reporting their household income in which 36.8% indicated theirs to be less than $35,000 annually and 37.3% reported over $75,000 annually. In comparison to national estimates, household incomes identified in this study are similar. For instance, household incomes below $35,000 and over $75,000 represented 33.4% and 35.4% of the population respectively (U.S. Census Bureau, 2010-2014). An equal proportion of adults were observed to be smokers (49%) and non-smokers (51%). Over half of adult respondents (58.4%) reported having good mental health while 14.1% reported having fifteen or more days of poor mental health.

Table 10

Characteristics of The Behavioral Risk Factors Surveillance System Respondents (Adults), 2012-2014

Characteristics	2012-2014 Sample* (*N*)	Weighted *N* (in thousands)	Weighted % [95% CI]
Marital status			
Married	2,049	3,111	69.5 [66.74 – 73.17]
Never married	247	426	9.5 [6.97 – 12.05]
Divorced	382	407	9.1 [7.41 – 10.75]
Member of unmarried couple	98	267	6.0 [3.62 – 8.30]
Separated	111	184	4.1 [2.78 – 5.42]
Widowed	80	85	1.9 [1.15 – 2.64]
Education			
Less than high school	216	570	12.7 [8.75 – 16.68]
High school graduate	625	769	17.2 [14.25 – 20.09]
Some college	875	1,117	24.9 [21.75 – 28.11]
College graduate	1,252	2,024	45.2 [40.88 – 49.48]

(continued)

Table 10 (continued)

Characteristics of The Behavioral Risk Factor Surveillance System Respondents (Adults), 2012-2014

Characteristics	2012-2014 Sample* (*N*)	Weighted *N* (in thousands)	Weighted % [95% CI]
Employment status			
Employed	2,018	2,874	64.2 [60.23 – 68.15]
Unemployed	948	1,603	35.8 [31.85 – 39.77]
Household income			
< $35,000	959	1,571	36.8 [32.61 – 41.02]
$35,000 - < $50,000	325	503	11.8 [8.77 – 14.79]
$50,000 - < $75,000	432	604	14.1 [11.02 – 17.27]
≥ $75,000	1,085	1,590	37.3 [32.93 – 41.58]
Home ownership			
Own	2,159	2,945	66.0 [61.66 – 70.26]
Rent	719	1,399	31.3 [27.03 – 35.62]
Other	86	121	2.7 [1.83 – 3.60]
Asthma prevalence			
Yes	517	632	14.1 [12.20 – 16.06]
No	2,445	3,843	85.9 [83.94 – 87.80]
Mental health well-being			
0	1690	2,602	58.4 [54.19 – 62.67]
1-14	832	1,223	27.5 [23.69 – 31.22]
≥ 15	427	629	14.1 [11.25 – 16.97]
Cigarette smoke			
Yes	535	706	49.0 [42.80– 55.17]
None	610	735	51.0 [44.82 – 57.20]

CI, Confidence Interval
*Unweighted count
†Counts for characteristics may not sum to total due to non-responses

Evaluation of Statistical Assumptions

Steps were taken to ensure the assumptions of the statistical tests were met. First, running correlations among the independent variables was performed. I reviewed the correlation matrix to assess values for correlation. For my study, I looked for values exceeding .8 as this would be indicative that two variables are correlated. While none of

the values exceeded .8, several independent variables were slightly high. For instance, having a pet in the home and permitting the pet in the bedroom had a correlation coefficient 0f .51187. Additional elevated coefficients were observed among cost barriers to physicians and specialists (.46513), cost barriers to physicians and medication (.42241), cost barrier to asthma specialist and medication (.37068).

An additional method I took to assess multicollinearity included fitting a regression model. Multicollinearity was present if variance inflation factor (VIF) surpassed 10 and the tolerance was near 0. The presence of mold in the school and having an insurance gap had VIFs near 10 and a low tolerance. A small sample size could contribute to the results for the presence of mold in the school whereas having an insurance gap could be truly correlated to a child having insurance. As a result, the two variables were not included in multivariable modeling.

Univariate analysis was performed to check for the frequency distribution and the normality of the data. Univariate analysis was performed for demographic characteristics and the three types of independent factors, environmental, personal, and social. There were no issues observed with outliers as majority of the variables were dichotomous. However, due to skip patterns, some questions appeared to have an increased number of missing data.

Environmental Factors

Environmental factors that were assessed included the presence of cockroaches within the home, pet ownership, presence of mold in the home and school, and the child's exposure to tobacco smoke. As outlined in Table 11, the majority of the environmental

factors were not observed among the population. However, pets within the home were observed in more than half of the population (54.2%). While over half of the children had pets in their home, approximately one-third (33.9%) had them within their bedroom.

Table 11

Environmental Characteristics of Asthma Call-Back Survey for Children 5-17 Years, 2012-2014

Environmental Factors	2012-2014 Sample*† (*N*)	Weighted *N* (in thousands)	Weighted % [95% CI]
Cockroaches			
Yes	214	490	10.9 [8.20 – 13.67]
No	2,752	3,989	89.1 [86.33 – 91.80]
Indoor Pets			
Yes	1,861	2,428	54.2 [49.87 – 58.57]
No	1,105	2,050	45.8 [41.43 – 50.13]
Pets in bedroom			
Yes	1,207	1,517	43.6 [38.71 – 48.40]
No	996	1,967	56.4 [51.60 – 61.29]
Pets in classroom			
Yes	94	163	4.0 [1.94 – 6.10]
No	2,623	3,897	96.0 [93.90 – 98.06]
Mold in home			
Yes	218	381	8.5 [6.23– 10.81]
No	2,742	4,094	91.5 [89.19 – 93.77]
Mold in school			
Yes	57	74	1.8 [0.87 – 2.70]
No	2,771	4,103	98.2 [97.30 – 99.13]
Exposure to ETS			
Yes	212	303	6.8 [5.32 – 8.20]
No	2,755	4,177	93.2 [91.80 – 94.68]

CI, Confidence Interval
ETS, Environmental tobacco smoke
*Unweighted count
†Counts for characteristics may not sum to total due to non-responses

Environmental Factors and HRQoL

The first research question, addressing which environmental factors were associated with asthma HRQoL, was answered by performing multiple linear regression models for both symptom-free days and the number of missed school days, and a cumulative logistic regression model for activity limitations. Table 12 shows the bivariate analysis among environmental factors and symptom-free days. Three of the six variables, presence of cockroaches, mold in school, and exposure to tobacco smoke were entered into the final model. Those variables were entered into the final model because their p-values met the entry requirements of $p<.20$.

Table 12

Bivariate Analysis for Environmental Factors and Symptom-Free Days

Environmental Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cockroaches					
No (reference)	-	-	-		-
Yes	-2.06	.311	28.72	4.74	**.0296**
Mold in home					
No (reference)	-	-	-	-	
Yes	8.69	.320	27.18	.00	.9936
Mold in school					
No (reference)	-	-	-	-	
Yes	8.77	.299	29.29	7.59	**.0060**
ETS					
No (reference)					
Yes	8.90	.323	27.56	21.38	**<.001**
Pets in home					
No (reference)	-	-	-	-	-
Yes	8.21	.449	18.30	2.09	**.1487**
Pets in room					
No (reference)	-	-	-	-	-
Yes	8.58	.497	17.27	.65	.4194
Pets in classroom					
No (reference)	-	-	-	-	-
Yes	8.61	.333	25.86	1.19	.2756

Adjusting for the child's age, gender, race, and ethnicity, the presence of mold in the school and ETS were found to be statistically associated with symptom-free days (Table 13). Specifically, mold observed in the school predicted almost a four-unit decrease in symptom-free days (Exp (β)= -3.738; p=.0090). Slightly over a three-unit decrease in symptom-free days was observed with ETS (Exp (β)= 3.228; p=<.0001). Overall, the null hypothesis can be rejected for this research question.

Table 13

Multiple Linear Regression Model for Environmental Factors and Symptom-Free Days

Environmental Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cockroaches					
No (reference)	-	-	-	-	-
Yes	-1.033	1.019	-1.01	1.07	.3108
Mold in school					
No (reference)	-	-	-	-	
Yes	-3.738	1.429	-2.62	3.97	**.0090**
ETS					
No (reference)					
Yes	-3.228	.826	-3.91	3.240	**<.0001**
Pets in home					
No (reference)	-	-	-	-	
Yes	.100	.607	.16	.03	.8696

Table 14 provides the statistics from the bivariate analysis for environmental factors and missed school days. Of the environmental factors, the sole variable that met the inclusionary p-value, .20, was the presence of mold in the school. Table 15 presents the adjusted model. After adjustment for the cofounding variables that were used for symptom-free days, the presence of mold in the school was not significant. Overall, the

null hypothesis for the research question to identify environmental factors associated with missed school days was not rejected.

Table 14

Bivariate Analysis for Environmental Factors and Missed School

Environmental Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cockroaches					
No (reference)	-	-	-		-
Yes	2.42	.240	10.11	.78	.3762
Mold in home					
No (reference)	-	-	-	-	
Yes	2.393	.210	11.41	.70	.4030
Mold in school					
No (reference)	-	-	-	-	
Yes	2.435	.241	10.11	3.02	**.0826**
ETS					
No (reference)					
Yes	2.492	.239	10.45	0.00	.9925
Pets in home					
No (reference)	-	-	-	-	-
Yes	2.646	.332	7.96	.39	.5334
Pets in room					
No (reference)	-	-	-	-	-
Yes	2.575	.414	6.22	1.48	.2238
Pets in classroom					
No (reference)	-	-	-	-	-
Yes	2.435	.242	10.04	.74	.3887

Table 15

Multiple Linear Regression Model for Environmental Factors and Missed School

Environmental Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Mold in school					
No (reference)	-	-	-		-
Yes	2.42	.240	10.11	.78	.3762

Bivariate analysis for activity limitations and environmental factors are presented in Table 16. Almost all predictors had an odds ratio (OR) of approximately one and high

p-values, which was indicative that the environmental factors were not associated with activity limitations. However, classroom pets were the only environmental factor eligible for the final model as its p-value was <.20. In Table 17, the adjusted statistics for classroom pets is presented. After adjusting for confounding factors, classroom pets were not found to predict activity limitations (OR=1.318; *p*=.5779). As a result, the null hypothesis for the research question, which personal factors of a child are associated with asthma HRQoL as measured by activity limitations, was not rejected.

Table 16

Bivariate Analysis for Environmental Factors and Activity Limitations

Environmental Factors	OR	95% CI		*p*-value
Cockroaches				
No (reference)	-	-	-	-
Yes	1.197	0.666	2.153	.5480
Mold in home				
No (reference)	-	-	-	-
Yes	.964	.513	1.808	.9078
Mold in school				
No (reference)	-	-	-	-
Yes	1.607	.513	5.035	.4152
Pets				
No (reference)	-	-	-	-
Yes	1.103	.749	1.625	.6192
Pets in classroom				
No (reference)	-	-	-	-
Yes	2.472	.798	7.654	**.1165**
ETS				
No (reference)	-	-	-	-
Yes	1.306	.782	2.180	.3075

Table 17

Cumulative Logistic Regression Model for Environmental Factors and Activity Limitations

Environmental Factors	OR	95% CI		*p*-value
Pets in classroom				
No (reference)	-	-	-	-
Yes	1.318	0.498	3.486	.5779

Personal Factors

Personal factors assessed included those for the child with asthma and the adult respondent. Variables for children included having an asthma action plan at home and on file in school and had taken an asthma management course. For adult respondents, mental health well-being was a personal factor of interest. Slightly over half (51.5%) of the children had an asthma action plan. However, the proportion of children with an asthma action plan on file at school was lower (36.1%).

Table 18

Personal Characteristics of Asthma Call-Back Survey for Children 5-17 Years, 2012-2014

Personal Factors	2012-2014 Sample*† (*N*)	Weighted *N* (in thousands)	Weighted % [95% CI]
Asthma action plan			
Yes	1,465	2,306	51.9 [47.64 – 56.15]
No	1,459	2,138	48.1 [43.85 – 52.36]
Asthma action plan in school			
Yes	1,394	2,063	46.1 [41.79 – 50.34]
No	1,574	2,416	53.9 [49.66 – 58.21]
Asthma management course			
Yes	375	679	15.2 [11.65 – 18.72]
No	2,587	3,794	84.8 [81.28 – 88.35]

CI, Confidence Interval
*Unweighted count
†Counts for characteristics may not sum to total due to non-responses

Personal Factors and HRQoL

Results for the bivariate analysis among the personal factors and HRQoL outcome, symptom-free days, are presented in Table 19. Two of the four factors, the child previously taking an asthma management course and the number of days the guardian's mental health was not good, were eligible for entry into the final multiple linear regression model.

Table 19

Bivariate Analysis for Personal Factors and Symptom-Free Days

Personal Factors	*β* Coefficient	SE	*t*-test	*F* test	*p*-value
AAP					
Yes (reference)	-	-	-		-
No	-.234	.454	-0.39	.15	.6994
AAP-School					
Yes (reference)	-	-	-	-	-
No	.664	.618	1.07	1.15	.2834
Management course					
Yes (reference)	-	-	-	-	-
No	1.116	.802	1.39	1.93	**.1647**
Mental health status					
0 days	-	-	-	-	-
1-14 days	1.928	.693	-2.78	6.07*	**.0024***
≥15 days	-1.256	.800	-2.68		

AAP, Asthma action plan
*Result for categorical variable

Upon adjustment for confounding factors, the guardian's mental health status was statistically significant (Table 20). For every day the adult's mental health was not good, a decrease in symptom-free days was observed (p=.0087). Moreover, having 1-14 days of poor health reduced symptom-free days by 1.737 units while having 15 or more days of poor mental health contributed to almost two-unit (1.957) reduction of symptom-free days. Overall, this means that one's decreased mental health was associated with a reduction in symptom-free days for the child with asthma. Therefore, the null hypothesis for this research question can be rejected.

Table 20

Multiple Linear Regression Model for Personal Factors and Symptom-Free Days

Personal Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Management Course					
Yes (reference)	-	-	-	-	-
No	.517	.765	.68	.46	.4994
Mental health					
0	-	-	-	-	
1-14 days	-1.737	.707	-2.46	4.77*	**.0087***
≥15 days	-1.957	.821	-2.38		

AAP, Asthma action plan
*Statistics for categorical data

Bivariate analysis for personal factors and missed school are presented in Table 21. An asthma action plan on file at school, previously taken an asthma management course, and the number of days the guardian's mental health status were not good were included into the multiple linear regression model.

Table 21

Bivariate Analysis for Personal Factors and Missed School

Personal Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
AAP					
Yes (reference)	-	-	-		-
No	.150	.455	.33	.11	.7422
AAP-School					
Yes (reference)	-	-	-		-
No	-1.911	.457	-4.18	17.46	**<.0001**
Management course					
Yes (reference)	-	-	-	-	-
No	-1.314	.704	-1.87	3.48	**.0620**
Mental health status					
0 days	-	-	-	-	-
1-14 days	.293	.546	.54	4.04*	**.0177***
≥15 days	2.308	.818	2.82		

AAP, Asthma action plan
*Statistics for categorical data

Results from the multiple linear regression model are presented in Table 22. Upon adjusting for the confounding variables, taking an asthma management course was not found to be statistically significant in predicting missed school (p=.5143). However, having an asthma action plan at school and the number of days the guardian's mental health was not good were associated with school absenteeism. Furthermore, not having an asthma action on file at school reduced school absenteeism by 1.79 units (p=.0001). The number of days the guardian's mental health day was not good contributed to a .449-unit increase in missed school days for guardians with 1-14 days of poor mental health and over two times higher for 15 or more days (2.323; p=.0090). Overall, the null hypothesis for this research question can be rejected.

Table 22

Multiple Linear Regression Model for Personal Factors and Missed School

Personal Factors	β Coefficient	SE	t-test	F test	p-value
AAP-School					
Yes (reference)	-	-	-		-
No	-1.79	.466	-3.85	14.80	**.0001**
Management course					
Yes (reference)	-	-	-	-	-
No	-.456	.699	-.65	3.48	.5143
Mental health status					
0 days	-	-	-	-	-
1-14 days	.449	.553	.81	4.72*	**.0090***
≥15 days	2.323	.766	3.03		

*Statistics for categorical data

Bivariate analysis for personal factors and activity limitations are presented in Table 23. Three of the four personal factors, having an asthma action plan at home and school and the guardian's mental health status, will be included into the multivariable model (Table 24). After adjusting for confounding variables, none of the personal factors

were statistically associated with activity limitations. As a result, the null hypothesis was not rejected for the research question, which personal factors of a child are associated with asthma HRQoL as measured by activity limitations?

Table 23

Bivariate Analysis for Personal Factors and Activity Limitations

Environmental Factors	OR	95% CI		*p*-value
AAP				
Yes (reference)	-	-	-	-
No	.654	0.447	.956	**.0286**
AAP-School				
Yes (reference)	-	-	-	-
No	.651	.442	.959	**.0298**
Management course				
Yes (reference)	-	-	-	-
No	.862	.486	1.532	.6133
Mental health status				
0 days (reference)	-	-	-	-
1-14 days	.2203	.808	1.923	**.1653***
≥15 days	.5204	.972	2.913	

*Statistics for categorical data

Table 24

Cumulative Logistic Regression Model for Personal Factors and Activity Limitations

Personal Factors	OR	95% CI		*p*-value
Asthma Action Plan				
Yes (reference)	-	-	-	-
No	.745	.495	1.122	.1583
AAP-School				
Yes (reference)	-	-	-	-
No	.675	.444	1.026	.0661
Mental health status				
0 days (reference)	-	-	-	-
1-14 days	1.332	.877	2.025	.0889*
≥15 days	1.773	1.036	3.037	

*Statistics for categorical data

Social Factors

As shown in Table 25, social factors that were assessed primarily pertained to access to health care. Those variables included cost barriers to primary care, asthma specialists, and prescriptions and one's insurance status, including the specific type and the presence of a gap in coverage. While barriers were only observed in a small proportion of children with asthma, the barrier to prescriptions was the most common with 7.2% reported for children followed by primary care and asthma specialists (2.7%; and 2.6% respectively). Almost all children had insurance and very few reported having an insurance gap. Slightly more than half (53.1%) of the children were insured by their parent's employer and almost a quarter (23.9%) of the children had Medicaid or Medicare insurance.

Table 25

Social Characteristics of Asthma Call-Back Survey for Children 5-17 Years, 2012-2014

Social Factors	2012-2014 Sample*† (*N*)	Weighted *N* (thousands)	Weighted % [95% CI]
Cost Barrier for Primary Care			
Yes	77	108	3.0 [1.82 – 4.25]
No	2,101	3,452	97.0 [95.75 – 98.18]
Cost Barrier for Asthma Specialist			
Yes	54	113	3.2 [.94 – 5.42]
No	2,125	3,448	96.8 [94.58 – 99.06]
Cost Barrier to Prescription			
Yes	154	302	8.5 [5.12 – 11.83]
No	2,023	3,258	91.5 [88.17 – 94.88]

(continued)

Table 25 (continued)

Social Characteristics of Asthma Call-Back Survey for Children 5-17 Years, 2012-2014

Social Factors	2012-2014 Sample*† (*N*)	Weighted *N* (thousands)	Weighted % [95% CI]
Have Insurance			
Yes	2,832	4,136	92.5 [89.26 – 95.66]
No	132	337	7.5 [4.34 – 10.74]
Insurance gap			
Yes	157	197	4.8 [3.29 – 6.24]
No	2,673	3,938	95.2 [93.76 – 96.71]
Insurance type			
Parent's Employer	1,778	2,379	58.0 [53.66 – 62.39]
Medicaid/Medicare	659	1,071	26.1 [22.30 – 29.93]
Other	207	361	8.8 [6.25 – 11.38]
CHIP	166	289	7.0 [4.46 – 9.64]

CI, Confidence Interval
*Unweighted count
†Counts for characteristics may not sum to total due to non-responses

Social Factors and HRQoL

Observed in Table 26, bivariate analyses for social factors and symptom-free days are presented. All social factors will be entered into the multiple linear regression model as their p-values met the .20 inclusion criteria. Furthermore, four of the six factors had p-values <.05. The multiple linear regression model is presented in Table 27. Of all of the independent factors, a cost barrier to medication was associated with symptom-free days. Moreover, that barrier resulted in over a two unit decrease in symptom-free days (p=.0033).

Table 26

Bivariate Analysis for Social Factors and Symptom-Free Days

Social Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cost Barrier-PCP					
No (reference)	-	-			-
Yes	-2.911	.923	-3.15	9.94	**.0017**
Cost Barrier-Specialist					
No (reference)	-	-	-	-	-
Yes	-3.529	.977	-3.61	13.04	**.0003**
Cost Barrier-Rx					
No (reference)	-	-	-	-	-
Yes	-2.861	.604	-4.74	22.46	**<.0001**
Insurance Status					
Yes (reference)	-	-	-	-	-
No	-2.130	1.507	-1.41	2.00	.**1578**
Insurance Gap					
No (reference)	-	-	-	-	-
Yes	-1.640	.860	-1.91	3.64	**.0569**
Insurance Type					
Parent's Employer (reference)	-	-	-	-	
Medicaid/Medicare	-1.857	.794	-2.34	2.64	**.0483***
CHIP	-1.729	1.026	-1.69		
Other	-1.525	.945	-1.61		

*Statistics for categorical data

Table 27

Multiple Linear Regression Model for Social Factors and Symptom-Free Days

Social Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cost Barrier-PCP					
No (reference)	-	-			-
Yes	-.640	1.104	-.58	.34	.5622
Cost Barrier-Specialist					
No (reference)	-	-	-	-	-
Yes	-2.078	1.425	-1.46	2.13	.1452
Cost Barrier-Rx					
No (reference)	-	-	-	-	-
Yes	-2.492	.847	-2.94	8.66	**.0033**

(continued)

Table 27 (continued)

Multiple Linear Regression Model for Social Factors and Symptom-Free Days

Social Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Insurance Status					
Yes (reference)	-	-	-	-	-
No	-	-	-	-	-
Insurance Gap					
No (reference)	-	-	-	-	-
Yes	-.500	1.038	-.48	.23	.6301
Insurance Type					
Parent's Employer	-	-	-	-	
(reference)	-1.014	.829	-1.22	.86	.4621*
Medicaid/Medicare	-1.225	.934	-1.31		
CHIP	-.857	1.095	-.78		
Other					

*Statistics for categorical data

Bivariate analyses for the outcome variable, missed school days, and social factors are presented in Table 28. All financial barriers, having a gap in health insurance, and the type of health insurance the child had were included in the multiple linear regression model (Table 29). After adjusting for confounding factors, a lapse in health insurance and the type of health insurance were associated with missed school. An insurance gap resulted in slightly over a two-unit decrease in missed school (p=.0001). A child that had CHIP health insurance resulted in over a three-unit increase in missed school followed by slightly over a one-unit increase in missed school among children with Medicaid or Medicare insurance (p=.0085).

Table 28

Bivariate Analysis for Social Factors and Missed School Days

Social Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cost Barrier-PCP					
No (reference)	-	-			-
Yes	2.185	1.051	2.08	4.32	**.0378**
Cost Barrier-Specialist					
No (reference)	-	-	-	-	-
Yes	4.890	2.700	1.81	3.28	**.0702**
Cost Barrier-Rx					
No (reference)	-	-	-	-	-
Yes	1.282	.868	1.48	2.18	**.1396**
Insurance Status					
Yes (reference)	-	-	-	-	-
No	.965	1.134	.85	.72	.3952
Insurance Gap					
No (reference)	-	-	-	-	-
Yes	-1.100	.395	-2.78	7.75	**.0054**
Insurance Type					
Parent's Employer (reference)	-	-	-	-	-
Medicaid/Medicare	1.936	.501	3.86	6.63	**.0002***
CHIP	.830	.781	1.06		
Other	3.434	1.561	2.20		

*Statistics for categorical data

Table 29

Multiple Linear Regression Model for Social Factors and Missed School Days

Social Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cost Barrier-PCP					
No (reference)	-	-			-
Yes	-1.944	1.086	-1.79	3.20	.0737
Cost Barrier-Specialist					
No (reference)	-	-	-	-	-
Yes	6.402	3.492	1.83	3.36	.0669

(continued)

Table 29 (continued)

Multiple Linear Regression Model for Social Factors and Missed School Days

Social Factors	β Coefficient	SE	*t*-test	*F* test	*p*-value
Cost Barrier-Rx					
No (reference)	-	-	-	-	-
Yes	.452	1.143	.40	.16	.6923
Insurance Gap					
No (reference)	-	-	-	-	-
Yes	-2.014	-3.90	.0001	15.20	**.0001**
Insurance Type					
Parent's Employer (reference)	-	-	-	-	-
Medicaid/Medicare	1.394	.594	2.35	3.91	**.0085***
CHIP	3.724	1.014	.88		
Other	.452	1.837	2.03		

*Statistics for categorical data

The results for the bivariate analysis between the social factors and the outcome, activity limitations, are presented in Table 30. Of the social factors, the child experiencing a financial barrier to seeing a physician and their insurance status were the two variables that met the inclusionary p-value, <.20. After adjusting for confounding factors, children that experienced a financial barrier to seeing a physician were 3.914 (p=.0052) times more likely than those that did not to report having activity limitations (Table 31). Children without health insurance were less likely to experience activity limitations. However, the association was marginally statistically significant p=.0541. As a result, the null hypothesis for this research question can be rejected.

Table 30

Bivariate Analysis for Social Factors and Activity Limitations

Social Factors	OR	95% CI		*p*-value
Cost Barrier-PCP				
No (reference)	-	-	-	-
Yes	2.342	1.005	5.457	**.0486**
Cost Barrier-Specialist				
No (reference)	-	-	-	-
Yes	1.291	.336	4.956	.7097
Cost Barrier to Prescription				
No (reference)	-	-	-	-
Yes	1.130	.550	2.322	.7383
Insurance				
Yes (reference)	-	-	-	-
No	.481	.191	1.211	.1201
Insurance Gap				
No (reference)	-	-	-	-
Yes	1.305	.678	2.513	.4248
Insurance Type				
Employer (reference)	-	-	-	-
Medicaid/Medicare	.947	.603	1.486	.4810*
CHIP	1.497	.782	2.864	
Other	1.397	.674	2.894	

*Statistics for categorical data

Table 31

Cumulative Logistic Regression Model for Social Factors and Activity Limitations

Social Factors	OR	95% CI		*p*-value
Cost Barrier-PCP				
No (reference)	-	-	-	-
Yes	3.914	1.503	10.196	**.0052**
Insurance				
Yes (reference)	-	-	-	-
No	.403	.160	1.016	**.0541**

Conclusion

In Chapter 4, I present the results for my three-overarching and subquestions. To test the hypothesis, multiple linear regression models for complex survey data were performed for the two HRQoL outcomes, symptom-free days and missed school days contributed to asthma. Factors associated with fewer symptom-free days included the presence of mold in the child's school and the number of days the guardian's mental health was not good. The guardian's diminished mental health was also found to be associated with school absenteeism. A cumulative regression model for complex survey data was applied to assess the relationship between environmental, personal, and social factors and the HRQoL outcome, activity limitations. Of the three groups of factors, only one variable, experiencing a financial barrier to seeing a physician, was found to be a strong predictor. The next and final chapter presents the conclusion of my research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

National cross-sectional data from 2,968 parents that completed the Asthma Call-back Survey (ACBS) for their child with asthma between 2012 and 2014 were analyzed. After weighting the data, the total population resulted in 4,479,285 children with asthma. In this quantitative study, I explored how health-related quality of life (HRQoL) of children with asthma was individually and cumulatively affected by environmental, personal, and social factors. HRQoL as measured by missed school, symptom-free days, and activity limitations was assessed due to the burden asthma has on a child's life. In addition, previous research on this area has been limited to clinical populations, restricting the scope of the research and the generalizability of results.

Environmental factors assessed included the presence of roaches in the home, mold in the home and school, exposure to tobacco smoke, and pets in the home and school. Personal factors that were analyzed included having an asthma action plan at home and on file at school, a history of taking an asthma management course, and the number of days the guardian's mental health status was not good. The final set of variables that were assessed for social factors included the child's health insurance status, the type of insurance, and the presence of a gap in their insurance. Multiple linear regression modeling was applied to assess the association for missed school days and symptom-free days and the three groups of factors. A cumulative regression model was utilized to test the association between the independent factors and activity limitations.

Main Findings

Of the children with a prevalence of asthma, the majority (58.7%) were boys, almost an equal distribution of children in the two age groups, 5-11 and 12-17 was observed (50.9% and 49.1% respectively), and most of the children were white (75.9%) and non-Hispanic (67.5%). With the exception of the presence of a pet in the home (54.2%), the exposure to other environmental factors were minimum. Slightly over half (51.5%) of the children had an asthma action plan, but the vast majority of them (84.8%) had not taken an asthma management course. Although barriers to health resources (i.e., primary care, asthma specialist, and medication) were not explored in the modeling, the barriers were very minimal in the population (2.7%, 2.6%, and 7.2% respectively). Almost all children had insurance (92.3%) and very few children had insurance gaps (4.4%). A variation was observed in the type of insurance children had, but 53.1% were covered under their parent's employer's insurance.

A considerable number of predictors were identified to be significant in univariate models, but not when entered into final multivariate models. In the models to identify the predictors of symptom-free days, an association was observed with the presence of mold in the school and the number of days the guardian's mental health was not good. The number of days the guardian's mental health was not good was the only predictor in models for school absenteeism. A lack of having an asthma action plan was the only predictor for activity limitations. Overall, no social factors were associated with any of the HRQoL outcomes.

Interpretation of Findings

Data for this specific period of time and age group are limited. While the exact prevalence of asthma for the 3-year period is unknown, the prevalence identified in the National Health Interview Surveys for all children under 18 years old was 14.0%, 12.7%, and 13.5% in 2012, 2013, and 2014 respectively (National Center for Environmental Health, 2014; National Center for Environmental Health, 2015; National Center for Environmental Health, 2016). The prevalence percent identified in my research could be an approximate reflection of asthma prevalence during this time for the participating states. Similar to existing literature, the prevalence of asthma was higher among boys than girls (Moorman, et al., 2012; Winer et al., 2012; Zahran et al., 2018)

Environmental Factors and HRQoL

Environmental factors found to be associated with a HRQoL outcome in this study was the association of observing mold inside the school and fewer symptom-free days. Moreover, almost a four-day reduction in the number of symptom-free days was observed. This finding can be supported by a study that measured mold inside schools of asthmatic children in which all classrooms tested had mold present (Baxi et al., 2013). Moreover, Baxi et al. (2013) found that mold spores were higher in classrooms where mildew was visible. Mold could impair a child's respiratory system, which could eventually lead to asthma exacerbation and reduce their symptom-free days.

Another association was observed with the environmental factor, ETS. Slightly over a three-day reduction in symptom-free days was observed among children exposed to tobacco smoke. These results contradict those that were found in another study in

which ETS was not associated with a child's quality of life among children living in public housing in Boston, MA (Levy et al., 2004). ETS was only observed to be associated with respiratory symptom scores in another multivariate analysis (Levy et al., 2004). However, Levy et al. (2004) caveated that results from modeling were limited due to a small sample size. While it was not explicitly stated, a reason why ETS may not have been associated with quality of life in this population could be due to smoking regulations in public housing. Overall, ETS could have been associated with quality in life in a larger population or among children that live in non-public housing communities.

With the exception of the presence of mold in the school and exposure to ETS, findings from this study showed that environmental factors such as the presence of cockroaches, pets in the home and at school, and mold in the home were not statistically associated with symptom-free days, school absenteeism, or activity limitations. These findings aligned with those of Hsu et al. (2016) in which mold reported in the school was identified to be associated with symptom-free days. The lack of identifying an association between environmental smoke and domestic pets is also supported by Deger et al. (2010). Overall, previous research suggests that environmental factors within schools could have greater effects on asthma outcomes than those in the home, which aligns with the findings in this study (Hsu et al., 2016; Sheehan et al., 2017).

Personal Factors and HRQoL

The number of days the guardian's mental health was not good was found to be associated with the HRQoL outcomes, symptom-free days, and school absenteeism. Moreover, there was a reduction in symptom-free days and an increase in school

absenteeism as the number of poor mental health days increased. While it is unclear whether the guardian's mental health is directly caused by the child's asthma condition, research has found that fear, limited sleep, missed work, and other stressors are prominent among caregivers of children with asthma (Levy et al., 2004; Milam et al., 2008; Kieckhefer & Ratcliffe, 2008; Quinn, Kaufman, Siddiqi, & Yeatts, 2010). Unlike this study that solely focused on the number of days the guardian's mental health was not good, Quinn et al. (2010) focused on the magnitude of the health outcome and its' association with higher or lower reporting of housing stressors. As potential proxies for HRQoL outcomes for this research, Quinn et al. (2010) observed higher associations among waking at night (proxy for symptom-free days) and exercise intolerance (proxy for activity limitations), but not school absences. Milam et al. (2008) observed an association between wheezing and parental stress among parents without asthma prevalence.

Remaining personal factors, including having an action plan and taking an asthma management course, were not associated with the three HRQoL outcomes. There could be other factors that were not assessed in this study that contributed to this finding. While asthma recommendations include the individual having a written plan and taking asthma management courses, the rates of both have been historically low (Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012; Zahran, Bailey, & Garbe, 2011). In this study, less than 50% of the children had an action plan and a little over ten percent of the population had ever taken a management course.

Social Factors and HRQoL

Of the social factors studied, having a cost barrier to prescriptions were associated with symptom-free days. Overall, a two and one-half -unit decrease in symptom-free days was identified among children experiencing the barrier. Previous research has found that physicians are less likely to ask parents about prescription costs when prescribing (Patel, Coffman, Tseng, Clark, & Cabana, 2009). Therefore, Patel et al. (2009) finding could support why this barrier was identified in my study.

Having an insurance gap and the type of health insurance the child had were social factors associated with missed school. An insurance gap was found to have a two-unit decrease in school absenteeism, which was unexpected. A previous study found that children within an insurance gap had an increased risk of poorly controlled asthma and activity limitations (Pearlman, Jackson, Gjelsvik, Viner-Brown, & Garro, 2012). Therefore, it would be assumed that children would miss more days if their asthma was poorly controlled. A potential reason for this finding could be contributed to inadequate power due to a small sample size. Moreover, less than 5% of the population had an insurance gap within the previous year. A small proportion of children without insurance is likely due to the accessibility of health care for children.

An association was identified among missed school and children with insurance other than a parent or guardian's employers'. This finding is partially supported in previous research (Hsu, Qin, Beavers, & Mirabelli, 2016). Hsu et al. (2016) found that children that had missed one or more days had Medicaid or Medicare insurance. However, the other types of insurance were all lower for any missed school. Non-

privatized health insurance such as Medicaid has been identified in other research to not have favorable outcomes for children with asthma (Chang et al., 2014). While it is not fully supported by the literature, private health insurance plans could be comprehensive in which more asthma services are covered as opposed to public plans such as Medicaid or CHIP. In a study among urban minority children in which majority of the study population had public insurance, the likelihood of poor children receiving asthma specialty care was low (Flores et al., 2009). Another potential reason for the association could be contributed to discriminatory practices among health care entities denying or delaying treatment for children with public insurance (Bisgaier & Rhodes, 2011). As a result, the delay in treatment can result in children missing school due to the presence of asthma symptoms.

A cost barrier to seeing a primary care physician and the lack of insurance were associated with activity limitations. Almost a four-unit increase in activity limitations were observed among children that experienced a cost barrier to seeing a physician. The activity limitations that children experienced could be contributed to their asthma being poorly controlled as a result of not seeing a physician. In comparison to children with insurance, those without it were found to have fewer activity limitations. This finding was unexpected as the limited access to health care can subsequently effect whether a child has access to resources to manage the disease. Similar to other factors with small sizes, the unusual results could be the result of inadequate power. For instance, only 7.5% of the total population lacked health insurance, so the deletion of participants for missing data in the modeling process would further reduce the number of viable

participants. As a result, the association observed between insurance status and activity limitations could be unreliable.

Limitations of the Study

Despite taking the necessary approaches statistically and methodology, my study's results are limited. As a cross-sectional study, causality cannot be established. Instead, associations between the factors and HRQoL outcomes are possible. Another limitation of the study is its lack of generalizability. Specifically, while the survey was administered nationally and the data was weighted, the results are only limited to the participating states. As a result, the prevalence of asthma cannot be determined for the entire country. A third limitation of the study are small percentages for responses for some variables. This limitation could be contributed to the skip patterns in which if a child did not meet the requirements for the preceding question then subsequent ones were skipped. Another issue that this limitation presented is the removal of a significant amount of data in the modeling process. The statistical software excluded participants in the modeling process if they had missing data for either dependent or independent variables, thus reducing the population size. While the number of deleted participants varied across the nine models, the one assessing the association between social factors and symptom-free days had the lowest number of participants, 35%. A final limiting factor was in which the questions were inconsistently asked in the survey. For instance, some questions were based on the previous year or within the past 14 or 30 days. This could result in recall bias as parents could have remembered events that recently occurred.

Recommendations

To address some of the limitations of my study and to expand the research, several recommendations are proposed. First, the data collection period to capture additional years of data should be extended. Another recommendation would be to increase the number of participating states. A final recommendation would be to explore interactions between the independent variables. These recommendations can subsequently further enhance the literature on childhood asthma and continue to help improve asthma management.

Extending years of data collection once it is available would increase the population size. While combining three years of data was advantageous, the weighted number of participants was still relatively low. Moreover, the CDC combines data into a PUDF once there is at least five years of data. Adding more years of data would increase in the study's power. That would increase the population sizes for specific questions that had low responses due to skip patterns.

Along with extending years of data collection, increasing the number of participating states and consistent participation among states would strengthen further research. States inconsistently participated in the survey, which adversely effected inferences that could be made by their available data. Expanding the survey to more states would increase the ability to generalize the findings to more children in the United States. Therefore, the health community would have a better understanding how asthma affects a child's HRQoL.

Aside from recommendations pertaining to the implementation of the survey, analyzing the data to assess interaction between variables is also recommended. The addition of interactions could lead to better understanding the relationships among the variables. Specially, my research sought out the main effects between the HRQoL outcomes and factors, but interactions could have existed between the factors. As a result, it could be difficult to truly ascertain how the factors all influence the HRQoL outcomes. Overall, this could be extremely critical to better understand asthma since it is a multifactorial disease.

Implications

An EST was the foundation for this research due to the multifaceted nature of asthma. The EST was utilized to explore how factors at various levels can directly and indirectly affect a child with asthma HRQoL. Moreover, most of the associations observed in this research fit into the inner-most systems including the micro, meso, and exo. At the microsystem, an association between environmental factors such as exposure to mold in the school and ETS and HRQoL outcomes. This finding is particularly important as the factors are part of the system closest to the child. As a result, the reduction of the exposures can potentially improve a child's HRQoL, but the failure to do so can contribute to further adverse consequences. Some factors that would have aligned with the mesosystem were not found to be associated with the HRQoL outcomes. For example, having an asthma action plan on file at school would have aligned with this system because it required the interaction between the child's two microsystems (i.e. home and school). Some factors fit into the exosystem, which was identified by the

child's type of insurance and its association with school absenteeism. Furthermore, given that public insurance is dependent upon the parent or guardian's income or the availability of health insurance through their employer, the child's HRQoL is indirectly effected by this. Also within the exosystem, extenuating circumstances can result in the parent or guardian's inability to afford the child's medication or pay for them to see their physician, which was associated with activity limitations and symptom-free days, respectively. Overall, the associations observed at the various systems imply that asthma is truly an ecological condition.

As multiple aspects contribute to the burden on asthma, addressing the disease requires a multi-step process. Results from this study have implications for positive social change at the child, family, community, and health care levels. At the child and family's level, results from my study can better educate them on how factors that they can modify affects their HRQoL. In addition, the study can empower the individual and their family to be advocates in their asthma management when interacting with their community and health care providers. This study showed that key components in asthma management such as having an asthma action plan and taking a management course was low. Therefore, they can request both from their health care provider. Also, associations were observed among cost barriers to obtaining medication and seeing a physician and HRQoL outcomes. As a result, parents can seek out free or reduced resources in their community or express their challenges with the health care provider. The results from this study have implications for positive social change at the community level by informing them of how critical their involvement is in ensuring the child's asthma is

better managed. Specifically, school nurses can partner with children and their families to have an asthma action plan on file and can help reduce children's exposure to irritants around the school. Also, now that most children have access to smart phones or other devices and technology has advanced drastically, technical developers could create innovative applications or devices to help with asthma management. For health care providers, the results can help with several aspects. First, the results can aide in the improvement of communication with the child and their family. Furthermore, physicians can begin to break down communication barriers among them and the patient as a result of providing education on the disease and engaging in conversations to better understand any challenges that may be a hinderance to asthma management. These results showed that almost half of the participants had an asthma action plan, which is low considering it is recommended in asthma guidelines. Therefore, these results can help health care providers with improving asthma management by encouraging them to develop the plan with the child and their family in addition to referring them to additional services such as a management courses.

Conclusion

Asthma is a leading chronic disease for children in the United States. A disease that can lead to increased morbidity for children, asthma can adversely affect a child's quality of life. This research explored the association between HRQoL outcomes including school absenteeism, symptom-free days, and activity limitations and environmental, personal, and social factors among school-age children with asthma in a national survey. Findings from this research not only contribute to the existing body of

literature, but they can help improve the quality of life for children with asthma. Moreover, children should be free to grow and enjoy every milestone in their life without the limitations of asthma.

References

Ahmad, N., Biswas, S., Bae, S., Meador, K. E. S., Huang, R., & Singh, K. P. (2009). Association between obesity and asthma in US children and adolescents. *Journal of Asthma*, *46*(7), 642-646. doi:10.1080/02770900802503123

Akinbami, L. J., Simon, A. E., & Rossen, L. M. (2016). Changing trends in asthma prevalence among children. *Pediatrics, 131*(1), 1-7. doi:10.1542/peds.2015-2354

Akinbami, L. J., Kit, B. K., & Simon, A. E. (2013). Impact of environmental tobacco smoke on children with asthma, United States, 2003-2010. *Academic Pediatrics, 13*(6), 508-516. doi:10.1016/j.acap.2013.07.003

Akinbami, L. J., Moorman, J. E., & Liu, X. (2011). Asthma prevalence, health care use, and mortality: United States, 2005-2009. *National Health Statistics Reports, 32*, 1-14. Retrieved from https://www.aap.org/en-us/Documents/medicalhome_resources_asthma_prevalence.pdf

American Association for Public Opinion Research. (2010). New considerations for survey researchers when planning and conducting RDD telephone surveys in the U.S. with respondents reached via cell phone numbers. Retrieved from https://www.aapor.org/AAPOR_Main/media/MainSiteFiles/2010AAPORCellPhoneTFReport.pdf

American Lung Association. (2012). Trends in asthma morbidity and mortality. Epidemiology and Statistics Unit. Retrieved from http://www.lung.org/finding-cures/our-research/trend-reports/asthma-trend-report.pdf

Bach, C. E. (2011). Asthma and the achievement gap among urban minority youth. *Journal of School Health, 81*(10), 606-613. doi:10.1111/j.1746-1561.2011.00634.x

Beck, A. F., Simmons, J. M., Huang, B., & Kahn, R. S. (2012). Geomedicine: Area-based socioeconomic measures for assessing risk of hospital reutilization among children admitted for asthma. *American Journal of Public Health*, *102*(12), 2308-2314. doi:10.2105/AJPH.2012.300806

Berglund, P. A. (2014). Analysis of survey data using the SAS survey procedures: A primer. Retrieved from http://www.isr.umichedu/src/smp/asda/Berglund%20Survey%20Data%20Analysis%20WIILL%20June%202014.pdf

Berkman, L. F., & Kawachi, I. (2000). *Social Epidemiology* (1st ed.). New York, NY: Oxford University Press.

Bhaumik, U., Norris, K., Charron, G., Walker, S. P., Sommer, S. J., Chan, E. … Woods, E.R. (2013). A cost analysis for a community-based case management intervention program for pediatric asthma. *Journal of Asthma*, *50*(3), 310-317. doi:10.3109/02770903.2013.765447

Bisgaier, J. & Rhodes, K. V. (2011). Auditing access to specialty care for children with public insurance. *New England Journal of Medicine, 364*, 2324-2333. doi:10.1056/NEJMsa1013285

Bloom, B., Jones, L. I., & Freeman, G. (2013). Summary health statistics for U.S. children: National Health Interview Survey, 2012. *National Center for Health*

Statistics, *10*(258). Retrieved from https://www.cdc.gov/nchs/data/series/sr_10/sr10_258.pdf

Bloomberg, G. R., Banister, C., Sterkel, R., Epstein, J., Bruns, J., Swerczek, L., … Garbutt, J. M. (2009). Socioeconomic, family, and pediatric practice factors affecting the level of asthma control. *Pediatrics*, *123*(3), 829-835. doi:10.1542/peds.2008-0504

Briones, K., Lustik, F., & LaLone, J. (2010). Could it be asthma? Using social marketing strategies to increase parent and caregiver knowledge of asthma symptoms in children in a rural community. *Health Promotion Practice*, *11*(6), 859-866. doi:10.1177/1524839909348735

Brofenbrenner, U. (1994). Ecological models of human development. *International Encyclopedia of Education, 3* (2nd ed.). Oxford, United Kingdom: Elsevier.

Bruzzese, J. M., Stepney, C., Fiorino, E. K., Bornstein, L., Wang, J., Petkova, E., & Evans, D. (2012). Asthma self-management is sub-optimal in urban Hispanic and African American/black early adolescents with uncontrolled persistent asthma. *Journal of Asthma*, *49*(1), 90-97. doi:10.3109/02770903.2011.637595

Butz, A. M., Breysse, P., Rand, C., Curtin-Brosnan, J., Eggleston, P., Diette, G. B., … Matsui, E. C. (2011). Household smoking behavior: effects on indoor air quality and health of urban children with asthma. *Maternal and Child Health Journal*, *15*(4), 460-468. doi:10.1007/s10995-010-0606-7

Butz, A., Kub, J., Donithan, M., James, N. T., Thompson, R. E., Bellin, M…. Bollinger, M. E. (2010). Influence of caregiver and provider communication on symptom

days and medication use for inner-city children with asthma. *Journal of Asthma, 47,* 478-485. doi:10.3109/02770901003692793

Butz, A. M., Walker, J., Land, C. L., Vibbert, C., & Winkelstein, M. (2007). Improving asthma communication in high-risk children. *Journal of Asthma, 44*(9), 739-745. doi: 10.1080/02770900701595683

Center for Disease Control and Prevention. (2016, September 14). 2014 Behavioral Risk Factor Surveillance System Asthma Call-Back Survey summary data quality report. Retrieved from https://www.cdc.gov/brfss/acbs/2014/pdf/ACBS_DataQualReport_14_REVISED Ap112017CLEARED.pdf

Center for Disease Control and Prevention. (2015, March 23). 2011-2013 Behavioral Risk Factor Surveillance System Asthma Call-Back Survey history and analysis guidance. Retrieved from https://www.cdc.gov/brfss/acbs/2013/pdf/acbs_2013.pdf

Center for Disease Control and Prevention. (2015, February 10). 2013 Behavioral Risk Factor Surveillance System Asthma Call-Back Survey summary data quality report. Retrieved from www.cdc.gov/brfss/acbs/2013/pdf/sdqreportacbs_13.pdf

Center for Disease Control and Prevention. (2014, June 9). BRFSS Asthma Call-back Survey. Retrieved from http://www.cdc.gov/brfss/acbs/index.htm

Center for Disease Control and Prevention. (2014, February 10). 2012 Behavioral Risk Factor Surveillance System Asthma Call-Back Survey summary data quality report. Retrieved from

https://www.cdc.gov/brfss/acbs/2012/pdf/sdqreportacbs_12.pdf

Center for Disease Control and Prevention. (2013). Weighting BRFSS data. Retrieved from https://www.cdc.gov/brfss/annual_data/2013/pdf/weighting_data.pdf

Center for Disease Control and Prevention. (2013 July). Asthma facts- CDC's National Asthma Control Program Grantees. Retrieved from http://austinpureair.com/uploadimage/139828838266969.pdf

Center for Disease Control and Prevention. (2013, March 9). About BRFSS. Retrieved from http://www.cdc.gov/brfss/about/index.htm

Center for Disease Control and Prevention. (2012 October 15). 2006-2010 Behavioral Risk Factor Surveillance System Asthma Call-Back Survey history and analysis guidance. Retrieved from https://www.cdc.gov/brfss/acbs/history/acbs_06_10.pdf

Cicutto, L., To, T., & Murphy, S. (2013). A randomized controlled trial of a public health nurse-delivered asthma program to elementary schools. *Journal of School Health,*83, 876-884. doi:10.1111/josh.12106

Clark, N. M., Dodge, J. A., Shah, S., Thomas, L. J., Andridge, R. R., & Awad, D. (2010). A current picture of asthma diagnosis, severity, and control in a low-income minority preteen population. *Journal of Asthma*, *47*(2),150-155. doi:10.3109/02770900903483824

Clark, N. M, Shah, S., Dodge, J. A., Thomas, L. J., Andridge, R. R., & Little, R. J. A. (2010). An evaluation of asthma interventions for preteen students. *American School Health Association, 80*(2), 80-87. doi:10.1111/j.1746-1561.2009.00469.x

Claudio, L., Stingone, J. A., & Godbold, J. (2006). Prevalence of childhood asthma in

urban communities: the impact of ethnicity and income. *Annals Epidemiology*, *16*(5), 332-340. doi:10.1016/j.annepidem.2005.06.046

Cui, W., Zack, M. M., & Zahran, H. S. (2015). Health-related quality of life and asthma among United States Adolescents. *Journal of Pediatrics*, *166*(2), 358-364. doi:10.1016/j.jpeds/.2014.10.005

Dean, B. B. Calimlim, B. M., Sacco, P., Aguilar, D., Maykut, R., & Tinkelman, D. (2010). Uncontrolled asthma: Assessing quality of life and productivity of children and their caregivers using a cross-sectional Internet-based survey. *BioMed Central,* 1-10. doi:10.1186/1477-7525-8-96

Dean, B. B., Calimlim, B. M., Kindermann, S. L., Khandker, R. K., & Tinkelman, D. (2009). The impact of uncontrolled asthma on absenteeism and health-related quality of life. *Journal of Asthma,46*(9), 861-866. doi:10.3109/02770900903184237

Deger, L., Plante, C., Goudreau, S., Smargiassi, A., Perron, S., … Jacques, L. (2010). Home environmental factors associated with poor asthma control in Montreal children: A population-based study. *Journal of Asthma*, *47*(5), 513-520. doi:10.3109/02770901003615778

Dougherty, R. H., Fahy, J. V. (2009). Acute exacerbations of asthma: Epidemiology, biology and the exacerbation-prone phenotype. *Clinical & Experimental Allergy. 39*(2), 193-202. doi:10.1111/j.1365-2222.2008.03157.x

Evans, A. T., Sadowski, L. S., VanderWeele, T. J., Curtis, L. M., Sharp, L. K., Kee, R. A., … Shannon, J. J. (2009). Ethnic disparities in asthma morbidity in Chicago.

Journal of Asthma, *46*(5), 448-454. doi:10.1080/02770900802492061

Fabian, M. P., Stout, N., Adamkiewicz, A., Geggel, A., Ren, C, Sandel, M., & Levy, J. (2012). The effects of indoor environmental exposures on pediatric asthma: A discrete event simulation model. *Environmental Health, 11*, 1-15. doi:10.1186/1476-069X-11-66

Fagnano, M., Bayer, A. L., Isensee, C. A., Hernandez, T., & Halterman, J. S. (2011). Nocturnal asthma symptoms and poor sleep quality among urban school children with asthma. *Academic Pediatrics*, *1*1(6), 493-499. doi:10.1016/j.acap.2011.05.006

Farion, K., Michalowski, W., Wilk, S., O'Sullivan, D., & Matwin, S. (2010). A tree-based decision model to support prediction of the severity of asthma exacerbation in children. *Journal of Medical Systems*, *34*, 551-562. doi:10.1007/s10916-009-9268-7

Flores, G., Snowden-Bridon, C., Torres, S., Perez, R., Walter, T., Brotanek, J. … Tomany-Korman, S. (2009). Urban minority children with asthma: Substantial morbidity compromised quality and access to specialists, and the importance of poverty and specialty care. *Journal of Asthma, 46,* 392-398. doi:10.1080/02770900802712971

Gandhi, P. K., Kenzik, K. M., Thompson, L. A., DeWalt, D. A., Revicki, D. A. … Huang, I. (2013). Exploring factors influencing asthma control and asthma-specific health-related quality of life among children. *Respiratory Research*, *10,* 26. doi:10.1186/1465-9921-14-26

Garbe, P. & Balluz, L. S. (2012). 2006-2010 Behavioral Risk Factor Surveillance System Asthma Call-Back Survey history and analysis guidance. Retrieved from http://www.cdc.gov/brfss/acbs/history/ACBS_06_10.pdf

Gerald, J. K., McClure, L. A., Harrington, K. F., Moore, T., Hernandez-Martinez, C., & Gerald, L. B. (2012). Measurement characteristics of the pediatric asthma health outcome measure. *Journal of Asthma*, *49*, 260-266. doi:10.3109/02770903.2012.656863

Gold, L. S., Yeung, K., Smith, N., Allen-Ramey, F. C., Nathan, R. A., & Sullivan, S. D. (2013). Asthma control, cost and race: Results from a national survey. *Journal of Asthma*, *50*(7), 783–790. doi:10.3109/02770903.2013.795589

Goodwin, R. D., & Cowles, R. A. (2008). Household smoking and childhood asthma in the United States: a state-level analysis. *Journal of Asthma*, *45*(7), 607–610. doi:10.1080/02770900802126982

Guilbert, T. W., Garris, C., Jhingran, P., Bonafede, M., Tomaszewski, K. J., Bonus, T. …& Schatz, M. (2011). Asthma that is not well-controlled is associated with increased healthcare utilization and decreased quality of life. *Journal of Asthma*, *4*8, 126-132. doi:10.3109/02770903.2010.535879

Gundersen, D. A., ZuWallack, R. S., Dayton, J., Echeveria, S. E., & Delnevo, C. D. (2014). Assessing the feasibility and sample quality of a national random-digit dialing cellular phone survey of young adults. *American Journal of Epidemiology, 179*(1), 39-47. doi:10.1093/aje/kwt226

Hazra, A. & Gogtay, N. (2016). Biostatistics series module 5: Determining sample size.

Indian Journal of Dermatology, 61(5), 496-504. doi:10.4103/0019-5154.190119

Herman, E. J. (2010). Conceptual framework of the controlling asthma in American Cities Project. *Journal of Urban Health, 8,* Suppl. 1, S7-S15. doi:10.1007/s11524-010-9473-1

Hester, L. L., Wilce, M. A., Gill, S. A., Disler, S. L., Collins, P., & Crawford, G. (2013). Roles of the state asthma program in implementing multicomponent, school-based asthma interventions. *Journal of School Health*, *83*(12), 833-839. doi:10.1111/josh.12101

Horner, S. D., Brown, S. A, & Walker, V. G. (2012). Is rural school-aged children's quality of life affected by their responses to asthma? *Journal of Pediatric Nursing, 27*(5), 491-499. doi:10.1016/j.pedn.2011.06.012

Hsu, J., Qin, X., Beavers, S. F., & Mirabelli, M. C. (2016). Asthma-related school absenteeism, morbidity, and modifiable factors. *American Journal of Preventive Medicine*, *51*(1), 23-32. doi:10.1016/j.amepre.2015.12.012

Jayawardene, W. P., YoussefAgha, A. H., Lohrmann, D. K., & El Afandi, G. S. (2013). Prediction of asthma exacerbations among children through integrating air pollution, upper atmosphere, and school health surveillances. *Allergy and Asthma Proceedings*,*34*,e1-e8. doi:10.2500/aap.2013.34.3629

Kim, H., & Mazza, J. (2011). Asthma. *Allergy, Asthma & Clinical Immunology*, 7(Suppl 1), 1-9. doi:10.1186/1710-1492-7-S1-S2

Lamb, A. K., Ervice, J., Lorenzen, K., Prentice, B., & White, S. (2011). Reducing asthma disparities by addressing environmental inequities: A case study of regional

asthma management and prevention's advocacy efforts. *Family & Community Health*, *34 Suppl 1*, S54–62. doi:10.1097/FCH.0b013e318202a81d

Levy, J. I., Welker-Hood, L. K., Clougherty, J. E., Dodson, R. E., Steinbach, S., & Hynes, H. P. (2004). Lung function, asthma symptoms, and quality of life for children in public housing in Boston: a case-series analysis. *Environmental Health, 3*(13), 1-12. doi: 10.1186/1476-069X-3-13

Lin, S., Kielb, C., Chen, Z., & Hwang, S. A. (2005). Childhood asthma hospitalization rates, childhood asthma prevalence, and their relationships in Erie County, New York. *Journal of Asthma*, *42*(8), 653-658. doi:10.1080/02770900500264846

Linder, S. H., & Sexton, K. (2011). Conceptual models for cumulative risk assessment. *American Journal of Public Health*, *101 Suppl 1*, S74-S81. doi:10.2105/AJPH.2011.300318

Maier, W. C., Arrighi, H. M., Morray, B., Llewllyn, C., & Redding, G. J. (1998). The impact of asthma and asthma-like illness in Seattle school children. *Journal of Clinical Epidemiological*, *51*(7), 557-568. doi:10.2026/S0895-4356(98)0027-4

Margellos-Anast, H., Gutierrez, M. A., & Whitman, S. (2012). Improving asthma management among African American children via a community health worker model: Findings from a Chicago-based pilot intervention. *Journal of Asthma*, *49*(4), 380-389. doi:10.3109/02770903.2012.660295

McCormack, M. C., Breysse, P. N., Matsui, E. C., Hansel, N. N. Williams, D., Curtin-Brosnan, J… Dlette, G. B. In-home particle concentrations and childhood asthma morbidity. (2009). *Environmental Health Perspectives, 117*(2), 294-298.

doi:10.1289/ehp.11770

McDaniel, M., Paxson, C., & Waldfogel, J. (2006). Racial disparities in childhood asthma in the United States: Evidence from the National Health Interview Survey, 1997 to 2003. *Pediatrics*, *117*(5), e868-e877. doi:10.1542/peds.2005-1721

McNeil, L. H., Wyrwich, K. W., Brownson, R. C., Clark, E. M., & Kreuter, M. W. (2006). Individual, social environmental, and physical environmental influences on physical activity among black and white adults: A structural equation analysis. *Annals of Behavioral Medicine*, *31*(1), 36-44. doi:10.1207/s15324796abm3101_7

Decker, K., Meyer, K., Littlefield, D., Thompson, W. D. (2008). Similar asthma prevalence estimates obtained from preadolescent and parent survey responses. *Journal of Clinical Epidemiology, 61*(6), 611-616. doi:10.1016/j.jclinepi.2007.07.014

Milam, J., McConnell, R., Yao, L., Berhane, K., Jerrett, M., & Richardson, J. (2008). Parental stress and childhood wheeze in a prospective cohort study. *Journal of Asthma*, *45*(4), 319–323. doi:10.1080/02770900801930277

Moonie, S. A., Sterling, D. A., Figgs, L., & Castro, M. (2006). Asthma status and severity affects missed school days. *Journal of School Health,* 76(1), 18-24. doi:10.1111/j.1746-1561.2006.00062.x

Moorman, J. E., Akinbami, L. J., Bailey, C. M., Zahran, H. S., King, M. E., Johnson, C. A., & Liu, X. (2012). National surveillance of asthma: United States, 2001-2010. *Vital & Health Statistics. Series 3, Analytical And Epidemiological Studies / [U.S. Dept. Of Health And Human Services, Public Health Service, National Center*

For Health Statistics], (35), 1-67. Retrieved from https://www.cdc.gov/nchs/data/series/sr_03/sr03_035.pdf

National Asthma Education and Prevention Program Coordinating Committee. (2007). Expert panel report 3: Guidelines for the diagnosis and management of asthma. National Heart, Lung, and Blood Institute. Retrieved from http://www.nhlbi.nih.gov/files/docs/guidelines/asthgdln.pdf

National Heart, Lung, and Blood Institute. (2014, August 4). What is asthma? Retrieved from http://www.nhlbi.nih.gov/health/health-topics/topics/asthma

National Heart, Lung, and Blood Institute. (2007). Expert panel report 3: Guidelines for the diagnosis and management of asthma. Retrieved from National Heart, Lung, and Blood Institute.

Nguyen, K.H., Boulay, E., & Peng, J. (2011). Quality of life and cost-benefit analysis of a home environmental assessment program in Connecticut. *Journal of Asthma*, *48*, 147-155. doi:10.3109/02770903.2010.535881

Nicholas, S. W., Jean-Louis, B., Ortiz, B., Northridge, M., Shoemaker, K., Vaughan, R., … Hutchinson, V. (2005). Addressing the childhood asthma crisis in Harlem: The Harlem Children's Zone Asthma Initiative. *American Journal of Public Health*, *95*(2), 245-249. doi:10.2105/AJPH.2004.042705

O'Connor, M. G., Saville, B. R., Hartert, T. V., & Arnold, D. H. (2014). Treatment variability of asthma exacerbations in a pediatric emergency department using a severity-based management protocol. *Clinical Pediatrics, 53*(13), 1288-1290. doi:10.1177/0009922813520071

Pearlman, D. N., Jackson, T. L., Gjelsvik, A., Viner-Brown, S., & Garro, A. (2012). The impact of the 2007-2009 US recession on the health of children with asthma: Evidence from the national Child Asthma Call-Back Survey. *Medicine and Health, Rhode Island*, *95*(12), 394-396. Retrieved from https://pdfs.semanticscholar.org/aa26/8f93100554481e141d7986629bea2a0b95c4.pdf

Permaul, P., Hoffman, E., Fu, C., Sheehan, W., Baxi, S., Gaffin, J., … Phipatanakul, W. (2012). Allergens in urban schools and homes of children with asthma. *Pediatric Allergy and Immunology*, *23*(6), 543–549. doi:10.1111/j.1399-3038.2012.01327.x

Pierannunzi, C., Town, M., Garvin, W., Shaw, F.E., & Balluz, L. (2012). Methodologic changes in the Behavioral Risk Factor Surveillance System in 2011 and potential effects of prevalence estimates. *Morbidity and Mortality Weekly Report*, *61*(22), 410-413. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6122a3.htm

Polivka, B. J., Chaudry R. V., Crawford, J., Bouton, P., & Sweet L. (2011). Impact of an urban healthy homes intervention. *Journal of Environmental Health*, *73*(9), 16-20. Retrieved from https://www.jstor.org/stable/26329216?seq=1#page_scan_tab_contents

Qayad, M. G., Pierannunzi, C., Chowdhury, P. P., Hu, S., Town, G. M., & Balluz, L. S. (2013). Landline and cell phone response measures in Behavioral Risk Factor Surveillance System. *Survey Practice, 6*(3). doi:10.29115/SP-2013-0014

Quinn, K., Kaufman, J. S., Siddiqi, A., & Yeatts, K. B. (2010a). Parent perceptions of

neighborhood stressors are associated with general health and child respiratory health among low-income, urban families. *Journal of Asthma*, *47*(3), 281-289. doi:10.3109/02770901003605324

Quinn, K., Kaufman, J. S., Siddiqi, A., & Yeatts, K. B. (2010b). Stress and the city: Housing stressors are associated with respiratory health among low socioeconomic status Chicago children. *Journal of Urban Health*, *87*(4), 688-702. doi:10.1007/s11524-010-9465-1

Rhee, H., Belyea, M. J. & Brasch, J. (2010). Family support and asthma outcomes in adolescents: Barriers to adherence as a mediator. *Journal of Adolescent Health*, *47*(5), 472-478.

Rowe, B. H., Bota, G. W., Clark, S., & Camargo, C.A. (2007). Comparison of Canadian versus American emergency department visits for acute asthma. *Canadian Respiratory Journal, 14*(6), 331-337. doi:10.115/2007/450489

Rudd, R. A., & Moorman, J. E. (2007). Asthma incidence: data from the National Health Interview Survey, 1980-1996. *Journal of Asthma*, *44*(1), 65-70. doi:10.1016/j.jadohealth.2010.03.009

Shalowitz, M.U., Sadowski, L.M., Kumar, R., Weiss, K.B., & Shannon, J.J. (2007). Asthma burden in a citywide, diverse sample of elementary schoolchildren in Chicago. *Ambulatory Pediatrics, 7*(4), 271-277. doi:10.1016/j.ambp.2007.03.004

Shedd, A. D., Peters, J. I., Wood, P., Inscore, S., Forkner, E… Galbreath, A. D. (2007). Impact of home environment characteristics on asthma quality of life and symptom scores. *Journal of Asthma*, *44*, 183-187.

doi:10.1080/02770900701209699

Shen, J. & Oraka, E. (2012). Complementary and alternative medicine (CAM) use among children with current asthma. *Preventive Medicine, 54*(1), 27-31. doi:10.1016/j.ypmed.2011.10.007

Sidora-Arcoleo, K., Feldman, J. M., Serebrisky, D., Spray, A. (2012). A multi-factorial model for examining racial and ethnic disparities in acute asthma visits by children. *Annals of Behavioral Medicine, 43*(1), 15-28. doi:10.1007/s12160-011-9328-3

Stevens, G. D., Pickering, T. A., & Laqui, S. A. (2010). Relationship of medical home quality with school engagement and after-school participation among children with asthma. *Journal of Asthma*, *47*(9), 1001-1010. doi:10.1080/02770903.2010.514636

Subbarao, P., Mandhane, P. J., & Sears, M. R. (2009). Asthma: Epidemiology, etiology and risk factors. *Canadian Medical Association Journal*, *181*(9), E181-E190. doi:10.1503/cmaj.080612

Sullivan, P. W., Smith, K. L., Ghushchyan, V. H., Globe, D. R., Lin, S., & Globe, G. (2013). Asthma in USA: Its impact on health-related quality of life. *Journal of Asthma*, *50*(8), 891-899. doi:10.3109/027770903.2013.813035

Takaro, T. K., Krieger, J., Song, L., Sharify, D., & Beaudet, N. (2011). The Breathe-Easy Home: The impact of asthma-friendly home construction on clinical outcomes and trigger exposure. *American Journal of Public Health*, *101*(1), 55-62. doi:10.2105/AJPH.2010.300008

Tsai, S., Ward, T., Lentz, M. J., Kieckhefer, G. M. (2012). Daytime physical activity levels in school-age children with and without asthma. *Nursing Research, 61*(4), 252-259. doi:10.1097/NNR.0b013e318255679c

Teach, S. J., Crain, E. F., Quint, D. M., Hylan, M. L., & Joseph, J. G. (2006). Indoor environmental exposures among children with asthma seen in an urban emergency department. *Pediatrics, 117*(4), S152-S158. doi:10.1542/peds.2005-2000M

Valerio, M. A., Andreski, P. M., Schoeni, R. F., & McGonagle, K. A. (2010). Examining the association between childhood asthma and parent and grandparent asthma status: implications for practice. *Clinical Pediatrics*, *49*(6), 535-541. doi:10.1177/0009922809356465

Wade, T. J. & Guo,J. J. (2010). Linking improvements in health-related quality of life to reductions in Medicaid costs among students who use school-based health centers. *American Journal of Public Health*, *100*(9), 1611-1616. doi:10.2105/AJPH.2009.185355

Welch, M. J., Lally, R., Miller, J. E., Pittman, S., Brodsky, L., Caplan, A. L.,…Wilfond, B. (2015). The ethics and regulatory landscape of including vulnerable populations in pragmatic clinical trials. *Clinical Trials, 12*(5), 503-510. doi:10.1177/1740774515597701

Winer, R. A., Qin, X., Harrington, T., Moorman, J., & Zahran, H. (2012). Asthma incidence among children and adults: findings from the Behavioral Risk Factor Surveillance System Asthma Call-back Survey—United States, 2006-2008.

Journal of Asthma, *49*(1), 16-22. doi:10.3109/02770903.2011.637594

Wittich, A.R., Li.Y., & Gerald, L.B. (2006). Comparison of parent and student responses to asthma surveys: Students grades 1-4 and their parents from an urban public school setting. *Journal of School Health, 76*(6),236-240.

Wu, A. C., Tantisira, K., Li, L., Schuemann, B., Weiss, S. T., & Fuhlbrigge, A. L. (2011). Predictors of symptoms are different from predictors of severe exacerbations from asthma in children. *Chest, 140*(1), 100–107. doi:10.1378/chest.10-2794

Wu, B. H., Cabana, M. D., Hilton, J. F., & Ly, N. P. (2011). Race and asthma control in the pediatric population of Hawaii. *Pediatric Pulmonology, 46*(5), 442-451. doi:10.1002/ppul.21387

Zahran, H.S., Bailey, C.M., Damon, S.A., Garbe, P.L., & Breysse, P.N. (2018). Vital signs: Asthma in children—United States, 2001-2016. *Morbidity Mortality Weekly Report*, *67*, 149-155. doi:10.15585/mmwr.mm6705e1

Zahran, H. S., Person, C. J., Bailey, C., & Moorman, J. E. (2015). Assessing asthma control and associated risk factors among persons with current asthma- Findings from the child and adult Asthma Call-back Survey. *Journal of Asthma, 52*(3), 318-326. doi:10.3109/02770903.2014.956894

Zahran, H. S., Bailey, C., Qin, X., & Moorman, J. E. (2014). Assessing asthma severity among children and adults with current asthma. *Journal of Asthma, 51*(6), 610-617. doi:10.3109/02770903.2014.892966

Zahran, H. S., Person, C. J., Bailey, C., & Moorman, J. E. (2012). Predictors of asthma self-management education among children and adults—2006-2007 Behavioral

Risk Factor Surveillance System Asthma Call-back Survey. *Journal of Asthma, 49*(1)*,* 98-106. doi:10.3109/02770903.2011.644012

Zahran, H., Bailey, C., & Garbe, P. (2011). Vital signs: Asthma prevalence, disease characteristics, and self-management education—United States, 2001-2009. *Morbidity Mortality Weekly Report*, *60*(17), 547-552. Retrieved from https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6017a4.htm?s_cid=mm6017a4_w

Zimmerman, B. J., Bonner, S., Evans, D., & Mellins, R. B. (1999). Self-regulating childhood asthma: A developmental model of family change. *Health Education & Behavior, 26*(1), 55-71. doi:10.1177/109019819902600106