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IMPACT OF PARENTAL STRESS ON ASTHMA MANAGEMENT BEHAVIORS AND HEALTH OUTCOMES: A LONGITUDINAL ANALYSIS OF INNER CITY SCHOOL-AGED CHILDREN.

A Dissertation Presented

by

AMANDA CONSTANCE GREEN

Submitted to the Office of Graduate Studies,
University of Massachusetts Boston,
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2015

Nursing Program

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ABSTRACT

IMPACT OF PARENTAL STRESS ON ASTHMA MANAGEMENT BEHAVIORS AND HEALTH OUTCOMES: A LONGITUDINAL ANALYSIS OF INNER CITY SCHOOL-AGED CHILDREN

December 2015

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Background. Asthma is a prevalent chronic condition with excess disease burden in school-aged, minority children from low income inner-city communities. Conceptualized within a nursing and socio-ecological framework, the purpose of this secondary analysis of a prospective study of inner-city school-aged children with asthma (School Inner-City Asthma Study [SICAS]) was to examine associations between characteristics of children and parents, parents stress, parent asthma management

behaviors (AMB) and child asthma outcomes, including emergency (ED) visits for asthma, missed school and asthma control.

Methods. The sample included 351 school-aged children (7.9 years old, SD= 1.9 years; 53.0% male; 95.7% minority). Parents reported their own perceived stress (Perceived Stress Scale) and AMBs (national guidelines) at baseline; child asthma outcomes were measured quarterly at follow-up. Generalized estimation equations were used due to the repeated quarterly wave nature of the data.

Results. The majority of parents (63.5%) reported moderate to high stress. Controlling for other participant characteristics, income and education were directly related to parent stress in this inner-city population. Parent stress also had a direct positive effect on child ED visits for asthma (OR=1.68, p=.014), which persisted when potential mediators were added to the model. Poor parent AMB of missing routine appointments (OR=2.32, p=.025) and pests in the home (OR=1.51, p=.001) also raised the likelihood of ED visits.

Parents who missed their child's healthcare appointments and have pests in their home were both more likely to live in an unmaintained neighborhood (OR=7.6, p=.001; OR=1.8, p=.002) and have more family members in their home (OR=5.0, p=.01; OR=2.0, p=.000).

Conclusions. Parents with high stress and who reside with large families in unmaintained neighborhoods are at higher risk for not performing AMBs that support the

best outcomes for their child with asthma. Low income and educational attainment raise parental stress that leads to costly ED visits for inner city children. Clinical interventions to facilitate increased routine visits and policy change for inner-city household pest control will help reduce ED visits related to asthma. Research on the implementation science of these interventions and role of parent stress on the effectiveness of these interventions in the inner-city population is necessary.

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CHAPTER ONE

INTRODUCTION

Background and Significance

Asthma currently affects an estimated 10.7 percent of school-aged children who are 5 to 17 years of age and residing in the United States ((Statistics., 2013). This rate is 28% greater than US adult asthma prevalence of 7.7 percent (L. J. Akinbami, Moorman, & Liu, 2011). Despite the medical advances in treatment, there is still a high rate of morbidity, mortality, urgent or emergent health care use and school absences due to this chronic condition (L. Akinbami, 2006; Organization, 2013; Statistics, 2012). The National Asthma Education and Prevention Program (NAEPP) defines asthma as a complex and chronic disorder of the airways that involves interactions between chronic inflammation of the lungs, airway obstruction and bronchial hyper-responsiveness (Program, 2007). The Global Initiative for Asthma (GINA) asserts that according to clinical studies, asthma can be controlled effectively by interventions that suppress and reverse these interactions (Asthma., 2012). These interventions are performed in various settings, including the hospital, the clinic and the home setting (GINA, 2006). However, knowledge of the impact of parent stress on the management behaviors they perform for their children is limited, especially in the inner-city population. The Institute of Medicine highlights psychosocial variables that may affect disease management as a critical area

targeted for research (Medicine, 2002). Minimal research attention has focused on addressing the impact of parent perceived stress on their child's asthma outcomes, especially in the inner-city population.

Purpose and Aims

Conceptualized within a nursing and sociological framework, the purpose of this secondary analysis of a prospective study focused on inner-city school-aged children with asthma (School Inner-City Asthma Study (SICAS)) was to examine associations between characteristics of inner city children and parents parent stress, parent asthma management behaviors and child asthma outcomes, including emergency visits for asthma, school absenteeism, and asthma control

Specifically, this study was designed to:

1. Examine characteristics of the child and parents' home and social environments and their associations with asthma control, urgent or emergent asthma visits and school absenteeism.

2a. Examine which parent or child characteristics lead to higher stress in parents of children with asthma.

2b. Examine the association of parent stress on the child's emergent asthma visits, school absenteeism, and asthma control.

2c. Explore the pathways of parent stress on parent management behaviors that affect the child's emergent asthma visits, school absenteeism, and asthma control.

3. Examine the effects of child and parent characteristics on the parent management behaviors performed.

Operational Definitions

Data used in the secondary analysis of the SICAS study is from parent report at baseline with the main outcomes extending through four follow-up time points. In the SICAS, children were followed for 1 year, with a total of 5 annual cohorts recruited from inner-city schools in a large urban area in the Northeast (Phipatanakul et al., 2011). Self-report data from parents included demographic information, home and neighborhood environment, parent perceived stress and questions pertinent to the child's asthma.

Inner-city home and social environment variables measured include the child's characteristics of age, gender race, health insurance, type of transportation, exposure to passive smoke, and the parent's characteristics of education, income and employment, marital status, housing, number of people in the home, number of children in the home, number of smokers in the home, and perceived maintenance of the neighborhood they live in.

Parent stress was measured using the Perceived Stress Scale, where perceived stress is defined as "the degree of which situations in one's life are appraised as stressful" (S. Cohen, Kamarck, & Mermelstein, 1983) (p.385). A global stress level more likely affects a person's illness process than specific live events that have occurred (S. Cohen et al., 1983). A shortened Perceived Stress Scale with four items was previously validated and used in SICAS.

Asthma control was measured by the Asthma Therapy Assessment Questionnaire (ATAQ), which includes seven questions about the child's asthma symptoms,

consequences of asthma like missed school and activity interference, parent's perception of their child's asthma control and quick-acting medication use. It is viewed as a validated tool that measures children's control and management by clinicians in order to identify children at risk for adverse outcomes (Skinner et al., 2004).

Urgent or emergent healthcare visits were defined as parent report of child's unscheduled healthcare visits related to asthma and occurring within the last year.

School absenteeism was defined as parent report of child's missed school days attributed to asthma and occurring within the last year.

Parent management behaviors were conceptualized as parent actions on the child's behalf to assist in controlling their child's asthma condition. Parent management behaviors measured reflect the four domains of asthma management described in the national guidelines (NAEPP): assessing and monitoring asthma, controlling environmental factors related to asthma, pharmacologic therapy and education for partnership in asthma care (Program, 2007). Not missing or skipping scheduled routine healthcare visits for asthma reflects the parent's role in assessment and monitoring of the child's condition. Eliminating passive smoke exposure, smokers in the home and pests in the home reflect the parent's role in controlling the home environment. Medication adherence by administering their child's preventive controller inhaler daily or some days reflects the parent's role in pharmacologic therapy. Lastly, having an asthma action plan (AAP), or a written treatment plan for asthma, is both the parent's and healthcare provider's role in the management domain of education and partnership.

Significance

Healthcare use and Missed Learning. According to data from the Centers for Disease Control and Prevention's (CDC) 2009 National Hospital Ambulatory Medical Care Survey, asthma causes approximately 774,000 emergency room visits for children under 15 years old a year (Association, 2012). Also, according to data from the CDC's National Hospital Discharge Survey, 1995-2010, asthma is the third highest cause of hospitalization of children (Association, 2012). The CDC's National Health Interview Survey found asthma caused 10.5 million missed school days for children ages 5-17 in 2008, and increased to 14.4 million missed school days in 2011 (L. J. Akinbami et al., 2011; Association, 2012). The World Health Organization has asserted that childhood asthma is responsible for many disability-adjusted life years lost and a substantial amount of medical costs (Organization., 2007).

Emergency department (ED) visit reduction for children with asthma remains elusive (Program, 2007). Data from the National Health Interview Survey indicate that minority children have higher prevalence rates of asthma compared to all children with asthma, with 16.4% of African American children and 17.7% of children of Puerto Rican descent, and an even more pronounced difference at or below the poverty level (Statistics, 2012). Measuring ED use and school absenteeism are outcomes used by national surveys commissioned by CDC ask parents and patients about these outcomes because of their importance in knowing the burden of asthma as a disease (L. J. Akinbami et al., 2011).

Understanding the effect parent management behaviors, as well as parent sociodemographic and psychosocial variables, on ED visits and missed school for

children with asthma was explored to provide insight for possible future interventions to mitigate use of the ED for asthma care and children missing school due to asthma symptoms, thus reducing healthcare costs and increasing academic success.

Lack of asthma control and medication management. While national clinical guidelines for asthma management are available, national implementation is varied. Data from a nationally representative sample of children with asthma from the Behavior Risk Factor Surveillance System Asthma Call Back Survey, reported between 17.1% to 33.7% of children per state who either used asthma medication, had asthma symptoms, or had a healthcare provider visit for asthma in the last year were taking corticosteroids for long-term asthma symptom relief, while 43.1% to 63.1% of these children per state had an asthma attack (Statistics, 2012). Children who need medications to control their asthma are not receiving or taking them, even though over half (52.7%) have had an asthma episode warranting this treatment for prevention of future attacks (Control, 2012). Children are suffering from preventable symptoms by not taking necessary treatment.

Healthcare Provider Role and Parent Role in Management. Effective treatment that reduces symptoms and utilization of emergency services are incorporated into professional guidelines (Program, 2007). The Global Initiative for Asthma (GINA) and the National Institutes of Health (NIH) believe that the problems from asthma would be averted if guidelines for asthma management are followed (Asthma, 2012; Program, 2007). The National Heart Lung Blood Institute (NHLBI) has developed asthma management guidelines through expert review of current literature, which include four domains of management (Program, 2007). Healthy People 2020 prioritized reducing

hospitalizations and ED visits related to asthma and increasing the use of the NAEPP guidelines in asthma management (2020., 2014).

The clinician role in the national asthma management guidelines is clearly defined under each of the four asthma management domains (Program, 2007), including assessing and monitoring asthma, education for partnership in asthma care, controlling environmental factors related to asthma and pharmacologic therapy. The healthcare provider assists in assessment and monitoring of the child's asthma by assessing the child's asthma control using physical exam and pulmonary function testing. The healthcare provider presents education for the management of the child's asthma by giving the patient and family a written asthma action plan, as well as teaching basic knowledge about asthma and its treatment. Healthcare providers can provide skin testing to determine the patient's sensitivity to allergens in order to assist in effective environmental management. Lastly, the healthcare provider prescribes pharmacologic therapy to assist in the prevention and treatment of asthma symptoms.

The Global Initiative for Asthma (GINA) recommends that healthcare providers include parents in management and emphasize the need for collaboration for successful self-management of asthma (Asthma., 2012). However, the role of the parents in asthma management is currently less defined comparatively to the healthcare provider's role. Constructing a clear role for parents in asthma management is crucial for managing the child's asthma at home, as well as in assisting the clinician in effective asthma management. While healthcare providers potentially counsel parents regarding asthma management behaviors in each of the domains, they cannot replace the parent's role of

action in these domains. For example, healthcare providers do prescribe treatment, but they do not buy the medication at the pharmacy or administer it regularly at home. Healthcare providers do monitor the child's symptoms in clinic, but cannot when the child is at home. Healthcare providers do tell parents what allergens the child is sensitive to, but cannot change the child's environment where they live. The healthcare provider reminds parents to use the written asthma action plan, but cannot be present to assist with its use when needed at home.

Healthcare providers educate patients throughout their patient's disease process, from diagnosis through to achieving asthma control. The importance of these behaviors which only parents are able to implement is currently not clearly communicated to parents by healthcare providers. For example, in a national sample of combined data (2006-2010), only 40% parents of children with active asthma (use asthma medications, have asthma symptoms, or have healthcare provider visits for asthma in the last year) were reported have heard from their healthcare provider recommendations to change their home environment to assist in managing their child's asthma (Control, 2012). Also, there is a similar low rate in providing the most agreed upon educational intervention for asthma management; the asthma action plan (AAP). Only 45.4% of parents of children with active asthma were given an AAP (Control, 2012). If AAPs are used with less than half of the children who need them nationally, than the importance of the other parent management behaviors are even less likely to be discussed by healthcare providers. Examining the impact of these parent management behaviors in the inner-city population on children's asthma outcomes was performed in this secondary analysis.

Conceptual Theoretical Empirical Framework

Orem's Self-care Framework and Bandura's Social Cognitive Theory have been used to guide and inform the research. The Self-Care Framework focuses on patients' and nurses' deliberate actions to meet self-care needs (Fawcett & Desanto-Madeya, 2013). Self-care activities are actions that support overall health, and self-management behaviors are an aspect of self-care activities that support the management of disease. The Social Cognitive Theory (SCT), developed with a key component of self-efficacy by Bandura in 1977, describes behavior change as a process influenced by personal characteristics, the environment, and human behavior (Institute., 2005). The SCT explains human behavior in the interaction between cognitive and environmental influences on behavior, and their reciprocal determinism.

Dependent Care. Children need management behaviors to be performed for the management of their condition; however, they may not be physically or cognitively capable of carrying out these behaviors without parental assistance and guidance. Thus, parents and guardians play an instrumental role in insuring their children's appropriate asthma management behaviors. The concept of dependent care is described by Orem (1987) as an "activity performed by responsible adults for socially dependent family members," (Orem, 1987) (p. 212). Self-management for children with asthma has already been described in the literature as "the behaviors that people with asthma and their family members perform to lessen the impact of this chronic illness," purporting management behaviors as combined efforts or actions in a family (Shegog et al., 2001) (p.50).

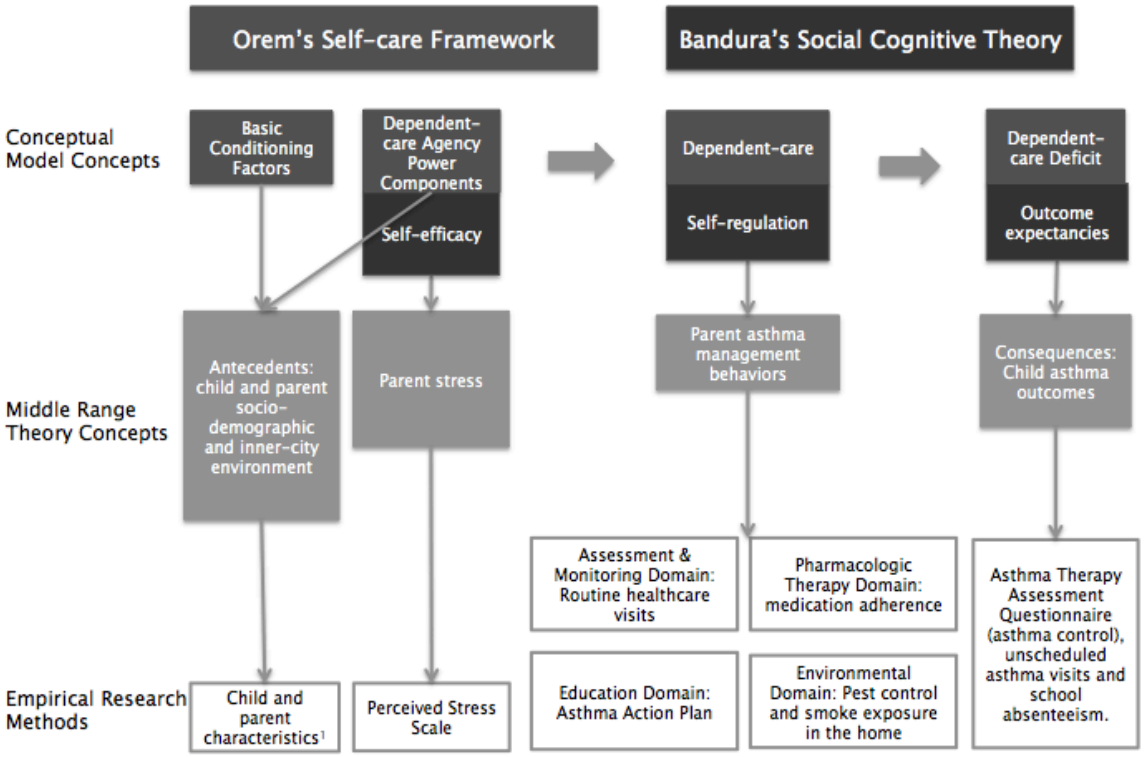

Figure 1. Conceptual-Theoretical-Empirical Model

Antecedents. A conceptual-theoretical-empirical (CTE) structure was created for management behaviors related to parents of children with asthma (Figure 1). Basic conditioning factors and dependent-care agency power components are represented by the theoretical concept of ***antecedents***, which are the sociodemographic characteristics of the parents and children with asthma. These include child characteristics and parent characteristics. Child characteristics include child age, gender, race, health insurance, and asthma severity. Parent characteristics include parent gender, parent race, income, education, marital status, housing, people in home, neighborhood and transportation. These characteristics represent the environmental influences on behavior and cognition in Bandura's SCT.

Self-efficacy and perceived stress. Self-efficacy, a part of the cognitive aspect that influences behavior in the SCT, is an exercise of control (Bandura, 1997). The perceived stress scale measures the amount of control a person believes they have over their life (Cohen, 1977). The NIH recommends that self-efficacy can be measured by using Cohen's Perceived Stress Scale, where psychological stress is an "adaptive capacity overload" (Toolbox). Self-efficacy, as a middle range concept stemming from dependent care agency, represents the parent's beliefs of their capability to control aspects in their life, which influences their behaviors. For parents of children with asthma, their perceived stress would influence the asthma management behaviors they do or do not perform. Dependent-care agency is represented by Bandura's concept of self-efficacy, which measures parent stress using the Perceived Stress Scale.

Attributes. The concept of self-management behavior reflects the concept of self-care by representing activities initiated and performed to support health, with self-management behaviors are only specific to managing disease (Ryan & Sawin, 2009). In the same way, the CTE middle-range concept of parent asthma management behaviors includes only behaviors related to asthma management, while more broad concepts of self-care or dependent-care in Orem's Self-care Framework are not considered for this analysis. Parent asthma management behaviors represent Orem's dependent-care concept and Bandura's self-regulation theoretical concept, and include all four categories of asthma management identified by the NAEPP. These categories include the assessment and monitoring domain, environment domain, medication domain, and education domain (Program, 2007).

Each of the domains has a variable or multiple variables that measure a parent's role in asthma management. The assessment and monitoring domain is measured by skipped primary care appointments. The environment domain is measured by the number of types of pests in the home, people who smoke in the house and known child's passive smoke exposure. The medication domain is measured by the frequency of administration of a controller medication. While there is no direct education management measurement performed by parents, the availability of an asthma action plan for the child is a co-management behavior of both healthcare providers and parents. Healthcare providers need to offer this plan and parents need to actively use the plan or ask for written information related to the child's treatment plan. These behaviors are each related to the parent's role in managing the child's asthma.

Consequences. The concept of dependent care deficits is represented by the theoretical concept of consequences and measured by the control section of the Asthma Therapy Assessment Questionnaire and other commonly measured outcomes, such as unscheduled healthcare visits and school absenteeism. The empirical methods will be expanded upon further in Chapter 3.

Dependent-care Deficit. Orem discusses how a dependent-care deficit leads to negative outcomes. Dependent-care deficits are recognized when dependent care agency power components do not support dependent-care enough to meet the therapeutic dependent-care demands for disease management to occur. In other words, if the antecedents (child and parent sociodemographic characteristics, inner-city environment and parent stress) do not support or allow the management behaviors (parent management

behaviors related to the child's asthma) to occur, then a dependent-care deficit will be evident, leading to negative consequences (uncontrolled asthma, unscheduled asthma visits and missed school).

CHAPTER TWO

REVIEW OF THE LITERATURE

This secondary analysis was designed to examine associations between characteristics of inner-city children and parents, parent stress, parent asthma management behaviors and child asthma outcomes, including emergency visits for asthma and school absenteeism. This chapter includes a review of literature on childhood asthma and parent asthma management behaviors, as well as a review, critique and synthesis of literature on parent stress related to child chronic disease, asthma outcomes, and parent management behaviors. This review of the literature provides a context for the secondary analysis performed, which addressed current gaps in the literature and the national call for more in-depth studies examining psychosocial variables that impact the management of this presently uncontrolled disease.

Asthma Development and Expression

The National Heart, Lung, and Blood Institute (NHLBI) convened an expert panel to create asthma diagnosis and disease management guidelines. Using the latest scientific evidence, they present a definition of asthma, the pathophysiology and environmental influences, diagnosis, and recommendations for the management of asthma (Program, 2007). The panel defines asthma as a chronic disorder of airway inflammation. Clinical characteristics of asthma are recurring symptoms, underlying inflammation, bronchial

hyper-responsiveness and airway obstruction (Program, 2007). Genetic patterns and phenotypes of this disorder are still undergoing evaluation. Phenotypes include intermittent asthma, persistent asthma, severe asthma, exercise-associated, and aspirin-sensitive, with all types manifesting airway inflammation (Program, 2007).

Asthma Severity and Asthma Control

Asthma severity was first defined in the NAEPP guidelines in 1991 as a classification of asthma into different categories base on symptoms, frequency of exacerbations, school attendance, with exercise tolerance and pulmonary function tests also influencing the severity assessment (Yawn, Brenneman, Allen-Ramey, Cabana, & Markson, 2006). These assessments happen before medication is initiated, with severity typically measured in the clinical setting at the start of therapy (Yawn et al., 2006). The only objective measure for asthma severity is a pulmonary function test (PFT), which measures the largest amount of air exhaled forcibly from the largest amount of air inhaled (FVC) with the amount of air forcibly exhaled in the first second (FEV1) (Program, 2007). Lung function is measured by forced expiratory volume (FEV) and forced vital capacity (FVC), with the ratio of these two measures calculated for an objective rating (Program, 2007).

Asthma control, however, uses similar assessments as asthma severity, yet they take place after treatment is initiated. Both international and national guidelines agree; determining the degree of a child's symptoms, or asthma control, is necessary to modify asthma therapy (Asthma., 2012; Program, 2007). Asthma control is a "short-term

evaluation of the adequacy of patient management and determines the need for clinical intervention" and is "a function of underlying severity plus the adequacy of management" (Vollmer, 2004). Asthma control can be measured by asthma symptoms, lung function, acute care use and quality of life, with patients who have controlled asthma exhibiting fewer symptoms, less acute care use, increased lung function or increased quality of life. Asthma control is often a patient or parent reported measure and some questionnaires are meant to assist clinicians in discerning the need for additional asthma management (Yawn et al., 2006). In the secondary analysis, asthma control was measured using the NAEPP guidelines as well as a validated tool for asthma control.

Medical Treatment

Children ages 5-11 years have specific guidelines for their medical management (Program, 2007). Pharmaceutical treatment depends on the severity of the child's asthma. This is measured using current symptoms, nighttime awakenings, interference with normal activity, lung function and exacerbations requiring short-acting medication therapy for quick relief and if any corticosteroid use is needed (Program, 2007). If a child's severity is intermittent, then a short-acting inhaler is given, and if severity is persistent, a long-acting relief inhaler is given as well. Even if a child with more severe asthma is well-controlled with few symptoms, they are more prone to asthma attacks (Program, 2007). For this reason, controlling for asthma severity is important when looking at outcomes. In the secondary analysis, asthma severity is controlled for in multivariate analysis with the main outcomes of unscheduled healthcare visits, school absenteeism and asthma control.

Assessment and monitoring of child's symptoms can prevent an asthma attack. These indications include the frequency of symptoms, nighttime awakenings, inhaler medication for symptoms control, and interference with activity (Program, 2007). For an acute exacerbation, the most common early respiratory symptoms are episodic coughing, shortness of breath, or wheezing (GINA, 2006). Parents monitoring their child's asthma symptoms can help them anticipate uncontrolled asthma and give the appropriate medications for treatment or avoid environmental allergens that may worsen their child's symptoms. Asthma action plans (AAPs) are written treatment plans for patients with asthma. AAPs assist parents identify which symptoms may lead to an attack, remind them to monitor their child's lung function with a peak flow monitor, remind parents of which environmental allergens to stay away from or eliminate, instruct parents on which inhaler to give and how often depending on the child's symptoms, and when their child's symptoms or lung function warrant going to the emergency department. The secondary analysis determined whether or not a parent was given an AAP.

Asthma Management Domains with Specific Parent Management Behaviors

Asthma management behaviors are actions taken to control asthma. These actions are necessary as asthma is a chronic, incurable disease. The global guidelines for asthma management stress the importance of active participation of both the healthcare provider and patient, or parent in the case of a child with asthma, for effective asthma management (Asthma., 2012). The goal of asthma management is asthma control, normal pulmonary function levels, normal activity levels, to prevent mortality and to prevent side effects of medications (Asthma., 2012). As previously mentioned, the national guidelines from the

NHLBI are based on evidence review and synthesis conducted by an expert panel (Program, 2007). These guidelines are based on the best evidence available, either tested in randomized control trials or quasi-experimental research. Expert consensus is used for guidelines where strong evidence is limited, and these guidelines are not strongly stated. Four essential components of asthma management frame the recommended guidelines. The four domains for asthma management are assessment and monitoring, pharmacological therapy, education and control of environmental factors (Program, 2007).

Assessment and Monitoring Domain

The assessment and monitoring domain includes initial assessment, periodic assessment and referral to an asthma specialist (Program, 2007). Asthma symptoms are manageable if recognized early on, communicated and treated (Program, 2007). Routine visits can help identify ongoing symptoms or pulmonary function that is not optimal and adjust treatment to prevent worsening of the condition. Parents need to bring children to their primary care provider or an asthma specialist regularly for monitoring. A randomized control study performed by the NHLBI Childhood Asthma Research and Education Network sought to examine what features of children will determine which medication would be most effective. This study with 144 children 6-17 years old with mild to moderate asthma revealed that monitoring the child's pulmonary function using FEV_1 should inform healthcare provider's choice on which controller medication to prescribe (Szefler et al., 2005). Parents bringing their children to a healthcare provider for a healthcare appointment to monitor their child's pulmonary function, and not related to a

current asthma exacerbation, is an important assessment and monitoring domain parent management behavior. In this analysis (SICAS), missing routine visits, which assist with assessment and monitoring of the child's symptoms, was examined in relation to child asthma outcomes.

Medications Domain

The medications domain includes prescribed medications as well as complementary and alternative medicines, and managing asthma exacerbations (Program, 2007). Anti-inflammatory medications have shown in rigid clinical trials and in common clinical settings that they are an essential component to asthma management (Program, 2007). Systemic steroids have shown to decrease inflammation, ED visits and hospitalizations (Altamimi et al., 2006; Qureshi, Zaritsky, & Poirier, 2001; Rachelefsky, 2003; Scarfone & Friedlaender, 2003). Parents who assist their children in regularly taking anti-inflammatory medications, which require daily administration, are performing the necessary medication domain asthma management behavior. This current analysis (SICAS) measured this domain's management by how often the child is given their anti-inflammatory (ICS) medication, whether it is daily, sometimes, with symptoms only or never.

Education Domain

The education domain includes regular review of information pertaining to asthma, a written AAP and an active partnership between provider and family (Program, 2007). It has been known for several decades that parental asthma knowledge has been associated with greater adherence to management regimen and decreased unplanned

healthcare visits and hospitalizations (Brook, Mendelberg, & Heim, 1993). Clinicians recognize this need and ideally integrate parental asthma self-management education into the child's care for asthma, as an area health service in Australia has done successfully (Burns, Gray, & Henry, 2008).

Brown and colleagues' systematic literature review of parent asthma management suggests early recognition of symptoms by parents is associated with prevention of asthma exacerbations(N. Brown, Gallagher, Fowler, & Wales, 2010). Results of a descriptive study of 100 parents of children with persistent asthma and a mean age of 4.4 years (SD= 2.1) conducted by Butz and colleagues supports these findings indicating that only 42% (N: 40/96) gave their children asthma medication when asthma medication was warranted with the symptom of coughing (Butz et al., 2004). The ability of parent to assess child's symptoms is essential in management, because young children may not be able to recognize or verbalize their symptoms adequately (Butz et al., 2004). Written treatment plans help with recognizing symptoms where medication administration is necessary, and only 39% of these children had an asthma action plan (Butz et al., 2004). As poor adherence is associated with treatment failure, a review of adherence measurements for children with chronic illness recommended written treatment plans as a solution (Quittner, Modi, Lemanek, Ievers-Landis, & Rapoff, 2008). A parent utilizing an AAP given to them by a healthcare provider is a fulfillment of the parent educational asthma management behavior. However, healthcare providers need to give AAPs for parents to use in order for parents to fulfill this behavior. The secondary analysis examined whether or not a child has an AAP and its relationship to the child's outcomes.

Environmental Domain

The environmental domain includes avoiding inhalant allergens and irritants, while controlling comorbid conditions (Program, 2007). In a retrospective survey of parents of children 8 years or younger in ICS therapy, Ranganathan and colleagues reported that a home environment with either a household member smoking, furry pets in the home or a damp or moldy environment was significantly more likely to be found in households of children with difficult to control asthma (N=41/57, 73%) than children with well-controlled asthma (5/23, 22%, $p<.0001$) (Ranganathan, Payne, Jaffe, & McKenzie, 2001). In a randomly selected nationwide sample of 896 children 2 to 12 years old with asthma, Cabana and colleagues found that 82% (N=582/717) of parents who could identify a trigger of their child's asthma reported attempting to change their environment to benefit their child's asthma (Cabana et al., 2004). However, just over half (51%) of the environmental interventions parents had reported were not consistent with the national guidelines and were likely not beneficial in preventing asthma symptoms in their child, revealing a continued need for education and prioritization of environmental interventions for parents (Cabana et al., 2004).

While pest elimination is the responsibility of parents, extermination can be difficult to keep allergen levels low. Gergen and colleagues showed in an inner-city extermination intervention (NCICAS), extermination only had a short period of effectiveness and allergen levels remained high enough to cause asthma symptoms in children with asthma (Gergen et al., 1999). Gergen found that treatment in all rooms would be needed and may need to happen over time to decrease the allergen levels in the

homes. Also, prevention of reinfestation techniques is recommended, especially in apartments or multiple unit buildings (Gergen et al., 1999).

Teaching children to avoid tobacco smoke has shown to be effective in self-management (J. V. Brown, Avery, Mobley, Boccuti, & Golbach, 1996). However, Wong and colleagues reported in a descriptive study of child-parent dyads that parents were able to assess more accurately than children the amount of indoor smoking that occurs, giving parents the responsibility to monitor their child's environment at home (Wong, Bernaards, Berman, Jones, & Bernert, 2004). Therefore, parents have a major part to play in detecting and protecting their children from environmental allergens that exacerbate their asthma. Environmental domain management behaviors that parents perform are providing a low tobacco exposure and low pest exposure home environment for their child with asthma. This secondary analysis examined the home environment management behaviors of child tobacco exposure, smokers in the home and pests in the home.

Barriers to Adoption of Asthma Management Domains

Adoption of management behavior recommendations for each asthma management domain by both clinicians and parents is needed. These clinical guidelines for asthma specific management are written for clinician use, yet necessary for use by parents of children with asthma as well. However, the guidelines' complexity and high quantity of educational messages are barriers for clinicians effectively communicating these management domains to parents. Because of these barriers, education performed by healthcare providers is commonly focused primarily on medication administration and seldom includes other domains. In a qualitative study of 40 inner-city, minority families

who have a child with asthma, healthcare provider education was reported to focus on medications and not about symptom prevention or self-management, with 8% of parents receiving written materials (Yoos et al., 1997). This secondary analysis examined each of parent asthma management domains to determine the influence of parent management behaviors on the child's asthma outcomes, controlling for asthma medication administration.

Necessity of Parent Role in Asthma Management

Cognitive, psychosocial and motor capabilities affect children's ability to manage their asthma, and, as a result, parents continue to be primarily responsible for asthma management through adolescence (Ayala et al., 2006; N. Brown et al., 2010; Program, 2007). While children have a role in asthma management, it is relatively minor compared to parents' influence on asthma management. In a qualitative study of 61 caregivers of children with asthma and 15 nurses, Brown and colleagues observed that five year old children can only perform 11% of asthma self-management behaviors by themselves and need adult assistance or supervision for the other skills (J. V. Brown et al., 1996).

Overall, evidence suggests that parents of children with asthma appear to understand their role in medication administration. In a qualitative study of 18 parents of children and adolescents with asthma 2-18 years old, parents' beliefs, knowledge and attitudes towards anti-inflammatory medication use was explored. Peterson and colleagues found that parents, commonly mothers, direct the asthma management of their children, "including medication administration, healthcare provider visits, management and communication with school and daycare and other activities outside of the home"

(Peterson-Sweeney, McMullen, Yoos, & Kitzman, 2003) (p.50). They add that routine visits with their PCP or asthma specialist would likely increase the parents' knowledge and improve outcomes (Peterson-Sweeney et al., 2003). A qualitative study using focus groups with 50 middle school children with asthma with a mean age of 12.5 years old (SD= 1.05), explored asthma management barriers and developmental issues. Ayala and colleagues found that adolescents were gaining more autonomy in asthma management from parents in the area of medication management, though parents continued to be involved in reminders to take medication and other aspects of medication management (Ayala et al., 2006).

These qualitative studies on parent versus child management behaviors suggest that parents direct the management of their child's asthma, while children actually perform a very small percent of behaviors, including adolescents. For this reason, this secondary analysis was designed to measure parent management behaviors, and not children's, to determine what management behaviors are associated with improved asthma outcomes.

Parents who are non-adherent in administering their child's asthma medications do not likely realize the importance of their role. A qualitative study examining the barriers to adherence to guideline-based care found that parents misjudge their child's ability to manage their asthma on their own. In a study of 20 parents of children 2-12 years old with asthma, in-depth interviews were performed after one year of electronically monitored adherence of their child's medication use (Klok, Lubbers, Kaptein, & Brand, 2014). Reasons for non-adherence to medications measured

objectively by electronic monitoring were reported as unawareness of non-adherence by parents and healthcare providers, a lack of parental drive to obtain high adherence and ineffective parent problem solving. Klok and colleagues found that parents placed excessive responsibility for medication adherence on children. Similarly, in a study of 30 African American caregivers and children 6 to 14 years old with asthma, only 7% had effective metered dose inhaler skills, yet 93% were taking their inhalers on their own (Winkelstein et al., 2000). Without parental supervision, these children had inadequate inhalation techniques (Winkelstein et al., 2000). Parents may be unaware of their child's medication adherence and may be unaware of their child's poor inhalation techniques, pointing to the child's need for parent directed medication management. As non-adherence in medication administration may demonstrate a lack of parent understanding of their role in asthma management or parents who experience stress relinquish this responsibility to children, this secondary analysis examined parent psychosocial variables (such as stress, knowledge and beliefs) on medication management and asthma outcomes.

Challenges to Parent Directed Asthma Management in an Inner-City Setting

Low-income, urban families experience stress related to many stressors from their environment and may not be equipped to overcome these stressors in order to have a sense of control. Socioeconomic, housing, neighborhood violence and other stressors may be unique to the urban environment, causing "urban stress" (Quinn, Kaufman, Siddiqi, & Yeatts, 2010b). This psychological stress is a "social pollutant" that could be caused by acute and chronic housing stressors in the urban environment, leading to biological changes or behaviors that impact health (Quinn et al., 2010b). This secondary

analysis was designed to explore potential stressors from the inner-city environment and their effect on the psychological stress experience of parents of children with asthma, as well as provide insight to into the connection between the parents' stress responses and their asthma management behaviors.

National Inner-City Study of School-Aged Children and their Caretakers

The National Cooperative Inner-City Asthma Study (NCICAS) sought to explore the factors that contribute to asthma morbidity in children in the inner city with an intervention of asthma counselors coordinating asthma care with a home environment control program. This intervention included two group sessions for parents and one individualized session related to asthma knowledge and healthcare provider communication, gave parents pillow and mattress covers to control dust, and sent healthcare providers blank asthma action plans, national guidelines, a spacer and a peak flow meter (Evans et al., 1999). This multi-center study enrolled 1,528 children and their caregivers visiting the ED or clinic from eight major cities across the US, with 398 of the visits related to acute symptoms of asthma (Kattan et al., 1997). Children were 4 to 9 years old, 73.5% were African American, 19.5% Hispanic, and 7% white or other race (Wade et al., 1997). 73.1% of children were enrolled in Medicaid, 65.7% went to the ED for asthma at some point in the last year. Parents had many living challenges, with 61% of households had <$15,000 annual income, 77% of parents were not married and only 66.7% of mothers or caretaker completed high school (Kattan et al., 1997). Parent stress was measured using the PERI Life Events Scale, which is a non-global measure of stress, revealing a high amount of life events in the last 12 months (mean 8.16, SD 6.36,

N=1,515) (Wade et al., 1997). Also, parent psychological symptoms were exceedingly high (BSI Global Severity Index level of 56.02 versus norm of 50), with 50% of the same reached clinical severity. However, children in this inner-city population had a similar rate of behavior problems as the general population (50 versus 57.3%) (Wade et al., 1997).

The individual life events scale (PERI Life Events Scale) reveals that parent stress is likely from urban poverty unrelated to the child's chronic disease, with a high amount of undesirable life events (8 events within a 12 month period). This study reveals that in the inner-city population, multiple life stressors and not the child's chronic illness likely explain parent stress. Wade also recognized that these psychological difficulties likely impair the parent's ability to effectively manage their asthma (Wade et al., 1997). The authors acknowledged these psychological difficulties may affect parent's ability for asthma management and called for more small, in-depth studies to examine this possible link (Wade et al., 1997).

Unscheduled asthma visits per year approached significance in the second year for the intervention group compared to the control group (difference: –0.35, 95% CI, –0.72, 0.03, p= .075) (Evans et al., 1999). An analysis of ED visits related to the parent's stress was not performed. Parents of children with asthma reported 39% of homes had one or more people smoking, with 48% of the children's urinary cotinine samples had more than 30 ng/mg (Kattan et al., 1997). The researchers recognized that the sample likely had higher morbidity than a population sample due to recruitment from medical facilities, with 17.1% of children hospitalized in the last year (Kattan et al., 1997). While

pest elimination is the responsibility of parents, even extermination can be difficult to minimize allergen levels. Gergen and colleagues showed that the NCICAS intervention of extermination only had a short period of effectiveness and allergen levels remained high enough to cause asthma symptoms in children with asthma (Gergen et al., 1999). Families in the inner-city have a difficult time controlling pests in the home (Gergen et al., 1999).

Asthma counselors in this NCICAS intervention described above were flexible to help families address non-asthma related needs to "reduce distractions in the family's life", which enabled them to focus on the child's asthma concerns (Evans et al., 1999). This secondary analysis examined the likelihood of non-asthma related concerns inducing parent stress, which negatively affects their attention toward their child's asthma management, hypothesized to reduce asthma management behaviors and cause negative child asthma outcomes.

Inner-city Challenges to Parent Asthma Management

Transportation

A qualitative study with interviews of 33 school nurses who work in urban public schools on barriers to care include a lack of asthma knowledge related to asthma as a chronic which requires ongoing care, as well as parent difficulty retrieving their children from school children who are having an attack if they have public transportation (Forbis, Rammel, Huffman, & Taylor, 2006). A qualitative study with in-depth interviews of 38 parents in an impoverished urban environment on asthma management revealed a lack of personal transportation (Grineski, 2008). Parents having public insurance are more likely

than parents with private insurance to have a lack of transportation. Taking the bus was reported as a time consuming method (Grineski, 2008). Difficult transportation was also discussed as a barrier to obtaining prescriptions (Grineski, 2008). These qualitative studies on parent management reveal that transportation, as well as a lack of asthma knowledge, are barriers to child asthma control. In the current analysis (SICAS) the role of transportation and asthma knowledge were examined with asthma outcomes and parent management behavior.

Asthma Care Plan and Asthma Specialist

In a descriptive study of 220 African American and Latino parents of children with asthma, 68% reported incomes below the poverty level, 83% had Medicaid, 83% were single and 75% had high school preparation or less (Flores et al., 2009). Results indicated that low socioeconomic status (SES) affects the child's asthma morbidity and medical care (Flores et al., 2009). African-Americans were more likely than Latinos to use emergency departments for routine asthma care (68% vs. 44%; $p < 0.01$), adjusting for SES, caregiver's educational attainment, and asthma severity. Low SES was associated with greater odds of having an asthma attack (OR: 1.6, 95% CI: 1.1-2.3), and lower odd of having an asthma care plan (OR: 0.6, 95% CI: 0.4, 0.9), adjusting for having an asthma specialist. Low SES also was associated with half the odds of having an asthma specialist (OR: 0.5, 95% CI: 0.2, 0.95). Having an asthma specialist increased the odds (OR: 5.0, 95% CI: 2.2, 11.3) of having a written treatment plan, adjusted for SES, caregiver's educational attainment, and asthma severity (Flores et al., 2009).

This secondary analysis examined the likelihood of parents who are below a low-

income threshold of $25,000 annual household income in having routine asthma care and a written treatment plan. The relationship between annual household income and parent management behaviors such as routine healthcare visits and having a written treatment plan was clarified by examining the association between routine care and a written treatment plan, controlling for socioeconomic status (Flores et al., 2009) and other demographic variables.

Tobacco Use and Financial Stress

A semi-structured interview study with African American parents of children with asthma found that even though parents of children with asthma know that smoking is not good for their child's asthma, child smoke exposure continued due to barriers to tobacco cessation (Halterman et al., 2007). The main barrier found was parents' need for smoking to assist in reducing their stress (Halterman et al., 2007). Specifically, financial stress was a trigger associated with continued tobacco use. Even though parents made efforts to reduce their amount of tobacco use around their children, they persisted due to their stress, addiction, and a lack the knowledge to reduce their child's passive smoke exposure (Halterman et al., 2007). Even though this study was on African American parents only, parent tobacco use and child smoke exposure are an aspect of parent environment management behaviors and are anticipated to be barriers to asthma control and poor asthma outcomes. In the secondary analysis, passive smoke exposure of children and number of adults who smoke in the home were measured and examined in relation to asthma outcomes, controlling for other demographic variables.

Primary Care Appointments

Qualitative interviews with 14 children with asthma and their 14 parents revealed aspects of relationships with healthcare providers that were barriers to management. Parents of children with asthma believed that a "lack of continuity" among healthcare providers is a barrier to asthma management. Parents who use urgent care to take care of their child's asthma problems are more likely to have a lack of continuity, where parent's commented that urgent care provides quick treatment, while primary care investigating the treatment plan (Buford, 2004). This secondary analysis examined the role of routine asthma care on asthma control and asthma outcomes, including urgent care or emergency department visits for asthma.

Parent Management Interventions and Reducing Acute Care in the Inner-City

Three interventional RCTs of parent asthma education management interventions did not produce significant change in the main outcome of interest, emergency department or urgent care visits. A randomized trial of an educational self-management intervention of a tailored written action plan and an education summary was administered at four urban pediatric emergency department sites for 464 families of children with asthma (Sockrider et al., 2006). This intervention significantly increased the amount of routine asthma healthcare visits 9 months after in the intervention group (OR: 1.85; 95% CI: 1.05–3.39); however, ED visits and missed school was not significantly different between intervention and usual care groups (Sockrider et al., 2006).

An RCT for parents of inner-city children with asthma 2-10 years old with Medicaid insurance using a lay coaching intervention for 18 months (N=120) or usual

care (N=121) revealed an impact on several management behaviors (Nelson et al., 2011). The intervention, related to asthma management at home and a collaborative relationship with a healthcare provider, did not significantly reduce ED visits (RR= .98, 95% CI .85-1.12) or hospitalizations (RR .99, 95%CI 0.59-1.14) compared to usual care. However, parents who had the intervention were more likely to bring their child for an asthma monitoring visit (RR: 136, 95% CI 1.05-1.75) and a non-asthma related PCP visit (RR 1.47, 95%CI 1.04-2.08) (Nelson et al., 2011).

Education management support by either of these two interventions increased routine care but did not decrease main outcome of ED visits. Examining the relationship between routine care and ED visits was a part of the current analysis (SICAS). Modifying these monitoring visits will likely affect ED visits if measured longitudinally. This secondary analysis of children with asthma was performed from a study that longitudinally followed parents and their children for 1 year and provided insight into the use of routine care on the outcome of ED use. The hypothesis of this secondary analysis was that assessment and monitoring parent management, measured by routine care, reduces the need or likelihood of a child going to the ED for asthma.

An RCT with a community sample of 362 parents of children with persistent asthma ages 5 to 12 years old, where 4 key behaviors were targeted: using controller medications, administering albuterol when noticing symptoms requiring it, have written treatment plan and having a collaborative relationship with the PCP, all of which reflect the NAEPP's guidelines for care (Garbutt et al., 2010). While the coaching was tailored based on the parent's readiness to change (Transtheoretical model), there was no other

parent-specific characteristic consideration done in the intervention. Garbutt's telephone coaching intervention, described in the education management domain, did not reduce the mean number of urgent visits (difference, 1.15; 95% CI, 0.82 to 1.61), but did decrease the number of children with very poor asthma in the control group compared to usual care (difference, 0.34; 95% CI, 0.21 to 0.48) (Garbutt et al., 2010). This intervention did not affect unscheduled visits, but did improve asthma control. Again, it is possible that affecting ED use could be seen if there is a longer follow-up period is possible. However, it is also possible that these interventions did not include key components to effectiveness, such as considering psychosocial or cultural aspects that may affect their effectiveness…

Taken together, these three statistically well-powered interventions did not affect the main outcome they intended to change, ED or urgent care visits, however, they did positively affect other supportive self-management behaviors. Measuring whether parent psychosocial characteristics independent of demographics and education level, such as parent stress and knowledge, were not examined in these interventions. What remains to be clarified is whether parent stress or other psychological characteristics are mitigating the effectiveness of these interventions of parent management on the outcome of interest. This secondary analysis examined the impact of stress on parent asthma management behaviors and their influence on the main outcome of emergency department visits.

The APA EBA Task Force performed a self-report instrument review related to treatment adherence. The task force strongly recommended that future research should focus on measuring the barriers to disease management and knowledge related to

treatment (Quittner et al., 2008). A barrier for parent management of chronic disease in their children is parent stress.

Parent Psychological Distress and Management Behaviors

Parent psychological distress can affect management behaviors or actions parents provide for their children in a general population. In a descriptive study of 400 parents of preschool children, maternal depressive symptoms measured by the Mental Health Inventory were associated with lower routine dental care in children ($p=.001$), brushing teeth less than twice a day ($p=.04$), low discipline consistency ($p=.005$) and low parenting confidence ($p<.001$) (Kavanaugh et al., 2006). However, routine child healthcare and immunization administration was not significantly different between mothers with or without depressive symptoms (Kavanaugh et al., 2006). Understanding what parent management behaviors are affected by parent psychological distress and to what extent this affects the child's outcomes is necessary for furthering future interventional research. The current study was designed in part to address this goal.

Parent Stress Affecting Asthma versus other Chronic Disease

One study explored the levels of stress of parents of children with asthma compared with parents of children with other chronic disease, further exploring a possible link between parent stress and the disease of asthma. A cross sectional study of parents of children with chronic disease (N=425) who are primarily Caucasian, have moderate income and are married, examined the relationship between parent stress and chronic illness (Hullmann et al., 2010). The types of chronic illness included asthma (N=97), type 1 diabetes (N=143), cystic fibrosis (N=58) and cancer (N=109). Parent stress, measured

by the Parenting Stress Index/Short Form (PSI/SF), was significantly negatively correlated with annual income (B=-.25, p<.01) *and positive correlated with parent-reported perceived child vulnerability (B=.41, p<.01)* in zero-order correlations. Differences between the disease groups was determined using a one-way ANCOVA with the PSI/SF as the dependent variable and diabetes, cancer, asthma and cystic fibrosis and annual family income entered as covariates. Parents of children with asthma reported significantly more parent stress (Mean PSI/SF score= 77.8, SD= 2.1) than parents of children with cystic fibrosis (M= 71.7, SD= 2.7) and parents of children with cancer (M= 69.2, SD=2.0), but was not significantly different than parents of children with type 1 diabetes (M=75.7, SD= 1.7) (Hullmann et al., 2010). This study revealed that parents of children with asthma do have significantly more stress than some chronic diseases, but not others (and that there are variations in stress levels of parents between chronic diseases) in homogenous, moderate income populations. However, this study did not control for any other possible factors that explain stress other than annual family income and type of diagnosis. In this secondary analysis of a low-income, diverse, inner-city children and their parents, parent stress is not thought to have originated from the fact that the child has asthma, but is influenced by other common sources of stress in an inner-city setting, such as financial, social or environmental sources.

Psychological Distress in Parents affecting Management Behaviors and Outcomes

Several studies examined the link between parent depressive symptoms and asthma related outcomes, such as asthma related quality of life and ED visits, as well as management behavior medication administration. Szabo and colleagues examined the

role of depression and health outcomes in a Hungarian sample of 7 to 17 year old children with asthma (N=108) and their parents (Szabó, Mezei, Kovári, & Cserháti, 2010). The control group consisted of 27 child/parent dyads, including children with chronic renal conditions 7 to 18 years old. There were no significant between-group differences in parent depression (Beck Depression Inventory) (asthma: 7.73 depressive points, SD 6.69; chronic renal disease: 9.61 points, SD 9.8). However, both groups had significantly more depression than the general population (5.24 points, SD 7.43, $p<.01$). Children with parents reporting more depressive symptoms had no significant difference in their psychological score than children of parents reporting less depressive symptoms (Child Depression Inventory score 9, range 0-29; CDI score 8, range 0-22, $p=.79$) (Szabó et al., 2010). This indicates that the children's psychological score, specifically measured as child depression, was not influenced by their parent's psychological score. Also, the parents psychological score was not related to their quality of life measured by the Juniper Pediatric Asthma Quality of Life Questionnaire, indicating that their depression may not affect their QOL related to their child's asthma (Szabó et al., 2010). This finding assisted in guiding the pathway in this secondary analysis, with parent psychological distress influencing parent actions, and not parent psychological distress influencing child psychological distress, leading to worse outcomes.

In a prospective descriptive study of inner-city minority mothers of children with asthma (N=158, mean age 7.9 years, SD 2.2 years), Bartlett and colleagues found differences in medication administration among children of mothers with high and low depressive symptoms (Bartlett et al., 2004). Over half of the children were prescribed a

daily anti-inflammatory controller inhaler (56.5%). In bivariate analyses, mothers with high depression were more likely to be unemployed ($p < .001$) and have lower income ($p=.004$). Bivariate analyses also indicated that mothers with more depressive symptoms were significantly more likely to feel unable to stop an asthma attack at home ($p=.009$) and their healthcare provider was less likely to explain what asthma medications are for and how to use them ($p=.003$). Also, children who have mothers with more depressive symptoms have problems taking medications ($p=.009$); they frequently forget to take medications ($p=.005$), and they forget to take medications 2 or more days in the past 2 weeks ($p=.014$). The overall association of depression and adherence measures was weak ($r= .253$ to $.172$, $p < .05$). Linear regression was used to examine the influence of maternal depression and other factors on ED use 6 months after baseline. Controlling for child age, household income, and asthma morbidity, maternal depressive symptoms was significantly associated with ED visits (regression coefficient: .032, 95% CI .005-.058, β .182, $p=.019$), as well as asthma symptoms in the last 6 months (regression coefficient: .024, 95% CI .009-.040, β .234, $p=.003$). However, a follow-up of self-reported medication adherence at six months was not significant in this model (Bartlett et al., 2004).

The study did not include parent beliefs about asthma-management practices in the ED model, which leaves the question as to what their impact on this outcome is for this population. Parent depression had a direct effect on ED visits, controlling for exogenous variables (Bartlett et al., 2004). While medication adherence did not impact ED visits controlling for maternal psychological distress, there was a short 6 month

window to capture whether children had an ED visit or not. The outcome for ED visits is optimally measured for 1 year due to seasonal variability related to rhinovirus infections that exacerbate asthma or seasonal allergic rhinitis. Also, there were very few demographic variables controlled for, possibly explaining some of the maternal distress and explaining some of the variance in the medication adherence variable. This secondary analysis filled these gaps by examining parent psychological distress of stress and its influence on asthma management behaviors like medication administration adherence and the outcome of ED visits, following children for one year and controlling for relevant demographic variables.

Demographic Challenges and Parent Stress

Several studies examining demographic characteristics related to parent stress, such as parent gender, education, marital status, and income. In a retrospective study of 383 children with chronic illness, where 90 (23.5%) had asthma, parent marital status, parent income and parent stress were examined (Mullins et al., 2011). The full sample was primarily Caucasian, middle income and married. Single mothers in this study were more likely to be from a minority group and have lower income than married mothers (X^2 (1): 28.97, $p< .001$; X^2 (6): 146.32, $p< .001$, respectively). Parent stress was measured using the short form of the Parenting Stress Index. In bivariate analysis, a direct relationship between marital status and parents stress was found (β: -.14, $p=.01$). However, the relationship was attenuated and became insignificant ($p>.05$) when controlling for parent income. Parent income mediated the relationship between marital status and parenting stress ($z=-3.72$, $p<.001$) (Mullins et al., 2011).

In a related study with a smaller sample of homogenous, moderate-income parents of children with asthma, gender, age, income and duration of illness were not significantly associated with parent stress in bivariate analyses (N: 60 children with asthma out of 231 with chronic disease) (Carpentier, Mullins, Wolfe-Christensen, & Chaney, 2008). Parent gender and income were significantly associated with parent stress in a hierarchical regression with parent stress as the outcome (β= -.290, $p < .05$; β= -.359, $p < .01$, respectively), with lower income and female gender associated with higher stress, controlling for parent age and an Attributional Style Questionnaire score. As length of illness was not significantly related to stress (β=-.028, n.s.), the relationship between living with a child with asthma and parent stress was not supported (Carpentier et al., 2008).

The parent demographic variables of parent marital status, household income and parent gender are associated with parent stress in the parents of children with asthma population in moderate-income, homogenous populations. Parent stress in an inner-city population is higher than moderate-income populations. The NCICAS inner-city study measured a significant amount of stressful life events of these parents in the last 12 months (mean 8.16, SD 6.36, N=1,515). What remains to be clarified are any differences in the type of demographic variables that influence parent stress in the inner-city population than a moderate-income population. This secondary analysis examined the relationship between parent marital status, household income and parent gender with parent stress in an inner-city population.

A well educated and high income population in an inner-city in India also reported parent education had an impact on parent perceived stress (Rastogi, Gupta, & Kapoor, 2009). A cross-sectional study measured parent education, medication management and perceived stress of parents of children with asthma (mean age 5.7 years, SD 2.7 years) in a well-educated, urban population in India (N= 134) (Rastogi et al., 2009). Parent education was negatively correlated with parent stress, as those without graduate education were twice as likely to have high stress (.28/.138= 2.02). 60% of parents acknowledged daily use of preventive asthma medication was useful to prevent symptoms, only 42% were on inhaled steroids at the time. 40% of this sample reported to miss school related to asthma and only 6.7% had an asthma action plan, with 8% having a problem with their school being equipped with rescue medication (Rastogi et al., 2009). Parent perceived stress was reported to not limit adherence to controller medication adherence or physical activity, however it was unclear what testing was done to reach this conclusion. This well educated, high-income population residing in an inner city in India may not have the same barriers to asthma management as a racially diverse, high stress inner-city population in North America. This secondary analysis tested these relationships in a larger sample with longitudinal data, in a diverse inner-city population.

Parent Stress and Demographics on Asthma Prevalence

In a secondary analysis that sought to determine if family stress influences asthma development by age 4, parent stress was associated with asthma onset (Klinnert, Kaugars, Strand, & Silveira, 2008). A diverse population of families of children with asthma starting age 9-24 months was followed to age 4 (N= 98). An analysis was conducted

using baseline questionnaires given in a nurse home visitor intervention. The family stress measurement included life events (21 items of possible stressful live events in the last year), unwanted thoughts, marital conflict and unsafe neighborhood. While this stress measurement measures stressful events or symptoms of stress, like unwanted thoughts, they are not specifically measuring how the parent perceives stress. Children with asthma (N=58) were significantly more likely to be in an unsafe neighborhood than children without asthma (N=40) (p=.02) (Klinnert et al., 2008). However, life events, martial conflict and unwanted thoughts were not associated with asthma onset.

No significant differences were observed in family stress as reported by married versus single parents (Klinnert et al., 2008). Family stress was significant in predicting asthma prevalence at age 4 when controlling for maternal mental health (p=.05), but became insignificant when controlling for maternal demographics such as race, marital status, and prenatal smoke exposure, illness severity and hospitalization (OR 1.07, p=.13). Single parents and a minority racial/ethnic group of either African American or Hispanic were significantly associated with a child having asthma at age 4 (OR=2.74, p=.04; p=.05 respectively), controlling for other parent characteristics, parent stress, illness severity and hospitalizations. Illness severity was also significantly associated with asthma diagnosis (OR 1.79, 95% CI 1.02-3.29, p=.05) (Klinnert et al., 2008).

Family stress was significant in predicting asthma prevalence not controlling for other variables, but the relationship was mediated by parent race and marital status, including other demographics. Unsafe neighborhood was significantly related to asthma onset, but family stress was not associated with asthma onset. Being a single parent and

from a minority group were significantly related to asthma prevalence, controlling for other demographics. These findings guided the analytic methods of the secondary analysis performed, with the inclusion of neighborhood, parent marital status and race/ethnicity groups in the analysis of parent stress and child asthma outcomes.

Global Measure of Stress: Perceived Stress

Perceived stress is a global measure of stress and defined as "the degree to which situations in one's life are appraised as stressful" (S. Cohen et al., 1983) (p.385). A global stress level more likely affects a person's illness process than the specific live events that have occurred (S. Cohen et al., 1983). Self-ratings of event stressfulness better predict health-related outcomes than looking only at events (S. Cohen et al., 1983). High perceived stress occurs when overall life stress is threatening and there is insufficient resources for the person to cope with the stressors.

A global measure of stress captures how a person is experiencing their stress, or whether they feel like they have any control in the circumstances of their life. A life events measure counts the number of potentially stressful events, yet does not capture how the person is perceiving stress or its influence on their sense of control in their life (Islam et al., 2011). This is especially relevant when examining whether stress impacts asthma management behaviors, or decisions that parents do or do not do based on the level of control they experience. Also, an intervention to address perception of stress and not the actual life events themselves, would be more effective if it was known which management behaviors perceived stress influences and which child asthma outcomes.

This secondary analysis measures perceived stress of parents and examines its effect on parent management behaviors and child asthma outcomes.

Parent stress and Child Asthma Symptoms or Inflammatory Markers

In the first year of life, prenatal parental stress has been shown to impact a child's chance of wheezing (Wood et al., 2011). The Urban Environment and Childhood Asthma study, a birth cohort of 560 babies, revealed that maternal stress (measured by the External Stress Score) measured prenatally predicted multiple days of wheezing in the first year of life (measured every 3 months) (Wood et al., 2011). Parent stress has been shown to increase the risk of a child developing asthma.

However, the relationship between parent stress and child asthma symptoms is unclear, especially after *in-utero or early life exposures.* A survey of 682 low-income urban parents of children with diagnosed and undiagnosed asthma explored urban housing stressors, including financial stressors of paying bills, for their impact on a parents' psychological stress. These factors were found to increase the risk of asthma symptoms, including activity intolerance and waking up at night, and unscheduled medical visits for children with asthma (Quinn, Kaufman, Siddiqi, & Yeatts, 2010a). These stressors do have an impact on child asthma symptoms, yet the pathway is not clear regarding the mechanism of influence on the child's health.

A Psychosocial Pathway through Parent Management Behaviors

Unknown psychosocial pathway. Controlling for child asthma severity and medications, a study measuring parent perceived stress partially explained the child's inflammatory processes, yet did not find a link between parent stress and child anxiety. In

a longitudinal study of children and adolescents 9 to 18 years of age with asthma (N=50) and healthy controls (N=33), parent stress measured using the 10 item PSS was associated with greater increases in the child's IL-4 production (B= .29, p=.019) (Wolf, Miller, & Chen, 2008). Asthma control was measured using the NAEPP guidelines, and a serum specimen of immune response protein interleukin 4 (IL-4) and eosinophilic catonic protein (ECP). Multiple regression explaining ECP in visit 2 controlled for the ECP level in visit 1, severity variables, medications, diagnosis of asthma, stress, and interaction of group (asthma or healthy) and parent stress. Parent stress explained some of the variance in child's inflammatory measures of ECP by 7.2% and IL-4 by 7.6% over 6 months, while controlling for all other variables (Wolf et al., 2008). This variation of the inflammatory measures over a six month period of time could be a problem for children with asthma, yet were not linked to any other child asthma outcomes, such as symptoms, healthcare visits or school absenteeism.

Wolf found that parent stress and depressive symptoms affect the child's inflammatory markers or physiological functioning. However, inflammatory markers did not fluctuate with altered child psychological state. An editorial by Buseke-Kirshbaum supports the conclusion that Wolf and colleague's data does not support- a pathway with parent stress working through child's stress to affect inflammation (Buske-Kirschbaum, 2008). Similarly, Szabo also notes that parent stress and child psychological functioning are not associated (Szabó et al., 2010). Szabo and colleagues examined the role of depression and health outcomes in a Hungarian sample of 7 to 17 year old children with asthma (N=108) and their parents. Children with parents reporting more depressive

symptoms had no significant difference in their psychological score than children of parents reporting less depressive symptoms (measured by the Child Depression Inventory score 9), indicating that the children's psychological score, child depression, was not influenced by their parent's psychological score. Also, the parents' psychological score was not related to the child's quality of life related to asthma.

The lack of an association between child anxiety and parent stress points to an alternate pathway between parent stress and biological mechanisms that does not include the child's psychological state, such as through parent management behaviors (Buske-Kirschbaum, 2008). There is a call for longitudinal studies examining the link between family functioning and disease processes in children (Buske-Kirschbaum, 2008). Identifying these parent factors, both psychological and behavioral, can assist in the development of new psychological intervention strategies to assist in improving the health of children with chronic disease. This analysis was designed in part to address this gap in existing evidence.

Parent stress and Parent Management Behaviors

Psychosocial distress has been associated with general management behaviors in parents. For example, maternal depression is associated with lower parent discipline, confidence and dental care (Kavanaugh et al., 2006). More specifically, parent stress and parent depression have been linked to asthma-specific management behaviors.

A randomized control study of inner-city African American parents revealed a relationship between lower parent stress and higher medication adherence (Celano et al., 2011). Parent stress was negatively associated with overall asthma management (r=-.41,

p= .006), including a medication adherence subscale (r=-.39, p< .01) (Celano, Klinnert, Holsey, & McQuaid, 2011). However, a more diverse sample, including Hispanic parents, is missing. Minimal data exist that focus on diverse populations and address barriers to child asthma management related to parent stress, especially inner-city "urban stress", encompassing household and neighborhood factors. Similarly, a prospective descriptive study of inner-city minority mothers of children with asthma revealed that mothers who had more depressive symptoms had children with lower medication adherence, as well as a positive association with higher child asthma symptoms and ED use at follow-up (Bartlett et al., 2004).

In an similar inner-city population in the Northeast, stress and parent management behaviors of medication administration and smoking attenuated part of the effect of exposure to violence and number of symptom days (Wright et al., 2004). However, the effects of parent stress and management behaviors on each other and on child symptom days were not examined. These associations between parents stress on management behaviors to affect child asthma outcomes is understudied.

Parent stress and Child ED visits

Children are taken to the ED for asthma for biological and behavioral reasons. Biologically, the child is having asthma symptoms that warrant immediate attention. Behaviorally, an adult needs to recognize that the child has these symptoms, is aware that help is needed and to transport the child to the ED, or to elicit assistance for transportation. However, different stressors can influence a parent's decision to bring the child to the ED. Financial stress, or cost sharing of medical care for asthma, may

influence a parent's decision. Low income families who had their care covered were more likely to take their child to their routine visits and to the ED (Fung et al., 2014). The relationship between parent stress on parent management behaviors of child routine appointments and child ED visits as a main outcome were examined in this analysis.

Understanding how parent stress affects these financial decisions of bringing the child to the ED is needed. In a sample of children recruited in the ED, single parents were shown to be 34% more likely to have psychological distress (measured by the 6 item Kessler 6 scale) (Moncrief, Beck, Simmons, Huang, & Kahn, 2014). Children returning to the ED within a year were significantly more likely to be in a single-parent household, with this relationship driven by household income. Parent characteristics, such as marital status, will be explored for influence on parent stress and main outcomes of asthma symptoms and ED visits.

Controlling for exogenous variables, parent depression was found to a have a direct effect on ED visits in an inner-city population (elementary schools from two urban areas) (Bartlett et al., 2004). However, there were a lack of characteristics explored that could contribute to parent stress and it's influence on ED visits. Also, ED visits was captured in a short 6-month time frame. The biological aspect of asthma symptoms and the behavioral aspect of parent decision and asthma management were not explored. Further exploration of the relationship between parent psychosocial distress and ED visits is needed.

Summary

The purpose of this secondary analysis was to examine the relationship between parent perceived stress, parent management behaviors of asthma and asthma control in school-aged children. A summary of the gaps identified in the literature, the contributions of this analysis and a response to a national call for research is given.

The Problem

Current asthma management by parents and clinicians nation-wide does do not meet the national guideline recommendations. Specifically, despite advances in treatment of asthma, children are still going to the emergency department for treatment of acute exacerbations. Clinicians are not providing written asthma management plans (AAPs) or performing environmental allergen teaching at optimal rates. Parents are not giving controller corticosteroid medications to children who clinically require this treatment or addressing adverse exposures in their home adequately. GINA emphasizes collaboration between parents and healthcare providers for child asthma management, and recommends parents be a part of the management care planning (Asthma., 2012). The IOM highlights psychosocial issues as critical areas for targeted research due to their likely effect on disease management (Medicine, 2002) (p.11). Understanding the barriers to asthma management in inner-city families, including psychosocial factors such as psychological distress or parent stress, is essential for the development of effective approaches to management and treatment.

Currently the literature is limited in addressing the relationship between parent stress of children with asthma, parent management behaviors and children's asthma

outcomes. Specifically, minimal data exist that focus on diverse populations and address barriers to child asthma management related to parent stress, especially inner-city "urban stress", encompassing household and neighborhood factors.

Rationale for Included Variables in Full Model

Parent Management Behaviors. Each of the parent management behaviors examined were based on the national guideline's recommendations for asthma management. While these guidelines are written for healthcare provider use, examining the educational messages related to asthma management for patients and parents of children with asthma determined which parent management behaviors to focus on for the analysis. The assessment and monitoring domain was measured by parents who were able to keep routine, non-emergent healthcare appointments for their child's asthma. The medication domain was measured by the frequency of the parents administering or assisting their children in administering their anti-inflammatory (ICS) controller medication. The education domain was represented by whether the parent has an AAP or not, which is a collaborative management behavior between the healthcare provider and the parent. The environmental domain was represented by whether the children were exposed to passive tobacco smoke, the number of smokers in the home and number of types of pests in the home.

Asthma knowledge, beliefs and self-efficacy. Parents do not always recognize their role in asthma management, leading to non-adherence to recommended treatment guidelines. Non-adherence in medication administration, regular assessment, and controlling the home environment may demonstrate a lack of parent understanding,

beliefs or knowledge related to asthma and their role in asthma management. Parent knowledge, beliefs, and self-efficacy related to medication management were examined.

Inner city challenges in this population that may affect parent management of their child's asthma management were explored. Specifically, the influence of transportation, asthma knowledge, household income, environmental exposures and other sociodemographic variables were examined related to current asthma management literature.

Gaps in Literature

Aim 1. There were minimal child, parent and inner-city characteristics explored or controlled for related to parent stress and parent management behavior literature related to child asthma outcomes. Inner-city challenges related to asthma management were explored, but were often not included in parent stress and child asthma outcomes literature. Findings from asthma prevalence study guided the analytic methods of the secondary analysis performed, with the inclusion of neighborhood, parent marital status and race/ethnicity groups in the analysis of parent stress and child asthma outcomes in children who were already diagnosed with asthma (Klinnert et al., 2008).

Aim 2a. Parent stress has been examined in qualitative literature, but there is a lack of exploration in quantitative analyses related to what has caused the parent stress. There is often an assumption that it is the child's condition that causes stress in the parents, however this is less likely in the inner-city population. However, other inner-city influences likely affect the inner-city population's stress levels and have yet to be explored in this population. Several studies examining demographic challenges related to

parent stress, such as parent gender, education, marital status, and income. What remains to be clarified are any differences in the type of demographic variables that influence parent stress in the inner-city population than a moderate-income population.

A portion of the parent's stress may be related to the child's asthma (Hullman 2010). However, it is worth noting that this stress of parents may not influence the child's psychological distress, causing inflammation (Szabó et al., 2010; Wolf et al., 2008). This secondary analysis examined child asthma severity in the parent stress model to examine the influence of the disease on parent's stress for parents who have children diagnosed with asthma.

Aim 2b and 2c. Parent stress and asthma outcomes have been explored. Parent depression had a direct effect on ED visits, controlling for exogenous variables (Bartlett et al., 2004). The study controlled for few variables that may influence parent stress and there was a short 6-month time period for measuring outcomes.

There is a lack of literature examining the mechanism that links parent stress to child asthma outcomes. As Wolf (Wolf et al., 2008) (2008) and Buseke-Kirshbaum (2009) point out, there is no indication of an association between parent stress levels and child anxiety levels, leading to the question of whether there is a psychosocial reason for the connection of parent stress and child outcomes. Szabo also notes that parent psychosocial distress and child psychological functioning are not associated (Szabó et al., 2010). A call for longitudinal studies examining the link between family functioning and the atopic disease process in children is addressed by this analysis.

Aim 3. In an inner-city population of parents of children with asthma who reported stress, number of household members was significantly associated with asthma management (Celano et al., 2011). There is a moderate amount of literature examining what inhibits parents from performing medication administration regularly, such as parent depression reduces medication administration adherence (Bartlett et al., 2004). However, there is less information on what demographic variables influence the other management behaviors of routine healthcare appointments, home environment management and obtaining an AAP from the healthcare provider.

Routine visits were positively associated with the parent management score (Celano et al., 2011). However, demographic variables that influence this relationship were not explored. Demographic variables that influence whether parents are performing home environmental behaviors such as pest management, reducing passive smoke exposure and smokers in the home, as well as demographic variables influencing whether or not parents obtain an AAP, have not been examined in the literature.

Contributions of the Analyses

To address the gaps in the parent stress literature, this analysis sought to examine relationship of financial, and environmental or social sources of stress in the parents of children with asthma population. Also, the need to examine parent psychological distress of stress and its influence on asthma management behaviors like medication adherence, healthcare visits with PCP or asthma specialist, and a home environment without negative exposures and the outcome of ED visits over a long period of one year was met in this analysis (Celano et al., 2011). Also, determining if parent and environmental

characteristics explain parent stress's role in the child's symptoms in a population of children with asthma, as they do for asthma prevalence, was examined (Klinnert et al., 2008). Also, environmental variables were rarely used in the literature and were explored in this analysis.

Specifically to the inner-city population, this study examined parent characteristics of gender, race, marital status and household income, and their association with parent stress, controlling for asthma severity (Celano et al., 2011; Klinnert et al., 2008). Higher parent stress is negatively associated with medication adherence in one inner-city population (Celano et al., 2011) and was tested in this analysis.

Minimal data exist regarding control for social and environmental factors in studies examining the link between parent stress and child symptoms or outcomes. More research attention devoted to measurements of neighborhood, home and parent characteristics and designed to explore the relationship of parent stress and child asthma control is needed, and the current study examined variables that measure these characteristics.

Studies could not find the link between child psychological measurements and parent psychological measurements (Szabó et al., 2010; Wolf et al., 2008), examining other influences of parent psychological distress, including stress, on child asthma outcomes is called for. The authors call for longitudinal studies to better understand the link between family functioning and atopic disease processes in children. This study was designed in part to fulfill that role.

A randomized control study with African American parents (98%) revealed a relationship between lower parent stress and higher medication adherence (Celano et al., 2011). However, a more diverse sample, including Hispanic parents, is missing. This analysis will explore parent perceived stress' influence on asthma management behaviors using a ***diverse sample***. Also, an analysis using ***longitudinal data*** is beneficial to measure the effect of stress on management and management on asthma outcomes. This analysis of parent perceived stress related to parent asthma management behaviors and asthma outcomes was designed to add unique and important information central to the pathway of influence of parent stress on child asthma outcomes in order to catalyze behaviors that promote good health outcomes. Defining this pathway will provide insight for possible future interventions to mitigate use of the ED for asthma care and children missing school due to asthma symptoms, thus reducing healthcare costs and increasing academic success.

CHAPTER THREE

RESEARCH DESIGN AND METHODS

Longitudinal analysis of major outcomes for children with asthma is minimal, as well as studies controlling for important mediators of parent stress in a child's environment—such as inner-city environment and parent management behaviors. This secondary analysis was conducted using existing data from a prospective, correlational study with a longitudinal design. The sample is unique, with substantial racial and ethnic diversity from an inner-city population of school-aged children and their parents. The methods used to test these hypotheses are discussed, including the study design, original study description, human subjects consideration, survey instruments used, dependent and explanatory variables included—along with transformations, and statistical methods used. Statistical methods employed in this secondary analysis included univariate and bivariate analyses, multivariate analyses with hierarchical regression, and generalized estimation equations for longitudinal outcome data.

Study Design

The data for the secondary analysis is from a prospective, correlational study that followed subjects quarterly for one year, and was conducted for five years. The analysis uses sociodemographic, inner-city environment, parent psychosocial and management behavior data that were measured at baseline each year, and the main outcome of interest;

emergent healthcare use, school absenteeism and asthma control measures, measured quarterly each year.

The School Inner-city Asthma Study (SICAS)

The Asthma Clinical Research Center at Boston Children's Hospital, Harvard Medical School conducted a 5 year prospective, NIH/NIAID funded longitudinal study, "School Inner-city Asthma Study" (SICAS) (Principal Investigator, Phipatankul) (Phipatanakul et al., 2011). This descriptive correlational study sought to evaluate if allergens or mold in a classroom increases the risk of asthma morbidity in inner-city children with asthma over 1 year. The target population for the SICAS study are inner city children who attend inner-city metropolitan schools, are between 5 and15 years old and come from English or Spanish-speaking families. The sampling frame included children with asthma in selected classrooms in selected schools from Spring 2008 to Spring 2012, totaling 38 schools and 400 children over five years. The recruitment goal was to enroll 100 students with asthma per year from 8-10 unique schools, repeated annually for 5 years. The survey population was parents of school-aged children with asthma from inner-city schools in a major urban area in the Northeast, United States.

The schools were selected from within an inner-city area in the Northeast by recruitment of school principals' participation. Convenience sampling was necessary due to the need for principal participation, yet racially and socioeconomically heterogeneous areas of the city were successfully recruited. Children in classrooms of participating schools were given a screening survey for their parent's to complete and return. Classrooms with the highest rate of completed forms were entered into the study. The

students who had asthma in the classrooms were enrolled in the study and had a baseline assessment at Children's Hospital Boston.

Inclusion and exclusion criteria. Children were included if they were entering grades 1-8 the following school year, attending one of the classrooms that were permitted to have classroom environment sampling, were able to provide assent if appropriate and guardian able to give informed consent. Also, children were required to have asthma (by healthcare provider diagnosis) and wheezing in previous 12 months or taking daily medicines for asthma or an unscheduled medical visit for asthma in the last year. Children were excluded if they had significant pulmonary diseases other than asthma, had cardiovascular disease with daily medication, were taking a beta blocker, or were unable to follow through with study procedures (Phipatanakul et al., 2011).

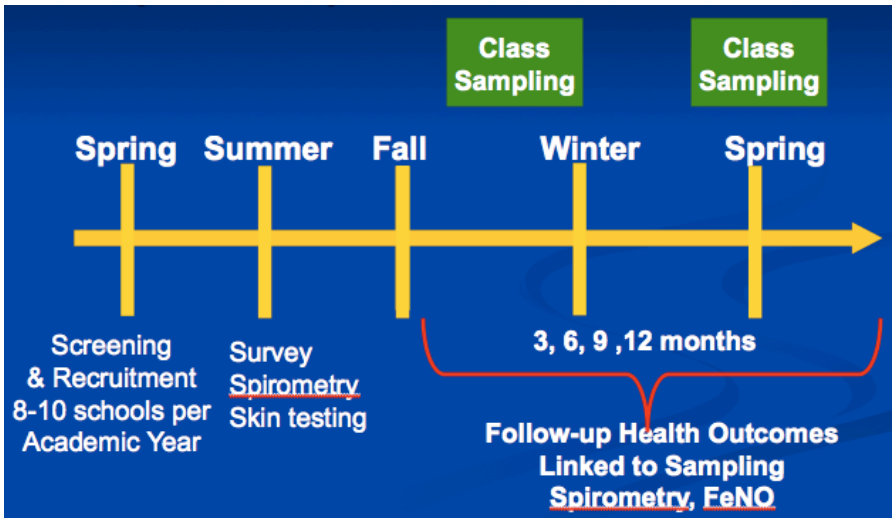

Figure 2. School Inner-City Asthma Study Annual Schema

Baseline and Follow-up Data. Basic sociodemographic data were collected with the recruitment survey. A baseline questionnaire was used to collect information from parents on their children's asthma symptoms, asthma control, their family's home, time

outdoors, the child's health, food allergies, asthma outcomes, medical care, medications, adherence to asthma therapy, parents' perceived stress, child's sleep and television use, and their neighborhood. Vacuumed dust samples in the child's home were taken at baseline. School environmental assessment with inspection surveys, school environmental dust sampling, school fungal spore sampling, and air pollution sampling were also performed. Follow-up assessments, which included the home environment, as well as many questions from the original baseline questionnaire at 3, 6, 9, and 12 months (Figure 2). The follow-up survey included information on the child's time outdoors, home environment, medication use, asthma symptoms, asthma control, asthma outcomes, asthma teaching done at their last appointment, adherence to asthma therapy, the child's sleep and television use, and their neighborhood.

Sample. 351 children completed a baseline visit and 298 (84.9%) had at least one follow-up visit, with 251 (71.5%) children completing all follow-up visits. The sample of children are highly diverse, with 35% African American and 37% Hispanic, which reflects an inner-city population. A national sample from the National Cooperative Inner-City Asthma Study was even more ethnically diverse, with 73.5% African American and 19.5% Hispanic (Kattan et al., 1997). The public schools in the inner-city area have 36% African American students and 40% Hispanic students (BPS, 2013), which reflects the SICAS population racially and ethnically.

Secondary Data Analysis of SICAS

The aims of the secondary data analysis were to:

1. Examine characteristics of the child and parents' home and social environments and their associations with asthma control, urgent or emergent asthma visits and school absenteeism.

2a. Examine which parent or child characteristics lead to higher stress in parents of children with asthma. 2b. Examine the association of parent stress on the child's emergent asthma visits, school absenteeism, and asthma control. 2c. Explore the pathways of parent stress on parent management behaviors that affect the child's emergent asthma visits, school absenteeism, and asthma control.

3. Examine the effects of child and parent characteristics on the parent management behaviors performed.

Aim 1 was addressed using bivariate analyses examining the gross effects of child and parent characteristics and the inner-city environment, looking for expected trends noted in the literature. Multivariate regression was performed for the main outcomes of emergent healthcare use, school absenteeism and asthma control. The coefficients of the characteristics were examined after other relevant mediators are introduced into the models, focusing on characteristics that are significant in explaining multiple outcomes. Also, zero-order correlations from the correlation matrix were used to inform the interpretation of changes in coefficients noted when new variables were stepped into the regression models.

Aim 2 similarly was addressed using bivariate analyses and multivariate analyses linking characteristics and mediators with main outcomes. Specifically, aim 2a was examined using bivariate analyses between characteristics and parent stress, and a logistic

regression model examining characteristics' effects on parent stress as the main outcome. Aim 2b. Bivariate analyses between parent stress and the main outcomes were performed, as well as examining the effect of parent stress on the main outcomes in the regression models. Aim 2c. Bivariate analyses between parent stress and parent management behaviors, as well as between parent management behaviors and the main outcomes, was performed. Multivariate tables including parent characteristics, management behaviors and main outcomes were added for clarification on variables of interest. Multivariate hierarchical regression models using GEE (cluster analysis model) were performed for the main outcomes, and the interaction between variables were examined as they were stepped in by the researcher—with zero-order correlations assisting in their interpretation.

Aim 3 parent management behaviors were examined as the main outcomes in logistic regression models using baseline data only, with relevant parent and child characteristics tested for significance. Characteristics that affected multiple outcomes significantly were examined further.

Path Model

It was hypothesized that parent perceived stress affects parent management behaviors, which influences the child's asthma control and then their emergent healthcare use or school attendance (Figure 3).

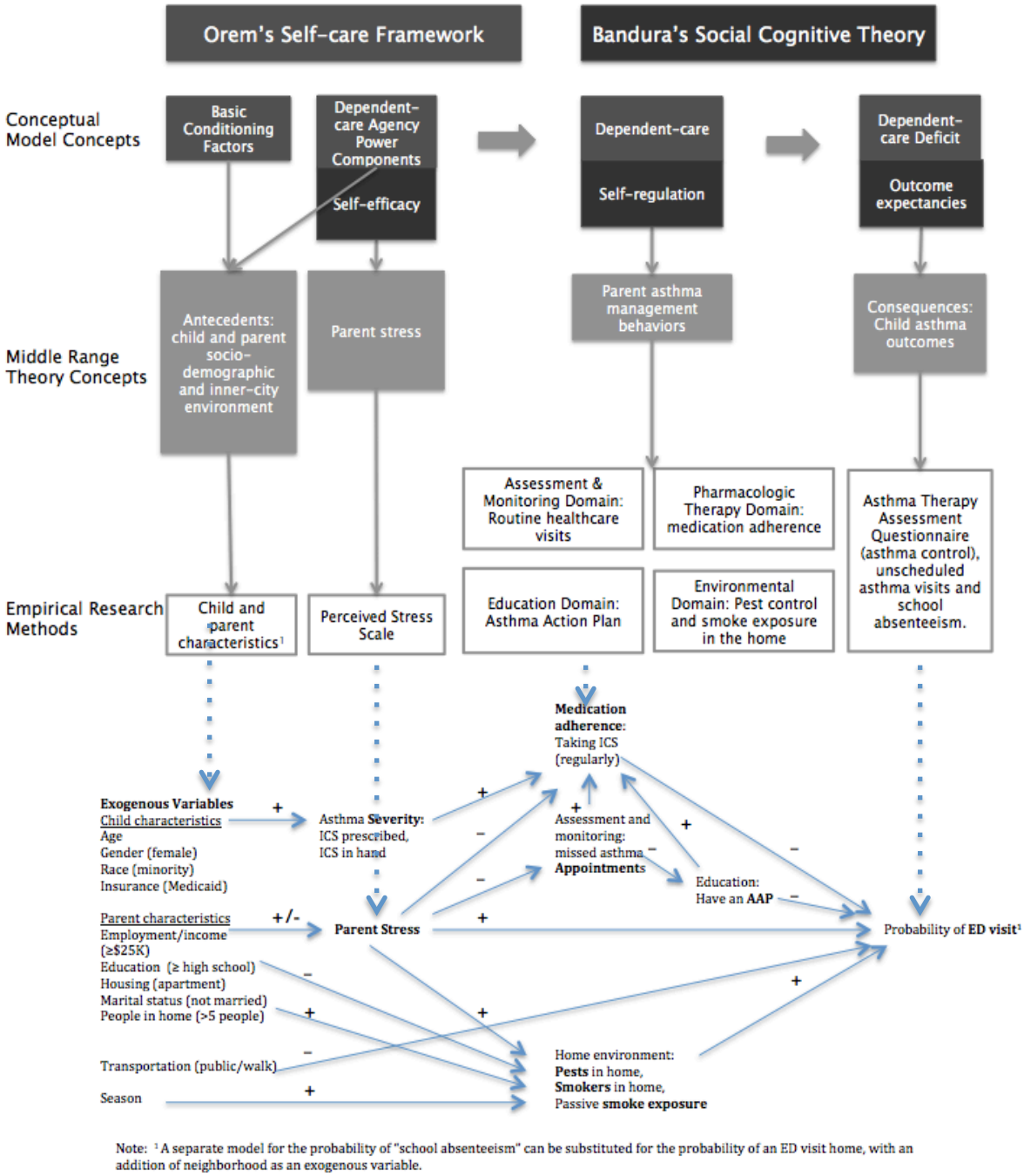

Figure 3. Conceptual-Theoretical-Empirical Model Linked with Path Model

Exogenous variables. The exogenous variables of child and parent characteristics are on the left side of the diagram. Even though there are no relationships shown between these variables for the path model, reciprocal influences may exist. However, they are

likely not influenced by any of the endogenous variables in the model. The relationships between the exogenous variables in affecting the main outcomes are explored more in Aim 1.

Parent stress. Parent stress is hypothesized to be positively associated with parents who are not married, have >5 people in the home and who take public transportation. These variables represent an inner-city environment, which includes less social support due to single parent marital status, possible increased responsibility at home with a higher number of children or adults in home, and inconvenience and unpredictability in with public transportation. Parent stress is likely negatively associated with parent income and education, with parents who have graduated high school and those who have regular employment or an annual household income greater than 25K have greater financial stability with a predicted lower stress level.

Asthma severity. Child characteristics are hypothesized to be positively associated with asthma severity. Children who are older are more likely to be diagnosed with asthma and have received an inhaler, with their asthma severity more likely to be determined. Children who are minorities are more likely to have higher asthma severity. As Medicaid insurance can be a proxy for socioeconomic status, children who are covered by this insurance may also be more likely to have higher asthma severity.

Medication adherence. Parent stress is likely negatively associated with medication adherence, as parents who feel they have less control in their lives may be less likely to prioritize administering their child's medication regularly as high of a priority as other life concerns. Asthma severity is positively associated with medication

adherence, as children with higher severity are more likely to have been prescribed and given more medications and teaching related to the importance of medication adherence, whether in the emergency or routine healthcare setting. Missing an appointment is negatively associated with medication administration, since parents who go to their child's routine appointments are more likely to have been taught about the necessity of medications in controlling their child's condition, had their medications updated based on the assessment done at the appointment and given a new prescription. Also, parents who go to a routine appointment are more likely to receive an asthma action plan, which discusses they type, dose and frequency of medication administration that is necessary, increasing the likelihood of a parent administering their child's medication regularly.

Assessment and monitoring. Parent stress is likely positively associated with missing routine appointments, with parents who feel that they have less control over their lives have made other needs take priority in their schedule or have a less flexible schedule that inhibits them attend a routine visit for their child's asthma.

Education. Missing healthcare appointments is hypothesized to have a negative association with having an AAP. Parents who do not make it to appointments are less likely to have an AAP due to less exposure to healthcare professionals that may provide treatment support for parent management of their child's asthma. There is no direct relationship hypothesized between parent stress and having an AAP due to the shared responsibility with the healthcare provider.

Home environment. Parent stress is likely positively associated with a negative home environment, including pests in the home, smokers in the home and passive smoke

exposure. Parents who are stressed likely do not make additional effort to remove negative exposures due to other concerns that are prioritized. Employment and education are negatively associated with negative household exposures because of the likelihood of living in a residence that potentially newer, well maintained, or managed well, that is more likely to be pest free. Also, financial strain has been shown to lead to increased smoke exposure, so a higher income may lead to a lower likelihood of smokers in the home or passive smoke exposure. The relationship between housing type and negative exposures is unclear, as parents who live in an apartment building may be more likely to have pest infestation due to the size of the building structure, yet maintenance by the owner may take care of pests, while pest exposure in a house may more likely be related to parent actions. Parents who are not married or have more people in the home are positively associated with a negative home environment, as parents who are single have less support at home to make changes at home related to reduce pests, and those with more people in the home are more likely to a person who smokes (and more chaos in the home to keep certain places clean in order to prevent pests). Parents and children who are more likely to take public transportation are less likely to be able to afford good housing and may be a more specific type of socioeconomic variable, which likely had a negative association with negative household exposures. Season is positively associated with pests, as pests are more likely to vary depending on the time of year, with warmer seasons increasing the likelihood of pests in homes.

Main outcomes of ED visits and school absenteeism. The probability of an ED visit is positively associated with parent stress. When parents who perceived themselves

has having less control in their lives are less likely to notice problems in their child's asthma until it needs to be addressed in an emergent way, due to the severity of the child's symptoms. Other priorities may distract parents from being able to proactively monitor their child's symptoms, or perform any of the preventive management behaviors. A direct, positive association between parent stress and the main outcome of ED visits is predicted due to the convenience of emergency departments being accessible any time of day, without any scheduling or planning required. Having a negative home environment is positively associated with main outcomes of ED visits and missed school due to the child having an inflammatory response and asthma symptoms due to the exposures in the home, increasing the likelihood of the necessity of emergent healthcare use or children staying home from school due to these symptoms. Medication administration is negatively associated with going to the ED or missing school, as parents who administer their child's medication regularly decrease the inflammatory response in their child's body, which reduces likelihood of severe symptoms necessitating going to the ED or missing school. Parents who miss appointments related to their child's asthma are less likely to have an accurate assessment of their child's symptoms or up to date medications that effectively control their child's inflammatory processes in their body, increasing the likelihood of severe asthma symptoms that necessitate going to the ED or missing school.

Transportation has a direct negative association with ED visits, as people who walk or take public transportation are less likely to go to the ED or miss school than those who have a car because of the greater difficulty getting to the ED in terms of time and

feasibility of exertion of a child with severe asthma symptoms or of picking children up from school if they are sick.

Main outcomes of asthma control. Asthma control is a positive outcome, where the relationships between parent management behaviors related to medication administration, missing appointments and home environment have the opposite sign of association than they did when associated with negative outcomes of ED visits or school absenteeism. Living in a well-maintained neighborhood has a positive relationship with asthma control, as having less negative exposures such as poor buildings and or feeling unsafe likely reduces more poor environmental exposures or urban stress that has a negative effect on asthma control. Lastly, parent stress does not have a direct link with asthma control, as its influence is hypothesized to work through parent management behaviors.

Human Subjects Considerations

The Children's Hospital, Boston, and the Brigham and Women's Hospital Investigational Review Board approved the SICAS study. The Research, Assessment, and Evaluation Division and Facilities Management Department of the Boston Public Schools also approved the SICAS study. The investigator was added to the study through successfully submitting an amendment to the Children's Hospital, Boston, and the Brigham and Women's Hospital Investigational Review Board. The University of Massachusetts Boston's Institutional Review Board granted an exemption for the analysis.

Measurement Instruments

A conceptual-theoretical-empirical structure was created for self-management behaviors related to parents of children with asthma (Figure 1). Empirical methods to measure the concepts of antecedents to management behaviors, management behaviors and consequences of management behaviors were selected. Antecedents to management behaviors for parents of children with asthma was identified as demographic characteristics of the sample, parent perceived stress of parents, and parent asthma knowledge questions, which are captured using the SICAS baseline questionnaire items and the Perceived Stress Scale (PSS) (S. Cohen et al., 1983). Management behaviors specific to parents of children with asthma were identified in the literature and were captured throughout the SICAS baseline and follow-up questionnaires. Consequences of management behaviors include asthma control and the asthma-related outcomes of ED visits and missed school. These were captured using the control section of the Asthma Therapy Assessment Questionnaire (ATAQ) (Skinner et al., 2004), using the NAEPP guidelines for control (Program, 2007) and outcome-related questions in the SICAS baseline and follow-up questionnaires.

Demographics

Demographic variables were ascertained from the baseline questionnaire (Table 2). ***Child characteristics*** include the child's age, gender, race or ethnic group, health insurance, and asthma severity. The child's age is a continuous measure of number of years old, converted from the child's date of birth given at baseline. For description of the sample and bivariate analysis, the child age variable was made dichotomous, "0" are

children ages 4 to 6 for children who are not school-aged and “1” are children ages 7 to 13, who are school-aged. Child gender is dichotomous, with “0” as male and “1” as female. Child race originally had seven categories including White, Black, Hispanic, Haitian/Creole, Asian, Native American, Mixed, Other, which was reduced to four categories due to a low response rate in four categories (Haitian/Creole, Asian, Native American and other), which were added to the “Mixed” category. During descriptive analysis, it was found the African American, Hispanic, and other categories had similar rates to each other (acting similarly in multivariate analysis as well), so these were added to become a “minority” category and the White category was kept as the reference group. The child’s health insurance name was recorded and were categorized into fiver groups, including Managed care, Medicaid, Medicaid Managed care, Private (employer) and cannot be determined. Isolating Medicaid and Medicaid managed care to determine if this population and its asthma care are any different from those with other types of insurance, these two categories were combined and the other categories were combined to become the reference group.

Asthma severity. Parents were also asked to bring in their asthma medications to the baseline visit with a monetary incentive, where staff at baseline wrote down the names of the medications brought. These include "Aerobid", "Advair", "Budesonide", "Pulmicort", "Asmanex", "Flovent", "Fluticasone", and "Fluticasone Proponate". The variable for having ICS in hand was created by someone on the team putting a “1” for if they brought an inhaler that was an ICS (and not a rescue inhaler) and a “0” if the parent did not. Both of these variables can be seen as severity measures, as the child has been

prescribed an ICS inhaler or the parent has an ICS inhaler with them shows their need to be taking medication as a reflection of their past symptoms being determined as moderate to severe by a healthcare provider who wrote the prescription. Children without ICS inhalers commonly have intermittent asthma that do not require ICS medication administration everyday, were not determined as having moderate to severe asthma by a healthcare provider yet or parents do not remember the child ever having this prescription.

Parent characteristics obtained at baseline were gender, race or ethnicity, education, household employment, household income, parent perceived stress, housing, neighborhood, marital status, people living together in the home, adults living in the home, children living in the home, transportation. Parent gender was kept dichotomous, with "0" as male and "1" as female. Parent race was categorized the same as child race for the same reasons. Parent education was originally a continuous variable, ranging from 0 to 16 for the highest number of years in school of either the head of the household or themselves, selecting the highest number of years. This variable was then made dichotomous, with "0" as <12 years and representing did not graduate high school, and "1" as >= 12 years, representing graduating high school or having a GED. Household employment was originally asked as the number of people in the household with a paying job and this continuous variable was made dichotomous by keeping "0" as no one and "1" as >=1 adult with a paying job in the household. Household income was asked categorically, with 10 categories each having a $10K range, starting at "<$15,000" and ending at "> $95,000". For descriptive purposes, this variable was made dichotomous by the 50th percentile, with one half of the households making <$25K as "0" and the other

half >=$25K as “1”. During multivariate analysis it was noted that the employment and income variables had very similar coefficients and it was decided to combine these two variables by making a dichotomous variable of “1” as employed or income >=$25K, and “0” with unemployed and income <$25K.

Parents were asked what type of house the child lives in, with five categories. Three categories were related to houses, one was apartment building and one as “other”. A dichotomous variable was constructed for descriptive purposes, with “0” combining the three house categories and “1” combining the apartment and other categories. Parent’s agreement of whether or not their neighborhood’s homes were well maintained had four categorical options with “definitely yes”, “mainly yes”, “mainly no” and “definitely no”, which were transformed into a dichotomous variable of “0” yes and “1” no. Transportation was asked about how the child gets to school, with six categories; personal car, city bus, school bus, subway, walk and other. For descriptive purposes this variable was made dichotomous, with “0” as personal car and the other categories as “1” which is largely comprised as the school bus and walk categories. “0” is thought of as an easily accessible mode of transportation for the child and family, and “1” is considered public transportation or walking. Parent marital status originally had five categories of married, divorced, single, widowed, separated and other. This was made dichotomous with “0” as married and “1” with all the other categories, the majority being single. The first iteration of this variable was made categorical with “0”married “1” single and “2” other with all other categories, “1” and “2” had very similar coefficients in the multivariate analysis and were combined. The number of people in the home was

originally continuous, ranging from 2 to 12. Several dichotomous variations of this variable were tried, with a final selection of "0" as <=4 and "1" >4 with "0" more likely being a traditional nuclear family and "1" with more adults or children in the home. Similarly, the number of children in the home and the number of adults in the home were also asked with a continuous number and both variables were made dichotomous, with "0" being one person and "1" being two or more people for each variable.

Season. Season adjusts for seasonal allergens and rhinoviruses. While it is not commonly adjusted for in the literature, it effects the child's symptoms related to asthma, and was controlled for in another pediatric inner-city asthma study (Busse et al., 2011). The four season variables are for a restricted cubic spline of days since school started, all of them together adjusting for season. The restricted spline requires all four variables and is applicable to baseline and all follow-up observations.

Parent Stress using the Parents' Perceived Stress Scale

Parent stress was ascertained on the baseline questionnaire using the 4-item Perceived Stress Scale (PSS4) (Table 3).

The instrument. The Perceived Stress Score has demonstrated in prior research adequate reliability (Chronbach's alpha= 0.88) and validity (Sheldon Cohen, 1988). The PSS has been used in school-aged children, young adults with asthma, adults with asthma and parents of infants (Kimura, Yokoyama, Kohno, Nakamura, & Eboshida, 2009; Milam et al., 2008; Wisnivesky, Lorenzo, Feldman, Leventhal, & Halm, 2010; Wright, Cohen, Carey, Weiss, & Gold, 2002). Parent perceived stress, measured by the PSS, of 496 parents of infants at 2-3 months predicted wheeze at 14 months of life (Wright et al.,

2002). A Japanese version of the PSS (JPSS) was used in 695 young adults ages 20-44 years old, and did not correlate with asthma severity, but did show a strong association with a mental component of a health survey (SF-8) and moderate correlation with quality of life (AQ20) (Kimura et al., 2009). 326 inner-city adults with asthma who had high stress measured by the PSS also had worse asthma control (ACQ), quality of life related to asthma (AQLQ) and medication adherence (MARS) (Wisnivesky et al., 2010).

A four-item Perceived Stress Scale (PSS4) has been used in a population of children ages 5-7 and was significantly associated with wheezing in school-aged children (Milam et al., 2008). Validation for both the four-item and fourteen-item scales were done when they were created, with a population of college students for the fourteen-item scale and tobacco cessation participants for the four-item scale (S. Cohen et al., 1983). The four-item scale has been validated on a low literacy adult population with asthma (Sharp, Kimmel, Kee, Saltoun, & Chang, 2007) and used with parents of children with asthma (Islam et al., 2011).

This analysis. The four-item Perceived Stress Scale (PSS4) was used at baseline in the whole sample of children enrolled in the SICAS study. The four questions are related to how the parents feel they are in control of things in their life, their feelings of confidence in handling problems, their feeling of whether things were going their way or not and their feelings about their ability to overcome difficulties (Table 3). The four-item scale consists of Likert-scale items with a 5 number range, with a score from 0 to 4. Questions two and three are reverse coded because their score has a negative relationship with stress, making all questions unilaterally measure stress. A sum of the item scores

creates a composite score ranging from 0 to 16, with 0 being no stress and 16 being the highest stress. Islam and colleagues dichotomized the score, with less than or equal to 4 being low stress and greater than 4 as high stress (Islam et al., 2011). Similarly, dichotomizing the score for descriptive purposes was done (Table 15).

SICAS Parent Management Questions

Questions related to parent management of their child's asthma are present throughout the baseline and follow-up questionnaires, including environmental management (Table 4), medication management (Table 5), assessment and monitoring management (Table 6), and education management (Table 7). .

Environmental Management

Parent management of the home environment has three components, including passive smoke exposure, number of smokers in the home and pests in the home (Table 4). Cigarette smoke is a well-known trigger for asthma attacks. Passive smoke exposure for the child was rated using five categories of how frequently the child is around people who smoke, including never, rarely, several times a month, several times a week and daily. This variable was made dichotomous, with never or rarely being "0" and several times a month to daily being "1".

The number of people who smoke in the child's house is an indicator of how much smoke is present in the child's home environment, whether the child is present while someone is smoking in the home or is exposed to the smoke allergen on the objects inside the home measures the child's exposure in the home. This continuous variable was made dicohotomous with "0" being no smokers" and "1" having at least one smoker living in

the home after more than one smoker's coefficients were not very different from having only one smoker. Pests in the home are triggers for asthma. Parents were asked what pests were in the home, including mice or rats, cockroaches, lady bugs and bed bugs, with "0" being none and "1" being "present" for each type of pest. Then the types of pests were added together for a continuous variable of types of pests in the home, ranging from 0 to 4. For descriptive purposes this variable was made dichotomous, with "0" as no pests and "1" at least one type of pest in the home.

Medication Management

Giving the child preventive medication like an ICS inhaler is used to help control the child's asthma. Whether the child has an ICS prescription or not and whether parents administer their child's ICS medication were determined as a part of medication management (Table 5).

Parents were asked if the child was ever prescribed ICS at baseline, with a dichotomous option of "0" no and "1" yes. Parents were then asked if the child takes the medication now, with five categories of "never takes it", "only takes it when having symptoms", "used to take it, but not now", "takes it some days, but not other days" and "takes it everyday". This variable was made dichotomous with children who take ICS everyday or somedays as "1", which is seen as having medication adherence, and children who take it only with symptoms or not at all as"0" as non-adherent to their ICS medication.

Assessment and Monitoring Management

The assessment and monitoring management question is related to consistent

follow-up related to the child's asthma. While healthcare providers monitor the children's asthma, parents have a role in getting their child there for their visits. Parents were asked if they had any problems with getting to an appointment, either related to transportation or inconvenient clinic hours open, and if it was because of these problems they missed the appointment (Table 6). This was a dichotomous variables, with "0" no skipping appointments and "1" as skipped appointments.

Educational Management

The education domain is related to parents receiving asthma education. While this may be thought of as the provider's role toward the parent, it is a shared responsibility to have an asthma action plan in place. The healthcare provider should initiate and the parent can choose to use it or ask for an updated version with treatment changes. There is also a role for the parent to be attentive during the visit and solicit a need for teaching. Parents were asked whether or not they have been given separate written instructions to use to assist with their child's asthma symptoms, with a dichotomous score of "1" yes and "0" no (Table 7).

Antecedents of Parent Asthma Knowledge and Self-efficacy

Several individual questions originally from the Asthma Therapy Assessment Questionnaire (ATAQ) were asked related to asthma knowledge (Table 8). Parent knowledge about asthma was determined by asking if they believe the child's medications can control their asthma, assessing whether parents understand the function of asthma medications (K8). Parents who do not think so or are not sure likely do not fully understand the role of the child's asthma medication. If a parent said "no" or was

unsure, they were categorized as “0” for not knowledgeable and those who thought the statement was true was categorized as “1” for knowledgeable. The ATAQ instrument scores these questions in this way, placing “unsure” with “no”.

Lack of self-efficacy. Self-efficacy is a belief in what you are able to do makes a difference in the intended goal. Merriam-Webster’s definition is “the power to produce a desired result or effect” (2015). Parents are asked if they feel that asthma medications do not really work (L8), with “1” as yes and “0” as no. Parent answer the question related to their belief that the medications they give their children will produce the desired effect of controlling their child’s asthma symptoms. In other words, the question examines whether parents have self-efficacy related to the medication management their child is receiving. If a parent answers “yes”, they are lacking the self-efficacy to help control their child’s asthma with the medications they are given.

Lack of asthma knowledge. Parents who admitted to believing their child was “all better” before finishing the prescription by agreeing yes “1” or disagreeing with no “0” likely show a lack of knowledge about asthma medications (L7). ICS medications need to be given regardless of symptoms and rescue medications are given only if the child has symptoms. Any steroids given should not be stopped until the prescription is done. So, parents who feel that their child’s medication is only for symptoms may be more at risk for not giving the child their ICS medications regularly.

School’s Role in Asthma Management

At baseline, parents were asked if their child had any problems at school with having their medication administered, with “1” as an answer of yes and “0” as no (Table

9).

Emergency Visits for Asthma (ED Visits)

ED visits, or unscheduled visits for asthma, were asked at baseline and all follow-up time periods, and ascertained by asking parents several consecutive questions (Table 10). These include if parents went for a medical visit for their child in the last year (baseline) or the last 3 months (follow-up), the reason for the visit (six categories, including asthma, pneumonia, respiratory/lung function, influenza, anaphylaxis or other) and if the visit was scheduled at least 24 hours before the appointment to discern whether it was scheduled/non-emergent or unscheduled/emergent (Table 8). If a child did have a visit related to asthma, then the continuous data remained the same as the scheduled question variable for an “unscheduled asthma visit,” and a “scheduled asthma visit" or "other type of visit" or an "unscheduled other type of visit” as “0”. This variable was made dichotomous, with at least one “unscheduled asthma visit” as a “1” and other as “0”. For descriptive univariate and bivariate analysis which use the number of children enrolled at baseline, a maximum unscheduled asthma visit variable was created with children who have ever had an unscheduled asthma visit, or “ED visit”, during baseline or follow-up and giving them a “1”, while children who never had an ED visit during baseline or follow-up were kept as “0”. In the multivariate analyses, ED visit was kept dichotomous with variation in baseline and all follow-up periods.

Asthma Control with the Asthma Therapy Assessment Questionnaire

The instrument. The Asthma Therapy Assessment Questionnaire (ATAQ) is a previously validated tool that measures children’s control and management by clinicians

in order to identify children at risk for adverse outcomes (Skinner et al., 2004). Skinner and colleagues (2004) performed a tool validation study for the ATAQ using 434 parents of children with asthma recruited from three managed care organizations. The children with asthma were primarily male and Caucasian sample with worsening asthma in the last 6 months. Asthma control was significantly associated with measures of physical health, psychosocial health, resource use and family impact. Shared decision making (related to HCP and management plans) was shown to be significantly associated with symptoms and parental satisfaction. Internal consistency and construct validity were shown. Some limitations to this study were a cross-sectional sample and a low response rate (49%).

This analysis. The ATAQ control section was ascertained in baseline and all follow-up time periods (Table 11). The control section of the ATAQ indicates the amount of asthma control within the last 4 weeks. It includes seven questions about symptoms and consequences of asthma. Five questions related to symptoms, missed school, and daily activity interference are dichotomized, with a score of 0 or 1. Two questions related to parent's perception of asthma control and quick-acting medication use have a 5 point scale, but are scored dichotomously with a 0 or 1. The scores are then summed for a total score ranging from 0 to 7, with typically 0 indicating no control problems and 7 indicating all 7 control problems (Skinner 2004). However, for this analysis, the score was coded so that 0 indicated control problems and 7 indicates no control problems, or "asthma control". Diette and colleague's scores categorized as 0 (0: no control problems), 1 (1-3: those who did not have composite hospitalization, ED/urgent care visit or doctor

visit), and 2 (4-7: those who did have one of those unscheduled visits) (Diette 2009). Total scores have been categorized in this study to reflect Diette's categories in reverse order, with 0 (0-3: those who did have one of those unscheduled visits), 1 (4-6: those who did not have composite hospitalization, ED/urgent care visit or doctor visit), and 2 is (7: no control problems). Similarly, this analysis has categorized the ATAQ control score in this way for descriptive purposes, yet with the largest number indicating no control problems (2) and the smallest value (0) indicating control problems (Table 15).

For descriptive univariate and bivariate analysis, which uses the number of children enrolled at baseline, a minimum asthma control variable was created. The child's lowest asthma control score in either baseline or any of the follow-up periods was kept, for comparison with other variables. Since 350 of the 351 fit the two lowest categories of asthma control, the one student was dropped and the variable with "0" as very uncontrolled asthma and "1" of "uncontrolled asthma" was kept these analysis. For the ***multivariate analyses***, asthma control was kept as categorical, with variation possible in the baseline and all follow-up periods.

Alternative Measure of Asthma Control Using National Guidelines

The National Heart, Lung, and Blood, Institute, along with the National Asthma Education and Prevention Program, has developed their own guidelines on what constitutes asthma control (Table 12) (Program, 2007). Accordingly, asthma control takes into account patient's symptoms, nighttime awakenings, interference with normal activity, short-acting beta2-agonist (SABA) use for symptom control, and lung function measured by FEV1 and/or FVC. Children ages 5-11 have well-controlled asthma with symptoms

<= 2 days per week, nighttime awakenings <= once per month, no interference with normal activity and SABA use <= 2 days per week (Program, 2007). Children ages 5-11 have not well-controlled asthma or very poorly controlled asthma with more frequent symptoms, nighttime awakenings, interference with activity or SABA use (Program, 2007). The variables of symptoms days, night symptoms, activity limitation and short acting bronchodilator (SABA) use were used to develop a composite score of asthma control using these guidelines (Table 13). The score places children in three categories, depending on their degree of symptoms and SABA use, including well controlled asthma (2), not well controlled asthma (1) and poorly controlled asthma (0). A minimum asthma control score was created for univariate and bivariate analyses, similarly to the ATAQ Control variable, yet all three categories were maintained.

Another measure with maximum number of days a child has had symptoms in the last 2 weeks was examined (Table 13B). Three questions related whether a child was wheezing, had limited activity and waking up because of symptoms, was asked of the parents, with an expected continuous answer of number of days child had experienced each in the last 2 weeks. Combining the maximum number of days a child has experienced symptoms made a continuous score.

School Absenteeism for Asthma

Missed school days due to asthma are measured by a continuous scale at baseline and all follow-up time periods (Table 14). Missed school days was also dichotomized into 0 for no missed school and 1 for any missed school due to asthma in the last 3 months for descriptive purposes as well. For descriptive univariate and bivariate analysis,

which use the number of children enrolled at baseline, a maximum school days missed variable was created with children who have ever missed school days related to asthma during baseline or follow-up and categorized them a "1", while children who never missed school for asthma during baseline or follow-up were kept as "0". In the ***multivariate analyses***, missed school was kept dichotomous with variation possible in baseline and all follow-up periods.

Statistical Methods

All data were analyzed using STATA 12.1.

Univariate and bivariate analyses

Descriptive statistics were used to describe parent and child characteristics, including the child's age, child's gender, parent gender, child's race, income, and health insurance. Each variable was tested for distribution and possible errors. Secondly, pairwise correlations were computed to explore associations between exogenous variables and parent management behaviors. Parents who skip their child's asthma appointments, who have an ICS inhaler in hand, and administer their child's ICS inhaler some days or everyday were described related to their asthma knowledge variables and parent perceived stress with pairwise correlations. Environmental management variables of people smoking in the home, the child exposed to passive smoke and pests present in the home were also described using pairwise correlations with housing and neighborhood variables. Pairwise correlations between independent variables (endogenous and exogenous) and the outcomes of interest, including ED visits, missed school and asthma control were computed to examine if significant existed. Sensitivity analysis was

performed with several independent categorical variables to isolate the most meaningful categorical grouping. Lastly, a correlation matrix was computed to further guide the univariate and bivariate comparisons made and the multivariate analyses.

Multivariate Analyses of Longitudinal Panel (Cohort) Data Analysis

The primary outcome in the multivariate analyses was ED visits, with secondary outcomes of asthma control and school absenteeism due to asthma. Due to the repeated measures on the same subjects, Generalized Estimation Equations (GEE) were used for analysis of the full dataset, with baseline and all follow-up data. The unit of analysis in these models was child per quarter, as each subject has 4 time points of follow-up data collected every 3 months (four time periods, five points of data collection with baseline and 4 follow-ups). For models with main outcomes that were "unrepeated" in nature, such as parent stress, logistic regression was performed using baseline data.

For a longitudinal analysis, data needs to be oriented in a cross-sectional nature, with a large number of patients and few time points. Ideally, there is a balanced sample of all patients in all periods. However, patients may not complete all follow-up time points, so this is not true for every patient. Patient heterogeneity dominates the estimation of relationships, however the degrees of freedom will be reduced based on the variability of the relationships between variables. The equation below shows the repeated t waves of inputs with separate α_i functions, with i-shifts constant

$$Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \varepsilon_{it}$$

Fixed effects are given α_i for each patient unique shift in Y_{it}. Least squares dummy variables (LSDV) that are established with ordinary least squares (OLS) are an

unbalanced option. F test to see if the variance of two populations is equal between simple variables (LSDV R^2 (0-1,281)) is not ideal. We do not have fixed effects.

Random effects assume that patients are a random sample of a larger population.

$Y_{it} = \alpha + \beta AC_{it} + \upsilon_i + \varepsilon_{it}$: $\Sigma[\upsilon_i] = 0$; $\Sigma[\upsilon_i^2] = \sigma_\upsilon^2$

$Pb[ED\ visit]_{it} = \alpha_i + \beta Z_i + \varphi\ parent\ stress_i + \varepsilon_{it}$: $\Sigma[\varphi\ parent\ stress_i] = 0$;

$\Sigma[\varphi\ parent\ stress_i^{\ 2}] = \sigma_{\varphi\ parent\ stress}^{\ 2}$

Random effects assume random drawing and pooled data. Random effects are done in STATA using mixed-random modeling, which takes into account repeated waves. Using random effects for this analysis is beneficial because it preserves degrees of freedom.

Generalized Estimation Equations

Generalized Estimation Equations (GEE) is a method of estimation of regression model parameters for correlated data, and are used for analyzing clustered longitudinal data. As this secondary analysis used data of subjects over time, clustering the data of each child is necessary. In other words, each child is an independent cluster, with multiple observations over time on one child (Shults, Ratcliffe, & Leonard, 2007). GEE is from the generalized linear models family, where linear, logistic and Poisson regression, which have a link function that characterizes the relationship of the mean response to covariates and the specification of a variance function that relates the variance of the outcomes as a function of the mean.

Hierarchical Regression

Hierarchical regression was performed to explain the primary and secondary outcomes, as well as parent management behaviors. For the main outcomes of emergent

asthma visits, school absenteeism, and asthma control, exogenous and endogenous variables were stepped into the models in the same order.

Main Outcome Model Steps

1. $Pb[\text{ED visit}^{1}]_{it} = \alpha_i + \beta Z_i^{2} + \varepsilon_{it}$

Exogenous variables are stepped in, including parent and child characteristics and season variables. The neighborhood variable is stepped in the asthma control model due to its possible association.

2. $Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \varepsilon_{it}$

Parent stress is stepped in.

3. $Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \varepsilon_{it}$

Child asthma severity measured by prescribed ICS treatment and currently have an ICS inhaler.

4. $Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \delta \text{ medication administration behavior}_{it} + \varepsilon_{it}$

Asthma severity variables were stepped in separately from the medication parent management behavior to isolate the impact of regular ICS administration on the main outcome.

5. $Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \delta \text{ medication administration behavior}_{it} + \kappa \text{ environment behaviors}_{it}^{3} + \varepsilon_{it}$

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[1] can be substituted for other main outcomes of school absenteeism or asthma control

[2] Z= exogenous variables (child and parent characteristics, season)

[3] The variable of smokers in the home does not have repeated waves.

Environmental behaviors of pests in the home, smokers in the home and passive smoke exposure are stepped in.

6. $Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \delta \text{ medication administration behavior}_{it} + \kappa \text{ environment behaviors}_{it} + \rho \text{ assessment behavior}_i + \varepsilon_{it}$

The negative parent assessment and monitoring behavior of the missing their child's asthma appointment is stepped in.

7. $Pb[\text{ED visit}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \delta \text{ medication administration behavior}_{it} + \kappa \text{ environment behaviors}_{it} + \rho \text{ assessment behavior}_i + \sigma \text{ educational behavior} + \varepsilon_{it}$

The educational behavior of the asthma action plan is a collaborative behavior of both healthcare providers and parents. This behavior is added to the model last in order to examine the model in the previous step with parent-initiated behaviors only, without any additional effect of a healthcare provider behavior in order to isolate the effect of parent only behaviors on the main outcome.

Aims 1 and 2 Path Models for Main Outcomes

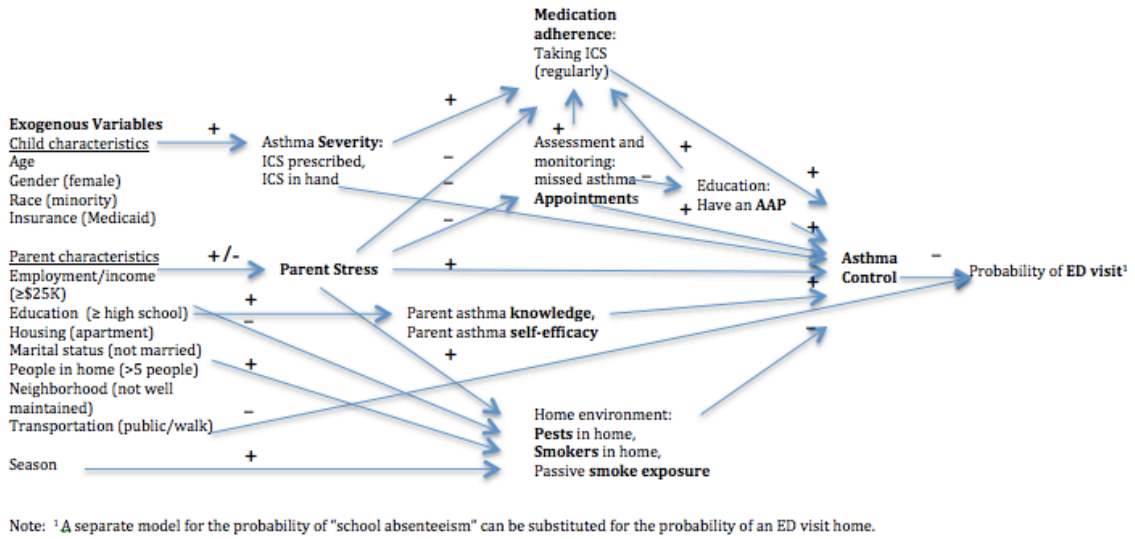

Figure 4. Path Model for Main Outcomes of ED Visits and School Absenteeism

$$\text{Pb[ED visit or school absenteeism]}_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \delta \text{ medication administration behavior}_{it} + \kappa \text{ environment behaviors}_{it} + \rho \text{ assessment behavior}_i + \sigma \text{ educational behavior}_i + \varphi \text{ asthma knowledge}_i + \psi \text{ asthma control}_{it} + \varepsilon_{it}$$

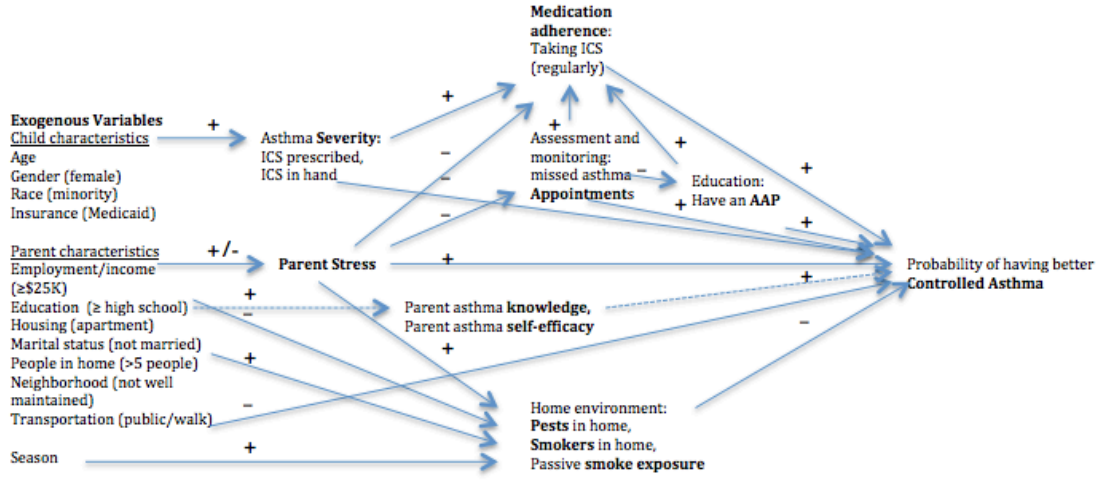

Figure 5. Path Model for Main Outcome of Child Asthma Control

$Pb[\text{asthma control}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \delta$ medication administration behavior$_{it}$ + κ environment behaviors$_{it}$ + ρ assessment behavior$_i$ + σ educational behavior$_i$ + φ asthma knowledge$_i$ + ε_{it}

Aim 2a Path Model for Parent Stress

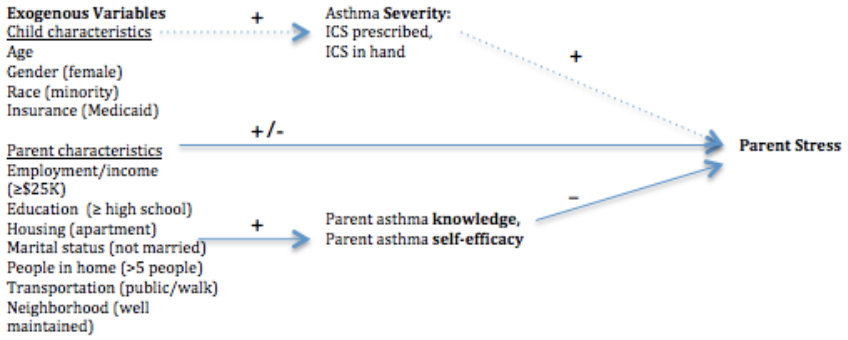

Figure 6. Parent Stress Model Path Diagram

$Pb[\text{Parent stress}]_i = \alpha_i + \beta Z_i + \varphi \text{ asthma knowledge}_i + \varepsilon_{it}$

Aim 3 Path Models for Parent Management Behaviors

Parent medication administration behavior.

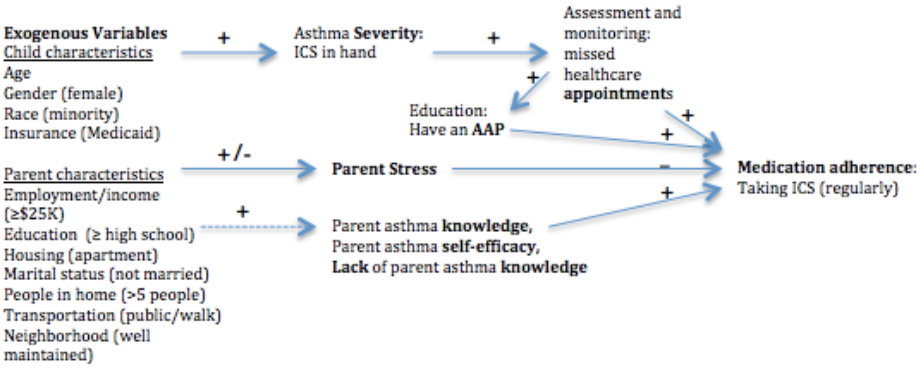

Figure 7. Parent Medication Administration Behavior Model Path Diagram

$Pb[\text{medication administration behavior}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta$ asthma severity/treatment$_i$ + κ environment behaviors$_{it}$ + ρ assessment behavior$_i$ + σ educational behavior$_i$ + φ asthma knowledge$_i$ + ε_{it}

Parent environmental behavior.

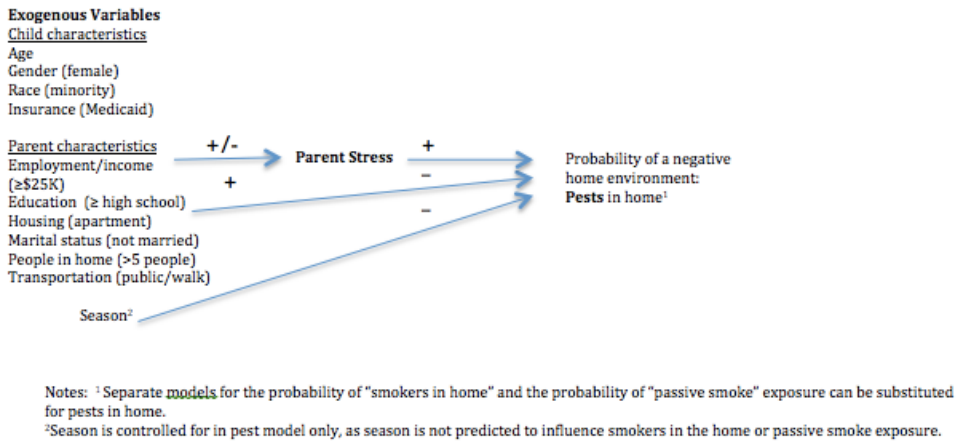

Figure 8. Parent Environment Behavior Model Path Diagram

$Pb[\text{environment behaviors}]_{it} = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \varepsilon_{it}$

Parent assessment & monitoring behavior.

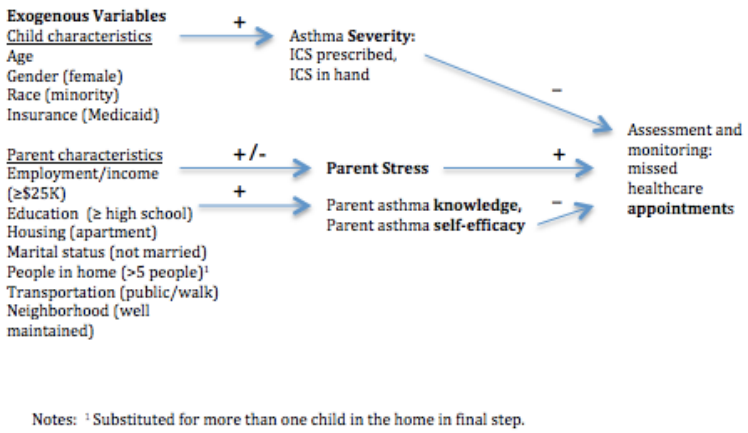

Figure 9. Parent Assessment & Monitoring Behavior Model Path Diagram

$Pb[\text{assessment behavior}]_i = \alpha_i + \beta Z_i + \varphi \text{ parent stress}_i + \theta \text{ asthma severity/treatment}_i + \varphi \text{ asthma knowledge}_i + \varepsilon_{it}$

Parent educational behavior.

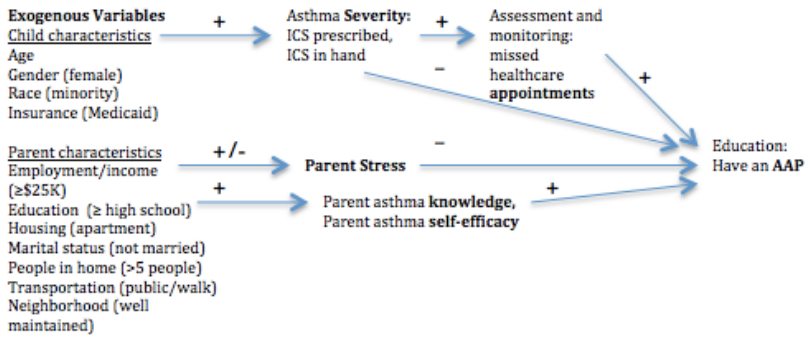

Figure 10. Parent Education Behavior Model Path Diagram

Pb[educational behavior]$_{it}$ = $\alpha_i + \beta Z_i + \varphi$ parent stress$_i$ + θ asthma severity/treatment$_i$ + ρ assessment behavior$_i$ + φ asthma knowledge$_i$ + ε_{it}

CHAPTER FOUR

STUDY RESULTS

Descriptive Results

Sample Description

Child characteristics. 351 school-aged children and their parents completed a baseline visit and 335 (95.4%) had at least one follow-up phone call, with 251 (71.5%) parents completing all follow-up phone calls. The mean age of the children was 7.9 years (1.9 SD), ranging from 4 to 13 years. The sample of children are highly diverse, with 34% (N=120) African American and 38% (N=133) Hispanic children, 4% (N=15) Caucasian children and 24% (N=83) other races, which reflects an inner-city population. Most children are on Medicaid or Medicaid Managed Care health insurance (N=255/342, 74.6%). When looking at a child's lowest score of asthma control using the ATAQ instrument from baseline and all follow-up periods, only one child had no control problems, with 59% (N=208/350) having uncontrolled asthma and 40% (N=142/350) having very uncontrolled asthma. Also, only 19.7% (N=69) had well controlled asthma, measured using the NAEPP guidelines. However, only 62.2% (N=217) of parents reported their children were ever prescribed an ICS inhaler to control their asthma. This reveals at least 18.1% of children with asthma who currently have uncontrolled asthma

but have never been prescribed an ICS inhaler ((1-.622)-.197= .181). 47.7% (N=165) of the children went to the ED or urgent care due to their asthma and 65.5% (N=230) missed school due to asthma at baseline or during the year of the study.

Parent characteristics. The majority of parents are mothers (N=337, 97.6%), minorities (N=327, 93.4%) and have completed high school (N=284, 80.9%) (Table 17). Most households have an annual income of less than $45,000 (N=212, 73.1%), half are less than $25,000 (N=145, 50.0%) and 23.1% (N=81) do not have someone in their household employed in a regular job and have less than $25,000 per year of annual income. Many parents reported moderate to high levels of stress (N=223, 63.5%), with a PSS score of five or greater. Most parents are unmarried (N=246, 70.1%), but live in a house (N=218, 62.3%), have more than 2 adults living in their home (N=223, 63.5%), and more than 2 children living in their home (N=284, 80.9%). It is unknown whether the adults in the home are intergenerational family members or partners, where there may be more variation in the families than the traditional nuclear family. Some parents report the houses in their neighborhood are not well maintained (N=68, 20.9%). The majority of children walk, ride a bike or take public transportation to school (N=239, 68.1%), with the rest of parents using a personal car to drop off their children. Environment exposures at home include tobacco smoke exposure and pest allergens for a moderate number of children in this study. 33% (N=116) of the children's households have at least one smoker in the home, and 35% (N=123) of children have daily to several times a month passive smoke exposure noticed by their parents. 67.2% (N=236) have at least one type

of pest reported in their home. Pests include mice or rats (N=177, 50.6%), cockroaches (N=76, 21.6%), lady bugs (N=61, 17.4%) and bed bugs (N=24, 6.9%).

Approximately half of parents brought their child's ICS medication with them at baseline (N=183, 52.1%). Of those whom have ICS prescribed and in hand, 55.9% (N=95/170) use it daily, 8.8% (N=15/170) use it some days, 26.5% (N=45) use it with symptoms and 8.8% (N=15) do not take it (Figure 11). Parents report problems with medication administration; such as any problem their child has taking medication (N=30, 9.6%), not having a schedule for taking medications (N=62, 20.1%) and children refusing to take medication (N=40, 12.8%). Parents also reported barriers to getting to medical appointments related to scheduling or getting time off work and transportation (N=42, 12%) and some parents reported skipping appointments for these reasons (N=24, 6.8%).

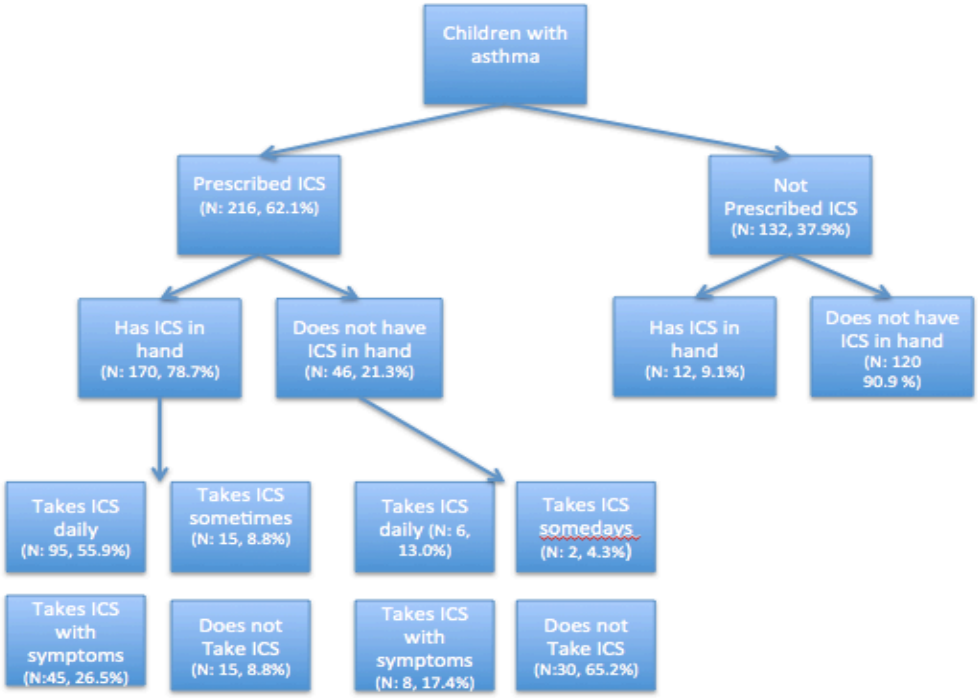

Figure 11. Inhaled Corticosteroid Decision Tree

Parent asthma knowledge was overall high, with 83.8% (N=294) of parents said they believed the child's medications could control their child's asthma. Also, only 19.6% (N=60/306) of parents feel that medications do not work to control their child's asthma (self-efficacy). However, 46.3% (N=137/296) of parents say they stop giving their child their medicine early if they feel better. This does show a lack of knowledge, as stopping any prescription early is not beneficial and asthma medication needs to be given on an ongoing basis as instructed. One third (N=123/349, 35.2%) of parents do not have an asthma action plan and 16.1% (N=46/285) report problems with their child's school giving their child medication.

Bivariate Analyses

Bivariate Analysis of Independent Variables and Main Outcomes (Aim 1, Aim 2b and Aim 2c)

Demographics (Aim1). Sample characteristics were compared with the outcomes of interest, ED visits, missed school, and asthma control (Tables 23-25). Except for child's age and parent's race, there were no significant between group (children who used the ED versus those who did not) differences in sociodemographic characteristics. Younger children ages 4-6 were 1.9 times more likely to be brought to the ED than older children (p=.013). Parents who are African American, Hispanic or another race were 3.4 times more likely to bring their child to the ED than Caucasian parents. Except for transportation, child and parent characteristics were not correlated with child school absenteeism. Children who ride in their parent's car were 1.7 times more likely to miss school (p = .038). Household income, maintenance of the

neighborhood and parent marital status were significantly associated with asthma control. Children from households with no one employed or had an annual income less than $25,000 were 1.7 times more likely to have very uncontrolled asthma (p=.036). Children were also more likely to have very uncontrolled asthma if their parents are not married (OR=1.8, p=.000) and if the houses in their neighborhood are not well maintained (OR=1.8, p =.015).

Parent stress (Aim 2b). Parents with moderate to high stress were 1.5 times more likely to bring their child to the ED for asthma (p=0.069) than parents with low stress. Parents who have a personal car were 1.64 times more likely to bring their child to the ED than parents of children who take the bus or walk (p=0.032). Neither missed school or asthma control was associated with parent stress.

Asthma severity and ICS inhaler use (Aim 2c). A child prescribed ICS is 2.1 times more likely to go to the ED for asthma (p=0.000), 1.6 times more likely to miss school because of asthma (p = .045) and 1.5 times more likely to have very uncontrolled asthma (p = .056) than those not prescribed ICS, showing prescription of a controller inhaler to indicate a higher severity of asthma than others. Parents who have ICS readily available are 2.6 more likely to bring their child to the ED than those who do not, likely also accounting for severity by the degree of need in having the medication available (p=0.000). Similarly, children were 2.0 times more likely to miss school (p= .003) and 1.8 times more likely to have very uncontrolled asthma (p= .008) when their parents had ICS readily available.

Parent management behaviors (Aim 2c). Taking the ICS inhaler was not associated with going to the ED, missed school or asthma control with the unadjusted variables. The assessment and monitoring, as well as the environment management variables were not significantly associated with ED visits in the unadjusted bivariate analysis. Missing appointments was not significantly associated with going to the ED or missing school with the unadjusted models. However, children who miss an asthma appointment are 3.2 times more likely to have very uncontrolled asthma (p = .007).

Environmental variables of smokers in the home, the child's passive smoke exposure and pests in the home were all significantly associated with (or approached significance) the child missing school and having very uncontrolled asthma in the unadjusted bivariate analysis. In the unadjusted analyses, children who had pests in their home were 1.9 times more likely to have very uncontrolled asthma (p = .021) and 1.7 times more likely to miss school (p = .059). Also, smokers in the home was significantly associated with children's missing school and approached significance in being associated with asthma control, with children being 1.7 times more likely to have their children miss school (p= .032) and 1.5 times more likely to have very uncontrolled asthma (p=.089). Children with passive smoke exposure were 1.8 times more likely to miss school (p = .015) and 1.5 times more likely to have very uncontrolled asthma (p = .067).

Asthma knowledge and self-efficacy. Parents who feel that asthma medications do not work (self-efficacy) were 2.0 times more likely to have very uncontrolled asthma

(p= .020), 2.1 times more likely to go to the ED (p= .013), and 2.4 times more likely to miss school (p = .015).

Outcomes. Children who have very uncontrolled asthma were 2.3 times more likely to go to the ED (p = .000) (Table 6) and children who go to the ED are 3.6 times more likely to miss school (p = .000) (Table 7).

Bivariate Analysis of Independent Variables and Parent Stress (Aim 2a)

Parent stress was partially explained by several demographic variables noted in the correlation matrix and are explored using bivariate tables (Table 18), including parent education, employment and income. Parents who make less than $25,000 annually were 1.8 times more likely to have moderate to high stress. Parents who are not employed were 1.7 times more likely to have moderate to high stress. Parents who did not complete high school were 2.1 times more likely to have moderate to high stress.

Bivariate Analysis of Independent Variables and Parent Management Behaviors (Aim 3)

Asthma severity and medication administration. Prescription of ICS for child by healthcare provider, parents having the medication and parent administration of the medication were described (Table 19). Children who were prescribed ICS medication (N=217/349, 62.2%) were most likely to have parents with ICS in hand (N=170/216, 78.7%). Just more than half of parents with ICS in hand were administering the medication every day (95/170, 55.9%) and a small amount administering some days (N=15, 8.8%). Over a quarter of parents with ICS in hand administered with symptoms (N=45, 26.5%) and some did not administer at all (N=15, 8.8%). The majority of parents

who did not have ICS on hand did not administer ICS (N=30, 65.2%). Over a third of the parents who have children with determined asthma severity, as indicated by having persistent enough asthma to be prescribed an ICS inhaler, and who also have the ICS inhaler in hand were not giving the medication (N=15, 8.8%) or were not administering the medication correctly by only giving when symptoms are present (N=45, 26.5%). Administering ICS medication irregularly, evidently due to a misunderstanding of its use and not access to the medication, is problematic and likely prevents children from having controlled asthma.

Children initially prescribed ICS did not have better asthma control than children who were not prescribed (considered less severe) at the beginning of the study (Table 19c). Also, none of the children who did not have ICS therapy initiated—who were thought to have lower severity—actually maintained well-controlled asthma throughout the year (Table 19d, with baseline and follow-up results). When examining each observation per child every 3 months over one year, children with higher severity did have less controlled asthma than those who were not prescribed (Table 19d). Only 3.5% of the observations on children who were not prescribed ICS and thought to have low asthma severity reported well-controlled asthma (N=18). ICS medication was not given regularly enough (Table 19b) to have an effect on the child's symptoms. It is also likely that more children have asthma requiring ICS therapy because of their uncontrolled asthma at baseline and throughout the study (Table 19c and 19d).

Parent stress and asthma knowledge by parent management behaviors. Parent characteristics of stress and asthma knowledge were described in bivariate

analyses with parent assessment and monitoring, medication, and education management behaviors due to the hypothesized relationship between these variables (Table 20). While missing appointments for asthma was reported at a low rate (6.8%), 12% of parents admitted barriers to keeping asthma appointments and is possibly larger than this if report bias may be present when asking this question, as skipping appointments may be perceived as negative. Parents with moderate to high stress were 6.9 times more likely to skip asthma appointments. Parents with less asthma knowledge were more 3.6 times more likely to skip asthma appointments (it is also possible if parents skip asthma appointments, parents are less likely to have asthma knowledge). Parents with more asthma knowledge were 3.1 times more likely to have ICS in hand.

Parents with asthma knowledge were 6.7 times more likely to have their child take their ICS inhaler some days or everyday ($p = .007$). Parents who had an asthma action plan are 4.4 times more likely to give their child their ICS medication some days or everyday ($p = .000$). Parents who believe that they do not need to give a child all of their prescription were 2.3 times less likely to give their child their ICS inhaler some or everyday ($p = .001$).

Parent and home environment characteristics by environment management behaviors. Parent income, education, and other home characteristics were examined with their environment management behaviors at home (Table 21). Households who do not have anyone employed or have an annual income of less than $25,000, the child with asthma is 1.6 times more likely to have passive smoke exposure ($p = .049$). Having two or more adults in the home approached significance with a 1.5 times greater likelihood of

smokers in the home (p = .085). Living in a neighborhood with homes that were not well maintained showed a 5.8 increase in likelihood of having pests in the home (p = .000). Having pests in the home was associated with having 5 or more people in the home (OR= 2.5, p = .002), as well as 2 or more children in the home (OR= 2.0, p = .018).

Parent and child characteristics by the shared educational behavior of having an asthma action plan. Parent and child characteristics were compared with having an asthma action plan, where recognizing those at risk for not receiving an AAP or parents who are unaware of receiving one at some point in their child's care (Table 22). Parents who did not complete high school were 2.3 times more likely to not have an asthma action plan (p = .002). Child health insurance approached significance in having an AAP, where children with Medicaid insurance were 1.6 times more likely to not have an asthma action plan (p = .081).

Bivariate Correlation Matrix

Using full data from baseline and all follow-up periods, a correlation matrix of primary study variables was constructed (Table 27). The outcome variable ED visits has many significant relationships with both exogenous and endogenous variables. Not controlling for other variables, ED visits are significantly correlated with younger children, parents who are minorities, parents who are not married, all seasons of the year, not taking the bus or walking (check-changes signs in multiple regression model), having high stress, not having people at home who smoke, having pests in the home, having an ICS prescribed, having an ICS in hand, missing doctor appointments, taking ICS (changes sign in multiple regression). Higher parent stress was significantly correlated

with going to the ED (correlation coefficient 0.063, $p<0.05$), as well as having older children, parents being Caucasian, male, having lower income, being unemployed, not graduating high school, having Medicaid insurance, being single, having smokers in the home, having more than four people in home, passive smoke exposure, pests in the home, an ICS prescription, missing appointments, take ICS, live in a house, have problems taking medicines and reside in a neighborhood with unmaintained homes.

These significant correlation coefficients with ED visits, parent stress, demographic and parent management variables necessitated an exploration of the pathways that lead to ED visits due to asthma using multivariate analysis.

Multivariate Analysis with Researcher Directed Step-wise Regression

Hierarchical regression was performed to explain the primary and secondary outcomes, as well as parent management behaviors. These models assist in further addressing the aims of this analysis. ***Aim 1*** was designed to examine the characteristics of the child and parents' home and social environments and their associations with asthma control, urgent or emergent asthma visits and school absenteeism. ***Aim 2a*** was designed to examine which parent or child characteristics lead to higher stress in parents of children with asthma. ***Aim 2b*** was designed to examine the association of parent stress on the child's emergent asthma visits, school absenteeism, and asthma control. ***Aim 2c*** was designed to explore the pathways of parent stress on parent management behaviors that affect the child's emergent asthma visits, school absenteeism, and asthma control. Lastly, ***aim 3*** was designed to examine the effects of child and parent characteristics on the

parent management behaviors performed. Each of the study's aims was addressed throughout the explanation of the regression models, with aims 1 and 2 found under the primary and secondary outcome models and aim 3 under the parent management behavior models.

ED Visit Step-wise Model

Emergency visits controlled for sociodemographics and season, then perceived stress, medication use, and asthma management behaviors were then stepped in (Table 26).

Step 1 (**Aim 1**). Child and parent demographic and season indicators were first added to the model to predict the likelihood of a child going to the ED related to asthma. This logistic model was estimated with 1,281 child-quarter observations using Generalized Linear Estimation (GEE) methods.[4] Coefficients in Step 1 reflect gross effects of included variables before controlling for other mediating variables. None of the demographic variables were significant in independently affecting the child's use of the ED. The child's minority status approached significance related to ED use (OR=3.59, p=.060). The parent's marital status becomes significant, with parents who are not married being 65% more likely to bring their child to the ED that parents who are married (OR = 1.65, 1.655-1.00 = 65.5, p = .033). Children who walk or take the bus to school, as

[4] The general STATA commands for the models are:
.xtset subjid visited
.xtgee EDvisitDI Z
where "subjid visited" indicate the child and quarter visit, respectively, EDvisitDI identifies those with at least 1 ED visit during a quarter, and Z is a vector of explanatory variables.

expected, are 41.2% (OR = -0.588, 0.588-1.00 = 41.2; p = .01) less likely to go to the ED than parents who drive their children in a personal car.

Step 2 (**Aim 2b**). After controlling for child characteristics, parent characteristics and season, parents with moderate to high stress are 67.7% more likely to take their children to the ED (OR=1.677, p=.014). The addition of stress increased the significance of child's minority status by 13.4% (4.069/3.588-1) with a negative zero-order correlation between parent stress and minority status of -0.0269, where children who are minorities have a 4.1 times greater likelihood of going to the ED (p = .041).

Step 3 (**Aim 2c**). Whether the child was ever prescribed an ICS inhaler or the parent brought one to the first Children's Hospital visit were stepped in as proxy for severity of asthma disease. Parents with ICS on hand were 4.2 times more likely to bring their children to the ED than parents who do not have ICS on hand (p = .000), reflecting high asthma severity. The addition of the two asthma severity variables decreased the effect of a child's minority status by 13.8% (OR = 3.5, 1-3.53/4.069, p = .065). The zero-order correlation of prescribed ICS with children who are minorities is +0.033 (Table 27), which, when multiplied by ICS logit coefficient reflects the "bias", or lower OR for minority children with ICS prescribed is controlled for. The decrease in the OR of minority children in going to the ED with the introduction of asthma severity reveals that it is not minority race, but asthma severity, that drives the probability of a child going to the ED in the model.

Step 4 (**Aim 2c**). Parents who administered ICS medications some days or everyday were 40% less likely to go to the ED (OR=0.60, 1.0-0.60= 0.40, p=.041) than

parents who administer mediation irregularly or not at all, controlling for asthma severity (and having access to the treatment on hand). Regular administration of ICS had a positive relationship with ED visits with a zero order coefficient of 0.083, and a negative relationship with going to the ED when controlling for asthma severity and all other variables in the model this far.

Step 5 (**Aim 2c**). Home environment variables of smokers in the home and pests in the home were significantly associated with ED visits (p=.000 for both), with passive smoke exposure's influence on ED visits approaching significance (OR=1.48, p=.087). Smokers in the child's home reduce the child's chances of going to the ED 47.7% (OR= 0.523, 1-.523 = .477, p = .000), which was an unexpected finding. Smoke exposure in the home did not have a protective effect on negative asthma outcomes in the literature; in fact, the variable smokers in the home was usually associated positively with negative asthma outcomes. Smoking in the home environment may have a social rather than a pathophysiological rationale for having a negative association with going to the ED. This effect of smokers in the home on main outcomes was examined with asthma control and school absenteeism models. Pests in the home increase the likelihood of children going to the ED by 61% (OR= 1.609, p=.000), as hypothesized.

Controlling for these environmental variables decreases the "bias" present in the housing variable and decreased the OR by 21% (1-.65718/.8313=20.95), revealing that children who live in houses were 34.3% more likely to go to the ED (OR= .657, 1-.657= 34.3, p=.049) than children who live in apartments. The zero-order correlation between living in an apartment and having pests is high: +.135 (Table 27). Those who live in

houses are more likely to have pests, both of which increased the likelihood of children going to the ED for asthma.

Step 6 (**Aim 2c**). Controlling for child and parent characteristics, including transportation, parent stress, and child asthma severity, parents who missed their child's medical appointment were 2.3 times more likely to take their child to the ED than those who do not skip (p = .017). The addition of missing an asthma appointment reduces the significance of the association between parent stress and ED visits by 5.7% (1-1.728/1.832) (p = .011), revealing that this management behavior of missing appointments partially mediates the role of parent stress on this child asthma outcome.

Step 7 (**Aim 2c**). The collaborative education management variable of having an AAP was not significant in affecting ED visits (OR=.87, p=.526). Housing, marital status, transportation, parent stress, asthma severity, medication administration, smokers in the home, pests in the home and missed appointments all remained significant in the final model, controlling for all other variables.

Step 8 (Aim 1). The addition of asthma knowledge and a lack of asthma self-efficacy were not significant in the model (OR=.600, p=.164; OR=1.05, p=.486). However, their addition changed the exogenous variables single marital status (OR=2.1, p=.006) and child minority race (OR=7.1, p=.036) to become significant, while housing in an apartment building became insignificant in the model (OR=.697, p=.115).

Step 9 (Aim 1). Asthma control was included in the model to examine its effect on going to the ED for asthma, as well as its effect on the other exogenous and endogenous variables. Well controlled asthma and uncontrolled asthma were negatively

correlated with the outcome (OR=.367, p=.000; OR=.061, p=.008) , with very uncontrolled asthma as the comparison group. Surprisingly, parent management behaviors of missed appointments, smokers in the home and pests in the home remained significant over and above the child's asthma control in predicting the probability of a child going to the ED for asthma. However, the parent management behavior correlations with ED visits reduced slightly, with missed appointments the most at 14.6% (1-2.323/2.719=14.6%), but remaining significant (OR=2.3, p=.025). The more uncontrolled the child's asthma, the higher the likelihood to go to the ED. There is a possibility that there is a subpopulation in the very uncontrolled asthma population that were more likely to go to the ED than others in that category and the ATAQ measure does not capture this group.

Minority child race, single parent status, transportation, asthma severity, smokers in the home, pests in the home, missed appointments all remain significant.

School Absenteeism Step-wise Model

Parent and child characteristics, season, child severity and parent stress were added first to the model, then parent asthma management behaviors, asthma knowledge, asthma self-efficacy, and asthma control were stepped in (Table 28). This logistic model is estimated with 1,271 child-quarter observations using Generalized Linear Estimation (GEE) methods.

Aim 1 and Aim 2b. Coefficients in Step 1 reflect gross effects of included variables before controlling for other mediating variables. The marital status variable approached significance in independently being associated with missed school, with

45.4% of children more likely to miss school if their parent is not married (OR = 1.454, p = .059). Neither the child's age, gender, race nor the parent's employment, education, housing, people in the home, health insurance, or transportation had an independent effect on the child missing school. Children with higher asthma severity were 2.3 times more likely to have their child miss school (OR=2.28, p=.000), measured by ICS in hand.

Parents with moderate to high stress were not more likely to have children miss school (related to asthma) than parents with low stress (OR= 1.02, p=.495). This was expected as parent stress had a low and insignificant zero-order correlation with the outcome (Table 27).

Steps 1, 2, 3 and 4 (Aim 2c). Children taking ICS medication some days or everyday was not associated with missed school (OR=.79, p=.279). Passive smoke exposure, smokers in the home and pests in the home were insignificantly related to missing school. Parents who skip their child's medical appointment were 2.2 times more likely to miss school (OR=2.17, p=.021). This reduces stress's effect on missing school by 65.2% (1-.032/.092), as stress became even more insignificantly related to missed school. The variable of children having an AAP was not significantly related to missing school (OR=.87, p=.444).

Step 5 (Aim 2c). A lack of parent knowledge of asthma medications significantly increased the child's chance of missing school by 51% (OR = 1.51, p = .054), with asthma knowledge not being significantly associated (p=.091, not shown in model). Missed appointment's significance is reduced by 7.1% with the addition of asthma knowledge in the model (1-1.8641/2.0067= .071), yet still trended towards significance

(OR=1.86, p=.074). Asthma severity remains significant as a moderating variable. Parents who were not married approached significance in being more likely to keep children home than parents who are married (OR=1.43, p=.097).

Asthma Control Step-wise Model (ATAQ)

There were a small number of children with continually controlled asthma (N=1/351, 0.3%) (Table 16), with a low number of total observations of children with asthma control at baseline or any follow-up time point (N= 54/1354, 4.0%). The difference between children with very uncontrolled asthma at any quarter (N=222/1354, 16.4%) from those that have controlled asthma was also examined. This distinction is clinically significant due to those with very uncontrolled asthma having worse outcomes, with a 2.3 times higher chance of going to the ED (OR=2.3, p=.000) and a 17.3 times higher chance of missing school (p=.000), not controlling for other variables (Table 25).

Parent and child characteristics, season, child severity and parent stress were added first to the model, then parent asthma management behaviors, asthma knowledge and asthma self-efficacy were stepped in (Table 29). This logistic model was estimated with 1,212 child-quarter observations using Generalized Linear Estimation (GEE) methods.

Aim 1 and Aim 2b. Coefficients in Step 1 reflect gross effects of included variables before controlling for other mediating variables. Girls were 68% more likely to have better controlled asthma than boys (OR=1.68, p=.008). Parents who were employed or had an annual income > 25K are 59% were more likely to have children with well controlled asthma (OR=1.59, p=.040). Parents who were not married were 49.7% more

likely to have children who have very uncontrolled asthma (OR=.503, 1-.503=.497, p=.007). Children who resided in a less maintained neighborhood were 39.3% less likely to achieve better controlled asthma (OR=.607, 1-.607= .393, p=.019). Children who were not driven by car to school were 47.0% more likely to have better asthma control (OR=1.47, p=.059). Children with higher asthma severity, measured by parents having ICS for their child in hand, were 59.4% less likely to have asthma control (OR= .4065, 1-.4065=.594, p=.000).

Parent stress was not significantly correlated with asthma control when stepped into the model (OR=1.182, p=.408). Also, child gender, parent marital status, parent income and neighborhood remained significant related to asthma control.

Step 1, 2, 3 and 4 (Aim 2c). Parent who administered ICS medications regularly had children who were not significantly more likely to have better controlled asthma (OR=1.47, p=.119). When stepped into the model, home environmental exposures such as passive smoke, smokers in the home, and pests in the home did not differ significantly between children with very uncontrolled asthma and those with better controlled asthma. Parents who missed appointments for their child's asthma were 55% less likely to have children with better asthma control (OR= .445, 1-.445=.555, p=.018). The variable, parents who had an AAP was not statistically more likely to have better controlled asthma.

Step 5 (Aim 1). Parents with asthma knowledge were twice as likely to have children with more controlled asthma, controlling for all other variables (OR=2.03, p=.022). A lack of asthma knowledge (L8) was not significant in the model (.7557,

p=.255, not shown). Adding asthma knowledge to the model reduced the neighborhood's effect on asthma control by 13.8% (.6851/.6018-1= .138), making it insignificant. There is a negative zero-order correlation between asthma knowledge and neighborhood of -0.1145, making this finding expected. Child gender also became insignificant (OR=1.41, p=.088), with a 3.8% reduction in significance with asthma knowledge added (1-1.4082/1.4642= .038). SES, marital status, transportation, asthma severity measured by ICS in hand and missed appointments all remained significantly associated with asthma control, controlling for all other exogenous and endogenous variables.

Parent Stress Step-wise Model

Child and parent demographic and season indicators were added first to the model to predict the likelihood of a parent having moderate to high stress, then child asthma severity, parent self-efficacy and parent knowledge were added to the model (Table 30). This logistic model is estimated with 302 baseline child observations using logistic regression. Parent and child characteristics that were thought to influence parent stress were entered into the model.

Step 1 (Aim 2a). Child characteristics of age and gender did not significantly influence parent stress. Parent gender was omitted in the analysis due to too few observations of male parents. The parent characteristic of race was entered and was not significantly associated with parent stress, controlling for child characteristics and parent socioeconomic status. Both parent education and socioeconomic status significantly affected parent stress, with parents who had household income of greater than $25,000 or regular employment having a 50.5% less chance (OR=0.495, 1-.495=.505, p=.021) and

parents who graduated high school having a 49.9% less chance of having moderate to high stress (OR=0.501, p=.034). The addition of parent characteristics of housing, marital status, number of people in the home and the child's health insurance type were not significant in influencing parent stress. However, the addition of these characteristics reduced the significance of socioeconomic status by 10.4% (0.543/0.495-1= .104, p=.06). This change was expected, as there were strong negative zero-order correlations between single parent status and socioeconomic status (-.258), and Medicaid health insurance and socioeconomic status (-.319) (Table 27). Transportation by bus or walking was not significant in affecting parent stress or any other variables in the model. Neighborhood of the parents' residence was added to the parent stress model and was trending towards significance in having an association with ED visits (OR: 1.701, p=.095). The addition of neighborhood to the model increased the socioeconomic status variable and significantly affected parent stress (OR=.486, p=.037). Unmaintained neighborhood had a negative zero-order correlation of -.064 with employment and greater than $25,000 per year—defined as socioeconomic status, which influenced the significance of SE in the model. The addition of neighborhood into the model increased socioeconomics' effect by 11% (1-0.486/0.546) (OR=.486, p=.037). Negative correlation between neighborhood and employment (-0.0636) in the zero-order correlation, which reduces the socioeconomic coefficient on stress controlling for neighborhood, which means those who are unemployed and have income <$25,000 income are even more likely to have stress. The number of subjects dropped from 327 to 302 with the addition of neighborhood, likely because of sensitivity to this question by parents, so this estimate is likely conservative.

Step 2. Asthma severity was not significantly associated with parent stress. While the zero-order correlation between severity and stress was positive for both ICS prescription (0.08) and ICS in hand (0.09), controlling for child and parent characteristics reduced this relationship to insignificance. This reveals that child and parent characteristics, which include demographics and inner-city social variables, explain parent stress in this population, not the child's asthma condition.

Steps 3 and 4. Adding asthma knowledge to the model mitigated the influence of parent education on parent stress by 6.0% (0.519/0.490-1=.0598) (OR=0.416, p=.132). However, the addition of lack of asthma knowledge did not mitigate the influence of education (OR=1.614, p=.184). Asthma knowledge could be a proxy for other types of knowledge or awareness that is broader than knowledge about medications only. These insignificant results of asthma severity and asthma knowledge on parent stress support the hypothesis that asthma is a small aspect of parent stress in this inner-city population, due to financial and/or other stressors.

Summary of Aims 1 and 2 Models

Aim 1. Four child and parent characteristics (N=4/12, 33.3%) were found to be significant in explaining at least one main outcome in the final models of ED visits and asthma control, with none significant in the final school absenteeism model. Parent marital status and transportation were significant in both main outcomes of asthma control and ED visits, and remained significant in these models after all the endogenous variables were added to the models. Parents who had single marital status were 46.4% less likely to have children with better controlled asthma (OR=.5364, 1-.536=.464,

p=.022) (Table 29) and 73.2% more likely to bring their child to the ED (OR= 1.732, p=.017) (Table 26). This approached significance in explaining school absenteeism (OR=1.43, p=.097). However, the variable, single parents, was not seen as significantly less likely to have children with poorer asthma control with the continuous ATAQ model and maximum symptom days (Table 40. Taking the bus or walking was associated with increased control in asthma (OR=1.546, p=.039) (Table 29) and decreased the risk of going to the ED (OR=.509, p=.001) (Table 26). However, there was no relationship between taking the bus or walking in the continuous ATAQ asthma control model or maximum symptom days (Table 40). It is possible that child gender and parent marital status are only significant in association with very uncontrolled children with asthma rather than overall asthma control in children (Table 29 and Table 40).

Controlling for other parent and child characteristics, the variable children who are minorities were more likely to use the ED than Caucasian children (OR=3.6, p=.060), and the relationship became significant when parent stress was added to the model (OR=4.07, p=.041) and when asthma control was added to the model (OR=6.61, p=.042) (Table 26). Child minority status approached significance in predicting school absenteeism (OR=2.79, p=.113). Controlling for baseline characteristics, and also after parent management behaviors and asthma knowledge were added, parents who have an annual household income of greater than $25,000 or regular employment were 82.0% more likely to have children with better asthma control (OR=1.73, p=.020) (Table 29). This relationship was also observed to approach significance in the continuous ATAQ model (OR=1.25, p=.075) (Table 37).

Asthma knowledge mediates child gender and neighborhood in asthma control model. Controlling for other child and parent characteristics, child gender was significant in explaining asthma control (OR=1.68, p=.008), but the significant correlation was decreased by 3.8% when parent asthma knowledge was added to the model (OR=1.408, 1-1.408/1.464=.038, p=.088). Similarly, neighborhood was significant independently with asthma control (OR=0.602, p=.022), but adding asthma knowledge to the model reduced its effect on asthma control by 13.8% (OR=.685, 1-.6851/.6018= .138, p=.103). This reduction was expected, as the variable of neighborhood had a moderate, negative zero-order correlation with asthma knowledge of -.10. Also, neighborhood was not significant for overall asthma control by continuous measure or symptom days (Table 37).

Aim 2a; explaining parent stress. In this inner-city sample of parents of children with asthma, there were a high number with moderate to high stress as measured by the 4-item Perceived Stress Scale (N=223, 63.5%) (Table 17), In bivariate analysis, moderate to high parent stress was negatively correlated with parent employment and income over $25,000 (OR = 0.49, p=.013), parent education of high-school graduate or higher (OR=0.48, p=0.019) and male parent gender (p=.030) (Table 18). Eight of 351 parents (2.3%) were fathers and all eight had moderate to high stress. Because of this observation, parent gender was omitted from the multivariate regression analysis. Controlling for all other variables in the parent stress model, parent education (OR= .416, p= .037) and parent income (OR=.416, p=.021) remained significant with parent stress in the multivariate regression analysis. Also, living in a neighborhood that is not well

maintained approached significance in correlation with parent stress, in both the bivariate analysis (OR = 1.67, p=.084) and multivariate analysis (OR = 1.7, p=.095).

Aim 2b; parent stress on main outcomes. Parents who had moderate to high stress had a 50% higher chance of taking their child to the ED than parents with low stress (p=0.069) (Table 23). Controlling for socio-demographics and parent management behaviors, parent stress was significant in explaining ED visits of children with asthma (OR= 1.73, p=.011). Parent stress remained significant when each parent management behavior introduced in the model. However, parent stress did not affect school absenteeism or asthma control in bivariate analysis or regression models.

Aim 2c; parent stress's effect on parent management behaviors in main outcome models. Comparing the effect of parent stress on a parent management behavior, the parent management behavior on ED visits and then if the management behavior influences parent stress's effect on ED visits was reported. Also, examining the parent management behaviors' effect on the main outcomes was examined.

Routine visits and parent stress. Stress influenced the parent management behavior of routine visits, with bivariate analysis showing parents with moderate to high stress were 6.9 times more likely to miss appointments than parents with low stress (OR=6.9, p=.003) (Table 20). Parents with stress are 5.3 times more likely to miss routine appointments than those with low stress, controlling for sociodemographic characteristics and child asthma severity (Table 33). In the ED model, parents who missed routine visits for their child's asthma were 2.5 times more likely to go to the ED than those who kept their routine visits (OR=2.50, p=.011) (Table 26). Parents missing their child's routine

asthma appointments mediated the role of stress on ED visits by 5.5% while controlling for other parent management behaviors, revealing that stress is a reason why parents missed routine appointments and influenced whether the child went to the ED for asthma (1-1.73/1.83=.546) (Table 26). This change was expected, as the zero-order correlation between missed appointments and parent stress was +.12 (Table 27).

Routine appointments and main outcomes. Missing the child's routine appointments was significantly correlated with all of the main outcomes. Missing appointments was associated with being 51.6% less likely to have more controlled asthma (OR=.484, 1-.445=.516, p=.018), 4.4 times more likely of having another symptom day (OR=4.426, p=.018), twice as likely to go to the ED (OR=2.50, p=.011), and twice as likely to miss school (OR=2.00, p=.042).

Medication administration and parent stress. Parents with moderate to high stress were 58% more likely to have their children take ICS medications regularly, either some days or everyday (OR=1.58, p=.058) (Table 20). There was no effect of parent stress on regular medication administration in the medication administration behavior model (1.358, p=.354) (Table 31). Controlling for parent and child characteristics, season, and other management behavior variables, the variable parents who administer the child's asthma medications regularly was negatively associated with going to the ED (OR=0.61, p=.049), (Step 6, Table 26), but it's effect on ED visits was mediated by having an asthma action plan (OR=.630, p=.070) (Step 7, Table 26). The effect of taking ICS regularly did strengthen the relationship between stress and ED visits by 4.7% (1.77/1.689-1), revealing a relationship between parent stress and medication

administration (zero order correlation=.12), with parents who experience more stress less likely to regularly administer their child's asthma medication, controlling for other variables (Table 26).

Medication administration and main outcomes. The variable parents who administer the child's asthma medications regularly was negatively associated with going to the ED (OR=0.612, p=.049) without AAP in the model (Table 26). The zero order correlation between AAP and medication administration (labeled "take ICS") was moderate at +.19 (Table 27). The multicollinear association between having an AAP and taking ICS in the ED visit model is likely explained by parents who had and used an AAP were aware of the appropriate frequency to administer the medication, and more likely to administer medications regularly.

Home environment variables and parent stress. Parent stress influenced passive smoke exposure in children, controlling for child and parent characteristics (OR=1.65, p=.037) (Table 37). This relationship was expected, with stress and passive smoke having a zero-order correlation of +0.11. However, passive smoke was not significantly related to ED visits in the full ED model (Table 26) and parent stress was only impacted 3.4% when home environment variables were added to the ED model (1.832157/1.77081= .034) (Table 26). Stress did not significantly influence parent management of smokers in the home or pests in the home in bivariate or regression analysis (Table 21 and Table 26).

Home environment variables and main outcomes. The variable, parents who had other family members in the home that smoke, did not affect the child's asthma

control (or maximum symptoms), yet decreased the likelihood of the child going to the ED by 45.4% (OR=.546, 1-.5461=.454 p=.001). While smoker in the home does not appear to affect asthma symptoms, yet is associated with bringing a child to the ED, this relationship between smokers in the home and not going to the ED likely reveals a lack of recognition of the child's need to go to the ED if their asthma is not under control by parents who smoke, not that the smoke influences the child's symptoms independently of asthma severity and other variable included in the asthma control model. Parent report of estimated frequency of child passive smoke exposure was not associated with any of the main outcomes of child ED visits, school absenteeism or asthma control. Controlling for all other variables, pests in the home were associated with ED visits (OR=1.51, p=.001), but not asthma control or school absenteeism.

Educational management behavior and parent stress. In bivariate and multiple regression analysis in the main outcome models, parent stress did not significantly influence parents having an AAP and the AAP did not affect any of the main outcomes.

Child asthma severity and main outcomes. Having ICS in hand by parents is a measure of asthma severity and significantly affects all the main outcomes. Asthma severity increases the risk for going to the ED (OR=5.82, p=.000), increases the risk for missing school (OR=2.52, p=.000) and decreases the likelihood of having more controlled asthma (OR=0.36, p=.000).

Parent Management Models (Aim 3)

Medication Administration Model (Take ICS)

Parent and child demographics, parent stress, child asthma severity and parent management behaviors of missed appointment and having an asthma action plan were first entered into the parent medication administration model, then parent asthma knowledge, self-efficacy and beliefs about stopping asthma medications were added into the second model (Table 31).

Model 1. None of the demographic variables were independently associated with medication administration. Parents who had an asthma action plan were 2.6 times more likely to have their children take ICS (OR = 2.6, p = .012). Asthma action plans do give clear instructions on which medications the child have been prescribed and when to take them.

Model 2. The addition of several asthma knowledge questions related to medication use provided additional insight on what is associated with medication administration. Parents who had asthma knowledge (who believe that ICS medications can control asthma) were 15.2 times more likely for the children to have asthma control (OR = 15.2, p = .010). This association was expected, as the zero order correlation between taking ICS and asthma knowledge was +0.18. Parents who lacked asthma knowledge by reporting they stop giving the child medications when their child's asthma was "better" were 65.0% less likely to have their children take their medications some days or everyday (OR = .350, p = .004). Parents with self-efficacy, who believe administering their child's asthma medication assists in their child's asthma control were 3.4 times more likely to administer their child's medication regularly (OR=3.4, p=.025).

Miss Appointments Model

Parent and child demographics were first entered into the missed child asthma appointments model, then parent asthma knowledge and self-efficacy were added into the second model (Table 32).

Model 1. Parents who had other people living in their home were 5.8 times more likely to skip appointments (OR = 5.89, p = .003). Parents who lived in a less maintained neighborhood were 6.8 times more likely to skip appointments (OR = 6.75, p = .001). Parents who had stress were 5.3 times more likely to skip appointments (OR = 5.34, p = .042).

Model 2. The effect of parent stress, the number of people who live in the home and the neighborhood remain significant with the addition of parent asthma knowledge and self-efficacy. The addition of asthma knowledge reduced the variance in the child's insurance variable, with insurance increasing in significance by 21.8% (1-11.495/9.437=.218). Parents who had children covered by Medicaid insurance were 11.5 times more likely to have missed appointments than children covered by other insurance companies, controlling for income, employment, and other demographic variables (OR=11.5, p=.038).

It is not clear what factor of Medicaid insurance would influence parents to miss appointments, so it is likely an aspect of parents who have children enrolled that might explain this association. Insurance type may be a more refined measurement of socioeconomic status and parents with this type of insurance may not have the same amount of employment flexibility to come to their child's appointments. However, when the variable, children in the household was substituted for number of people in the

household, insurance was not significant in explaining missed school. Children in home were likely the explanation of missed school; children with Medicaid insurance are more likely to have more children in the home.

Asthma Action Plan Model

Parent and child demographics were first entered into the asthma action plan model, then parent asthma knowledge and self-efficacy were added into the second model (Table 33).

Model 1. Parent education was significantly correlated with having an AAP. This relationship remained significant when asthma knowledge was included in the model. It is possible that parents may not recognize that they have been given an AAP, yet the question to parents is clear about receiving written instructions. More likely, healthcare providers may not give parents of children with asthma a written plan if they believe it will not help parents. This judgment made by healthcare providers is plausible because of a perceived literacy problem or perceived lack of interest in written materials. Children who have more severe asthma also are more likely to have an AAP, as predicted. Children with higher severity of asthma may trigger the healthcare provider to see the need for providing the parent with an AAP due to the severity of the child's medical condition, as well as the child being more likely to have gone to the ED or a healthcare visit multiple times, increasing the likelihood of obtaining an AAP at one of the visits.

Model 2. With the addition of parent asthma knowledge and self-efficacy, transportation increased in significance with having an AAP by 20.9% (OR=1.956, 1-1.956/1.618=.2089, p=.049). Children who took the bus or walked were 1.9 times more

likely to have an AAP, controlling for missed appointments and asthma knowledge. The inclusion of asthma knowledge and self-efficacy reduced the significance of asthma severity on obtaining an AAP by 21.1% (OR= 2.13, 1-2.129/2.696= .211, p=.057), yet remained significant. While asthma knowledge was not significant in explaining parents obtaining an AAP, it reduced the effect of asthma severity on having an AAP.

Further examination of the AAP model revealed that the addition of parent reported ED visits to the model reduces the significance of transportation (OR=1.898, p=.062, not shown). This finding suggests that transportation affects ED visits, supporting the notion that parents often receive asthma action plans in the ED, and that transportation is a barrier to ED visits as well as trending on significant in affecting parents receiving asthma action plans.

Pests in Home, Passive Smoke Exposure and Smokers in Home Models

Parent environment management behaviors of pests in the home, passive smoke exposure to their children and having smokers in their home were examined in separate models, which included parent and child characteristics, as well as parent stress in each (Table 34).

Pests in the home model. Homes with more than 5 people were twice as likely to have pests in the home (OR = 2.00, p = .000), controlling for housing type and other demographic variables. Parents who lived in a neighborhood that they believe is not well maintained were 1.8 times more likely to have pests in their home (OR = 1.79, p = .002). Parents with higher education were 39.1% less likely to have pests in their home than parents who have low education (OR = .609, p = .044).

Parents who were employed or had an income greater than $25,000 per year approached significance and were 34.8% less likely to have pests in the home (OR = .652, p = .066), controlling for housing type. The variable, people living in apartments, approached significance in association with pests in the home, indicating they are 1.4 times more likely to have pests than those who live in houses (OR = 1.37, p = .094).

Passive smoke model. Parents with moderate to high stress were 1.65 times more likely to report their child was exposed to passive smoke than parents with low stress (OR = 1.65, p = .037). Parents who were Caucasian were 54.2% more likely to be exposed to passive smoke (OR=.4580, 1-.4580= .542, p=.072). This finding is marginally significant.

Smokers in the home model. Parents who lived in homes where people smoke were 2.1 times more likely to not be married (OR = 2.08, p = .023). Also, these parents were 2.6 times more likely to have Medicaid insurance if they had other smokers living in their home (OR = 2.61, p = .005). Child enrollment in public health insurance is likely another estimate of socioeconomic status, in addition to the employment and income variable, and assists in refining the measure of SES, revealing this relationship of lower income households and smokers in the home. Neither housing type nor number of people in the home independently affected if there were smokers present or not.

Summary of Aim 3 Models

Missed appointments and pests in the home. Two groups, those who had a large family (>4 people) and living in an unmaintained neighborhood, both increased the likelihood of children missing appointments and having pests in their homes. Parents

were 5.0 times more likely to miss their child's appointments if they had more than four people in their home (OR=4.99, p=.012) and were 7.6 times more likely to miss them if they lived in an unmaintained neighborhood (OR: 7.61, p=.001) (Table 32). Also, parents were 5.2 times more likely to miss appointments if they had moderate to high stress (OR=5.20, p=.050) (Table 32). Parents were twice as likely to have pests in the home if they had more than four people living in the house (OR=2.00, p=.000), controlling for housing type and other exogenous variables, as well as 1.8 times more likely to have pests if living in an unmaintained neighborhood (OR: 1.79, p=.002) (Table 34). Also, parents with higher education had a 39.1% lower likelihood of having pests in their home (OR=.609, 1-.609=.391, p=.044), controlling for income and other exogenous variables (Table 34). While the number of people living in a home, which likely represents a child's family, and the neighborhood lived in, are both difficult to change, the behaviors of missing appointments and pests in the home are modifiable.

Passive smoke and smokers in the home. Parent stress increased the likelihood of passive smoke exposure 1.6 times (OR=1.653, p=.037), and, as mentioned, increased the likelihood of missing an appointment by 5.3 times (OR=5.342, p=.042) (Table 34, 37). Parent stress was still significant in influencing passive smoke exposure even controlling for the family's income and employment, parent education, number of people in the home, and the neighborhood environment. Having a single parent doubled the likelihood of having people who smoked living at home (OR=2.1, p=.023), which could include the parent or another adult family member (Table 34).

Having an AAP. Parent education of graduating high school or more increased the likelihood of the child having an asthma action plan 2.7 fold (OR=2.943, p=.008), controlling for asthma severity, asthma knowledge, asthma self-efficacy, and other exogenous factors (Table 33). It is unknown if healthcare providers decide whether or not to give parents of children with asthma an AAP if they believe the parents are less likely to use it, possibly due to literacy concerns or interest shown by the parents, or in an effort to reduce complexity in management by giving more paper. Another explanation is that healthcare providers do give written management plans, yet parents with less education are less likely to look at the papers given or regard them as important in their child's management, forgetting or not being fully aware that they do have these instructions. Also, transportation increases the likelihood of parents having an AAP almost twice (OR 1.96, p=.049).

Medication administration. The addition of parent asthma knowledge related to medications had a large effect on medication administration, a small effect on missed appointments and no effect on having an AAP. Parents with asthma knowledge were 15.2 times more likely to have regular medication administration (OR=15.2, p=.010), parents with self efficacy related to medications were 3.4 times more likely to perform regular medication administration (OR=3.35, p=.025), and those misinformed about the role of medications are 65.0% less likely to continue giving medication regularly (OR=.350, 1-.350=.650, p=.004). Knowledge and self-efficacy, as well as having an AAP, are modifiable factors. Taking ICS regularly was significantly associated with children going to the ED for asthma, not controlling for AAP in the model. Taking medication regularly

was not significantly related to asthma control measure, yet was related to ED visits, which leads to a possible explanation that regular ICS use does not effect categories of control or uncontrolled asthma but exacerbations that are severe enough to go to the ED, which may be lost in the asthma control score.

Sensitivity Analysis

Lagged model. A lag test only for two variables, passive smoke and pests in the home, was performed due to only their measurement every quarter (Table 35). Passive smoke remained insignificant and pests in the home reduced the correlation by 17.6% (1-1.29/1.566) (p= .024), but remained significant. With the change in pest's significance, missed appointments increased in association with ED visits by 10.6% (1- 2.5958/2.346) (p = .007). The parent management behavior variables demonstrated similar covariance. Pests were predictive of ED visits, controlling for demographic variables, parent stress, asthma severity and other parent management behaviors.

Sensitivity test using alternate asthma control measure. Using alternate measures for main outcomes of interest assists with confirming the associations of dependent variables on the independent variable (Table 37). An alternate measure for asthma control was examined. Maximum symptom days were also substituted for ATAQ asthma control, where asthma severity and missed appointments also retained significance (OR= 3.89, p= .000; OR= 4.42, p= .018, respectively) and with pests gaining significance (OR= 1.6, p=.004).

Functional form. Asthma control using the ATAQ Control was tested using both the continuous measure (1-7) and the dichotomous measure (combined scores 1-3 and 4-

7) (Table 37). The dichotomous variable combined scores 1-3 to create a "very uncontrolled" asthma category and a "better controlled" category to explore further what is associated with "very uncontrolled" asthma. The continuous ATAQ Control model found two significant associations, asthma severity (OR= .576, p= .000) and missed appointments (OR = .507, p= .001). The dichotomous model testing better controlled asthma, as opposed to very uncontrolled asthma, found these associations of asthma severity and missed appointments significant as well. Child gender (OR= 1.46, p= .049), socioeconomic status (OR= 1.82, p= .008), marital status (OR= .56566807, p= .024), and neighborhood (OR= .581, p= .014) were also significant.

Fifteen variables in the main model (N=15/24, 62.5%) were transformed from multiple categories to dichotomous for the analysis. These include child age, child race, parent race, income, parent education, apartment, not married, number of people in the home, insurance, neighborhood, transportation, parent stress, take ICS, people who smoke in home and pests in home. These variables were transformed to create a method of measuring a variable that provides useful categories. For example, using a continuous parent stress ranging from 1 through 16 examined the association between parent stress and ED visits, with the likelihood of the child going to the ED for every one point higher the parent has of reporting stress. By placing the continuous variable of parent stress in the main outcome model, parent stress became insignificant (OR= 1.06, p=.081), with a 33.8% (1-1.057832/1.728849=.338) decline in association with ED visits (Table 36). Creating a dichotomous variable of parent stress, based on the literature, with scores 0 through 4 meaning low stress and 4 through 16 being moderate to high stress, parent

stress becomes significant in the main ED model. Parents with moderate to high stress had a greater risk of bringing their child to the ED than parents with low stress, controlling for other variables.

CHAPTER FIVE

DISCUSSION AND CONCLUSIONS

Asthma is a controllable condition. However, the challenges of the inner city and parent characteristics directly affect these children's outcomes in controlling their asthma, going to the ED for asthma and school absenteeism. This section discusses the secondary analysis performed in light of what has been previously reported in the literature. First, comparing the study sample with other inner-city analyses and national rates a better understanding of generalizability. Second, discussing the results of each aim and identifying pathways identified in this analysis are discussed. Lastly, applying the results of the analysis to policy and future research are highlighted.

Study Overview

The Asthma Clinical Research Center at Boston Children's Hospital, Harvard Medical School conducted a 5 year prospective, NIH/NIAID funded longitudinal study, "School Inner-city Asthma Study" (SICAS) (Principal Investigator, Phipatanakul) (Phipatanakul et al., 2011). This descriptive correlational study sampled children with asthma in selected classrooms of schools in a major urban area in the Northeast, United States, each year for 5 consecutive years. The students who had asthma in the classrooms were enrolled in the study and had a baseline assessment at Children's Hospital Boston. Children were required to have asthma that was diagnosed by a healthcare provider in the

past and either had wheezing in the last year, or had an unscheduled medical visit for asthma in the last year, or was taking daily medicines for asthma. A baseline questionnaire was used to collect information from parents' demographic information and the child's asthma specific information, as well as parent stress. Follow-up phone calls to parents at 3, 6, 9, and 12 months collected home environment and asthma outcome information.

Comparison with national sample and with other inner-city asthma study.

This inner-city population of children with asthma has high asthma severity, with a high amount of AAPs given and a comparable amount of ED visits compared to national child asthma rates. Almost two thirds (N=217, 62.2%) of children have been prescribed an ICS inhaler, indicating persistent asthma severity, which is much higher than the national ICS prescription rates of 17.1% to 33.7% (Statistics, 2012). While it is ideal that every child has a written asthma action plan (AAP), 64.8% (N=226) of children in this inner-city sample have a plan. This is, however, greater than the national average of 45.4% of children with asthma were given AAPs (Control, 2012) (http://www.cdc.gov/asthma/acbs/table6.htm). This may be due to the higher asthma severity in this population, leading to multiple healthcare visits for asthma, increasing the chances of a parent obtaining an AAP for their child. Parents reported almost half (N=165, 47.7%) of the children visited the ED or urgent care for asthma at least once prior or during the study, which is similar to the national asthma attack rate of 43.1% to 63.1% in US states (Statistics, 2012).

Demographics comparison. Compared to an inner-city study population sampled from four urban areas in the US, this analysis had similar child race diversity and percent of children on Medicaid insurance. Similar to the multi-center, national study that informed the design of SICAS, the National Cooperative Inner-City Asthma Study (NCICAS), children in this study were racially diverse with a low percent of Caucasian children (Garbutt et al., 2010; Nelson et al., 2011; Sockrider et al., 2006). There were a similar number of children on Medicaid (74.6% versus 73.1%). However, more parents have higher education (SICAS: 80.9% completing high school, NCICAS: 66.7% completing high school), higher income (SICAS: 50% <$25,000, NCICAS: 61% <$15,000), less unmarried parents (SICAS: 70.9%, NCICAS: 77%) and fewer children in SICAS appear to have gone to the ED (47.7% versus 65.7%).

Compared to a study from three urban and surrounding areas in the US from practices affiliated with a managed care organization, the Pediatric Asthma Care Patient Outcomes Research Team II (PAC PORT II) study, there was a similar number of smokers in the home reported, but this analysis included a larger number of houses with pest exposure. The SICAS inner-city population with asthma has a high rate of pest exposure, with 67.2% reporting at least 1 type of pest in their home at baseline, compared to the PAC PORT II study with 18% home pest exposure (Finkelstein et al., 2002). Also, SICAS reported 33.1% of parents reported a smoker in the home, which is similar to PAC PORT II study reporting 30% (Finkelstein et al., 2002). It is possible that the PAC PORT II study sample had both urban and suburban participants, reducing the likelihood of parents reporting pest exposure. Yet, the number of homes with smokers was

comparable. Overall, the SICAS analysis is representative of inner city residents in the US, except slightly more educated and higher income than other inner-city environments, who have gone to the ED for asthma less often. This difference strengthens the results of this analysis, as it is likely more difficult to see an effect of management behaviors on the main outcome with a lower number of ED events.

Aim 1 Analyses and Interpretation of the Findings

Results indicated a small number of child and parent characteristics related to child asthma outcomes examined in current literature of studies including parents of children with asthma. The analysis explored twelve child and parent characteristics, including child age, gender, race, insurance, transportation type, parent gender, household income, parent education, housing, marital status and number of people in the household, and season in all of the main outcome models of childhood asthma. These variables were determined as important to the model because they were either controlled for in other studies or hypothesized to have an effect on the outcomes. Four of these twelve (25%) were significant in explaining the probabilities of children going to the ED and/or the child having asthma control, controlling for other characteristics, asthma severity, and parent management behaviors. Marital status and transportation were significant in explaining the probability of the child going to the ED and probability of having more controlled asthma. Child minority race increased the likelihood of a child going to the ED. Household income increased the likelihood of a child having better controlled asthma. No characteristics remained significant in the final school absenteeism model.

Child race. Child race has been shown to be an important factor in population based study related to ED visits for asthma. However, at risk calculations of race has shown a decreased risk of ED visits in racial minorities than what has been believed in the past (L. J. Akinbami et al., 2011). However, this analysis approached significance for an increased risk for children who are minorities to have a greater likelihood of a probability going to the ED, controlling for child and parent personal and inner-city living characteristics (OR=3.6, p=.060). The variance of the model was refined once asthma knowledge was included, and child race became significant (OR=6.61, p=.042) (Table 26). Child race increased in effect by 127%, with this direction of change expected as asthma knowledge's zero-order correlation with race was +.06 and a negative zero-order correlation with a lack of self-efficacy of -.11 (1-7.1419/3.1442 = -1.27). Child minority race, independent of asthma knowledge and self-efficacy, shows an increased likelihood of going to the ED (Table 26), but not of having more uncontrolled asthma (Table 29). It is possible that parents of children with asthma who have minority status may have different decision making processes than Caucasian parents as to when to bring a child to the ED, not related to (controlling for/regardless of) asthma knowledge and self-efficacy. Flores and colleagues found that African American parents were more likely to use the ED use as usual source of asthma care than Latino parents (OR=3.6, 95% CI=1.7, 7.8), adjusted for child gender, asthma specialist, poverty, caregiver's educational attainment, and asthma severity (Flores et al., 2009).

Transportation. The majority of children did not take a personal car to school (68.1%) (Table 17). Parents who drive their child to school would likely have access to a

car regularly and would be able to drive their children to the ED if the child develops concerning asthma symptoms. In bivariate analyses, parents of children with asthma who had a car were 60% more likely to bring their child to the ED then parents who took public transportation (OR 1.6, p=.032) (Table 23). This relationship persisted when controlling for all other variables in the final model, as children taking the bus or walking were 49.6% less likely to go to the ED (OR=.504, p=.003) (Table 26). However, children who took the bus or walked were more likely to have better controlled asthma (OR=1.546, p=.039) (Table 29). It is possible that children who took the bus or walked had more regular moderate physical exertion resulting in better pulmonary function or less symptoms. However, this dataset does not support further analysis of physical activity and asthma control. Also, transportation's effect was independent of income, where income had a strong negative correlation with taking the bus or walking (-0.24, p=.000) (Table 27). Regardless of income, children who take the bus or walk to school and have asthma are in better shape or have reported fewer symptoms than those who are driven to school. Whether walking or taking the bus may improve respiratory function, or those with symptoms are more likely to be driven to school, remains to be clarified.

Marital status and income. 70.1% of parents in the secondary analysis are single. In bivariate analysis, single parents were 1.8 times more likely than married parents to have children with very uncontrolled asthma (p=.015), and approached significance in being more likely to bring their child to the ED for asthma (p=.137). Controlling for all other variables in the final outcome models, parents who are single were 43.5% less likely to have children with more controlled asthma (OR=.565, 1-.565=.435, p=.024) and

79% more likely to bring their child to the ED (OR= 1.79, p=.017) (Table 26 and Table 29).

In a secondary study of 383 children with chronic illness, including 90 children with asthma, single mothers were described (Mullins et al., 2011). The sample of parents were primarily Caucasian, had moderate household income and were married (Mullins et al., 2011). Single mothers were more likely to be from a minority group and have lower income than married mothers (X^2 (1): 28.97, p< .001; X^2 (6): 146.32, p< .001, respectively) (Mullins et al., 2011). In this analysis, child race and parent income were significant with main outcomes independent of the parent's marital status. Child race remained significant in the ED model with single parents controlled for and income remained significant in the asthma control model with single parent status controlled for (Table 26 and Table 29).

Aim 2a Analyses and Interpretation of the Findings

Parents in the current study were primarily mothers (97.7%); the majority are single (70.1%), and from a minority racial or ethnic group (93.6%). Half have an annual household income of less than $25,000 per year (50.0%) and have 2 or more children living at home (80.9%). Almost two thirds of these women have moderate to high perceived stress in their lives (N=223, 63.5%), where these feelings of not having control over their circumstances are primarily explained by education and income (Table 30).

Parent and child characteristics in an inner city were explored to see if any explained parent stress in the parents of children with asthma population. Income and education were confirmed to be related to parent stress in this inner-city population, with

parent gender unable to be examined because of the low participation of fathers in the study. Bivariate analyses showed parent stress to be significantly associated with parent education and household income/employment, with neighborhood maintenance and asthma knowledge approaching significance. Controlling for all other parent child characteristics and child asthma severity, parent education and household income remained significant in hierarchical regression. Parents who graduated high school were 57.9% less likely to have moderate to high stress (1-0.421=.579, p=.042) (Table 30). Parents who had an adult living in their home with regular employment or income greater than $25,000 annually were 53.1% less likely to have moderate to high stress (1-0.469=.531, p=.042) (Table 30). A moderate income population had parent income significantly related to parent stress in their hierarchical regression (β= -.359, p< .01) (Carpentier 2008). Also, parent gender was significant in that study (β= -.290, p< .05) related to parent stress. This inner-city analysis had a low number of fathers participating (N=8) and all were in the moderate to high parent stress category, which omitted parent gender from the regression analysis. Education in a high-income inner-city population in India found graduate level education to be associated with lower parent stress (Rastogi et al., 2009). In this low-come inner-city population, education level at high school graduation level or above was associated with lower stress. It appears that varying levels of education affects parent stress differently depending on socioeconomic status.

Marital status was not associated in the inner-city population with parent stress as in a moderate-income population. In a moderate-income population of parents of children with chronic illness, marital status was significantly related to parent stress, and was

attenuated by parent income (Mullins 2011). In this analysis of an inner-city population, parent marital status was not significantly related to parent stress in the bivariate analysis (p=.167, Table 18) and its effect on parent stress was attenuated by other variables in the main model (p=.791, Table 30).

Child asthma severity was not significantly related to parent stress in bivariate or multivariate analyses. Asthma knowledge or asthma self-efficacy also was not significantly related to parent stress. This is consistent with what was noted in a middle-income group of parents of children with asthma; duration of illness was not significantly associated with parent stress in hierarchical regression (Carpentier et al., 2008). None of the child characteristics were significant in association with parent stress in bivariate or regression analyses, revealing that the child or their asthma condition do not appear to affect parent stress compared to other stressors.

Even though it was predicted that the urban environment would have unique stressors that would contribute to parent stress (Quinn et al., 2010b), none of the urban environment variables such as housing and neighborhood were significantly associated with parent stress in the bivariate and regression analyses. Living in an unmaintained neighborhood approached significance with parent stress in both bivariate (OR: 1.67, p=0.084, Table 18) and controlling for all other variables in the full regression model (1.554, p=.194, Table 30). Even though urban environment may affect parent stress, it did not affect their stress over and above the variables of income and education. However, these sources of stress are likely the same across populations.

Hierarchy of needs. Income, education and neighborhood effecting parent stress is logical and expected, irrespective of population. According to Maslow's hierarchy of needs in his Theory of Human Motivation (1943), personal and financial security dominate other needs that are not seen as equally important. If parents feel insecure financially, stress is most likely to come from these problems rather than others perceived as less threatening. Also, they may be more likely to focus their attention and efforts on these problems financial problems, rather than attempting to affect other problems not recognized as equally important. Parents likely recognize their need for financial resources to provide for themselves and their family, but may not recognize parent management behaviors such as keeping asthma management healthcare visits as equally important. However, if parents understand that management behaviors are "safety nets" (1943) against their child having worsened, uncontrolled asthma and possibly costing time and money going to the ED or missing school, then they are more likely to make these a priority and act on them.

Using this insight into what is associated with high stress in inner-city parents of children with asthma will enable future research and interventions to be tailored to those at risk for high stress (mothers with low education—less than high school diploma, low income--<$25,000 household annual income or not regularly employed household members, and living in a not well maintained neighborhood), to be able to reduce their stress and its effect on their child's outcome are implications of these findings.

Aim 2b Analyses and Interpretation of the Findings

There are few analyses comparing parent stress and main outcomes. Controlling for exogenous variables, parent depression was found to a have a direct effect on ED visits in an inner-city population (elementary schools from two urban areas) (Bartlett et al., 2004). In this analysis, parents who have moderate to high stress were found to have a 50% higher chance of taking their child to the ED than parents with low stress (p=0.069) (Table 23). Controlling for socio-demographics and parent management behaviors, parents with moderate to high stress were 64.5% more at risk to bring their child to the ED for asthma (OR= 1.645 p=.029). Parent stress remained significant when each parent management behavior and asthma control were introduced in the model. However, parent stress did not affect school absenteeism or asthma control in bivariate analysis or regression models.

Parent stress was not associated with missed school in the bivariate (p = 0.366) (Table 26) and multivariate model (OR= .032, p= 0.18) (Table all 4 models). Parent stress was not associated with asthma control in bivariate (p = 0.508) (Table 25) or multivariate model (OR= 0.168, p= 0.82) (Table all 4 models). Even though the relationship between parent stress and asthma symptoms in Milam (2008) was not found in this secondary analysis, other neighborhood and social variables did explain asthma control. Income, marital status, neighborhood, transportation, asthma severity and missed appointments were related to asthma control (Milam et al., 2008).

Controlling for exogenous and endogenous variables, parent stress remained significant in predicting ED visits even though asthma control was stepped into the model.

Parent stress effects parents' decisions on whether to go to the ED for their child's asthma, regardless of the child's level of asthma control as measured by the ATAQ. It is possible that the ATAQ does not capture children's severe symptoms that lead to going to the ED, but that it captures general symptoms in the last 2 weeks of interviewing the parents (while there are 3 months between follow-up contact with the parents). It is possible that children who go to the ED may have an asthma attack that necessitates going to the ED but is not readily apparent with the questionnaire. Controlling for age, child gender, race, parent history of asthma, community, language and wheeze at baseline, PSS scores in quartiles approached significance in predicting child wheeze (Milam et al., 2008). However, this analysis did not find this association between parent stress and asthma control.

Aim 2c Analyses and Interpretation of the Findings: Psychosocial Pathways

Determining the pathway between parent stress and child asthma outcomes has not been addressed in the literature sufficiently. Biological pathways from parent psychosocial distress to child psychosocial distress have been considered, but there has been a lack of association between parent psychosocial distress measures and child psychosocial distress measures (Szabó et al., 2010; Wolf et al., 2008). A study considered parent stress affecting the child's inflammation, leading to increased child reactivity to air pollution (Islam et al., 2011). However, the mechanism linking parent stress and the child's inflammation was not examined (Islam et al., 2011) (Islam 2011). Another psychosocial pathway is proposed, where parent management behaviors mediate parent stress and child asthma outcomes. Celano examined parent stress and parent management

behaviors, however this study did not examine child asthma outcome measures of ED visits, school absenteeism or asthma control (Celano et al., 2011).

There is a ***lack of literature*** examining the mechanism that links parent stress to child asthma outcomes. As Wolf and Buseke-Kirshbaum postulate, there may be a psychosocial pathway between parent stress and child asthma outcomes, with a need for longitudinal analysis to examine this link (Wolf et al., 2008). This analysis took the examination of parent perceived stress and child asthma outcomes further by examining the relationship of parent psychosocial and management behaviors with child asthma outcomes.

While parent stress was only significant with ED visits as a main outcome, the pathways of management behaviors affecting asthma control and school absenteeism without stress were also examined. Management behaviors that are influenced by parent stress on the main outcome of ED visits may also affect these other two outcomes and understanding that relationship may assist in discerning the value of influencing that management behavior, as it affects multiple outcomes.

Two main pathways. This analysis found two main pathways of parent stress and child asthma main outcomes. First, parent stress significantly affects parents missing appointments, which significantly affects all of the main child asthma outcomes, including ED visits, school absenteeism and asthma control. Secondly, parent stress affects passive smoke exposure, which trends in significance in affecting ED visits, as well as asthma control. Understanding these pathways and developing a strategy to intervene on multiple points is an important next step. Moderate to high parent stress

affected the two parent management behaviors of routine visits and passive smoke exposure.

First Pathway: Missed healthcare visits. Stress influences the parent management behavior of routine visits, with bivariate analysis showing parents with moderate to high stress were 6.9 times more likely to skip appointments than parents with low stress (OR=6.9, p=.003) and the multivariate analysis showing parents with moderate or high stress were 5.3 times more likely to skip an appointment (p=.042). Missing a child appointment was significantly associated with all of the main outcomes. Missing appointments was associated with being 55.5% less likely to have more controlled asthma (OR=.445, 1-.445=.555, p=.018), 4.4 times more likely of having another symptom day (OR=4.426, p=.018), twice as likely to go to the ED (OR=2.346, p=.017), and twice as likely to miss school (OR=2.168, p=.021).

As parent stress significantly affects ED visits in the ED model, the ED model parents missing their child's routine asthma appointments reduces the role of stress on ED visits by 5.7%, revealing that stress is a reason why parents miss routine appointments and influences whether the child goes to the ED for asthma.

Second Pathway: Passive smoke. Parent stress was significant in explaining passive smoke (OR= 1.65, p=.037). A qualitative study of inner-city parents of children with asthma noted that parent knowledge related to the harm of passive smoke exposure for their children with asthma was present, yet their stress—primarily stemming from financial situations, increased their tobacco use, as well as in the presence of their

children. In this analysis, parent stress was partially explained by parent income and education, which is consistent with these qualitative findings (Table 30).

Stress did not significantly influence parent management of the home environment in bivariate analysis or have influence on the main outcomes mediated by home environment in regression analysis (Table 21 and Table 26). The addition of home environment management of pests in the home, smokers in the home and passive smoke exposure changed the influence of stress on ED visits by only 3.4% (1-1.832/1.771=.034), indicating that these do not influence the relationship between parent stress and the probability of the child going to the ED (Table 26). Parent stress was significant in explaining passive smoke (OR= 1.65, p=.037) (Table all models), but not explaining smokers in the home or pests at home. Passive smoke approached significance in explaining ED visits (Table 26) when controlling for all other demographic and parent management variables, while smokers in the home and pests were significant in impacting ED visits (Table 26).

Alternate Pathways to ED visits

Third Pathway: Pests Pathway. As predicted, pests had a positive impact in the probability of a child going to the ED for asthma (OR= 1.57, p= .000) (Table 26). However, as mentioned, home environment did not mediate the effect of parent stress on ED visits (Table 26) and stress did not explain the risk of parents having pests in their home (Table 34).

Controlling for income, housing type and neighborhood, parents with lower education still had a higher risk of having pests in their home (Table 34). While education

itself may not directly influence action in this area, there may be an element of a sense of control or proactive action that is missing in this population in order to address this problem adequately. Parents with lower education were twice as likely to have higher stress (OR: 2.07,p=.017, Table 18), which could also mean possible lower empowerment to act or change circumstances. Empowering parents to ask for an AAP and to persist in extermination or prevention of pests in their home may assist in better outcomes for their children.

While air pollution's effect on lung function was mediated by parent stress in Islam's study (Islam et al., 2011), none of the environmental exposures at home was mediated by parent stress in all of the models. Other possible neighborhood environmental influences such as walking or taking the bus (OR= 1.560816 (p= .033) and neighborhood maintenance (OR= .58105825, p= .014) were both significantly related to asthma control, controlling for other demographics and parent management behaviors. Home environmental exposures were all significantly related to going to the ED, while pests was also significant in predicting asthma control (OR= 1.6030635, p=.004) (Table 26 and Table 29).

F**ourth Pathway: Asthma severity and medication administration (Lack of Controller Medication Therapy and Lack of Medication Adherence)**. Children that were included in the analysis had their asthma diagnosed by a healthcare provider in the past, not diagnosed at baseline. These healthcare providers in the past, before the child's recruitment to the study, must have assessed the child's asthma symptoms at that time and likely assigned an asthma severity rating of either intermittent or persistent, in order

to determine if the child needs long-term controller medication treatment. Children with intermittent asthma are not given long-acting medication, but their symptoms will be reassessed at their next medical visit to see if short-acting medication is sufficient in controlling the child's symptoms. However, children with persistent asthma are prescribed ICS treatment, according to national asthma treatment guidelines (NAEPP criteria), where symptoms consist of either twice or more days with asthma symptoms per week, waking up at night due to asthma twice a month or other frequent symptoms. For those children who were not prescribed ICS controller therapy, it is likely that the child's asthma was intermittent at the time and not severe enough to warrant initiation of medications.

It is likely that children in the study not prescribed ICS, and must have been thought to have intermittent asthma by their primary care providers, likely requiring ICS therapy due to the uncontrolled nature of their asthma at baseline and throughout the study (Table 19c and 19d). The children's healthcare providers may be unaware of the child's uncontrolled asthma due to the low frequency of obtaining information on the child's symptoms. Clinic visits are the only current mechanism in the healthcare system today that primary care providers are informed of the child's symptoms. However, parents reporting the child's symptoms by phone every three months revealed the extent of each child's uncontrolled asthma, and this information, if given to healthcare providers, would likely change their prescription of ICS and teaching of mediation administration for the children who do have ICS prescribed already.

Also, for children who were ***prescribed*** ICS medication, this medication was not administered regularly enough by parents whose children were prescribed ICS and had ICS in hand to have an effect on the child's symptoms **(Table 19b)**. An additional measure of asthma severity are parents who fill the ICS prescription, called ICS in hand, who likely believe that their child's asthma is severe enough to have this medication on hand. These children with more severe asthma whose parents have their ICS medication in hand were more likely to have very uncontrolled asthma than those who did not (Table 19e). All the children's asthma in the study was uncontrolled (N=142, 40.5%) or very uncontrolled (N=208, 59.3%) at some point in the study, except for one child, and points to insufficient asthma management, including management with medications (Table 16).

Asthma Severity and Medication Administration on the Main Outcomes

Whether the child was ever prescribed an ICS inhaler or the parent had the child's ICS inhaler in hand were proxies for the child's asthma severity. Children with higher asthma severity measured by parents having ICS on hand were 5.1 times more likely to bring their children to the ED (p = .000), are 2.3 times more likely to have their child miss school related to asthma (OR=2.28, p=.000) and 59.4% less likely to have better asthma control (OR= .4065, 1-.4065=.594, p=.000), controlling for all other variables.

However, regular medication administration by parents had an opposite effect on these outcomes. Parents who administer ICS medications some days or everyday were 40% less likely to go to the ED (OR=.6012, 1.0-.6012= 0.3988, p=.041) than parents who administer mediation irregularly or not at all, controlling for asthma severity. Regular ICS medication administration approached significance when stepped into the asthma

control model (OR=1.47, p=.119), but lost significance when other parent management behaviors were controlled for (Table 29). ICS medication administration was not related to school absenteeism.

Even though regular medication administration only approached significance in explaining asthma control, it was significant in explaining ED visits. A possible explanation is that ED visits is a more refined measure of very uncontrolled asthma or specifically asthma exacerbations necessitate action by the parent to seek immediate medical attention. Regular medication administration may prevent a child having an asthma exacerbation, but not necessarily very uncontrolled asthma symptoms.

Parent stress, medication adherence and ED visits. In bivariate analyses, parents with moderate to high stress were 58% more likely to have their children take ICS medications regularly (some days or everyday) (p=.058) (Table 20). Due to this positive relationship, the effect of taking ICS regularly does strengthen the relationship between stress and ED visits by 4.7% (1.77/1.689-1) in the multivariate model, with parents who do give their child asthma medication regularly experience more stress controlling asthma severity and other demographic variables. In another inner-city population study, the bivariate analysis showed parent stress was negatively associated with overall asthma management (r=-.41, p= .006), as well as three subscales, including medication adherence (r=-.39, p< .01), balanced integration and the child's response to symptoms (Celano et al., 2011). These findings could be different because in this secondary data analysis, the children who took ICS regularly were children with higher asthma severity. Asthma severity heavily influences medication adherence, with children

who have higher asthma severity being 34.8 times more likely to take ICS regularly (p=.000), controlling for other demographic variables and parent stress (Table of all SMB models). While taking ICS significantly reduced the chances of the child going to the ED for asthma (OR= .611, p= .049) controlling for all other variables (Table 20), parent stress did not influence whether or not the parent gives their child ICS regularly over asthma severity (Table 31). Asthma severity, not parent stress, had the greatest influence on medication adherence.

Parent Role in Medication Adherence

In this analysis, 33.9% (N=118) of parents ensured their child took medications some days or everyday. In multivariate analysis, asthma severity and having an AAP were associated with medication adherence controlling for demographics. Parents who had an AAP were 2.6 times more likely to have their child administer their medications regularly (OR= 2.56, p=.012). In a sample of 30 African American parents and children 6 to 14 years old with asthma, 93% were taking their inhalers on their own yet only 7% could use a metered dose inhaler correctly (Winkelstein et al., 2000).

Parents who do not supervise their children to administer their medication regularly or correctly may lack asthma knowledge or self-efficacy related to medication management. In this secondary analysis, parent asthma knowledge and self-efficacy were shown to be associated with medication adherence. Parents who had asthma knowledge were 15.2 times more likely to be adherent (OR=15.2, p=.004); parents who believe they do not need to continue to administer medications regularly are 96.8% less likely to be adherent (OR=.035, p=.004). Parent beliefs of medication effectiveness, also known as

self-efficacy, related to medication administration, were 3.4 times more likely to be adherent (OR=3.35, p=.025).

In a primarily Caucasian, moderate-income sample, children who have mothers with more depressive symptoms were observed to have problems taking medications (p=.009); they frequently forgot to take medications (p=.005) and forgot to take medications 2 or more days in the past 2 weeks (p=.014) (Mullins et al., 2011). However, parent stress of this inner-city population in this analysis approached significance in an unadjusted analysis (OR=1.58, p=.058, Table 20), yet became insignificant in explaining medication adherence when controlling for demographics, missed appointments and asthma knowledge questions (OR= 1.40, p=.360). As this model of medication administration controlled for many child and parent characteristics that are relevant to this management behaviors, the relationship between medication administration and parent stress was mediated by child and parent characteristics, revealing a more accurate finding. More analyses examining parent psychosocial variables with management behaviors need to control for relevant characteristics.

Overall, the literature suggests that parents of children with asthma appear to understand their role in medication administration. In a qualitative study of 18 parents of children and adolescents with asthma 2-18 years old, parents' beliefs, knowledge and attitudes towards anti-inflammatory medication use was explored. Peterson and colleagues found that parents, commonly mothers, direct the asthma management of their children, "including medication administration, healthcare provider visits, management and communication with school and daycare and other activities outside of the home"

(Peterson-Sweeney et al., 2003, p.50). A qualitative study using focus groups of 50 middle school children with asthma, with a mean age of 12.5 years (SD= 1.05), explored asthma management barriers and developmental issues. Ayala and colleagues found that adolescents were gaining more autonomy in asthma management from parents in the area of medication management, though parents continued to be involved in reminders to take medication and other aspects of medication management (Ayala et al., 2006).

Parents who are non-adherent in administering their child's asthma medications do not likely realize the importance of their role. A qualitative study examining the barriers to adherence to guideline-based care found that parents misjudge their child's ability to manage their asthma on their own. In a study of 20 parents of children 2-12 years old with asthma, in-depth interviews were performed after one year of electronically monitored adherence of their child's medication use (Klok et al., 2014). Reasons for non-adherence to medications measured objectively by electronic monitoring were reported as unawareness of non-adherence by parents and healthcare providers, a lack of parental drive to obtain high adherence and ineffective parent problem solving. Klok and colleagues found that parents placed excessive responsibility for medication adherence on children (Klok et al., 2014). Similarly, in a study of 30 African American caregivers and children 6 to 14 years old with asthma, only 7% had effective metered dose inhaler skills, yet 93% were taking their inhalers on their own (Winkelstein et al., 2000). Without parental supervision, these children had inadequate inhalation techniques (Winkelstein et al., 2000). Parents may be unaware of their child's medication adherence

and may be unaware of their child's poor inhalation techniques, pointing to the child's need for parent directed medication management.

Assisting Parents in Obtaining Asthma Control

Medication administration concerns can be addressed using previously trialed interventions (Garbutt et al., 2010; Nelson et al., 2011; Sockrider et al., 2006). These interventions, while not successful in changing ED visits, the asthma counselor techniques can continue to be used in conjunction with an intervention aimed at addressing the child's uncontrolled asthma with treatment monitoring by the PCP.

Tackling the excess burden of uncontrolled asthma could be related to feedback to the PCP related to the child's asthma symptoms via using an asthma control score. Providers may be unaware about how poorly controlled their patient's asthma is due to their infrequent visits and snapshots of their patient's lung function. Providers who believe the child has intermittent asthma are likely not aware that the child had an asthma control score at some point throughout the year, putting them at risk for going to the ED or missing school. Having a way of communicating the child's symptoms regularly to the PCP would enable the PCP to make recommendations for the child's care. Parents could assess their child's asthma symptoms at home and report these (either by calling on the phone, texting, using an app and/or going online) without needing to come to a routine visit every time, relay information to the clinic regularly, and have suggestions come back about medication changes.

Also, involving parents in medication management during clinic visits may increase parent medication administration. An experimental study was conducted in an

emergency department with a convenience sample of 86 inner-city children ages 1 to 5 years, with their parents included in hands-on treatment of their children's asthma exacerbation in the ED setting (Hussain-Rizvi, Kunkov, & Crain, 2009). Parents were 7.5 times more likely to be using the same treatment device (metered dose inhaler with spacer) two weeks later than parents who were not included in the treatment (Hussain-Rizvi et al., 2009). This in-person medication administration intervention involving parents in the medication domain of management at the clinic may potentially increase medication administration adherence at home.

Parent and Child Characteristics on Parent Management Behaviors

Aim 3 Analyses and Interpretation of the Findings

Asthma care plan. The secondary analysis revealed that 68.4% of children had an AAP (N=349). A study on a similar population by Flores and colleagues was 44% of children had an AAP (N=220). Nationally, the average rate for receiving an AAP is 45.4% for children with active asthma (Control, 2012) (http://www.cdc.gov/asthma/acbs/table6.htm). While the rate of AAPs is higher in this secondary analysis than the national average, this sample also has a high rate of uncontrolled asthma. . Ideally, all of these children would have an AAP in order to make the treatment plan clear to parents of children with asthma and for parents to recognize symptoms and use it when their child is having asthma symptoms (Butz et al., 2004). In a qualitative study of 40 inner-city, minority families who have a child with asthma, healthcare provider education was reported to focus on medications and not about

symptom prevention or self-management (Yoos et al., 1997). In this study, only 8% of participants had written materials given to them related to their treatment.

In the secondary analysis, parents reporting they have an AAP for their child was explained by asthma severity and parent education, where children with higher asthma severity were 2.7 times more likely to have an AAP (OR=2.70, p=.005) and parents who have more than a high school education being 2.7 times more likely to have an AAP (OR=2.70, p=.004) (Table 33). Flores and colleagues found in their multivariate analysis revealed that boys were more likely than girls to have an AAP (OR=1.9, 95% CI=1.1, 3.5) and having an asthma specialist (OR=5.0, 95% CI=2.2, 11.3) controlling for race, poverty, parent education, and asthma severity. They did not report on parent education or asthma severity as being significant. The sample was primarily African American families (81%) with some Latino families (19%), had lower income families (67% below federal poverty threshold), and had a lower amount of children with AAPs (44%), which could explain the different associations found. This secondary analysis also adjusted for additional sociodemographic and home environment variables, such as housing type, marital status, number of people in the home, insurance type, transportation, neighborhood, parent stress, asthma severity and missed appointments in the AAP model.

Routine visits. This secondary analysis found that parents of children with asthma missed their child's routine visit were 5.9 times more likely to have 5 or more people in their home (OR=5.89, p=.003), were 6.75 times more likely to live in a less maintained neighborhood (OR=6.75, p=.001) and 5.3 times more likely to have moderate to high parent stress (OR=5.34, p=.042). Having multiple family members or children

with competing needs, as well as having high stress, reduces a parent's ability to bring their child to routine appointments. Living in a less well maintained neighborhood may indicate lower accessibility to a local clinic for appointments. In another inner-city sample, Celano and colleagues also found that the number of household members was negatively associated with asthma management (r=-.42, p=.005), while child age or gender and parent age, education or marital status were not (Celano et al., 2011).

Tobacco use (passive smoke exposure and smokers in the home). A third of parents reported their child had passive smoke exposure daily to several times a month (N=123, 35.0%) and a third reported one or more smokers in their home (N=116, 33.0%) (Table 17). Parents with moderate to high stress were 60% more likely to expose their child to passive smoke (OR=1.65, p=.037) than parents with low stress, controlling for other demographics including income (Table 34). This supports the qualitative study by Halterman (2007) where stress was a trigger for continued tobacco use by parents of children with asthma in an inner-city setting (Halterman et al., 2007). Specifically, financial stress was a trigger for continued tobacco use.

While stress was not significant for explaining smokers in home, health insurance and parent marital status were significant. Children on Medicaid health insurance were 2.6 times more likely to have smokers in the home (OR=2.6, p=.005). While health insurance is informative as to the coverage of medical expenses, it is also a proxy for socioeconomic status with eligibility for coverage in low income populations. Halterman postulated that it was financial stress that caused smoking in the home (Halterman et al., 2007), and since this analysis only has information about stress from one parent, it is

possible that another parent or family member has stress related to low SES, as measured by Medicaid coverage, and increases the number of people who smoke in the home. Also, single parents were 2.1 times more likely to have their child exposed to more smokers at home (OR=2.08, p=.023) than married parents, controlling for all other demographics. Single parents may have more stressors or other social reasons for smoking or having smokers in their homes than parents who are married, giving their child higher risk for passive smoke exposure.

There also may be underreporting of passive smoke exposure. In a national sample of inner-city children with asthma, parents report 39% were exposed to smoke, with 48% of children having high urinary cotinine detected, indicating all of these children were exposed to high smoke at home (Kattan et al., 1997). This secondary data analysis did not have an objective measure of tobacco exposure, which is a limitation. Even with conservative samples, the results models are insightful related to the associations observed with tobacco exposure.

Pests. 67.2% (N=236) of parents reported at least 1 type of pest in their home. Parent education, number of people in the home and neighborhood were significantly related to pest exposure. Parents who lived in a less maintained neighborhood were 80% (OR=1.79, p=.002) more likely to have pests in the home. Homes with 5 or more people were 2 times (OR= 2.00, p=.000) more likely to have pests, likely due to less time or ability to enact on preventive measures to keep a household free of pests. Parents with higher education were 39.1% less likely to have pests in the home than those who had lower education (OR=.609, p=.044).

While pest elimination is the responsibility of parents, extermination can be difficult to keep allergen levels low. Gergen and colleagues showed in an inner-city extermination intervention (NCICAS), extermination only had a short period of effectiveness and allergen levels remained high enough to cause asthma symptoms in children with asthma (Gergen et al., 1999). There was poor compliance by families regarding cleaning instructions. Gergen postulated that without high family or community support in these changes, there is a low likelihood for change, as well as higher motivation likely needed to be fostered for these changes (Gergen et al., 1999). Gergen found that treatment in all rooms would be needed and may need to happen over time to decrease the allergen levels in the homes (Gergen et al., 1999). Also, prevention of reinfestation techniques is recommended, especially in apartments or multiple unit buildings.

Conclusions

The majority of parents of children with asthma (63.5%) in the inner city had moderate to high stress, which is higher than moderate-income populations. Income and education were directly related to parent stress in this inner-city population, while asthma severity was not associated. Parent stress in higher socioeconomic status populations in other studies was also explained by income and education. This analysis also found that asthma severity was not significant in explaining parent stress, suggesting that there is low or no impact of the child's disease on a parent stress in an inner-city environment. Also, living in an unmaintained neighborhood approached significance in explaining

stress, yet did not show significance over and above a parent's socioeconomic status and education level.

Controlling for demographics, parent stress had a direct effect on child ED visits for asthma, including and not including endogenous variables in the model. Controlling for all characteristics and mediating variables, children who are racial or ethnic minorities, parents who drove a car and single parents were more likely to bring their child to the ED for asthma. Similarly, children who had parents with higher income, were married and who took public transportation were more likely to have better controlled asthma. Also, child asthma severity, child asthma control, smokers in the home, pests in the home, and missed appointments were significant in affecting the probability of children going to the ED in the final model, controlling for parent, child, and inner-city characteristics and season. Regular medication administration's effect on ED visits was mediated by the parent having an asthma action plan.

Other studies have not examined the pathways of parent stress affecting child asthma outcomes through parent management behaviors guided by the national child asthma management guidelines (Program, 2007). Missed appointments and passive smoke exposure are two prominent pathways that mediated parent stress and child asthma outcomes. Moderate to high stress in parents lead to parents being more likely to miss appointments, which was significantly associated with a child going to the ED for asthma, missing school for asthma and having very uncontrolled asthma. Moderate to high stress was the only characteristic that was associated with passive smoke exposure in children and trended on significance in explaining the probability of a child going to the ED for

asthma. Other pathways that lead to poor asthma outcomes for children include pests in the home and irregular medication administration were examined. Exploring the implications of these findings on practice, future research and policy is an essential step in reducing costly healthcare services for children with asthma and improving asthma control.

IMPLICATIONS FOR PRACTICE, FUTURE RESEARCH AND POLICY

Implications for Practice

Streamlining the process for rescheduling appointments over the phone may reduce mothers missing appointments that are critical to prevent child ED visits. Ease of transfer for rescheduling, electronic programs for after hours scheduling, as well as online scheduling may assist these groups. Staff that has flexibility built into schedule for ability to reschedule the same day or in the near future, including an asthma specialist at the clinic may also be helpful. Parents who take public transportation and have a more difficult time coming to the clinic may need this assistance Incorporating the parent management behaviors from the national guidelines into clinician education would assist in parent's awareness of the impact these behaviors have on their child's outcomes or time spent in the ED. Clinicians need to discuss the home environment exposures that exacerbate asthma at the visit. Parents need information on how to look for pests and exterminate adequately. Tailoring this information to parents who are more at risk for bringing their child to the ED, such as single, minority status mothers, has potential to enhance treatment compliance in diverse, vulnerable families.

Parents can also be screened for tobacco use during a child's clinic visit. Parents can also be screened for stress using the four-item Perceived Stress Scale. Discussing parent's concerns and offering resources that may assist in empowering parents to overcome stress. As a qualitative study of this population revealed, parent behaviors such as tobacco use often comes from financial stress. Parents can be offered stress

management assistance program online and other assistance related to the stressors parents identify.

Implications for Future Research

Almost two decades ago, a national study for inner-city children with asthma concluded that more small, in-depth studies needed to be performed to examine the link between parent asthma management and their psychological difficulties. While this analysis (SICAS) has assisted in fulfilling this call, more qualitative and quantitative research is needed.

Empowering mothers, especially those at risk for having higher stress (low education, low income, and living in a not well maintained neighborhood), and enabling them to overcome their stress and manage their child's asthma by keeping preventative routine healthcare appointments and limiting their child's passive smoke exposure in their control is likely to result in improved child asthma outcomes.

Qualitative Research

Understanding the barriers to parents missing appointments, which leads to more adverse outcomes in asthma control, costly healthcare use and missed school, is necessary. Parent stress, having a large family, and living in an unmaintained neighborhood were significant in affecting parents to miss appointments. Asthma knowledge approached significance in association in the full model of missed appointments as well. Exploring how this effect missed appointments in a qualitative study would assist in refining an intervention to address parent stress and missed appointments.

Flores and colleagues found that African American parents were more likely to use the ED use as usual source of asthma care than Latino parents (OR=3.6, 95% CI=1.7, 7.8), adjusted for child gender, asthma specialist, poverty, caregiver's educational attainment, and asthma severity (Flores et al., 2009). A qualitative study of urban parents of children with asthma revealed barriers to quality asthma care, one of which is a preference of ED care because of the perceived higher quality of care given (Mansour, Lanphear, & DeWitt, 2000). Nelson and colleagues hypothesized that a lack of alternative sources of effective acute management guidance may result in an overreliance in the ED (Nelson et al., 2009). Parents of children with asthma believed that a "lack of continuity" among healthcare providers is a barrier to asthma management. Parents who use urgent care to take care of their child's asthma problems are more likely to have a lack of continuity (Buford, 2004, p.159) and this was affirmed in parent's comments about urgent care giving a quick treatment, with primary care investigating the treatment plan (Buford, 2004). Further qualitative work exploring this barrier to keeping asthma appointments is needed.

Quantitative Research

The interventional studies completed to date with parents of children with asthma were effective in addressing asthma control, but not ED visits. Parents have not been commonly included in the asthma management interventions tested in schools. Coffman and colleagues performed a review of literature on school-based asthma education programs (Coffman, Cabana, & Yelin, 2009). They found that parents were included in an intervention in 62% (15/24) of school-based asthma education programs, but had a

limited role in and were generally excluded from any education or management instruction (Coffman et al., 2009). Several types of home interventions focused on parents of children with asthma.

Lay coaching and telephone coaching interventions of parents of children with asthma are effective in changing some parent management behaviors, but not child main outcomes of ED visits or missed school (Garbutt et al., 2010; Nelson et al., 2009; Nelson et al., 2011; Sockrider et al., 2006). In an educational self-management intervention performed once in the ED, a tailored AAP and education summary related to medication administration was performed, which assisted in increasing routine visits but not reducing ED visits (Sockrider et al., 2006). In an 18 month lay coaching intervention, asthma management at home was taught, as well as a collaborative relationship with a healthcare provider was developed, which assisted in increasing routine visits, but not ED visits (Nelson et al., 2011). A one year telephone coaching intervention that included all parent management behavior intervention categories except did home environment management such as tobacco use and pests in the home, did not effect ED visits (Garbutt et al., 2010). However, this intervention did affect asthma control in children with very poorly controlled asthma. ***Gaps*** noted in these interventions include: 1. None addressed parent psychosocial factors in their intervention. This secondary analysis reveals that parent stress directly affects ED visits, as well as routine visits. An intervention for parents of children with asthma to address their stress is necessary. 2. Not all of the management behaviors were included in these interventions.

One intervention conducted by a highly motivated group did include all of the parent management behaviors recommended by the national guidelines. The Allergy & Asthma Network Mothers of Asthmatics (AANMA) launched its Great American Asthma Challenge (GAAC): Real Strategies for Living and Breathing the NIH Guidelines program in urban neighborhoods in Baltimore, MD, Chicago, IL, and Richmond, VA (NHLBI, 2010). This intervention educated patients and families related to parent management behaviors of controller medication use, AAPs, assessing severity in clinic, monitory asthma control, schedule routine visits regularly, and control environmental exposures. These reflect that national guidelines for asthma management.

However, there is no mention of measuring outcomes. Also, tailoring the intervention to those at highest risk for negative outcomes or addressing parent stress or self-efficacy is not currently addressed. Potentially modifying this intervention based on the results of this study and measuring outcomes are feasible next steps.

Parent Stress Intervention. A parent stress intervention for parents of children with asthma has not been previously tested. Measuring parent stress using the four-item Perceived Stress Scale in the community or clinic setting is likely feasible. Supporting their effort to make appointments with primary care or with the asthma specialist should be key. Schools naturally intake students with asthma, asking for ICS medications and an AAP for the child. While there is reported low adherence on these actions by parents, additionally capturing their stress level and tracking the child related to their appointments would enhance identification of children at risk for going to the ED and missing school by not keeping appointments.

The majority of interventional studies that include parents of children with asthma are recruited from the clinical or ED setting. However, school interventions, such as SICAS, are important in elucidating the relationship of all of the exposures in both settings that affect the child's asthma outcomes. Healthcare personnel, such as a clinical nurse specialist, would "intake" children with asthma in the schools at the beginning of the year by contacting parents over the phone and capturing key information that lead to ED visits. Parents who have pests in their home, and who do not have in house support in caring for their child all are at risk to bring their child to the ED. Parents who use public transportation have a barrier going to the ED. After an assessment of these factors is done, discussing strategies to overcome these barriers to good asthma care can be conducted using point-of-care resources. Making these resources available to parents by their child bringing them home, being available in the school and in the clinic is important, as well as healthcare professionals discussing them. Motivational interviewing of parents with stress may be a strategy to assist in finding solutions to working with the stress in a parent's life to increase the management behaviors for asthma to be controlled.

Also, parent stress needs to be addressed before first before passive smoke exposure can be impacted. Parents in this study with smokers in the home were twice as likely to be ***single*** (OR= 2.096, p=.021), controlling for number of people in the home and other parent characteristics. Single parents were more likely to have a smoker in the home, so targeting a tobacco cessation intervention to this demographic, which is the majority of the sample, would assist in tailoring the intervention.

Cost Savings

A prospective cost-effectiveness study designed based on the NCICAS study, revealed that the intervention was more expensive than usual care by $245 per child in the first year and had a cost of $9.20 per symptom day by the second year, but was cost saving for children with severe asthma in the second year (Sullivan et al., 2002).

Implications for Policy

Policy implications: The only standardized parent education for asthma in clinical practices this far is the asthma action plan. However, this is currently not well disseminated or utilized for communicating messages to parents for adequate asthma management. There are no asthma management guidelines that mirror the current national guidelines that parents are made aware of.

Stakeholders who are necessary to support school-aged children with asthma in the inner city include the parents of the child with asthma, healthcare provider, school nurse, public health organizations and public health departments. Public health organizations and public health departments have an interest in seeing asthma rates improve and their operations or evaluations of asthmatics' health management are being affected.

Stakeholder	How Affected	Related Organizations	Capacity to Address Problem	Motivation to Solve Problem
Child's parent(s)	Current liaison between PCP and school nurse, also use the plan to treat	Asthma & Allergy Network Mothers of Asthmatics	Low to moderate: one strong group (AANMA), but are not very	Low to moderate: depending on their child's severity.

	the child at home. Care deeply about child's health	(AANMA): the leading national nonprofit organization to reduce asthma prevalence and severity	organized at a state or local level	
Primary Care Providers	To fill out AAP and give instruction to family	Health care organizations (ie. Children's Hospital Boston) and health care plans for reimbursement (ie. Neighborhood Health Plan)	High: strong lobbying support	Low: no incentives or penalties for completing or not completing AAP, but do care about pediatric health
School Nurses	To receive the AAP and reinforce explanation to child and family regularly, to use the plan to treat child while at school	National Association of School Nurses, Massachusetts School Nurse Organization	Moderate: fairly organized as a group, but do not have high numbers.	High: strongly affects the care they give and the safety of the children in their school whether or not they have an AAP
School Administration	Support the school nurse with appropriate tools, space and coordination to receive AAPs	National Association of State Boards of Education, Massachusetts Teachers Association	Moderate to High: organized and strong voice	Low: likely not aware of problem with the lack of AAPs, does not directly affect their role
Public Health Organizations	Support the health of the population they are interested in and want to see asthma prevalence decrease	American Lung Association New England, Boston Asthma Initiative	Moderate: known to be focused on issue	High: want to show improvement in outcomes for people with asthma due to their work

Public Health Departments	Support the health of the population they are interested in and want to see asthma prevalence decrease	Massachusetts Department of Public Health/School Health Services	High: directly report to government, highly respected	Moderate: many different initiatives they are working on

Figure 12.Childhood Asthma Stakeholder Matrix

There are many different organizations in Massachusetts that have a focus on asthma care. A stakeholder matrix was developed to understand their interest in asthma and policy involvement to increase asthma management in the home (Figure 3). If the organization had a program related to asthma, they were rated with a "high" asthma focus. Organizations also partner together, such as the American Lung Association and the Environmental Protection Agency to raise awareness on asthma causes (Environmental Protection Agency, 2012). Also, the Mass Asthma Action Partnership collaborates with many of the organizations in the stakeholder matrix to form the Strategic Plan for Asthma in Massachusetts (Mass Asthma Action Partnership, 2012). This strategic plan includes working with homes, schools and other settings to improve asthma management for residents in Massachusetts.

Stakeholder	**Asthma goals**	**Asthma focus**	**Policy focus**
New England: Regional			
American Lung Association New England	Asthma services in NE, Asthma Friendly Schools Initiative	High	Moderate-High
Environmental Protection Agency, New England Region	Knowledge and awareness for QOL for people with asthma Healthy Communities Grants to test interventions related to home exposures	Moderate	Moderate-High

Allergy and Asthma Foundation of America New England Chapter	Education, advocacy, speakers, media support for asthma awareness	High	Low-Moderate
Massachusetts: State-wide			
Tobacco Free Massachusetts Coalition	Policy for tobacco free environments	Low	High
Neighborhood Health Plan	Education and tools for clinicians and patients for asthma management	Low	Low
Massachusetts Department of Public Health/School Health Services	School health manual, school nurse role in asthma care	Moderate	High
Massachusetts Department of Public Health/Bureau of Environmental Health	Asthma tracking and surveillance in schools-Pediatric Asthma Tracking Program, funded by CDC	Moderate	Low
American Lung Association Massachusetts	Asthma services in MA	High	Moderate
Massachusetts Teachers Association	Union, advocacy	Low	High
Massachusetts Coalition for Occupational Safety and Health	Training and building alliances	Low-Moderate	High
MASSPIRG	Advocacy, organization, litigation	Very Low	High
Boston; City-wide			
Boston Public Health Commission	Asthma Prevention and Control, Healthy Homes Program and statistics for asthma in Boston	High	Moderate
Harvard Pilgrim Healthcare	Asthma Disease Management Program, asthma nurse educators available	High	Low
Children's Hospital Boston	Community Asthma Initiative	High	Low
Boston Asthma Initiative	Home visits, school-based interventions, community-based forums, and strong ties with local health centers	High	Low
Multilateral			
Health Resources in Action	Mass Asthma Action	High	High

	Partnership: state-wide partnership between orgs		
National Association of State Boards of Education	Green Cleaning for Schools	Low	Moderate

Figure 13. Public Health Organizations, Public Health Departments and Professional Organizations Stakeholder Matrix

Preventive Services to Children, Parents and Homes.

The Center for Medicaid and Medicare Services (CMS) updated a regulation (42 CFR section 440.130) for preventive services provided by community health workers or asthma educators who are referred by a physician or licensed practitioner for beneficiaries to be reimbursed (Pearson, Goates, Harrykissoon, & Miller, 2014). The Boston Asthma Home Visit Collaborative offers free home visiting services to Boston residents. The collaborators include the Boston Public Health Commission, the Neighborhood Health Plan, Boston Children's Hospital, Brigham and Women's Hospital, and Tufts Medical Center. These home visits are related to asthma management counseling and home environment assessment.

Gergen and colleagues have noted that extermination in all rooms and over time is necessary to reduce allergen levels for a clinical impact of reduced symptoms to be noticed (Gergen et al., 1999). The extent of the home services and asthma counseling provided in the programs discussed remains to be clarified Measurement of the family's compliance to recommendations and effectiveness needs to be measured. Making a concerted effort for families who have 5 or more members on environmental recommendations in order to prevent pests is needed. Resources to help parents with the stressors that affect their perceived stress are often not addressed by stakeholders or in home visits. Also, tobacco cessation services may be recommended, but effectiveness of

these recommendations on outcomes of tobacco cessation and child asthma symptoms is unknown. Parent stress or financial stress are not currently targeted in these interventions and appear to be a gap in the interventions, affecting their impact. It is unknown if the visits assist parents in scheduling or keeping routine appointments or administering their child's medications regularly. Testing technology interventions, such a mobile phone interventions, related to messaging for medication adherence in this population is needed.

Parent and Healthcare Provider Communication. Stakeholder organizations are beginning to understand the need for communication between primary care providers in hospitals and health clinics with school nurses. Having routine appointments and an up- to- date AAP for each child with asthma have potential to are prevent the child going to the ED, reducing costs related to asthma. This communication process is complex, as there are multiple steps of communication between these systems to have a form completed and returned to the nurse. A more accessible electronic medical record for parents, school nurses and clinics to access for the most up -to -date AAP and technology to enhance appointment reminders and ease of rescheduling to parent's phones needs to be implemented and examined for effectiveness in improving child asthma outcomes.

Limitations

Strengths and Weaknesses. The results of this study may be generalized to children with asthma in the inner city and their parents. However, parents likely have increased access to health care due to the high number of hospitals and clinics located in Boston, compared to other inner-city populations. As this may lend to reduced variability in measures of children prescribed medications, appointments and ED use, this increased

access to care does not detract from the results found in this study. Also, most children had Medicaid insurance. As Massachusetts has a low rate of uninsured residents and Medicaid covering asthma medications at no cost to the family (check), there may not be the same barriers as other states without public insurance or a high uninsured population.

SICAS was recruited at a community level; in the schools, which addresses NCICAS's concern of recruiting children with a higher morbidity than the inner-city population (Kattan et al., 1997). Social desirability may be a problem of the self-report data obtained from parents in this study. Parent reported symptoms are also less likely to be reported than the child's actual asthma symptoms. Kieckhefer and colleagues reported significant differences between child and parent symptoms and nighttime awakening reporting, often with parents underreporting symptoms (Kieckhefer & Trahms, 2000). Therefore, children's asthma control, which uses parent reported asthma symptoms in its calculation, may be over-reported.

The order of administration of the SICAS and instruments was in the reverse order of the conceptual model, asking about symptoms related to asthma control, then parent management questions and lastly parent perceived stress. This order limits respondent bias of parents constructing their own impressions of the relationship between these items.

Coverage Error. Children who may be under-covered in this study include those who do not attend public school in Boston. **Sampling Error.** Certain classrooms were selected for this study based on the rate of returned initial parent surveys. Since this rate is random by classroom, there is likely no error.

Feedback effect. When measuring the effect of parent management behaviors on asthma control or ED visits, being absolutely certain that asthma control or ED is a function of management behaviors alone and not the outcomes on management behaviors is important. Similarly, ED visits should be measured as a function of parent stress and not include the potential feedback of an ED visit on parent stress. An estimated lag model was tested in the sensitivity analysis to explore a possible feedback effect of the child's outcome on parent management behaviors. However, since parent management behaviors other than pests in the home and passive smoke exposure were not measured in all time-points, the feedback effect was not able to be tested for all desired variables in the model. The full lagged model of the main outcome ED visits with pests in the home, passive smoke exposure and asthma control only lagged variables was not statistically different than the reported full model. Ideally, if parent management behaviors were measured in all time points, then a sequential equation model would be ideal to test the potential feedback effect.

Conclusion

Marital status, income, child race and transportation were directly related to the child's asthma outcomes. The majority of parents of children with asthma (63.5%) in the inner city had moderate to high stress. Income and education were directly related to parent stress in this inner-city population, while asthma severity was not associated. Controlling for demographics, parent stress has a direct effect on child ED visits for asthma, including and not including endogenous variables in the model. Also, Child asthma severity, child asthma control, smokers in the home, pests in the home, and

missed appointments were significant in the final ED model, controlling for parent, child, and inner-city characteristics and season. Missed appointments and passive smoke exposure are two prominent pathways that mediated parent stress and child asthma outcomes. Other pathways that lead to poor asthma outcomes for children include pests in the home and irregular medication administration were examined.

Parent stress had both direct and indirect pathways in affecting the main outcome of children going to the ED for asthma. Parent management behaviors of routine healthcare appointments and having pests in the home also had a significant impact on this outcome, controlling for demographics and inner-city characteristics. Implications for practice include streamlining rescheduling appointments with flexible staff to accommodate barriers to routine appointments. Also, teaching parents the essential behaviors needed to prevent undesirable child asthma outcomes, as well as screening for tobacco use. Future research should focus on exploring the barriers parents have to performing essential asthma management tasks that lead to better child outcomes quantitatively and qualitatively, as well as testing a parent stress intervention tailored for inner-city parents of children with asthma. Lastly, policy implications include partnering with current efforts of stakeholders who are funding home visits for assistance in controlling the home environment to positively impact the child's asthma outcomes.

Funding

Financial support was provided by the Jonas Center for Nursing and Veterans Healthcare for this analysis. The School Inner-City Asthma Study was supported by NIH grants R01 AI 073964, R01AI 073964-02S1, K24 AI 106822 and U10HL098102 (PI: Phipatanakul). This work was conducted with the support from Harvard Catalyst/The Harvard Clinical and Translational Science Center (NIH Award # UL1 TR001102 and financial contributions from Harvard University and its affiliated academic healthcare centers. The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard Catalyst, Harvard University and its affiliated academic healthcare centers, the National Center for Research Resources, or the National Institutes of Health.

This work was conducted with support from Harvard Catalyst, The Harvard Clinical and Translational Science Center (National Center for Research Resources and the National Center for Advancing Translational Sciences, National Institutes of Health Award 1UL1TR001102-01 and financial contributions from Harvard University and its affiliated academic health care centers). The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard Catalyst, Harvard University and its affiliated academic health care centers, or the National Institutes of Health

This study was supported by grants R01AI073964, R01AI073964-02S1, K24AI106822, K23AI106945, K23ES023700, K23AI104780, U10HL098102, U01AI110397 from the National Institutes of Health. This work was conducted with the

support from Harvard Catalyst/The Harvard Clinical and Translational Science Center (NIH Award # 8UL1TR000170) and financial contributions from Harvard University and its affiliated academic healthcare centers. The content is solely the responsibility of the authors and does not necessarily represent the official views of Harvard Catalyst, Harvard University and its affiliated academic healthcare centers, the National Center for Research Resources, or the National Institutes of Health CTSU PI (Nagler).

REFERENCES

Akinbami, L. (2006). The state of childhood asthma, United States, 1980-2005. *Advance Data*, (381), 1–24. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17180851

Akinbami, L. J. (2011). Asthma Prevalence , Health Care Use , and Mortality : United States , 2005 – 2009, (32).

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 http://www.ncbi.nlm.nih.gov/pubmed/21355352

Altamimi, S., Robertson, G., Jastaniah, W., Davey, A., Dehghani, N., Chen, R., … Colbourne, M. (2006). Single-dose oral dexamethasone in the emergency management of children with exacerbations of mild to moderate asthma. *Pediatric Emergency Care*, *22*(12), 786–93. doi:10.1097/01.pec.0000248683.09895.08

American Lung Association. (2012). *Asthma & Children Fact Sheet*. Retrieved from http://www.lung.org/lung-disease/asthma/resources/facts-and-figures/asthma-children-fact-sheet.html

Ayala, G. X., Miller, D., Zagami, E., Riddle, C., Willis, S., & King, D. (2006). Asthma in middle schools: what students have to say about their asthma. *The Journal of School Health*, *76*(6), 208–14. doi:10.1111/j.1746-1561.2006.00098.x

Backer, V., Nepper-Christensen, S., & Nolte, H. (2006). Quality of care in patients with asthma and rhinitis treated by respiratory specialists and primary care physicians: a 3-year randomized and prospective follow-up study. *Annals of Allergy, Asthma & Immunology : Official Publication of the American College of Allergy, Asthma, & Immunology*, *97*(4), 490–6. doi:10.1016/S1081-1206(10)60940-4

Bandura A. (1997). Self-efficacy: The exercise of control. New York: WH Freeman

Bartlett, S. J., Krishnan, J. A., Riekert, K. A., Butz, A. M., Malveaux, F. J., & Rand, C. S. (2004). Maternal depressive symptoms and adherence to therapy in inner-city children with asthma. *Pediatrics*, *113*(2), 229–37. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/14754931

Brook, U., Mendelberg, A., & Heim, M. (1993). Increasing parental knowledge of asthma decreases the hospitalization of the child: a pilot study. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *30*(1), 45–9. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8428857

Brown, N., Gallagher, R., Fowler, C., & Wales, S. (2010). The role of parents in managing asthma in middle childhood: An important consideration in chronic care. *Collegian*, *17*(2), 71–76. doi:10.1016/j.colegn.2010.04.006

Brown, J. V, Avery, E., Mobley, C., Boccuti, L., & Golbach, T. (1996). Asthma management by preschool children and their families: a developmental framework. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *33*(5), 299–311. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8827937

Buford, T. A. (2004). Transfer of asthma management responsibility from parents to their school-age children. *Journal of Pediatric Nursing*, *19*(1), 3–12. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/14963865

Burns, C., Gray, M., & Henry, R. (2008). The development , dissemination and evaluation of written information as a component of asthma management for parents of children with asthma, 9–13.

Buske-Kirschbaum, A. (2008). Treating the parents to heal the child? *Brain Behav Immun, 22*(4), 431-432.

Busse, W. W., Morgan, W. J., Gergen, P. J., Mitchell, H. E., Gern, J. E., Liu, A. H., . . . Sorkness, C. A. (2011). Randomized trial of omalizumab (anti-IgE) for asthma in inner-city children. *N Engl J Med, 364*(11), 1005-1015.

Butz, A., Huss, K., Mudd, K., Donithan, M., Rand, C., & Bollinger, M. (2004). Asthma Management Practices at Home in Young Inner‐City Children. *Journal of Asthma*, *41*(4), 433–444. doi:10.1081/JAS-120033985

Butz, A. M., Huss, K., Mudd, K., Donithan, M., Rand, C., & Bollinger, M. E. (2004). Asthma management practices at home in young inner-city children. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *41*(4), 433–44. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15281329

Cabana, M. D., Slish, K. K., Lewis, T. C., Brown, R. W., Nan, B., Lin, X., & Clark, N. M. (2004). Parental management of asthma triggers within a child's environment. *The Journal of Allergy and Clinical Immunology*, *114*(2), 352–7. doi:10.1016/j.jaci.2004.04.047

Carpentier, M. Y., Mullins, L. L., Wolfe-Christensen, C., & Chaney, J. M. (2008). The relationship of parent self-focused negative attributions to ratings of parental overprotection, perceived child vulnerability, and parenting stress. *Families, Systems, & Health, 26*(2), 147-163.

Celano, M., Klinnert, M., Holsey, C., & McQuaid, E. (2011). Validity of the family asthma management system scale with an urban african-american sample. *Journal of Pediatric Psychology (J PEDIATR PSYCHOL).*

Chiang, L.-C., Huang, J.-L., & Lu, C.-M. (2003). Educational diagnosis of self-management behaviors of parents with asthmatic children by triangulation based on PRECEDE-PROCEED model in Taiwan. *Patient Education and Counseling*, *49*(1), 19–25.

Chiang, L.-C., Huang, J.-L., Yeh, K.-W., & Lu, C.-M. (2004). Effects of a self-management asthma educational program in Taiwan based on PRECEDE-PROCEED model for parents with asthmatic children. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *41*(2), 205–15. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15115173

Christian, B. J., D'Auria, J. P., & Fox, L. C. (n.d.). Gaining freedom: self-responsibility in adolescents with diabetes. *Pediatric Nursing*, *25*(3), 255–60, 266. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12024340

Coffman, J. M., Cabana, M. D., & Yelin, E. H. (2009). Do school-based asthma education programs improve self-management and health outcomes? *Pediatrics*, *124*(2), 729–42. doi:10.1542/peds.2008-2085

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, *24*(4), 385–96. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/6668417

Coutinho, M., McQuaid, E., & Koinis-Mitchell, D. (2013). Contextual and cultural risks and their association with family asthma management in urban children. *Journal of Child Health Care (J CHILD HEALTH CARE)*.

DeFrances, C. J., Cullen, K. A., & Kozak, L. J. (2007). National Hospital Discharge Survey: 2005 annual summary with detailed diagnosis and procedure data. *Vital and Health Statistics. Series 13, Data from the National Health Survey*, (165), 1–209. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18350768

Derogatis, L. R., & Melisaratos, N. (1983). The Brief Symptom Inventory: an introductory report. *Psychological Medicine*, *13*(3), 595–605. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/6622612

Dinakar, C., Van Osdol, T. J., & Wible, K. (2004). How frequent are asthma exacerbations in a pediatric primary care setting and do written asthma action plans help in their management? *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *41*(8), 807–12. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/15641630

Eckshtain, D., Ellis, D. A., Kolmodin, K., & Naar-King, S. (2010). The effects of parental depression and parenting practices on depressive symptoms and metabolic control in urban youth with insulin dependent diabetes. *Journal of Pediatric Psychology*, *35*(4), 426–35. doi:10.1093/jpepsy/jsp068

Evans, R., Gergen, P. J., Mitchell, H., Kattan, M., Kercsmar, C., Crain, E., . . . Wedner, H. J. (1999). A randomized clinical trial to reduce asthma morbidity among inner-city children: results of the National Cooperative Inner-City Asthma Study. *J Pediatr, 135*(3), 332-338.

Fawcett, J., & Desanto-Madeya, S. (2013). *Contemporary nursing knowledge analysis and evaluation of nursing models a nd theories* (3rd ed.). Philadelphia.: F.A. Davis Co.

Finkelstein, J. A., Fuhlbrigge, A., Lozano, P., Grant, E. N., Shulruff, R., Arduino, K. E., & Weiss, K. B. (2002). Parent-reported environmental exposures and environmental control measures for children with asthma. *Arch Pediatr Adolesc Med, 156*(3), 258-264.

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. *J Asthma, 46*(4), 392-398. doi:10.1080/02770900802712971

Forbis, S., Rammel, J., Huffman, B., & Taylor, R. (2006). Barriers to care of inner-city children with asthma: school nurse perspective. *J Sch Health, 76*(6), 205-207. doi:10.1111/j.1746-1561.2006.00097.x

Fung, V., Graetz, I., Galbraith, A., Hamity, C., Huang, J., Vollmer, W. M., . . . Wu, A. C. (2014). Financial barriers to care among low-income children with asthma: health care reform implications. *JAMA Pediatr, 168*(7), 649-656. doi:10.1001/jamapediatrics.2014.79

Friday, G. A., Khine, H., Lin, M. S., & Caliguiri, L. A. (1997). Profile of children requiring emergency treatment for asthma. *Annals of Allergy, Asthma & Immunology : Official Publication of the American College of Allergy, Asthma, & Immunology*, *78*(2), 221–4. doi:10.1016/S1081-1206(10)63391-1

Garbutt, J., Bloomberg, G., Banister, C., Sterkel, R., Epstein, J., Bruns, J., … Wells, S. (2007). What constitutes maintenance asthma care? The pediatrician's perspective. *Ambulatory Pediatrics : The Official Journal of the Ambulatory Pediatric Association*, *7*(4), 308–12. doi:10.1016/j.ambp.2007.03.007

Garbutt, J. M., Banister, C., Highstein, G., Sterkel, R., Epstein, J., Bruns, J., … Bloomberg, G. R. (2010). Telephone Coaching for Parents of Children With Asthma, *164*(7), 625–630.

Gergen, P. J., Mortimer, K. M., Eggleston, P. A., Rosenstreich, D., Mitchell, H., Ownby, D., . . . Malveaux, F. (1999). Results of the National Cooperative Inner-City Asthma Study (NCICAS) environmental intervention to reduce cockroach allergen exposure in inner-city homes. *J Allergy Clin Immunol, 103*(3 Pt 1), 501-506.

Global Initiative for Asthma. (2012). *Global strategy for asthma management and prevention*.

Grineski, S. (2008). Coping with asthma in the central city: parental experiences with children's health care. *J Health Care Poor Underserved, 19*(1), 227-236. doi:10.1353/hpu.2008.0025

Gruchalla, R. S., Pongracic, J., Plaut, M., Evans, R., Visness, C. M., Walter, M., … Mitchell, H. (2005). Inner City Asthma Study: relationships among sensitivity, allergen exposure, and asthma morbidity. *The Journal of Allergy and Clinical Immunology*, *115*(3), 478–85. doi:10.1016/j.jaci.2004.12.006

Guyatt, G. H., Juniper, E. F., Griffith, L. E., Feeny, D. H., & Ferrie, P. J. (1997). Children and adult perceptions of childhood asthma. *Pediatrics*, *99*(2), 165–8. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9024440

Halterman, J. S., Aligne, C. A., Auinger, P., McBride, J. T., & Szilagyi, P. G. (2000). Inadequate therapy for asthma among children in the United States. *Pediatrics*, *105*(1 Pt 3), 272–6. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10617735

Healthy People 2020. (2014). Respiratory Diseases: Asthma. Retrieved June 04, 2014, from http://www.healthypeople.gov/2020/topicsobjectives2020/objectiveslist.aspx?topicId=36

Hilliard, M. E., Monaghan, M., Cogen, F. R., & Streisand, R. (2011). Parent stress and child behaviour among young children with type 1 diabetes. *Child: Care, Health and Development*, *37*(2), 224–32. doi:10.1111/j.1365-2214.2010.01162.x

Hullmann, S. E., Wolfe-Christensen, C., Ryan, J. L., Fedele, D. A., Rambo, P. L., Chaney, J. M., & Mullins, L. L. (2010). Parental overprotection, perceived child vulnerability, and parenting stress: a cross-illness comparison. *J Clin Psychol Med Settings, 17*(4), 357-365. doi:10.1007/s10880-010-9213-4

Hung, C.-C., Chen, Y.-C., Mao, H.-C., & Chiang, B.-L. (2002). Effects of systematic nursing instruction of mothers on using medication and on health status of asthmatic children. *The Journal of Nursing Research : JNR*, *10*(1), 22–32. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11923898

Hussain-Rizvi, A., Kunkov, S., & Crain, E. (2009). Does Parental Involvement in Pediatric Emergency Department Asthma Treatment Affect Home Management? *Journal of Asthma*, *46*(8), 792–795. doi:10.3109/02770900903104532

Institute of Medicine. (2002). *The Future of the Public's Health in the 21st Century*.

Islam, T., Urman, R., Gauderman, W. J., Milam, J., Lurmann, F., Shankardass, K., McConnell, R. (2011). Parental stress increases the detrimental effect of traffic exposure on children's lung function. *Am J Respir Crit Care Med, 184*(7), 822-827. doi:10.1164/rccm.201104-0720OC

Kattan, M., Mitchell, H., Eggleston, P., Gergen, P., Crain, E., Redline, S., . . . Wedner, H. J. (1997). Characteristics of inner-city children with asthma: the National Cooperative Inner-City Asthma Study. *Pediatr Pulmonol, 24*(4), 253-262.

Joesch, J. M., Kim, H., Kieckhefer, G. M., Greek, A. A., & Baydar, N. (n.d.). Does your child have asthma? Filled prescriptions and household report of child asthma. *Journal of Pediatric Health Care : Official Publication of National Association of Pediatric Nurse Associates & Practitioners*, *20*(6), 374–83. doi:10.1016/j.pedhc.2006.02.003

Kavanaugh, M., Halterman, J., Montes, G., Epstein, M., Hightower, A., & Weitzman, M. (2006). Maternal depressive symptoms are adversely associated with prevention practices and parenting behaviors for preschool children. *Ambulatory Pediatrics (AMBULATORY PEDIATR)*.

Kieckhefer, G. M. (1988). The meaning of health to 9-, 10-, and 11-year-old children with chronic asthma. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *25*(6), 325–33. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/3235421

Kieckhefer, G. M., & Trahms, C. M. (n.d.). Supporting development of children with chronic conditions: from compliance toward shared management. *Pediatric Nursing*, *26*(4), 354–63. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12026469

Klinnert, M. D., Kaugars, A. S., Strand, M., & Silveira, L. (2008). Family psychological factors in relation to children's asthma status and behavioral adjustment at age 4. *Family Process*, *47*(1), 41–61. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18411829

Klok, T., Lubbers, S., Kaptein, A. A., & Brand, P. L. (2014). Every parent tells a story: why non-adherence may persist in children receiving guideline-based comprehensive asthma care. *J Asthma, 51*(1), 106-112.

La Roche, M. J., Koinis-Mitchell, D., & Gualdron, L. (2006). A culturally competent asthma management intervention: a randomized controlled pilot study. *Annals of Allergy, Asthma & Immunology : Official Publication of the American College of Allergy, Asthma, & Immunology*, *96*(1), 80–5. doi:10.1016/S1081-1206(10)61044-7

Lieu, T. A., Quesenberry, C. P., Capra, A. M., Sorel, M. E., Martin, K. E., & Mendoza, G. R. (1997). Outpatient management practices associated with reduced risk of pediatric asthma hospitalization and emergency department visits. *Pediatrics*, *100*(3 Pt 1), 334–41. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9282702

Lozano, P., Finkelstein, J. A., Carey, V. J., Wagner, E. H., Inui, T. S., Fuhlbrigge, A. L., Weiss, K. B. (2004). A multisite randomized trial of the effects of physician education and organizational change in chronic-asthma care: health outcomes of the Pediatric Asthma Care Patient Outcomes Research Team II Study. *Archives of Pediatrics & Adolescent Medicine*, *158*(9), 875–83. doi:10.1001/archpedi.158.9.875

Manandhar, K., Bajracharya, B. L., Dhakal, S., & Shrestha, M. (2006). Morbidity pattern of children with asthma: a prospective study. *Kathmandu University Medical Journal (KUMJ)*, *4*(3), 324–8. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/18603927

Mangione-Smith, R., DeCristofaro, A. H., Setodji, C. M., Keesey, J., Klein, D. J., Adams, J. L., McGlynn, E. A. (2007). The quality of ambulatory care delivered to children in the United States. *The New England Journal of Medicine*, *357*(15), 1515–23. doi:10.1056/NEJMsa064637

Mansour, M. E., Lanphear, B. P., & DeWitt, T. G. (2000). Barriers to asthma care in urban children: parent perspectives. *Pediatrics*, *106*(3), 512–9. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10969096

Martin, M., Beebe, J., Lopez, L., & Faux, S. (2010). A qualitative exploration of asthma self-management beliefs and practices in Puerto Rican families. *Journal of Health Care for the Poor and Underserved*, *21*(2), 464–74. doi:10.1353/hpu.0.0285

Mcquaid, E. L., Walders, N., Kopel, S. J., Ms, C., Fritz, G. K., & Klinnert, M. D. (2005). Pediatric Asthma Management in the Family Context : The Family Asthma Management System Scale, *30*(6), 492–502.

Milam, J., McConnell, R., Yao, L., Berhane, K., Jerrett, M., & Richardson, J. (2008). Parental stress and childhood wheeze in a prospective cohort study. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *45*(4), 319–23.

Modi, A. C., & Quittner, A. L. (2006). Barriers to treatment adherence for children with cystic fibrosis and asthma: what gets in the way? *Journal of Pediatric Psychology*, *31*(8), 846–58. doi:10.1093/jpepsy/jsj096

Moncrief, T., Beck, A. F., Simmons, J. M., Huang, B., & Kahn, R. S. (2014). Single parent households and increased child asthma morbidity. *J Asthma, 51*(3), 260-266.

Mullins, L. L., Wolfe-Christensen, C., Chaney, J. M., Elkin, T. D., Wiener, L., Hullmann, S. E., . . . Junghans, A. (2011). The relationship between single-parent status and parenting capacities in mothers of youth with chronic health conditions: the mediating role of income. *J Pediatr Psychol, 36*(3), 249-257.

National Asthma Education and Prevention Program. (2007). Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *The Journal of Allergy and Clinical Immunology*, *120*(5 Suppl), S94–138. doi:10.1016/j.jaci.2007.09.043

National Cancer Institute. (2005). Theory at a Glance: A Guide for Health Promotion Practice, 2nd Edition.

National Center for Health Statistics. (2012). *Health, United States, 2011: With special feater on socioeconomic status and health.* Hyattsville, MD.

National Center for Health Statistics. (2013). *Health, United States, 2012: With special featur on emergency care.* Hyattsville, MD.

Nelson, K. A., Freiner, D., Garbutt, J., Trinkaus, K., Bruns, J., Sterkel, R., … Strunk, R. C. (2009). Acute asthma management by a pediatric after-hours call center. *Telemedicine Journal and E-Health : The Official Journal of the American Telemedicine Association*, *15*(6), 538–45. doi:10.1089/tmj.2009.0005

Nelson, K., Highstein, G., Garbutt, J., Trinkaus, K., Fisher, E., Smith, S., & Strunk, R. (2011). A randomized controlled trial of parental asthma coaching to improve outcomes among urban minority children. *Archives of Pediatrics & Adolescent Medicine*, *165*(6), 520–6. doi:10.1001/archpediatrics.2011.57

Orem, D. (1987). *Self-care and health promotion: Understanding self-care* (2003 ed.). New York, NY: Springer.

Pearson, W. S., Goates, S. A., Harrykissoon, S. D., & Miller, S. A. (2014). State-based Medicaid costs for pediatric asthma emergency department visits. *Prev Chronic Dis, 11*, E108. doi:10.5888/pcd11.140139

Peterson-Sweeney, K., McMullen, A., Yoos, H. L., & Kitzman, H. (2003). Parental perceptions of their child's asthma: management and medication use. *Journal of Pediatric Health Care : Official Publication of National Association of Pediatric Nurse Associates & Practitioners*, *17*(3), 118–25. doi:10.1067/mph.2003.31

Phipatanakul, W., Bailey, A., Hoffman, E. B., Sheehan, W. J., Lane, J. P., Baxi, S., … Gold, D. R. (2011). The school inner-city asthma study: design, methods, and lessons learned. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *48*(10), 1007–14. doi:10.3109/02770903.2011.624235

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. *J 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. *J Urban Health, 87*(4), 688-702. doi:10.1007/s11524-010-9465-1

Quittner, A. L., Modi, A. C., Lemanek, K. L., Ievers-Landis, C. E., & Rapoff, M. A. (2008). Evidence-based assessment of adherence to medical treatments in pediatric psychology. *Journal of Pediatric Psychology*, *33*(9), 916–36; discussion 937–8. doi:10.1093/jpepsy/jsm064

Qureshi, F., Zaritsky, A., & Poirier, M. P. (2001). Comparative efficacy of oral dexamethasone versus oral prednisone in acute pediatric asthma. *The Journal of Pediatrics*, *139*(1), 20–6. doi:10.1067/mpd.2001.115021

Rachelefsky, G. (2003). Treating exacerbations of asthma in children: the role of systemic corticosteroids. *Pediatrics*, *112*(2), 382–97. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12897291

Ranganathan, S. C., Payne, D. N., Jaffe, A., & McKenzie, S. A. (2001). Difficult asthma: defining the problems. *Pediatric Pulmonology*, *31*(2), 114–20. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11180686

Rastogi, D., Gupta, S., & Kapoor, R. (2009). Comparison of asthma knowledge, management, and psychological burden among parents of asthmatic children from rural and urban neighborhoods in India. *The Journal of Asthma : Official Journal of the Association for the Care of Asthma*, *46*(9), 911–5. doi:10.3109/02770900903191323

Reeves, M. J., Bohm, S. R., Korzeniewski, S. J., & Brown, M. D. (2006). Asthma care and management before an emergency department visit in children in western Michigan: how well does care adhere to guidelines? *Pediatrics*, *117*(4 Pt 2), S118–26. doi:10.1542/peds.2005-2000I

Ryan, P., & Sawin, K. (2009). The Individual and Family Self-Management Theory: background and perspectives on context, process, and outcomes. *Nursing Outlook (NURS OUTLOOK)*.

Sawicki, G. S., Strunk, R. C., Schuemann, B., Annett, R., Weiss, S., & Fuhlbrigge, A. L. (2010). Patterns of inhaled corticosteroid use and asthma control in the Childhood Asthma Management Program Continuation Study. *Annals of Allergy, Asthma & Immunology : Official Publication of the American College of Allergy, Asthma, & Immunology*, *104*(1), 30–5. doi:10.1016/j.anai.2009.11.004

Sawyer, M. G., Spurrier, N., Whaites, L., Kennedy, D., Martin, A. J., & Baghurst, P. (2000). The relationship between asthma severity, family functioning and the health-related quality of life of children with asthma. *Quality of Life Research : An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation*, *9*(10), 1105–15. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11401043

Scarfone, R. J., & Friedlaender, E. (2003). Corticosteroids in acute asthma: past, present, and future. *Pediatric Emergency Care*, *19*(5), 355–61. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/14578839

Sharp, L. K., Kimmel, L. G., Kee, R., Saltoun, C., & Chang, C. H. (2007). Assessing the Perceived Stress Scale for African American adults with asthma and low literacy. *J Asthma, 44*(4), 311-316.

Shegog, R., Bartholomew, L., Parcel, G., MM, S., Masse, L., & Abramson, S. (2001). Impact of a computer-assisted education program on factors related to asthma self-management behavior. *Journal of the American Medical Informatics Association (J AM MED INFORM ASSOC)*.

Shults, J., Ratcliffe, S. J., & Leonard, M. (2007). Improved generalized estimating equation analysis via xtqls for quasi-least squares in Stata *The Stata Journal, 7*(2), 147-166.

Skinner, E. A., Diette, G. B., Algatt-Bergstrom, P. J., Nguyen, T. T., Clark, R. D., Markson, L. E., & Wu, A. W. (2004). The Asthma Therapy Assessment Questionnaire (ATAQ) for children and adolescents. *Dis Manag, 7*(4), 305-313. doi:10.1089/dis.2004.7.305

Smith, S. R., Jaffe, D. M., Fisher, E. B., Trinkaus, K. M., Highstein, G., & Strunk, R. C. (2004). Improving follow-up for children with asthma after an acute Emergency Department visit. *The Journal of Pediatrics*, *145*(6), 772–7. doi:10.1016/j.jpeds.2004.08.029

Sockrider, M. M., Abramson, S., Brooks, E., Caviness, A. C., Pilney, S., Koerner, C., & Macias, C. G. (2006). Delivering Tailored Asthma Family Education in a Pediatric Emergency Department Setting : A Pilot Study. doi:10.1542/peds.2005-2000K

Sullivan, S. D., Weiss, K. B., Lynn, H., Mitchell, H., Kattan, M., Gergen, P. J., . . . Investigators, N. C. I.-C. A. S. N. (2002). The cost-effectiveness of an inner-city asthma intervention for children. *J Allergy Clin Immunol, 110*(4), 576-581.

Szabó, A., Mezei, G., Kovári, E., & Cserháti, E. (2010). Depressive symptoms amongst asthmatic children's caregivers. *Pediatric Allergy and Immunology : Official Publication of the European Society of Pediatric Allergy and Immunology*, *21*(4 Pt 2), e667–73. doi:10.1111/j.1399-3038.2009.00896.x

Szefler, S. J., Phillips, B. R., Martinez, F. D., Chinchilli, V. M., Lemanske, R. F., Strunk, R. C., … Taussig, L. M. (2005). Characterization of within-subject responses to fluticasone and montelukast in childhood asthma. *The Journal of Allergy and Clinical Immunology*, *115*(2), 233–42. doi:10.1016/j.jaci.2004.11.014

Toelle, B. G., & Ram, F. S. F. (2004). Written individualised management plans for asthma in children and adults. *The Cochrane Database of Systematic Reviews*, (2), CD002171. doi:10.1002/14651858.CD002171.pub2

Van Es, S. M., Nagelkerke, A. F., Colland, V. T., Scholten, R. J., & Bouter, L. M. (2001). An intervention programme using the ASE-model aimed at enhancing adherence in adolescents with asthma. *Patient Education and Counseling*, *44*(3), 193–203. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11553420

Vollmer, W. M. (2004). Assessment of asthma control and severity. *Annals of Allergy, Asthma & Immunology : Official Publication of the American College of Allergy, Asthma, & Immunology*, *93*(5), 409–13; quiz 414–6, 492. doi:10.1016/S1081-1206(10)61406-8

Wade, S., Weil, C., Holden, G., Mitchell, H., Evans, R., Kruszon-Moran, D., … Wedner, H. J. (1997). Psychosocial characteristics of inner-city children with asthma: a description of the NCICAS psychosocial protocol. National Cooperative Inner-City Asthma Study. *Pediatric Pulmonology*, *24*(4), 263–76. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9368260

Whittemore, R., Jaser, S., Chao, A., Jang, M., & Grey, M. (2012). Psychological experience of parents of children with type 1 diabetes: a systematic mixed-studies review. *The Diabetes Educator*, *38*(4), 562–79. doi:10.1177/0145721712445216

Williams, S. G., Schmidt, D. K., Redd, S. C., & Storms, W. (2003). Key clinical activities for quality asthma care. Recommendations of the National Asthma Education and Prevention Program. *MMWR. Recommendations and Reports : Morbidity and Mortality Weekly Report. Recommendations and Reports / Centers for Disease Control*, *52*(RR-6), 1–8. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12696781

Winkelstein, M. L., Huss, K., Butz, A., Eggleston, P., Vargas, P., & Rand, C. (2000). Factors associated with medication self-administration in children with asthma. *Clin Pediatr (Phila), 39*(6), 337-345.

Wisnivesky, J. P., Lorenzo, J., Feldman, J. M., Leventhal, H., & Halm, E. A. (2010). The relationship between perceived stress and morbidity among adult inner-city asthmatics. *J Asthma*, *47*(1), 100-104.

Wolf, F. M., Guevara, J. P., Grum, C. M., Clark, N. M., & Cates, C. J. (2003). Educational interventions for asthma in children. *The Cochrane Database of Systematic Reviews*, (1), CD000326. doi:10.1002/14651858.CD000326

Wong, G. C., Bernaards, C. A., Berman, B. A., Jones, C., & Bernert, J. T. (2004). Do children with asthma and their parents agree on household ETS exposure? Implications for asthma management. *Patient Educ Couns, 53*(1), 19-25. doi:10.1016/S0738-3991(03)00123-X

Wood, R. A., Bloomberg, G. R., Kattan, M., Conroy, K., Sandel, M. T., Dresen, A., . . . Gern, J. E. (2011). Relationships among environmental exposures, cord blood cytokine responses, allergy, and wheeze at 1 year of age in an inner-city birth cohort (Urban Environment and Childhood Asthma study). *J Allergy Clin Immunol*, *127*(4), 913-919.e911-916.

World Health Organization. (2007). *Global surveillance, prevention and control of chronic respiratory diseases: a comprehensive approach*. Geneva: World Health Organization. Retrieved from http://www.who.int/gard/publications/GARD_Manual/en/

World Health Organization. (2013). Asthma. Retrieved from http://www.who.int/mediacentre/factsheets/fs307/en/

Wright, R. J., Cohen, S., Carey, V., Weiss, S. T., & Gold, D. R. (2002). Parental stress as a predictor of wheezing in infancy: a prospective birth-cohort study. *Am J Respir Crit Care Med, 165*(3), 358-365. doi:10.1164/ajrccm.165.3.2102016

Wright, R. J., Mitchell, H., Visness, C. M., Cohen, S., Stout, J., Evans, R., & Gold, D. R. (2004). Community violence and asthma morbidity: the Inner-City Asthma Study. *Am J Public Health, 94*(4), 625-632.

Yang, B.-H., Chen, Y.-C., Chiang, B.-L., & Chang, Y.-C. (2005). Effects of nursing instruction on asthma knowledge and quality of life in schoolchildren with asthma. *The Journal of Nursing Research : JNR*, *13*(3), 174–83. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/16237629

Yawn, B. P., Brenneman, S. K., Allen-Ramey, F. C., Cabana, M. D., & Markson, L. E. (2006). Assessment of asthma severity and asthma control in children. *Pediatrics*, *118*(1), 322–9. doi:10.1542/peds.2005-2576

Yoos, H. L., Kitzman, H., Henderson, C., Mcmullen, A., Jill, K. S., & Elizabeth, S. H. (2007). in Childhood Asthma, *56*(3), 167–174.

Table 1. Instruments for Measuring Asthma Management

Instrument	Studies Reporting use	Other Domains Covered	# Of Items	Most Relevant Population Instrument Validated In and Administration Type	Purpose of Instrument in Studies
Education Domain					
Satisfaction with Information about Medications Scale	(Horne, 2001)	Medications, and Assessment & Monitoring Domain	16 items Likert 5-point scale.	Asthmatic adults who were either inpatient or outpatient. No severity rating. In person.	Assess the extent to which patients feel they have received enough information about prescribed medications.
Asthma Illness Representation Scale	(Yoos, 2003) (Yoos, 2007) (Sidora-Arcoleo, 2008)	Medications, and Assessment & Monitoring Domain	39 items Likert 5-point scale. 3 sections.	Parents of children with asthma from clinical practice settings. Moderate minority representation with primarily mild to moderate persistent asthma. Over the phone and in person.	To identify at-risk populations and circumstances for underutilization of anti-inflammatory medications, and designed to capture both the professional and lay representations of asthma.
Beliefs about Medications Questionnaire	(Conn 2007) (Yilmaz 2012) (Horne, 1999)	Medications, and Assessment & Monitoring Domain	18 items Likert 5-point scale. Two domains.	Parents of children with asthma who have primary care. Low minority representation and primarily moderate asthma. Over the phone and in person.	How much a parent feels a medication is necessary to maintain their child's health, and concern, which includes concerns about dependency and adverse effects.
Treatment Satisfaction Questionnaire for Medication	(Atkinson, 2004)	Medications, and Assessment & Monitoring Domain	14 items Likert 7-point scale.	Adults with asthma from home. Done electronically.	To assess patient's satisfaction with various medications designed to treat, control or prevent a wide variety of medical conditions.
Medications Domain					
The Medication Adherence Scale	(Conn, 2007)	Assessment & Monitoring Domain	8 items Likert 7-point scale.	Parents of children with asthma from primary care. Low minority representation and primarily moderate to severe asthma. Over the phone.	Measures adherence to daily preventive asthma medication use by parent report.
The Risks for Nonadherence Scale	(Adams, 2007) (Bauman 2002)	Education, and Assessment & Monitoring Domain	13 items Dichotomous Yes/No.	Primary caregivers of children with asthma 3-17 years old from community health clinics and emergency departments. Large minority representation. Asthma severity evenly	A summary score of characteristics of a child's regimen and characteristics of the caregiver or child that is related to

				distributed. In person, self-administered.	nonadherence.
Disease Management Interview-Asthma	Modi, 2006)		28 Items	Parents of children with asthma and children with asthma ages 6 to 13 were interviewed. Children who used daily medications.	Used to calculate rates of self-reported adherence to medical treatment regimens.
Assessment and Monitoring Domain					
Asthma Management Questionnaire	(Spurrier, 2005)	None.	49 items Likert 6-point scale. 5 scenarios.	Parents of school-aged children with asthma who were admitted to a hospital within the last 2 years for asthma. Administered during home visit.	Measure the range of behaviors that parents use when their children either develop asthma symptoms or are at risk of developing asthma symptoms.
Asthma Control Test	(Adams, 2007)	Medications Domain	5 items Likert 5-point scale.	Primary caregivers of children with asthma 3-17 years old from community health clinics. Large minority representation. Asthma severity evenly distributed. Manually filled out form.	Measure individuals' control over their asthma symptoms, activity restriction, shortness of breath, use of rescue medications and self-rating of Asthma Control in the past 4 weeks.
Childhood Asthma Control Test	(Yavuz, 2012)	None	3 items for parents, 4 items for children. Close-ended questions.	Parents of children with asthma and children with asthma from a hospital visit. Primarily mild intermittent to moderate persistent asthma and a homogenous population from Turkey. In person.	Determine the disease control levels of children with asthma.
Asthma Control Questionnaire	(Honkoop 2013) (Juniper, 1999)	Medications Domain	6 items Likert 6-point scale.	Adult asthmatics from community and asthma clinics. Primarily Caucasian sample with varying amounts of severity. Filled out online and also by interviewer.	Identifying patients at risk and for evaluating the effects of treatment.
Family Asthma Management System Scale	(Walker, 2010) (McQuaid 2005)	Education, Medications, and Environmental Domains	8 subscales 9-point scale, rated by researcher. Semi-structured interview.	Parents of children with asthma from asthma and allergy clinics and the community. Primarily Caucasian and mild to moderate asthma severity In person, administered by researcher.	Assesses different domains of family asthma management behaviors.
Environmental Domain					
Home Environmental Control Inventory	(Tzeng 2010)	None	42 items. Unknown scale. Five domains.	Parents of children with asthma from medical centers. Moderate to severe asthma. In person.	Measure the control of environmental asthma triggers.

Control Measures					
Pediatric Asthma Health Outcome Measure	(Gerald, 2012)	Assessment & Monitoring Domain	3 items 2 dichotomous and 1 ordinal.	Parents of children with asthma from asthma clinics. Primarily minority representation and primarily mild to moderate asthma. In person.	Designed to measure quality-adjusted life years (QALY) in children with asthma, as a multi-attribute outcome measure.
Asthma Therapy Assessment Questionnaire	(Skinner, 2004)	Assessment & Monitoring, Medications, and Education Domains	20 items Dichotomous Yes/No.	Parents of children with asthma from large managed care organizations that had two or more visits in the past year. Primarily Caucasian representation and most with worsened asthma in the last six months. Survey.	Identify indicators of potential care problems in several categories, including symptom control, behavior and attitude barriers, and communication gaps.
CAN Questionnaire	(Perez-Yarza, 2009)	Assessment & Monitoring Domain	9 items Likert 5-point scale.	Parents of children with asthma from hospital outpatient clinics. Children with moderate to severe asthma. In person, self-administered.	To assess asthma control in children with asthma.
Self-Management Behavior Attributes					
Pediatric Asthma Caregivers Quality of Life Questionnaire	(Juniper, 1996)	Assessment and Monitoring Domain	13 items Likert 7-point scale. Two domains: emotional function and activities.	Parents of children with asthma from clinics and the community. In person, self-administered.	Measure the areas of function important to the primary caregivers of children with asthma.

Table 2. Child and Parent Demographic Questions

Question
Child race
C28. How would you describe [CHILD]'s race, nationality, or ethnic background (check all that apply) 00 White 01 Black 02 Hispanic [ask C28a] 03 Haitian/Creole 04 Asian 05 Native American 06 Mixed, Specify _____ 07 Other, Specify _____
Household employment and Household Income
C33. How many adults in the home have a regular paying job now?
C34. What is the total annual household income during [LAST CALENDAR YEAR] from all sources before taxes of everyone in [CHILD]'s home? Please point to the answer closest to the household annual income. [PLEASE USE CUE CARD] 1 > $95,000 2 = $85,000 - $94,999 3 = $75,000 - $84,999 4 = $65,000 to $74,999 5 = $55,000 to $64,999 6 = $45,000 to $54,999 7 = $35,000 to $44,999 8 = $25,000 to $34,999 9 = $15,000 to $24,999 10 = < $15,000 99 Don't know 77 Refuse to say
Housing
C2. Does [CHILD] live in a: One-family house detached from any other house…...1 One-family house attached to one or more houses…...2 Building with 2-3 apartments (multi family house)…..3 Building with 4 or more apartments…….4 Other…….5 C2a. Please specify other:_____ Don't know……..99
Neighborhood Housing
T1a. Are the houses in the

neighborhood well maintained?

0 Definitely Yes
1 Mainly Yes
2 Mainly No
3 Definitely No
7 Refused to say
9 Don't Know

Transportation

D1. What method of transportation does [CHILD] usually use to go to school?

Personal car……1
City bus …….2
School bus……..3
Light rail…….4
Metro/ subway……....5
Motorcycle……..6
Bicycle……....7
Walk……....8
Other……...9 Specify: a._____

Marital Status

C32. What is your current marital status? [PROMPT IF NECESSARY.]

Married..... 1
Divorced..... 2
Single 3
Widowed..... 4
Separated..... 5
Other……6 Specify:_____

Number of People in the Home, Number of Children, Number of Adults

C26. How many people live in [CHILD]'s home, including [CHILD] and you?
[The respondent should be included, if appropriate.]

C26a. How many of these household members are children?
(less than 18 years old)

C26b. How many of these household members are adults?
(18 years and over)?

Table 3. 4-Item Perceived Stress Scale (PSS4)

Questions	Baseline (N: 351)	Coding for Composite score
1.In the last month, how often have you felt that you were unable to control the important things in your life?		
Never (0)	101 (28.8)	0
Almost never (1)	71 (20.2)	1
Sometimes (2)	134 (38.2)	2
Fairly often (3)	34 (9.7)	3
Very often (4)	11 (3.1)	4
2.In the last month, how often have you felt confident about your ability to handle your personal problems?		
Never (0)	23 (6.6)	4
Almost never (1)	20 (5.7)	3
Sometimes (2)	84 (23.9)	2
Fairly often (3)	95 (27.1)	1
Very often (4)	129 (36.8)	0
3.In the last month, how often have you felt that things were going your way?		
Never (0)	27 (7.7)	4
Almost never (1)	32 (9.1)	3
Sometimes (2)	120 (34.2)	2
Fairly often (3)	115 (32.8)	1
Very often (4)	57 (16.2)	0
4.In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?		
Never (0)	79 (22.5)	0
Almost never (1)	97 (27.6)	1
Sometimes (2)	125 (35.6)	2
Fairly often (3)	36 (10.3)	3
Very often (4)	14 (4.0)	4
Sum Total		0-16
Mean (SD) Scores ≤4 for low stress Scores >4 for high stress		5.6 (3.07) 128 (36.5) 223 (63.5)

Table 4. Environmental Management Questions

Question	Baseline
Passive smoke exposure	
C21, D1. How frequently is your child around people who are smoking? Would you say…	
Never (0)	74/351 (21.1)
Rarely (1)	17 (4.8)
Several times a month (2)	32 (9.1)
Several times a week (3)	119 (33.9)
Daily (4)	109 (31.0)
People Smoking in Home	
C22. How many people who live in [CHILD]'s home smoke?	continuous
Pests in Home	
C15a-d (baseline: past 12 months), D3. Have you seen any of the following in your home in the past 3 months? (Yes = 1; No = 0)	
a. Cockroaches	76/351 (21.6)
b. Bed bugs	24 (6.9)
c. Mice	177 (50.6)
d. Lady bugs	59 (16.8)

Table 5. Medication Management Questions

Questions
Prescribed ICS
K3. Has [CHILD] ever had a prescription for an asthma drug that is not used for quick relief? This drug would be used to control asthma. Yes (1) or No (0)
Take ICS medication
K3a. If yes, how does [CHILD] take this drug now? Never took it……0 Only takes it when having symptoms……..1 Used to take it, but not now…….2 Takes it some days, but not other days……3 Takes it everyday…….4
ICS medication in hand
K1. During the past 12 months, did [CHILD] take any medicines for asthma? Yes (1) or No (0)
Name K1a1._____

Table 6. Assessment and Monitoring Management Questions

Question	Baseline
Barrier to having appointment	
L12. Many people have problems making and keeping doctor's appointments for their child's asthma. Sometimes appointments are hard to get or people have to wait a long time. Sometimes it is hard to get to the office or they are not open at good times. In the past 3 months, have you had any problems making or keeping appointments for [CHILD]'s asthma? Yes (1) or No (0)	44/351 12.54
L12a. In the past 3 months, have you missed any appointments or chosen not to make one because of these problems? Yes (1) or No (0)	24/44 54.55

Table 7. Educational Management Questions

Question	Baseline
Asthma Action Plan	
K11. Has a doctor or health care provider ever given you separate written instructions, not including prescriptions, explaining what to do when [CHILD] starts wheezing? Yes (1) or No (0)	226/349 (64.8)

Table 8. Asthma Knowledge Questions

Question	Baseline
Child Asthma Knowledge	
K7. Do you believe [CHILD] is able to take his/her asthma drug(s) as directed? Yes (1), No (0), Don't know (0)	296/351(84.33)
Parent Asthma Knowledge	
K8. Do you believe the drug(s) [CHILD] takes can control his/her asthma? Yes (1), No (0), Don't know (0)	294/351(83.76)
L7. There are times when people think the child is all better before finishing the prescription. In the past 3 months, have you thought [CHILD]'s asthma was better before finishing the prescription? Yes (1) or No (0)	137/296 (46.3)
Self-efficacy (related to mediations)	
L8. Some families feel that the asthma medications do not really work. In the past 3 months, have you felt this way? Yes (1) or No (0)	60/306 (19.6)

Child Refuses Medications	
L4. Sometimes families have trouble giving asthma medicines because the child refuses to take the medicine. Sometimes it's because the child is too busy playing or the medicine tastes bad or makes him/her feel funny. In the past 3 months, has this ever been a problem in your family? Yes (1) or No (0), or NA (missing)	40/312 (12.8)

Table 9. School's Role in Asthma Management

Question	Baseline
School's Role in Asthma Management	
K15. Have you had any problems in the past 12 months in dealing with [CHILD]'s taking medications at school? Yes (1) or No (0), Doesn't Take Meds at School or Don't now (missing)	46/285 (16.1)

Table 10. Emergent or Unscheduled Visit Outcome Score

Question	Baseline
Emergent or Unscheduled Visit Outcome Score	
J7, H5.Not counting hospitalizations, during the past 3 months did [CHILD] see a doctor or health care provider for any reason? Include visits to an emergency room, a doctor's office, or a clinic. Yes (1) or No (0)	0 or 1
J7a. How many times? _____Visits	≥0
J7c. Was that visit for asthma or another reason? [1=Asthma, 2= Pneumonia, 3=Respiratory (lung) infection, 4= Influenza, 5= anaphylaxis (life threatening reaction to food) 0=Other]	0 - 5
J7d. Was that an appointment that was scheduled at a clinic/ dr. office at least 24 hours ahead or was it an emergency visit at an ER, clinic, or dr. office? Clinic/ Dr. office, schedule (1), Clinic/ Dr. office, unscheduled (2), ER (3).	1 - 3

Table 11. Asthma Therapy Assessment Questionnaire (ATAQ) Control Section

Question	Baseline	Coding for Composite score
Asthma Therapy Assessment Questionnaire (ATAQ) Control Composite score		
1. In the past 4 weeks, did [CHILD] 1a. Have wheezing or difficulty breathing when exercising? Yes (1) or No (0)	161/348 (46.3)	0 or 1
1b. Have wheezing during the day when not exercising? Yes (1) or No (0)	74/348 (21.3)	0 or 1
1c. Wake up at night with wheezing or difficulty breathing? Yes (1) or No (0)	111/349 (31.8)	0 or 1
1d. Miss days of school because of his/her asthma? Yes (1) or No (0)	58/349 (16.6)	0 or 1
1e. Miss any daily activities because of his/her asthma? Yes (1) or No (0)	66/351 (18.8)	0 or 1
7. How would you rate you/ your child's asthma control during the past 4 weeks? Not controlled at all (0)	4/343 (1.2)	1
Poorly controlled (1)	5 (1.5)	1
Somewhat controlled (2)	78 (22.7)	1
Well controlled (3)	161 (46.9)	0
Completely controlled (4)	95 (27.7)	0
6a. Think about how the inhaler / nebulizer was used in the past 4 weeks. What was the highest number of times in one day it was used? 0 times (0)	4/176 (2.3)	0
1 to 2 times (1)	103 (58.5)	0
3 to 4 times (2)	62 (35.2)	0
5 to 6 times (3)	4 (2.3)	1
Over 6 (4)	3 (1.7)	1
Sum Total		0-7
Reverse Code Sum Total (Highest score = Good Control) Mean (SD)		0-7 3.9 (1.38)

Table 12. National Asthma Education and Prevention Program (NAEPP) Guideline Assessing Asthma Control

		Well Controlled	Not Well Controlled	Very Poorly Controlled
NAEPP Guidelines	Symptoms	≤2 days/week but not more than once on each day	>2 days/week or multiple time on ≤ 2 days/week	Throughout the day
	Nighttime awakenings	≤1x/month	≥2x/month	≥2x/week
	Interference with normal activity	None	Some limitation	Extremely limited
	Short-acting beta$_2$ agonist use for symptom control	≤2 days/week	>2 days/week	Several times per day
	Lung Function • FEV_1 or peak flow • FEV_1 /FVC	>80% >80%	60-80% 75-80%	<60% <75%
This analysis's variables used	Symptoms	Once or twice a week (H4 0,1)	Three to six times a week, Once a day (H4 2,3)	More than once a day (H4 4)
	Nighttime awakenings	Not at all (H5 0)	Once or twice (H5 1)	Two to three nights a week, Four or more nights a week (H5 2,3)
	Interference with normal activity	None of the time, a little of the time (H2 0,1)	Some of the time (H2 2)	Most of the time, all of the time (H2 3,4)
	Short-acting beta$_2$ agonist use for symptom control	Once or less, Two to three times a week (H6 0,1)	Four to six times a week (H6 2,3)	Once or twice per day, three or more times per day (H6 4,5)
	Lung Function • FEV_1 or peak flow • FEV_1 /FVC	unknown	unknown	unknown

Table 13. National Asthma Education and Prevention Program (NAEPP) Guideline Asthma Control Composite Score

Question	Baseline	Coding for Composite score
National Asthma Education and Prevention Program (NAEPP) Guideline		
H4. During the past 4 weeks, how often has [CHILD] had shortness of breath?		
Not at all (0)	169/343 (49.3)	2
Once or twice a week (1)	131 (38.2)	2
Three to six times a week (2)	25 (7.3)	1
Once a day (3)	9 (2.6)	1
More than once a day (4)	9 (2.6)	0
H5. During the past 4 weeks, how often did [CHILD's] asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake him/her up at night or earlier than usual in the morning?		
Not at all (0)	189/348 (54.3)	2
Once or twice (1)	112 (32.2)	1
Two to three nights a week (2)	35 (10.1)	0
Four or more nights a week (3)	12 (3.4)	0
H2. In the past 4 weeks, how much of the time did [CHILD's] asthma keep him/ her from getting as much done at school or home as he/she would like?		
None of the time (0)	204/347 (58.8)	2
A little of the time (1)	99 (28.5)	2
Some of the time (2)	35 (10.1)	1
Most of the time (3)	6 (1.7)	0
All of the time (4)	3 (0.9)	0
H6. During the past 4 weeks, how often has [CHILD] used his/her rescue inhaler or nebulizer medication (such as albuterol)?		
Not at all (0)	176/348 (50.3)	2
Once a week or less (1)	93 (26.6)	2
Two to three times a week (2)	40 (11.4)	1G
Four to six times a week (3)	10 (2.9)	1
Once or twice per day (4)	25 (7.1)	0
Three or more times per day (5)	6 (1.7)	0

Table 14. Missed School Outcome Score

Questions	Range	Baseline	Score
Missed School Outcome Score			
I1, H2**.** In the past 3 months, how many days did [CHILD] miss school due to asthma? _____ Days	≥0	146/351 (41.6)	0= no missed school, 1= missed school due to asthma in the last 3 months

Table 15. Variable Description Summary Table

Variable Acronym	Description	Type	Measurement
Child Characteristics			
Child age	Child age in years	continuous	range: 4-13
Child gender	Child gender	dichotomous	1= male, 2=female
Child race or ethnic group	Child race or ethnic group	Categorical (0-4)	0= white, 1= African American, 2= Hispanic, 3= mixed race, 4= other
Child race	Child race or ethnic group	dichotomous	0= white, 1= minority
Child health insurance	Child's health insurance	dichotomous	0=Private, other 1= Medicaid or Medicaid Managed Care
Prescribed an ICS controller inhaler	Prescribed ICS inhaler	dichotomous	0=not prescribed, 1=prescribed ICS
Parent Characteristics			
Parent gender	Parent gender	dichotomous	1= male, 2=female
Parent race or ethnic group	Parent race or ethnic group	Categorical (0-4)	0= white, 1= African American, 2= Hispanic, 3= mixed race, 4= other
Parent race	Parent race or ethnic group	dichotomous	0= white, 1= minority
Household income	Parent income	dichotomous	0=<$25,000, 1= ≥$25,000
Employed	Household employment	dichotomous	0=no regularly employed people in the home, 1=at least 1 regularly employed
Employed or <$25,000 household income	Household SES	dichotomous	
Parent education	Parent education	dichotomous	0=did not complete high school, 1= completed
Housing: apartment building	Housing type	Dichotomous	0=house, 1= apartment building
Parent marital status	Parent marital status	Dichotomous	0=married, 1=single
People in Home	Number of people living in home	Dichotomous	0=family of four people, 1=5 or more people
Take the bus or walk	Transportation	Dichotomous	0=child is driven by car, 1= child takes public transportation or walks
Asthma knowledge	Asthma knowledge	Dichotomous	
Lack asthma self-efficacy		Dichotomous	1= parent stops medications early

Has an ICS controller inhaler	ICS medication brought with parent or "in hand"	Dichotomous	1= parent has child's treatment, 0= parent does not have child's treatment
Parent Stress			
Parent stress	PSS4	Continuous	Range: 0-16
Parents with moderate to high perceived stress	PSS4	Dichotomous	0= PSS4 score 0-4 for low stress, 1= PSS4 score 5-16 for moderate to high stress
Parent Management			
Administer ICS med some days or everyday		Dichotomous	1= takes some days or everyday
Smoker(s) in home	Smokers in home	Dichotomous	1= at least one smoker in the home
Passive smoke exposure	Passive smoke exposure	Dichotomous	1= child was exposed to smoke in the last month
Pests in home	Pests reported in home	Dichotomous	1= at least one type of pest in the home
Missed healthcare appointments	If parent skipped routine appointment	Dichotomous	1= if parent skipped a routine appointment
Asthma action plan	If parent has an asthma action plan	Dichotomous	1= if parent has an asthma action plan
Outcomes			
ED visits	ED visits for asthma	Categorical	
ED visits dichotomous	ED visits for asthma	Dichotomous	0= no ED visits, 1= ED visit
Maximum ED visits dichotomous	ED visits for asthma	Dichotomous	0= no ED visits, 1= ED visit in any of the follow-ups
School absenteeism/missed school	Missed school related to asthma	Dichotomous	0= did not miss school related to asthma, 1= missed school in last 3 months
Maximum missed school	Missed school related to asthma	Dichotomous	0= no missed school in any follow-ups, 1= missed school in any of the follow-ups
ATAQ Child Asthma Control	ATAQ Control domain	Continuous (0-7)	0=poor control, 7= good control
ATAQ Child Asthma Control, categorical	ATAQ Control domain in categories	Categorical (0-2)	2=no control problems 1= control problems, 0= control problems with unscheduled visit
Very uncontrolled asthma	ATAQ Control domain in very uncontrolled and better controlled categories	Dichotomous	0= Very uncontrolled asthma, 1= Better controlled asthma

Table 16. Characteristics of School-aged Participants (N=351)

Child Characteristic	% (N=351)
Exogenous Variables	
Mean child age (SD)	7.9 years (1.88)
Ages 4-6 years	27.1
Ages 7-13 years	72.9
Child Gender: Male	53.0
Child Race or Ethnic Group	
White	4.3
Black	34.2
Hispanic	37.9
Other	23.6
Child Race or Ethnic Group: Minority	95.7
Health Insurance: Medicaid, Medicaid Managed Care	74.6
Ride public transportation, bike or walk to school	68.1
Prescribed an ICS Controller Inhaler	62.2
Has an ICS Controller Inhaler	52.1
Outcomes	
Very uncontrolled asthma (ATAQ)	40.5
Unscheduled asthma visit to ED or UC	47.7
School absenteeism related to asthma	65.5

Notes: N=351 unless otherwise specified
Source: Boston Children's Hospital's SICAS baseline data, follow-up data used to create max variables for the three outcomes.
All variables had <1% missing, except for health insurance (2.6%)

Table 17. Characteristics of Parent Participants (N=351)

Parent Characteristic	% (N=351)*
Exogenous Variables	
Parent Gender: Female	97.7
Parent Race: Minority	93.4
Parent Education: Parent completed high school	80.9
Employed or <$25,000 household income	76.9
Parents with Moderate to High Perceived Stress (PSS)	63.5
Housing: apartment building	37.7
Neighborhood: Not well maintained	20.9
Marital status: parent not married	70.1
People in Home: >4 people	38.8
Asthma knowledge	83.8
Lack asthma self-efficacy	19.6
Stop medications early	46.3
Asthma Management Behaviors	
Several times a month to daily passive smoke exposure	35.0
Smoker(s) in home	33.0
Have at least 1 type of pest in the home	67.2
Cockroaches (C15a)	21.6
Bed bugs	6.9
Mice or rats	50.6
Lady bugs	17.4
Administer ICS med some days or everyday	33.9
Missed Healthcare Appointments	6.84
Asthma action plan	64.8

Notes: N=351 unless otherwise specified
Source: Boston Children's Hospital's SICAS baseline data
* all Ns had <2% missing, except for neighborhood (7.4%), asthma knowledge (8.6%) and asthma self-efficacy (12.8%) and stopping medications early (15.7%)

Table 18. Child and Parent Characteristics by Parent Stress (N=351)

	Parents with Low Stress (N=128) %	**Parents with Moderate to High Stress (N=223) %**	**Odds Ratio* (95% CI)**	**p values****
Child age, 4-6 years old	31.2	24.7		0.181
7-13 years old	68.8	75.3		
Child gender: Female	46.9	47.1		0.970
Parent Gender: Male	0	3.6		0.030
Parent Race: Minority	92.1	94.2		0.458
Employed or ≥$25,000 income	**84.4**	**72.7**	**0.49 (0.28-0.86)**	**0.013**
Parent Education: completed high school	**87.5**	**77.1**	**0.48 (0.26-0.89)**	**0.019**
Housing: apartment building	32.8	40.5		0.151
Marital status: parent not married	34.4	27.4		0.167
People in Home: >4 people	42.2	36.8		0.316
Insurance: Medicaid, Medicaid Managed Care	70.6	76.8		0.203
Transportation: Ride public transportation, bike or walk to school	64.1	70.4		0.220
Neighborhood: Not well maintained	15.8	23.9	1.67 (0.93-3.00)	0.084
ICS prescribed	59.1	64.0		0.363
ICS in hand	50.0	53.4		0.544
Asthma knowledge	95.0	89.5	0.44 (0.17-1.14)	0.083
Asthma self-efficacy	16.2	21.5		0.260

Notes:
Source: Boston Children's Hospital baseline SICAS data
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else.
** all Ns had <2% missing, except for insurance (2.6%), neighborhood (7.4%), asthma knowledge (8.6) and asthma self-efficacy (12.8%)

Table 19. Inhaled Corticosteroid (ICS) Decision Tree Tables

Table 19a: Prescribed ICS and ICS in hand

	No ICS in hand	ICS in hand	total
Not prescribed ICS	120 (90.91)	12 (9.09)	132 (37.82)
Prescribed ICS	47 (21.66)	170 (78.34)	217 (62.18)
total	167 (47.85)	182 (52.15)	349, p=.000
Notes: Source: Boston Children's Hospital SICAS data, baseline data			

Table 19b: Prescribed ICS, ICS in hand and Medication Administration

		Does not take ICS	Administers with symptoms	Administers some days	Administers everyday	Total (col%)
Not prescribed ICS	No ICS in hand	120 (90.91)				120 (90.91)
	ICS in hand	12 (9.09)				12 (9.09)
		132 (100)				132
Prescribed ICS	No ICS in hand	30 (65.22)	8 (17.39)	2 (4.35)	6 (13.04)	46 (21.30
	ICS in hand	15 (8.82)	45 (26.47)	15 (8.82)	95 (55.88)	170 (78.70)
p=0.000		45 (20.83)	53 (24.54)	17 (7.87)	101 (46.76)	216
Notes: Source: Boston Children's Hospital SICAS data, baseline data						

Table 19c: Asthma Control and ICS Prescribed at Baseline

	Very Uncontrolled		Uncontrolled		Controlled		Total	
Not prescribed ICS ICS (lower severity)	18	13.64	107	81.06	7	5.30	132	37.82
Prescribed ICS (higher severity)	48	22.12	161	74.19	8	3.69	217	62.18
	66	18.91	268	76.79	15	4.30	349	p = 0.127
Notes: Source: Boston Children's Hospital SICAS data, baseline data								

Table 19d: Asthma Control and ICS Prescribed at Baseline and all Follow-ups

	Very Uncontrolled		Uncontrolled		Controlled		Total	
Not prescribed ICS (lower severity)	61	11.87	435	84.63	18	3.50	514	38.22
Prescribed ICS	157	18.89	369	76.90	35	4.21	831	61.78

(higher severity)								
	218	16.21	1074	79.85	53	3.94	1,345	Pr = 0.002
Notes: Source: Boston Children's Hospital SICAS data, baseline data								

Table 19e: Asthma Control and ICS in Hand at Baseline

	Very Uncontrolled		Uncontrolled		Controlled		Total	
No ICS in hand (lower severity)	20	11.90	138	82.14	10	5.95	168	47.86
ICS in hand (higher severity)	47	25.68	131	71.58	5	2.73	183	52.14
	67	19.09	296	76.64	15	4.27	351	p = 0.002
Notes: Source: Boston Children's Hospital SICAS data, baseline data								

Table 20. Parent Stress and Asthma Knowledge by Parent Management Behaviors

Parent Asthma Knowledge	Did not Skip Appointments		Skipped Appointments		Odds Ratio* (95% CI)	p values**
Moderate to high stress	201	61.47	22	91.67	6.9 (1.59-29.83)	0.003
Child refuses to take medication	35	12.11	5	21.74		0.184
Child can take medications correctly	275	88.71	21	91.30		0.702
Asthma knowledge	277	92.64	17	77.27	0.27 (0.09-0.80)	0.018
Asthma action plan	212	65.03	14	60.87		0.686
Stop medications early	125	45.79	12	52.17		0.555
Lack asthma knowledge	54	19.08	6	26.09		0.416
	No ICS on hand		**ICS on hand**			
Moderate to high stress	104	61.90	119	65.03		0.544
Child refuses to take medication	16	11.85	24	13.56		0.655
Child can take medications correctly	134	88.74	162	89.01		0.938
Asthma knowledge	127	86.99	167	95.43	3.12 (1.32-7.36)	0.009
Asthma action plan	85	51.20	141	77.05	3.20 (2.02-5.07)	0.000
Stop medications early	58	47.54	79	45.40		0.716
Lack asthma knowledge	22	16.92	38	21.59		0.309
	Does not take ICS some or everyday		**Takes ICS some or everyday**			
Moderate to high stress	138	60.00	83	70.34	1.58 (0.98-2.54)	0.058
Child refuses to take medication	24	12.57	16	13.56		0.800
Child can take medications correctly	189	88.32	104	89.66		0.713
Asthma knowledge	183	88.41	108	97.30	4.72 (1.39-16.05)	0.013
Asthma action plan	124	54.39	99	83.90	4.37 (2.51-7.62)	0.000
Stop medications early	95	53.98	40	34.19	0.44 (0.27-0.72)	0.001
Lack asthma knowledge	31	51.7	29	48.3		0.084
	No Asthma Action Plan		**Asthma Action Plan**			
Moderate to high stress	78	63.41	143	63.27		0.979
Child refuses to take medication	16	16.84	24	11.16		0.169
Child can take medications correctly	93	84.55	201	90.95		0.082
Asthma knowledge	94	88.68	198	92.96		0.196
Stop medications early	40	43.96	95	46.80		0.651
Lack asthma knowledge	17	18.48	43	20.28		0.716

Notes:
Source: Boston Children's Hospital SICAS baseline and follow-up data.
Odds ratio displayed only with significant p-values from Pearson chi-squared relationships.
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else. Odds ratios are explaining very uncontrolled asthma.
** all Ns had <2% missing, except for child can take asthma medications correctly (5.1%), less asthma knowledge (8.6%), child refuse to take medication (11.1%), lack asthma knowledge (12.8%), stop medications early (15.6%)

Table 21. Parent and Home Environment Characteristics by Environmental Management Behaviors

Home Environment Variable	No Passive Smoke		Passive Smoke Exposure		Odds Ratio* (95% CI)	p values**
Live in an apartment building	63	31.82	69	45.39		0.009
Neighborhood not well maintained	35	18.82	33	23.74		0.280
5 or more people in home	83	41.92	53	34.64		0.165
2 or more children living in home	161	81.31	123	80.39		0.828
2 or more adults in Home	130	65.66	93	60.78		0.347
Employed or <$25,000 income	38	19.19	43	28.10	0.61 (0.37-1.00)	0.050
Parent did not complete high school	34	17.17	33	21.57		0.299
Moderate to high stress	120	60.61	130	67.32		0.195
	No People who Smoke in Home		**People who Smoke in Home**			
Live in an apartment building	91	38.72	41	35.65		0.578
Neighborhood not well maintained	42	19.35	26	24.07		0.325
5 or more people in home	86	36.60	50	43.10		0.239
2 or more children living in home	186	79.15	98	84.48		0.232
2 or more adults in Home	142	60.43	81	69.83	1.52 (.94-2.44)	0.086
Not employed or <$25,000 income	51	21.70	30	25.86		0.384
Parent did not complete high school	41	17.45	26	22.41		0.265
Moderate to high stress	146	62.13	77	66.38		0.436
	No Pests in Home		**Pests in Home**			
Live in an apartment building	25	34.25	107	38.63		0.492
Neighborhood not well maintained	4	5.56	64	25.30	5.76 (2.02-16.41)	0.001
5 or more people in home	17	23.29	119	42.81	2.46 (1.36-4.46)	0.003
2 or more children living in home	52	71.23	232	83.45	2.04 (1.12-3.70)	0.020
2 or more adults in Home	41	56.16	182	65.47		0.142
Not employed or <$25,000 income	13	17.81	68	24.46		0.230
Parent did not complete high school	11	15.07	56	20.14		0.326
Moderate to high stress	46	63.01	177	63.67		0.918

Notes:
Source: Boston Children's Hospital SICAS baseline and follow-up data.
Odds ratio displayed only with significant p-values from Pearson chi-squared relationships.
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else. Odds ratios are explaining very uncontrolled asthma.
** all Ns had <1% missing except for neighborhood not well maintained (7.4%)

Table 22. Child and Parent Characteristics by Having an Asthma Action Plan

	No Asthma Action Plan		**Asthma Action Plan**		**Odds Ratio* (95% CI)**	**p values****
Child age, 4-6 years old	33	26.83	62	27.43		0.904
7-13 years old	90	73.17	164	72.57		
Parent Race (Minority)	114	92.68	211	93.78		0.694
Not employed or <$25,000 income	94	76.42	175	77.43		0.830
Parent Education: Parent did not complete high school	34	27.64	32	14.16	2.32 (1.34-4.00)	0.002
Medicaid, Medicaid Managed Care	96	80.00	157	71.36	0.62 (0.36-1.06)	0.081

Notes:
Source: Boston Children's Hospital SICAS baseline and follow-up data.
Odds ratio displayed only with significant p-values from Pearson chi-squared relationships.
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else. Odds ratios are explaining very uncontrolled asthma.
** all Ns had <1% missing except for Medicaid or Medicaid Managed Care Child Health Insurance (3.1%)

Table 23. Child and Parent Characteristics, AMBs and Child Asthma Outcomes by Emergency Visits for Asthma

Variable	No ED visit 186, (53.0%)		ED visit 165 (47.0%)		Odds Ratio* (95% CI)	p values**
Sociodemographics						
Child Age, M (SD), y	M: 8.2	SD: 1.8	M: 7.6	SD: 1.9		351
4-6 years old	40	21.51	55	33.33		
7-13 years old	146	78.49	110	66.67	0.54 (0.34-0.88)	0.013
Child Gender	98	52.69	88	53.33		0.904
Child Race or Ethnic Group						0.222
White	11	5.91	4	2.42		
Black	57	30.65	63	38.18		
Hispanic	71	38.17	62	37.58		
Other	47	25.27	36	21.82		
Parent Gender (Male)	3	1.65	5	3.07		0.382
Parent Race						
White	18	9.68	5	3.05		
Minority	168	90.32	159	96.95	3.41 (1.24-9.39)	0.018
Employed	135	74.18	120	74.53		0.940
Parent Income						0.814
≥$25,000	77	49.36	68	50.75		0.814
Employed or ≥$25,000 annual household income	143	76.88	127	76.97		0.984
Not employed or <$25,000 income	43	23.12	38	23.03		0.984
Parent Education						
Parent did not complete high school	40	21.51	27	16.36		0.221
Parent completed high school	146	78.49	138	83.64		
Current Health Insurance						0.613
Private insurance	46	25.14	41	25.79		
Medicaid, Medicaid Managed Care	137	74.86	118	74.21		0.613
Live in an apartment building	73	39.46	59	35.76		0.476
Homes in neighborhood not well maintained	36	21.18	32	20.65		0.906
Parent not married	124	66.67	122	73.94		0.137
2-4 People living in home	115	61.83	100	60.61		0.815
5 or more people in home	71	38.17	65	39.39		
2 or more children living in home	149	80.11	135	81.82		0.684
Parent Perceived Stress Measures						
Parent Perceived Stress						
Score of 0-4 (Low stress)	76	40.86	52	31.52	--	
Score of 5+ (Moderate to high stress)	110	59.14	113	68.48	1.50 (0.97-2.33)	0.069
Parent Management Behaviors						
Ride public transportation, bike or walk to school	136	73.12	103	62.42	0.61 (0.39-0.96)	0.033
Prescribed ICS	99	53.51	118	71.95	2.23 (1.42-3.48)	0.000
ICS in hand	75	40.32	108	65.45	2.80 (1.82-4.33)	0.000

Taking ICS med some days or everyday	56	30.27	62	38.04		0.127
Several times a month to daily passive smoke	66	35.48	57	34.55		0.854
Have at least 1 pest in the home	144	77.42	134	81.21		0.382
Smokers in home	67	36.02	49	29.70		0.209
No Skipped Appointments	176	94.62	151	91.52		0.249
Skipped appointments	10	5.38	14	8.48		
Child refuses to take medication	15	9.68	25	15.92		0.099
Child can take medications correctly	147	87.50	149	90.30		0.416
Asthma knowledge	150	91.46	144	91.72		0.934
Asthma action plan	118	63.78	108	65.85		0.686
Stop medications early	65	44.22	72	48.32		0.479
Lack asthma knowledge	21	13.91	39	25.16	2.08 (1.16-3.74)	0.014
Knowledgeable	130	86.09	116	74.84		
School problem with child's med	16	10.74	30	22.06	2.35 (1.22-4.54)	0.011
No problem	133	89.26	106	77.94		
Asthma Control Measures						
No Control Problems	12	6.45	3	1.82		0.032
Uncontrolled asthma	174	93.55	162	98.18		
ATAQ Better Asthma Control	127	68.65	81	49.09	0.44 (0.28-0.68)	0.000
Outcomes						
Missed school	98	52.69	132	80.00	3.59 (2.23-5.79)	0.000

Notes:
Source: Boston Children's Hospital SICAS baseline and follow-up data.
Odds ratio displayed only with significant p-values from Pearson chi-squared relationships.
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else.
Odds ratios are explaining very uncontrolled asthma.
** all Ns had <1% missing except for child gender (1.8%), employed (2.3%), income (17.4%), Medicaid or Medicaid Managed Care Child Health Insurance (3.1%), neighborhood (7.4%), asthma knowledge (8.6%) and asthma self-efficacy (12.8%) and stopping medications early (15.7%)

Table 24. Child and Parent Characteristics, AMBs and Child Asthma Outcomes by Missed School due to Asthma

Variable	No Missed School 121, (34.47 %)		Missed School 230 (65.5%)		Odds Ratio* (95% CI)	p values**
Sociodemographics						
Child Age, M (SD), y	M: 8.2	SD: 1.8	M: 7.6	SD: 1.9		
4-6 years old	28	23.14	67	29.13		0.230
7-13 years old	93	76.86	163	70.87		
Child Gender	55	45.45	110	47.83		0.672
Child Race or Ethnic Group						
White	6	4.96	9	3.91		0.341
Black	**46**	**38.02**	**74**	**32.17**		
Hispanic	38	31.40	95	41.30		
Other	31	25.62	52	22.61		
Parent Gender (Male)	2	1.71	6	2.63		0.590
Parent Race						0.391
White	6	5.00	17	7.39		
Minority	114	95.00	213	92.61		0.391
Employed	93	78.81	162	72.00		0.170
Parent Income						0.710
≥$25,000	48	48.48	97	50.79		
Employed or ≥$25,000 annual household inco	98	80.99	172	74.78		0.189
Not employed or <$25,000 income	23	19.01	58	25.22		0.189
Parent Education						
Parent did not complete high school	25	20.66	42	18.26		0.587
Parent completed high school	96	79.34	188	81.74		
Current Health Insurance						0.951
Private insurance	30	25.64	57	25.33		
Medicaid, Medicaid Managed Care	87	74.36	168	74.67		0.951
Live in an apartment building	43	35.54	89	38.86		0.541
Homes in neighborhood not well maintained (T1aDI)	19	17.12	49	22.90		0.224
Parent not married	83	68.60	163	70.87		0.979
2-4 People living in home	74	61.16	141	61.30		0.754
5 or more people in home	47	38.84	89	38.70		0.754
2 or more children living in home	99	81.82	185	80.43		
Parent Perceived Stress Measures						
Parent Perceived Stress						
Score of 0-4 (Low stress)	48	39.67	80	34.78		0.366
Score of 5+ (Moderate to high stress)	73	60.33	150	65.22		
Parent Management Behaviors						
Ride public transportation, bike or walk to school	91	75.21	148	64.35	0.60 (0.36-0.97)	0.038
Prescribed ICS	66	55.00	151	65.94	1.58 (1.01-2.49)	0.046
ICS in hand	50	41.32	133	57.83	1.95 (1.24-3.04)	0.003

Not taking ICS med or not taking regularly	83	69.17	147	64.47		0.379
Taking ICS med some days or everyday	37	30.83	81	35.53		0.379
Several times a month to daily passive smoke	45	37.19	111	48.26	1.75 (1.11-2.76)	0.015
Have at least 1 pest in the home	89	73.55	189	82.17	1.66 (0.98-2.81)	0.060
Smokers in home	31	25.62	85	36.96	1.70 (1.04-2.77)	0.033
Skip Appointments	7	5.79	17	7.39		0.571
No skipped appointments	114	94.21	213	92.61		
Child refuses to take medication	7	6.93	33	15.64	2.49 (1.06-5.84)	0.031
Child can take medications correctly	96	86.49	200	90.09		0.324
Asthma knowledge	100	94.34	194	90.23		0.212
Asthma action plan	75	61.98	151	66.23		0.430
Stop medications early	40	43.48	97	47.55		0.516
Lack asthma knowledge	11	11.46	49	23.33	2.35 (1.16-4.76)	0.017
Knowledgeable	85	88.54	161	76.67		
School problem with child's med	11	11.96	35	18.13		0.185
Asthma Control Measures						
No Control Problems	5	4.13	10	4.35		0.924
Uncontrolled asthma	116	95.87	220	95.65		
ATAQ Better Asthma Control	112	92.56	96	41.92	0.06 (0.03-0.12)	0.000
Outcomes						
Unscheduled asthma visit	33	27.27	132	57.39	3.6	0.000
	88	72.73	98	42.61		

Notes:
Source: Boston Children's Hospital SICAS baseline and follow-up data.
Odds ratio displayed only with significant p-values from Pearson chi-squared relationships.
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else. Odds ratios are explaining very uncontrolled asthma.
** all Ns had <1% missing except for child gender (1.8%), employed (2.3%), income (17.4%), Medicaid or Medicaid Managed Care Child Health Insurance (3.1%), neighborhood (7.4%), asthma knowledge (8.6%) and asthma self-efficacy (12.8%) and stopping medications early (15.7%)

Table 25. Child and Parent Characteristics, AMBs and Child Asthma Outcomes by Asthma Control

Variable	Very uncontrolled asthma 142, (40.6%)		Better controlled Asthma 208 (59.4%)		Odds Ratio* (95% CI)	p values**
Sociodemographics						
Child Age, M (SD), y						
4-6 years old	40	28.17	55	26.44		0.721
7-13 years old	102	71.83	153	73.56		
Child Gender: Female	59	41.55	105	50.48		0.100
Male	83	58.45	103	49.52	1.44 (0.94-2.22)	
Child Race or Ethnic Group						0.999
White	6	4.23	9	4.33		
Black	49	34.51	71	34.13		
Hispanic	53	37.32	79	37.98		
Other	34	23.94	49	23.56		
Parent Gender (Male)	3	2.16	5	2.44		0.865
Parent Race						0.246
White	12	8.45	11	5.31		
Minority	130	91.55	196	94.69		0.246
Employed	97	70.29	157	76.96		0.166
Parent Income						0.503
≥$25,000	56	47.46	88	51.46		
Employed or ≥$25,000 annual household inco	101	71.13	168	80.77	--	0.036
Not employed and <$25,000 income	41	28.87	40	19.23	1.72 (1.04-2.83)	0.036
Parent Education						
Parent did not complete high school	32	22.54	35	16.83		0.183
Parent completed high school	110	77.46	173	83.17		
Current Health Insurance						0.317
Private insurance	31	22.63	56	27.45		
Medicaid, Medicaid Managed Care	106	77.37	148	72.55		0.317
Live in an apartment building	55	39.01	76	36.54		0.640
Homes in neighborhood not well maintained	42	31.11	26	13.68	0.35 (0.20-0.61)	0.000
Parent not married	110	77.46	136	65.38	0.54 (0.33-0.88)	0.013
2-4 People living in home	82	57.75	133	63.94		0.242
5 or more people in home	60	42.25	75	36.06		0.242
2 or more children living in home	109	76.76	174	83.65		0.107
Parent Perceived Stress Measures						
Parent Perceived Stress						0.508
Score of 0-4 (Low stress)	49	34.51	79	37.98		
Score of 5+ (Moderate to high stress)	93	65.49	129	62.02		
Parent Management Behaviors						

Ride public transportation, bike or walk to school	91	64.08	147	70.67		0.194
Prescribed ICS	96	68.09	120	57.97	0.65 (0.42-1.02)	0.062
ICS in hand	86	60.56	96	46.15	0.56 (0.36-0.87)	0.008
Not taking ICS med or not taking regularly	87	61.70	142	68.93		0.163
Taking ICS med some days or everyday	54	38.30	64	31.07		0.163
Several times a month to daily passive smoke	70	49.30	82	39.42	0.68 (0.44-1.04)	0.076
Have at least 1 pest in the home	121	85.21	156	75.00	0.52 (0.31-0.92)	0.021
Smokers in home	54	38.03	61	29.33	0.69 (0.44-1.08)	0.078
Skip Appointments	16	11.27	8	3.85	0.31 (0.13-0.75)	0.010
Child refuses to take medication	26	19.55	14	7.87	0.35 (0.17-0.70)	0.003
Child can take medications correctly	122	85.92	173	83.17		0.489
Asthma knowledge	120	84.51	173	83.17		0.740
Asthma action plan	90	63.83	135	65.22		0.790
Stop medications early	54	41.54	82	49.70		0.163
Lack asthma knowledge	34	25.76	26	15.03	0.51 (0.29-0.90)	0.019
School problem with child's med	31	25.00	15	9.38	.0.31 (0.16-0.60)	0.001
Outcomes						
Unscheduled asthma visit	84	59.15	81	38.94		0.000
	58	40.85	127	61.06	--	
Missed school	133	93.66	96	46.15	0.06 (0.03-0.12)	0.000
	9	6.34	112	53.85		

Notes:
Source: Boston Children's Hospital SICAS baseline and follow-up data.
Odds ratio displayed only with significant p-values from Pearson chi-squared relationships.
* calculated only if Pearson's Chi-squared showed a significant relationship. Did not control anything else. Odds ratios are explaining very uncontrolled asthma.
** all Ns had <1% missing except for child gender (1.8%), employed (2.3%), income (17.4%), Medicaid or Medicaid Managed Care Child Health Insurance (3.1%), neighborhood (7.4%), asthma knowledge (8.6%) and asthma self-efficacy (12.8%) and stopping medications early (15.7%)

Table 26. Odds Ratios of Characteristics and Mediating Variables with ED Visits in Multivariate Analysis

	Step 1	Step 2 + parent stress	Step 3 + asthma severity	Step 4 + Medication Management	Step 5 +Environment Management	Step 6 + Assessment Management	Step 7 + Education Management	Step 8 + Asthma knowledge & Self-efficacy	Step 9 + Asthma Control
Child race	3.59 (.060)	**4.07 (.041)**	3.53 (.065)	3.49 (.065)	3.18 (.089)	3.16 (.087)	3.14 (.089)	**7.14 (.036)**	**6.61 (.042)**
Housing	.88 (.541)	.86 (.458)	-0.21 (1.01)	.83 (.373)	**.66 (.049)**	**.63 (.031)**	**.64 (.035)**	.70 (.115)	.652 (.066)
Marital Status	**1.66 (.033)**	**1.62 (.042)**	1.58 (.055)	**1.67 (.032)**	**1.84 (.013)**	**1.79 (.017)**	**1.73 (.025)**	**2.05 (.006)**	**1.85 (.021)**
Transportation	**0.59 (.008)**	**0.58 (.006)**	**.52 (.001)**	**.51 (.001)**	**.49 (.001)**	**.50 (.001)**	**.51 (.001)**	**.45 (.001)**	**.50 (.003)**
Parent Stress		**1.68 (.014)**	**1.69 (.013)**	**1.77 (.008)**	**1.83 (.005)**	**1.73 (.011)**	**1.73 (.011)**	**1.56 (.047)**	**1.64 (.029)**
Prescribed ICS			.85 (0.563)	.99 (.984)	.94 (.821)	.92 (.763)	.90 (.699)	.73 (.319)	.73 (.309)
ICS medication			**4.21 (.000)**	**5.13 (.000)**	**5.72 (.000)**	**5.71 (.000)**	**5.82 (.000)**	**5.22 (.000)**	**4.80 (.000)**
Takes ICS				**.60 (.041)**	**.61 (.05)**	**.61 (.049)**	.63 (.070)	.69 (.160)	.71 (.199)
Smokers in home					**.52 (.000)**	**.54 (.001)**	**.55 (.001)**	**.54 (.001)**	**.54 (.002)**
Passive smoke					1.48 (.087)	1.45 (.104)	1.44 (.113)	1.36 (.217)	1.42 (.165)
Pests in home					**1.61 (.000)**	**1.57 (.000)**	**1.57 (.000)**	**1.54 (.001)**	**1.51 (.001)**
Missed Appointments						**2.35 (.017)**	**2.50 (.011)**	**2.74 (.007)**	**2.32 (.025)**
Asthma Action Plan							.87 (.526)	.77 (.263)	.78 (.300)
Asthma Knowledge								.60 (.164)	.59 (.166)
Asthma self-efficacy								1.05 (.486)	1.02 (.947)
Uncontrolled asthma									**.37 (.000)**
Controlled asthma									**.06 (.008)**
cons	1.02 (.991)	.44 (0.600)	.19 (.283)	.23 (.350)	.24 (.337)	.32 (.450)	.34 (.470)	.73 (.850)	.73 (.850)
N	1,281 (335)	1,281 (335)	1,272 (333)	1,271 (332)	1,266 (332)	1,266 (332)	1,260 (330)	1,047 (284)	1,047 (284)

Notes
* p<0.05; ** p<0.01
Controlling for 10 characteristics (child age, child gender, parent gender, household income/employment, parent education, parent marital status, people in home, medical insurance, transportation), child asthma severity and season.
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.

Table 27. Correlation Matrix of Independent and Dependent Variables

	ED visit	Child age	Child gender	Parent gender	Child race	Parent race	Socioeconomic	Parent education	Housing	Marital status	People in home	Child insurance	Neighborhood
ED visit	1.00												
Child age	-0.06	1.00											
Child gender	-0.06	-0.07	1.00										
Parent gender	-0.06	-0.04	0.04	1.00									
Child race	0.07	0.02	0.03	0.15	1.00								
Parent race	0.07	0.07	0.02	0.24	0.74	1.00							
Socioeconomic	0.03	-0.11	0.03	-0.08	-0.10	-0.08	1.00						
Parent education	0.02	-0.02	0.04	-0.06	-0.01	-0.06	0.13	1.00					
Housing	0.00	-0.11	-0.06	-0.03	0.16	0.12	-0.01	0.02	1.00				
Marital status	0.06	-0.03	-0.01	0.12	0.29	0.27	-0.26	-0.16	0.20	1.00			
People in home	0.03	0.02	0.09	-0.03	0.05	0.01	0.14	0.04	-0.06	-0.22	1.00		
Child insurance	0.01	0.00	-0.01	0.03	0.24	0.24	-0.33	-0.20	0.24	0.27	0.02	1.00	
Neighborhood	0.01	-0.05	0.09	0.07	0.09	0.02	-0.04	-0.03	0.12	0.07	0.16	0.10	1.00
Season 1	-0.27	0.04	0.03	0.02	0.01	0.01	-0.01	0.02	0.02	0.00	0.00	-0.03	-0.05
Season 2	-0.19	0.02	0.02	0.00	0.01	0.00	-0.01	0.02	0.02	0.00	-0.01	-0.01	-0.04
Season 3	-0.17	0.01	0.02	0.00	0.01	0.00	-0.01	0.02	0.01	0.00	-0.01	-0.01	-0.04
Season 4	-0.15	0.01	0.01	0.00	0.01	-0.01	-0.01	0.01	0.01	0.00	0.00	-0.01	-0.03
Transportation	-0.13	0.15	0.01	0.10	0.17	0.22	-0.24	-0.16	0.20	0.23	0.00	0.30	0.13
Parent stress	0.07	0.08	0.01	-0.12	-0.01	0.07	-0.16	-0.16	0.08	0.05	-0.04	0.05	0.09
Prescribed ICS	0.11	-0.06	-0.11	-0.03	0.02	0.04	0.09	0.03	0.08	0.04	-0.05	-0.07	0.00
ICS in hand	0.23	-0.15	-0.08	-0.04	0.02	0.00	0.07	0.05	0.06	0.07	-0.06	-0.02	0.02
Med administration	0.06	-0.03	-0.09	-0.11	-0.04	-0.03	0.04	0.08	0.10	0.06	-0.09	-0.06	0.04
Smokers in home	-0.08	0.07	0.00	0.02	0.08	0.04	-0.09	-0.09	-0.06	0.14	0.12	0.14	0.06
Passive smoke	0.04	0.05	-0.04	0.01	0.06	0.02	-0.05	-0.02	0.08	0.11	-0.08	0.09	0.02

Pests in home	0.15	-0.01	0.00	0.01	0.09	0.08	-0.08	-0.08	0.13	0.02	0.14	0.09	0.19
Missed appointm	0.16	0.01	-0.04	0.04	0.05	0.07	-0.04	0.06	0.10	0.03	0.20	0.14	0.14
AAP	-0.04	0.02	0.01	0.04	-0.02	0.03	0.01	0.18	0.06	-0.01	-0.05	-0.09	-0.07
Asthma knowledge	-0.02	0.03	0.03	-0.04	0.06	0.03	0.06	0.10	-0.01	0.01	0.04	-0.06	-0.10
Self-efficacy	0.02	-0.12	-0.05	-0.02	-0.11	-0.13	-0.04	-0.08	0.04	0.00	-0.08	0.00	0.05
L9	-0.07	-0.02	0.10	0.04	0.04	-0.03	0.16	0.14	-0.07	-0.18	0.10	0.00	0.11
Skip med.s	-0.02	0.21	0.06	-0.05	-0.04	-0.06	0.05	-0.03	-0.12	0.02	-0.08	0.01	0.00

	Transportation	Parent stress	Prescribed ICS	ICS in hand	Med administration	Smokers in home	Passive smoke	Pests in home	Missed appointment	AAP	Asthma knowledge	Self-efficacy	Stop med.s
Transportation	1.00												
Parent stress	0.03	1.00											
Prescribed ICS	-0.07	0.10	1.00										
ICS in hand	-0.08	0.08	0.58	1.00									
Med administration	-0.06	0.12	0.56	0.58	1.00								
Smokers in home	0.16	0.09	-0.05	-0.06	0.00	1.00							
Passive smoke	0.13	0.11	0.02	0.02	0.08	0.42	1.00						
Pests in home	0.09	0.06	-0.03	-0.06	-0.10	0.09	0.10	1.00					
Missed appointm	0.00	0.12	0.02	0.06	0.02	0.04	0.08	0.15	1.00				
AAP	0.07	-0.06	0.12	0.19	0.22	0.02	0.06	-0.05	0.04	1.00			
Asthma knowledge	-0.08	-0.05	0.04	0.02	0.04	-0.02	0.01	-0.03	-0.06	0.05	1.00		
Self-efficacy	0.00	0.09	0.05	0.10	0.11	-0.07	-0.03	0.00	0.04	-0.04	-0.20	1.00	
Stop med.s	0.02	-0.08	-0.01	-0.02	0.03	0.01	-0.01	-0.08	-0.10	0.07	0.07	-0.06	1.00

Table 28. Odds Ratios of Characteristics and Mediating Variables with Missed School in Multivariate Analysis

	Step 1 + Medication Management	**Step 2 + Environment Management**	**Step 3 + Assessment Management**	**Step 4 + Education Management**	**Step 5 + Asthma knowledge & Self-efficacy**	**Step 6 + Asthma Control**
			Odds Ratio (p value)			
Parent Stress	1.129 (.486)	1.096 (.599)	1.032 (.855)	1.027 (.878)	1.046 (.809)	1.138 (.485)
Administer ICS med some/everyday	.787 (.279)	.786 (.278)	.783 (.269)	.801 (.324)	.742 (.199)	.762 (.240)
Smoker(s) in home		1.015 (.909)	1.028 (.834)	1.029 (.831)	1.000 (1.00)	.970 (.828)
Passive smoke exposure		1.191 (.320)	1.175(.363)	1.152 (.426)	1.086 (.669)	1.244 (.286)
≥ 1 type of pest in home		1.146 (.130)	1.126 (.194)	1.126 (.195)	1.102 (.319)	1.084 (.446)
Missed Healthcare Appointments			2.168 (.021)	2.007 (.042)	1.785 (.095)	1.410 (.328)
Asthma action plan				.871 (.444)	.847 (.398)	.844 (.377)
Asthma knowledge					.673 (.154)	.745 (.340)
Lack of self-efficacy					1.479 (.080)	***1.490 (.070)***
Uncontrolled asthma						**.126 (.000)**
Controlled asthma						**.128 (.000)**
constant	.0725 (.061)	.069 (.055)	.087 (.079)	.090 (.084)	.216 (.314)	.730 (.835)
N	1271 (332)	1266 (332)	1266 (332)	1260 (330)	1047 (284)	1047 (284)

Notes:
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.
Generalized estimation equations used for model.
Controlling for 12 characteristics (child age, child gender, parent gender, child race, household income/employment, parent education, housing, parent marital status, people in home, medical insurance, transportation), child asthma severity and season.

Table 29. Odds Ratios of Characteristics and Mediating Variables with Asthma Control in Multivariate Analysis

	Step 1 + Medication Management	**Step 2 + Environment Management**	**Step 3 + Assessment Management**	**Step 4 + Education Management**	**Step 5 + Asthma knowledge & Self-efficacy**
		Odds Ratio (p value)			
Parent Stress	1.102 (.630)	1.110 (.608)	1.183 (.414)	1.169 (.448)	1.234 (.339)
Administer ICS med some/everyday	1.472 (.119)	1.451 (.137)	1.429 (.155)	1.408 (.179)	1.446 (.174)
Smoker(s) in home		0.958 (.785)	0.934 (.665)	0.944 (.716)	0.967 (.840)
Passive smoke exposure		1.043 (.583)	1.085 (.723)	1.086 (.721)	1.113 (.668)
≥ 1 type of pest in home		0.854 (.176)	0.890 (.321)	0.894 (.341)	0.934 (.586)
Missed Healthcare Appointments			**0.445 (.018)**	**0.484 (.038)**	**0.487 (.049)**
Asthma action plan				1.092 (.675)	1.118 (.628)
Asthma knowledge					***1.873 (.068)***
Lack of self-efficacy					.858 (.558)
cons	1.499 (.349)	5.206 (.305)	3.607 (.424)	3.846 (.402)	3.133 (.532)
N	1,212 (308)	1,207 (308)	1,207 (308)	1,201 (306)	1004 (265)

Notes:
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.
Generalized estimation equations used for model.
Controlling for 12 characteristics (child age, child gender, parent gender, child race, household income/employment, parent education, housing, parent marital status, people in home, medical insurance, transportation), child asthma severity, and season.

Table 30. Odds Ratios of Characteristics and Mediating Variables with Parent Stress in Multivariate Analysis

	Step 1		**Step 2 + Asthma severity**		**Step 3 + Asthma self-efficacy**		**Step 4 + Asthma knowledge**	
	Odds Ratio (p value)							
Income/employment	**0.486**	**(0.037)**	**0.490**	**(0.040)**	**0.469**	**(0.042)**	***0.503***	***(0.068)***
Parent education	**0.416**	**(0.021)**	**0.379**	**(0.014)**	**0.421**	**(0.042)**	0.501	(0.114)
Prescribed an ICS Controller Inhaler			1.306	(0.442)	1.358	(0.422)	1.396	(0.385)
Has an ICS Controller Inhaler			0.968	(0.924)	1.004	(0.991)	1.027	(0.943)
Lack of self-efficacy					1.614	(0.184)	1.256	(0.586)
Asthma knowledge							0.451	(0.272)
cons	1.380 (0.739)		1.307 (.787)		.734 (0.775)		1.364 (0.795)	
N	302		300		262		251	
R^2	0.054		0.057		0.061		0.056	

Notes:
Source: Boston Children's Hospital baseline SICAS data.
Generalized estimation equations used for model.
Controlling for 10 characteristics (child age, child gender, parent gender, child race, housing, parent marital status, people in home, medical insurance, transportation) and season.

Table 31. Odds Ratios of Characteristics with Medication Administration in Multivariate Analysis

	Model 1		**Model 2 + Asthma knowledge & Self-efficacy**	
Variable	**OR (p value)**			
Child age	1.108	(0.219)	1.110	(0.269)
Child gender	0.676	(0.224)	0.701	(0.327)
Parent gender	0.154	(0.099)	omitted	
Child race	0.323	(0.143)	0.371	(.318)
Income/employment	0.915	(0.840)	1.189	(0.720)
Parent education	1.370	(0.528)	0.703	(0.546)
Housing	0.970	(0.932)	1.078	(0.848)
Marital status	1.388	(0.403)	1.633	(0.262)
People in Home	0.938	(0.858)	1.061	(0.881)
Insurance	0.783	(0.540)	0.792	(0.609)
Transportation	0.954	(0.896)	0.785	(0.568)
Neighborhood	1.999	(0.094)	1.872	(0.179)
Parent Stress	1.370	(0.348)	1.399	(0.360)
Prescribed ICS	-		-	
ICS in Hand	**31.06**	**(0.000)**	**21.86**	**(0.000)**
Missed Appointment	0.870	(0.836)	1.260	(0.745)
Asthma action plan	**2.557**	**(0.012)**	**3.510**	**(0.004)**
Asthma knowledge			**15.23**	**(0.010)**
Asthma self-efficacy			**3.352**	**(0.025)**
Stopped medications			**0.350**	**(0.004)**
cons	1.289081 (0.10)		.003	(0.003)
N	304		239	
R2	0.3511		0.3499	

Notes: Controlling for season.
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.

Table 32. Odds Ratios of Characteristics with Missed Appointments in Multivariate Analysis

	Model 1	**Model 2 + Asthma knowledge & Self-efficacy**
Variable	**OR (p value)**	
Child age	1.168 (0.303)	1.249 (0.180)
Child gender	0.447 (0.162)	0.644 (0.470)
Parent gender	omitted	omitted
Child race	omitted	omitted
Income/employment	0.813 (0.738)	1.236 (0.763)
Parent education	1.543 (0.576)	1.991 (0.437)
Housing	1.765 (0.304)	1.444 (0.550)
Marital status	1.982 (0.328)	1.640 (0.500)
People in Home	**5.890 (0.003)**	**4.987 (0.012)**
Insurance	**9.437 (0.060)**	**11.495 (0.038)**
Transportation	0.446 (0.215)	0.482 (0.307)
Neighborhood	**6.755 (0.001)**	**7.610 (0.001)**
Parent Stress	**5.342 (0.042)**	**5.202 (0.050)**
Prescribed ICS	1.297 (0.763)	0.793 (0.808)
ICS in Hand	0.967 (0.968)	1.721 (0.563)
Asthma action plan		
Asthma knowledge		***0.127 (0.062)***
Asthma self-efficacy		0.490 (0.425)
Stopped medications		
cons	.0002575 (0.001)	.0004721 (0.004)
N	281	237
R2	0.2743	0.2957

Notes:
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.
Controlling for season.

Table 33. Odds Ratios of Characteristics with Having an Asthma Action Plan in Multivariate Analysis

	Model 1		**Model 2 + Asthma knowledge & Self-efficacy**	
Variable	**OR (p value)**			
Child age	1.059	(0.427)	1.045	(0.588)
Child gender	1.134	(0.630)	1.130	(0.680)
Parent gender	2.367	(0.307)	3.298	(0.194)
Child race	0.701	(0.509)	0.788	(0.714)
Income/employment	0.974	(0.937)	0.688	(0.347)
Parent education	**2.695**	**(0.004)**	**2.943**	**(0.008)**
Housing	1.140	(0.645)	1.386	(0.328)
Marital status	1.043	(0.895)	0.880	(0.722)
People in Home	0.925	(0.780)	1.031	(0.923)
Insurance	0.711	(0.295)	0.607	(0.190)
Transportation	1.618	(0.095)	**1.956**	**(0.049)**
Neighborhood	0.905	(0.762)	0.724	(0.377)
Parent Stress	1.029	(0.918)	0.845	(0.591)
Prescribed ICS	1.077	(0.828)	0.962	(0.922)
ICS in Hand	**2.696**	**(0.005)**	**2.129**	**(0.057)**
Missed Appointment	0.734	(0.585)	0.875	(0.831)
Asthma action plan				
Asthma knowledge			1.478	(0.544)
Asthma self-efficacy			0.872	(0.750)
Stopped medications				
cons	.0619 (0.159)		.0458 (0.154)	
N	305		255	
R2	0.0847		0.0857	

Notes:
* p<0.05; ** p<0.01
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.
Controlling for season.

Table 34. Odds Ratios of Characteristics with Pests in Home, Passive Smoke and Smokers in Home in Multivariate Analysis

	Pests in Home Model	**Passive Smoke Model**	**Smokers in Home Model**
		OR (p value)	
Child age	0.991 (0.85)	1.080 (0.19)	1.036 (0.607)
Child gender	1.005 (0.98)	0.964 (0.87)	0.994 (0.980)
Parent gender	.969 (0.96)	1.971 (0.42)	0.951 (0.956)
Child race	2.07 (0.14)	.4580 (.072)	0.442 (0.123)
Income/employment	**0.652 (0.07)**	1.135 (0.64)	1.090 (0.787)
Parent education	**0.609 (0.04)**	.988 (0.97)	1.023 (0.946)
Housing	1.34 (0.13)	1.280 (0.28)	0.701 (0.193)
Marital status	.912 (0.68)	1.542 (0.12)	**2.081 (0.023)**
People in Home	**2.00 (.000)**	0.712 (0.16)	1.178 (0.543)
Insurance	.841 (0.43)	1.55 (0.12)	**2.609 (0.005)**
Transportation	1.067 (0.70)	1.051 (0.80)	1.209 (0.511)
Neighborhood	**1.790 (.002)**	.906 (0.61)	1.323 (0.362)
Parent Stress	1.12 (0.54)	**1.653 (.037)**	1.120 (0.676)
cons	1.58 (0.750)	0.034 (0.073)	.194 (0.428)
N	1,222	1,219	309
R2	na	na	0.0572

Notes:
Controlling for season.
Source: Boston Children's Hospital SICAS data, baseline and follow-up data for Pests in Home Model and Passive Smoke Model. Baseline data for Smokers in Home Model only.

Table 35. Odds Ratios of Characteristics and Mediating Variables with Emergency Department Visits in Multivariate Analysis in a Lagged Model

ED Visits (GEE)	**Without a Lag**	**Pests and Passive Smoke in Home Lags**	**Asthma Control Lag**
	Correlation coefficient (p value)		
Child age	-0.050 (0.90)	-0.045 (0.82)	-0.007 (0.09)
Child gender	-0.173 (0.82)	-0.189 (0.89)	-0.094 (0.32)
Parent Gender	-1.254 (1.90) .2854 (.057)	-1.219 (1.86)	-1.723 (2.09)*
Child Race (minority)	1.888 (2.03)* 6.6087 (.042)	1.921 (2.07)*	1.539 (1.27)
Employed or income >25K	0.091 (0.34)	0.083 (0.30)	-0.094 (0.26)
Parent education (Graduated HS)	0.087 (0.29)	0.030 (0.10)	-0.041 (0.10)
Housing (Apartment)	-0.428 (1.84)	-0.351 (1.51)	-0.585 (1.73)
Marital Status (Not married)	0.617 (2.31)* 1.8542 (.021)	0.582 (2.20)*	0.923 (2.42)*
People in Home (>5 people)	0.287 (1.24)	0.269 (1.16)	0.315 (0.99)
Health Insurance (Medicaid)	-0.169 (0.64)	-0.223 (0.84)	0.235 (0.61)
Transportation (bus or walk)	-0.685 (2.95)** .50399 (.003)	-0.635 (2.76)**	-1.073 (3.35)**
Parent Stress	0.497 (2.18)* 1.6446 (.029)	0.526 (2.30)*	0.371 (1.15)
Prescribed ICS	-0.320 (1.02)	-0.177 (0.57)	0.415 (0.88)
ICS medication in hand	1.568 (5.41)** 4.7951 (.000)	1.505 (5.24)**	1.984 (4.64)**
Takes ICS	-0.345 (1.29)	-0.382 (1.43)	-0.700 (1.94)
People in home who smoke	-0.621 (3.17)** .5372 (.002)	-0.553 (2.94)**	-0.747 (2.54)*
Passive smoke	0.349 (1.39)	-0.050 (0.21)	0.150 (0.39)
Pests in home	0.412 (3.23)** 1.5102 (.001)	0.231 (1.84)	0.342 (1.71)
Missed Appointments	0.843 (2.24)* 2.3231 (.025)	0.970 (2.57)*	1.295 (2.64)**
AAP (K11)	-0.242 (1.04)	-0.207 (0.89)	-0.346 (1.08)
Asthma Knowledge (K8)	-0.533 (1.38)	-0.551 (1.43)	-1.305 (2.62)**
Asthma self-efficacy (L8)	0.018 (0.07)	0.038 (0.14)	-0.206 (0.58)
Uncontrolled asthma	-1.003 (4.42)** .36685 (.000)	-1.003 (4.44)**	-0.708 (2.12)*
Controlled asthma	-2.799 (2.64)** .06089 (.008)	-2.925 (2.76)**	-0.444 (0.61)
cons	0.875 (0.51)	1.049 (0.61)	0.714 (0.32)
N	1,047	1,046	774

Notes
ORs displayed under correlation coefficients in selected variables for further description.
Controlling for season.
Source: Boston Children's Hospital SICAS data, baseline and follow-up data

Table 36. Sensitivity Test of Parent Stress in ED Visit Model

ED Visit Model (GEE)	**ED model with parent stress continuous measure**	**ED model with parent stress continuous measure**
	Correlation coefficient (p value)	
Child age	-0.040 (0.77)	-0.033 (0.63)
Child gender	-0.182 (0.93)	-0.175 (0.90)
Parent Gender	-0.880 (1.44)	-0.938 (1.53)
Child Race (minority)	1.152 (1.71) 3.16459 (.087)	1.044 (1.54)
Employed or income >25K	-0.098 (0.40)	-0.106 (0.43)
Parent education (Graduated HS)	0.099 (0.37)	0.060 (0.23)
Housing (Apartment)	-0.465 (2.16)* .62829 (.031)	-0.444 (2.07)*
Marital Status (Not married)	0.583 (2.39)* 1.790541 (.017)	0.563 (2.31)*
People in Home (>5 people)	0.283 (1.33)	0.246 (1.16)
Health Insurance (Medicaid)	0.023 (0.09)	0.004 (0.01)
Transportation (bus or walk)	-0.689 (3.33)** .5019142 (.001)	-0.687 (3.32)**
Parent Stress dichotomous	0.547 (2.55)* 1.728849 (.011)	
Parent Stress continuous		0.056 (1.74) 1.057832 (.081)
Prescribed ICS	-0.085 (0.30)	-0.093 (0.33)
ICS medication in hand	1.742 (6.55)**	1.710 (6.48)**
Takes ICS	-0.492 (1.97)*	-0.419 (1.70)
People in home who smoke	-0.625 (3.39)**	-0.622 (3.36)**
Passive smoke	0.375 (1.63)	0.368 (1.60)
Pests in home	0.449 (3.87)**	0.446 (3.87)**
Missed Appointments	0.853 (2.40)*	0.868 (2.43)*
cons	-1.132 (0.75)	-0.865 (0.58)
N	1,266	1,266

Notes
* p<0.05; ** p<0.01
ORs displayed under correlation coefficients in selected variables for further description.
Controlling for season.
Source: Boston Children's Hospital SICAS data, baseline and follow-up data.

Table 37. ATAQ Continuous Asthma Control Model and Maximum Symptom Models

GEE models **Range**	**ATAQ Control continuous Model** **1-7**	**Maximum Symptom Model** **0-14**	**Maximum Symptom Model** **0-42**
	Correlation coefficient (p value)		
Child age	0.020 (0.77)	-0.121 (1.58)	-0.183 (1.32)
Child gender	0.165 (1.71)	0.109 (0.39)	0.357 (0.69)
Parent Gender	0.146 (0.44)	1.182 (1.22)	1.720 (0.97)
Child Race	0.232 (0.95)	-0.150 (0.21)	-0.581 (0.44)
Employed or income >25K	0.224 (1.78)	-0.574 (1.55) .5635 (.120)	-1.274 (1.90) .2796 (.058)
Parent edu	-0.082 (0.59)	-0.235 (0.58)	-0.302 (0.41)
Apartment	-0.161 (1.52)	-0.050 (0.16)	0.201 (0.35)
Marital status	-0.145 (1.23)	-0.290 (0.84)	-0.627 (1.00)
LiveTogether5	-0.073 (0.68)	-0.178 (0.56)	-0.014 (0.02)
Insurance: Medicaid	-0.189 (1.58)	0.486 (1.39)	0.730 (1.14)
Neighborhood	-0.153 (1.37)	0.200 (0.59)	0.533 (0.90)
Transportation	0.121 (1.22)	-0.042 (0.14)	-0.085 (0.16)
Parent stress	0.001 (0.01)	0.417 (1.38)	0.716 (1.30)
Prescribed ICS	0.045 (0.36)	-0.679 (1.85) .5069 (.065)	-1.231 (1.85) .29206907 (.065)
ICS med in hand	-0.550 (5.01)** .57708 (.000)	1.364 (4.13)** 3.9106 (.000)	2.458 (4.26)** 11.679 (.000)
Medication administration	0.163 (1.22)	-0.028 (0.07)	0.161 (0.23)
People in home who smoke	-0.102 (1.30)	0.339 (1.47) 1.404 (.142)	0.556 (1.33)
Passive smoke	0.025 (0.23)	-0.036 (0.11)	0.188 (0.34)
Pests	-0.098 (1.81)	0.479 (2.91)** 1.6138 (.004)	0.633 (2.22)* 1.8835 (.026)
Missed Appointments	-0.634 (2.89)** .53047 (.004)	1.518 (2.35)* 4.5621 (.019)	2.610 (2.23)* 13.604 (.026)
AAP	-0.040 (0.38)	-0.120 (0.39)	-0.169 (0.30)
cons	4.835 (6.18)**	0.579 (0.25)	0.964 (0.23)
N	1,201	1,201	1,201

Notes
* p<0.05; ** p<0.01
ORs displayed under correlation coefficients in selected variables for further description.
Controlling for season.
Source: Boston Children's Hospital SICAS data, baseline and follow-up data