

Abstract

Maternal depressive symptoms, asthma management self-efficacy, patient-healthcare provider relationship, and asthma management in children

Background: The presence of depressive symptomology in female primary caregivers of children with asthma has been shown to impact child asthma outcomes. However, there is a dearth of research related to the underlying individual and family level factors that impact this relationship among an ethnically diverse population. The objective of the current study was to examine how maternal depressive symptoms are associated with child pulmonary function and medication adherence through parent and child asthma management self-efficacy and the patient-healthcare provider relationship.

Methods: The current study was part of a larger, longitudinal study recruiting Latino and Non-Latino Black children with asthma ranging from 10-17 years old from outpatient clinics in the Bronx, New York. 153 female primary caregiver-child dyads participated in the current study. The Center for Epidemiologic Studies Depression Scale (CES-D) assessed maternal depressive symptoms. The Parent and Child Asthma Management Self-Efficacy Scales (P-ASE and C-ASE, respectively) were used to measure parent and child asthma perceived self-efficacy. The Medication Adherence Rating Scale (MARS) was used to assess self-reported asthma medication adherence. The Patient-Healthcare Provider Relationship was measured by a subscale of the Asthma Illness Representation Scale (AIRS). Pulmonary function was measured with spirometry (assessed by percent predicted FEV₁).

Results: The sample was comprised of female primary caregivers who as a majority, self-identified as non-Latino Black (35.3%) or Puerto Rican (33.3%). Of the participating children, the mean age was 13.31 (SD = 2.3), with 52% identifying as male and 48% identifying as female. Higher maternal depressive symptoms were significantly associated with lower child asthma attack prevention-specific self-efficacy ($a = -3.07, p = 0.01$). The parent attack prevention subscale of the P-ASE was significantly correlated with the total score on the patient-health care provider subscale ($r = .239, p < .01$), indicating that better self-efficacy related to attack prevention was associated with a stronger patient-provider relationship. The interaction effect between maternal depressive symptoms x child age for parent asthma management self-efficacy was significant ($\beta = 1.26, p = 0.04$). This demonstrated that for younger children, as maternal depressive symptoms increased, parent perceived asthma management self-efficacy decreased. Neither parent ($ab = -0.05, 95\% \text{ CI } [-0.88, 1.12]$) nor child ($ab = 0.02, 95\% \text{ CI } [-0.03, 0.11]$) asthma management self-efficacy mediated the relationship between maternal depressive symptoms and child pulmonary function. Neither the patient-healthcare provider relationship ($ab = -0.02, 95\% \text{ CI } [-0.11, 0.03]$) nor child asthma management self-efficacy ($ab = 0.01, 95\% \text{ CI } [-0.03, 0.08]$) mediated the relationship between maternal depressive symptoms and medication adherence.

Discussion: Mediation did not occur in any of the statistical models. The present study was innovative in examining the associations between maternal mental health and child asthma outcomes among an ethnically diverse population. Maternal depressive symptoms were associated with prevention-specific aspects of child asthma management self-efficacy, which stresses the importance of considering both the child and mother individually and as a dyad in

pediatric asthma care. Results of the study also reinforce the importance of considering the quality of the patient-provider relationship and how this relationship may impact perceived self-efficacy related to asthma management. The findings additionally highlight the importance of considering the mental health of the mother and the implications of maternal mental health on child asthma outcomes. It is imperative that pediatric providers not only increase discussions around effective asthma management and care to both the mother and the child, but also consider the role of maternal depressive symptoms.

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relationship, and asthma management in children

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Introduction

Asthma Prevalence

Asthma is the most commonly diagnosed childhood chronic illness (ALA, 2012), affecting an estimated 6.2 million (8.4% of) American children (CDC, 2014). Asthma is a respiratory disease of the airways, characterized by sensitive airways, reversible airway obstruction, inflammation, production of mucus, and pervasive narrowing which can lead to a complete loss of air in the case of acute attacks (Waxmonsky et al., 2006). Prevalence, morbidity, and mortality rates of the disease in the United States have steadily increased over the past decade. Asthma is the leading cause of limitation in physical activity in children (Bai, Hillemeier, & Lengerich, 2007). There were 14.4 million school absences in 2008, for which asthma was the primary reason (ALA, 2012). Asthma incurs \$56.0 billion dollars in costs annually (Barnett & Nurmagambetov, 2011), creating a chief public health concern.

Asthma prevalence is higher among Black individuals (11.2%) compared to White (7.7%) and Latino (6.5%) individuals, revealing critical ethnic and racial disparities (CDC, 2014). In New York City (NYC), the child lifetime prevalence rate (16.1%) is higher than the national average (13.3%) (Schwarz et al., 2008), with inner-city minority children affected at substantially greater rates (Crocker et al., 2009). Rates of hospitalization due to asthma in NYC are 1.8 times higher as compared to national rates (Corburn, Osleeb, & Porter, 2006). An increasing linear trend of asthma prevalence was also found in poor children compared to near-poor and non-poor children (Akinbami, Simon, & Rossen, 2016). Specifically in the Bronx, there is an increased disease prevalence which produces the highest asthma burden and rates of child hospitalizations in NYC (Schwarz et al., 2008). The Bronx has among the highest child asthma prevalence and asthma-related hospitalization rates and is one of the most socio-economically

disadvantaged areas of the United States (Schwarz et al., 2008). Asthma prevalence rates among Non-Latino Black children (14.3%) and Latino children (11.7%) in the Bronx are higher than all other groups, with the most elevated rates seen in Puerto Rican children (16.1%) (Akinbami et al., 2012; Akinbami, Simon, & Rossen, 2016). Among Latino subgroups, Puerto Ricans have the highest prevalence, morbidity, and mortality rates (Akinbami et al., 2012; Akinbami, Simon, & Rossen, 2016; CDC, 2014). Compared to White children, Puerto Rican and Black children display higher rates of emergency department utilization (Canino et al., 2012). In addition, Black children have a significantly higher rate of overnight hospitalizations and mortality compared to their White peers (Akinbami et al., 2012).

Despite these ethnic and racial discrepancies in asthma prevalence, morbidity, and mortality, limited research addresses the underlying causal mechanisms of the differences (Canino et al., 2006). It has been established that genetic factors such as varying lung volume capacity contribute to this variation across racial/ethnic groups (Chen et al., 2013). Additional pathways have been investigated including the impact of asthma beliefs, environmental factors, and health care system characteristics (Canino et al., 2006), but none of these factors have been clearly supported as the cause of differences in asthma health outcomes. As the literature base is relatively limited, research focusing on factors directly impacting asthma morbidity among the Latino and Black pediatric population is crucial.

Maternal Depressive Symptoms:

Depression is a highly prevalent psychological illness that majorly impacts an individual's daily functioning and quality of life (Gaynes, Burns, Tweed, & Erickson, 2002). Women are two times as likely to be diagnosed with depression, disproportionately affecting women in their 20's and 30's who are considered of child bearing age (Desai & Jann, 2000). At a

global level, depression is the leading mental health concern diagnosed in mothers and produces a myriad of negative consequences for their children (De Castro et al., 2017). For inner-city women, factors such as poverty, poor socioeconomic status, unemployment, and giving birth at a young age put women at an increased risk for depression (Heneghan, Silver, Bauman, Westbrook, & Stein, 1998). Among adults with asthma, research indicates that the prevalence of depressive symptoms, as measured by the Center for Epidemiologic Studies Depression Scale (CES-D), was 18%, compared to adults without asthma (Eisner, Katz, Lactao, & Iribarren, 2005). Results of this study indicated that depressive symptoms reported by these adults with asthma were associated with decreased asthma-related quality of life, decreased physical health status, increased asthma severity ratings, and increased likelihood of hospitalization (Eisner et al., 2005). In addition, as observed in a mostly female, African American sample of women with asthma who were hospitalized for an acute asthma exacerbation, depressive symptoms (as also measured by CES-D) were shown to be associated with poor asthma treatment adherence (Smith et al., 2006).

Maternal depression not only impacts the mother herself, but also the child. Robust research efforts indicate that these maternal depressive symptoms pose a negative influence on a child's developmental progress, behavior, mental health, pursuit of health care, and overall safety (Lim, Wood, & Miller, 2008). Additionally, there is a profound literature base suggesting that maternal depression is a likely risk factor for negative health outcomes in children (Easter, Sharpe, & J. Hunt, 2015). Previous studies suggest that mothers of children with chronic illness endorse higher overall prevalence of depressive symptoms (Jaser, Whittemore, Ambrosino, Lindemann, & Grey, 2007; Yuksel et al., 2007). It has also been shown that having a child with

chronic illness is enough of a risk factor for developing depression among mothers (Heneghan, Silver, Bauman, & Stein, 2000).

More specifically, mothers of children with asthma demonstrate elevated rates of depressive symptoms compared to mothers of children who do not have an asthma diagnosis (Easter et al., 2015; Shalowitz, Berry, Quinn, & Wolf, 2001). As seen in an urban, low-socioeconomic sample of caregivers of children with asthma, 43% of mothers met criteria for depression as measured by the Beck Depression Inventory (BDI), compared to 17.5% of mothers of children without asthma (Leão et al., 2009). Among Black children with physician-rated severe asthma status, prevalence for maternal depressive symptoms as measured by the Center for Epidemiological Studies Depression Scale (CES-D) was noted at over 60% (Otsuki et al., 2010). Compared to mothers of healthy children, a meta-analysis of over 25,000 caregivers demonstrated a medium effect size for increased depressive symptoms noted in the 4,300 mothers of children with asthma (Easter et al., 2015). As a result, there are various hypotheses as to why this population of mothers of children with asthma display increased symptoms of depression. Although the research design of previous studies did not support causality, some investigators infer that the stress of caring for a child with asthma causes the mother to develop depression (Wood et al., 2018). Conversely, the longitudinal study of urban Black families demonstrated that baseline maternal depressive symptoms (measured by CES-D) predicted child asthma symptoms at follow-up, but baseline child asthma symptoms did not significantly predict maternal depressive symptoms at follow-up (Otsuki et al., 2010). These findings suggest maternal depressive symptoms may have a causal effect on childhood asthma control. Moreover, it is likely that managing a child with a chronic disease such as asthma contributes to the

mother's experience of depression, but further research is needed to understand the directionality of these variables.

Maternal Depressive Symptoms, Self-Efficacy, and Asthma Management

Depressive symptomology can have a negative impact on the way caregivers provide disease management (Kessler, 1997), and research suggests a strong impact of maternal depressive symptomology on child asthma control (Shalowitz et al., 2001; Wood et al., 2018). . Asthma management is complex and involves meticulous monitoring of symptoms and triggers and adherence to a variety of medications. The presence of high levels of depressive symptoms in mothers of children with asthma can have a negative influence on a mother's ability to successfully manage her child's asthma, negatively affecting the child's medication adherence and overall medical outcomes (Bender, 2006; Butz, Eggleston, Huss, Kolodner, & Rand, 2000; Wood et al., 2002). The endorsement of depressive symptoms by mothers of children with asthma has been shown to be a risk factor for emergency department (ED) use (Bartlett et al., 2001) and for lower pulmonary function (Feldman et al., 2013) among inner-city children with asthma.

Self-efficacy, or the confidence in one's knowledge and ability to perform asthma-related duties (Martínez, Pérez, Ramírez, Canino, & Rand, 2009), has been shown to be strongly associated with asthma management (Bartlett et al., 2004), whereby increased self-efficacy is associated with better asthma management. Asthma management requires extensive participation by caregivers, including assessing and monitoring symptoms, preventing exposure to triggers, administering preventative inhaled corticosteroid (ICS) medication, managing acute exacerbations, and communicating with providers (NIH, 2007). In a sample of Puerto Rican mothers and children aged 5-12, mothers who endorsed high levels of maternal depressive

symptoms reported lower levels of asthma management self-efficacy and sense of confidence in their capacity to aptly take care of their child with asthma (Martínez et al., 2009). As seen among an inner-city, African American sample of families with children aged 4-11, mothers who endorsed high levels of depressive symptoms measured by the CES-D were 40% more likely to take their child to the emergency room compared to mothers with low levels of symptomology (Bartlett et al., 2001). Among this same sample, in contrast to mothers with low levels of depressive symptoms, mothers with elevated depressive symptoms were eight times more likely to endorse they did not know how to use or understand the functionality of their child's asthma medications and felt like they do not know how to address an asthma exacerbation at home (Bartlett et al., 2004). These mothers were also shown to feel less able to cope with challenges that arise in asthma management and as a result, were more likely to misinterpret symptoms and feel overwhelmed by their child with asthma (Bartlett et al., 2004). Although these associations have been explored empirically, there have been no studies to date that have focused on asthma management self-efficacy with maternal depressive symptoms and asthma outcomes among low-income Latino and African American families.

The Biobehavioral Family Model (BBFM)

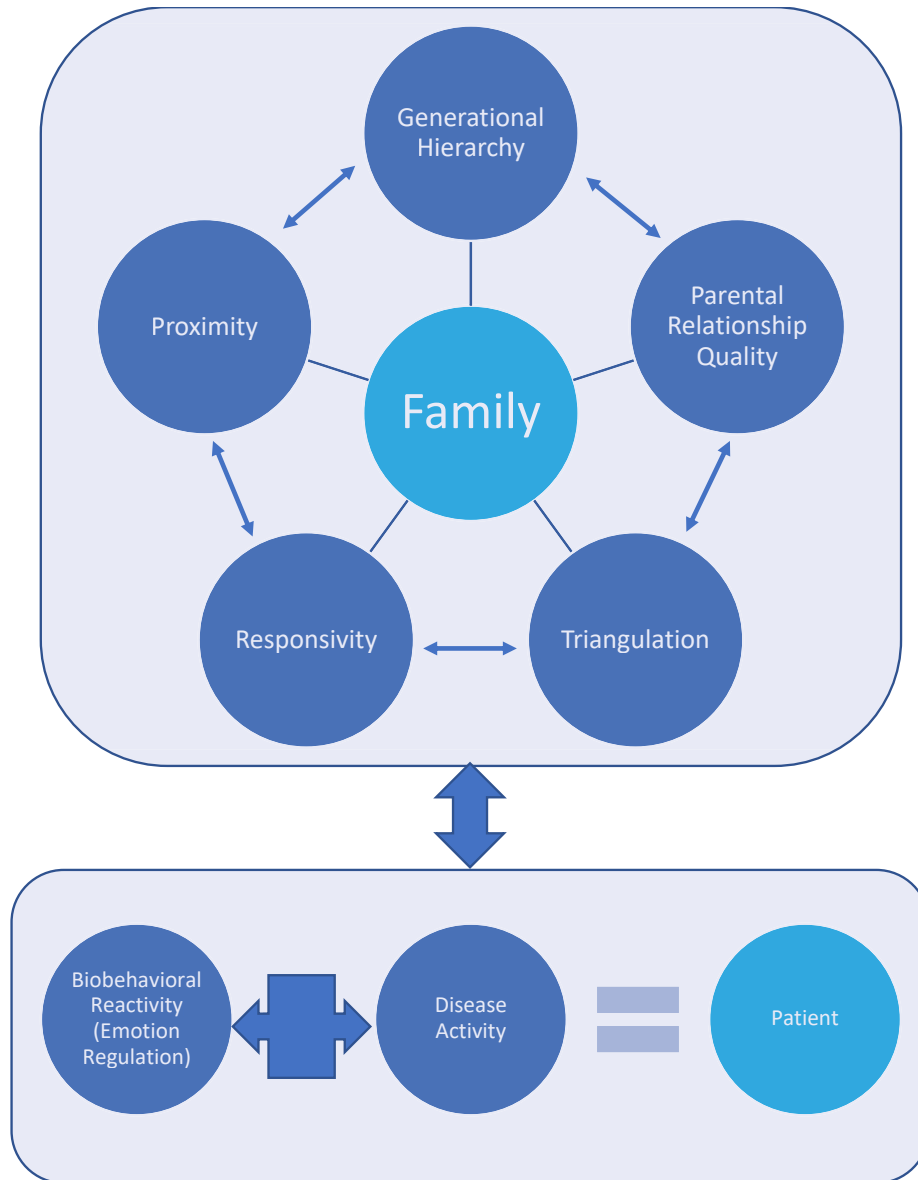
Maternal depression is one of the most prominent psychosocial factors associated with childhood asthma outcomes (Wood et al., 2018). The few studies that have addressed the impact of maternal depressive symptoms and parental characteristics on child asthma control have supported a strong association between maternal depressive symptoms and outcomes such as asthma morbidity and health care utilization (Pak & Allen, 2012). Lim Wood, Miller (2008) and Simmens (2011) used the multilevel biobehavioral family model (BBFM) to test various pathways in which parental depressive symptoms directly and indirectly influence child physical

and psychological health. The original BBFM is a biopsychosocial model rooted in neuroscience theory, suggesting that family relationship dynamics both impact and are impacted by the psychological and physical functioning of each family member within a family system (Wood, 1993). The model states that a patient's behavioral reactivity (emotion regulation) and disease activity are either protected or exacerbated by the family structure. The family structure is defined as the interaction between constructs of family proximity, generational hierarchy, parental relationship quality, interpersonal responsiveness, and triangulation (Wood, 1993).

Family proximity is defined by the patterns of sharing emotional, physical, and decision-making and/or problem-solving content within the family system. Generational hierarchy is delineated by the structural patterns of a family whereby the elders or parents are responsible for taking care of the younger family members and so forth (Wood, 1993). This construct may be impacted by culture as the familial and caretaking responsibilities of certain age groups within a family unit vary by culture. Parental relationship quality follows the assumption that the family system has two parents, to which the quality is assessed on a continuum of negative or dysfunctional to positive or functional. Interpersonal responsiveness is defined by the individual patterns of emotional and behavioral responsiveness and in this model, triangulation is conceptualized in two ways; 1) a coalition of the child with illness along with one parent against the other parent or 2) both parents enacting their entire focus on the child and the child's illness (Wood, 1993). This model was developed for the intention of integrating family patterns and disease processes and exploring the impact they have on one another.

Figure 1.

Biobehavioral Family Model Replicated from Wood (1993)



Wood, 1993 Diagram

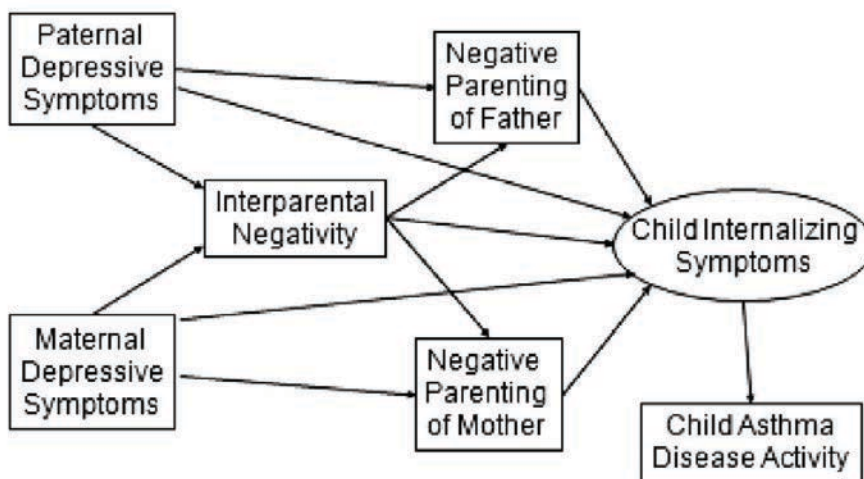
Results of the model applied to the pediatric asthma population support that the presence of a negative emotional climate in the family system of children with asthma is associated with

child emotional dysregulation and poor asthma disease activity (Wood, Klebba, & Miller, 2000). Negative emotional climate was explained by the following factors: first, when children with asthma perceived parental conflict within their family system, this was also associated with the presence of triangulation and insecure father-child relatedness (Wood et al., 2000). Further, triangulation and hopelessness perceived by the child with asthma were shown to have an impact on vagal activation, a method of airway compromise seen in asthma. As a result, children who perceived themselves and their asthma as the root of parental conflict were associated with worse asthma outcomes. Vagal activation was also shown to be associated with a negative interpersonal relatedness between the child and the male primary caregiver, specifically. Based on these findings, the team further adapted the model within the pediatric asthma population by introducing a new construct of parent-child interaction and attachment as a potential mediator of child psychological symptoms and asthma outcomes (Wood et al., 2000). The most recent version of the model was developed to further understand the complex associations between parental depressive symptoms and family interpersonal stress on child physical and emotional disease activity (Lim, Wood, Miller, & Simmens, 2011).

Figure 2.

Model of the Pathways of Effect of Paternal and Maternal Depressive Symptoms of Child

Internalizing Symptoms and Asthma Disease Activity from Lim, Wood, Miller, & Simmens (2011)



Lim, Wood, Miller, & Simmens (2011)

These findings suggested that the effect of maternal depressive symptoms on child asthma control may occur indirectly through mediating factors, which include negative parenting behaviors and child internalizing symptoms (Lim et al., 2011). As the pathways of effect from maternal depression to child asthma outcomes are not as strongly investigated, the current study aimed to adapt the BBFM to address these pitfalls. See the methods section for the current study's proposed pathways of effect.

Maternal Depressive Symptoms and Child Asthma Management Self Efficacy

Although caregivers are identified as the primary manager of their child's illness, as children age into adolescence their role within their own management increases. Findings indicate that increased child asthma related self-confidence and perceived self-efficacy in one's own ability to mitigate their asthma symptoms are related to better asthma outcomes (Lavoie et al., 2008). Many factors may contribute to a child's perceived self-efficacy in the management of

their asthma, including the presence of psychopathology. As evidenced by a meta-analysis of anxiety disorders in children with asthma, the estimated prevalence of a child having a comorbid anxiety disorder was 22.7% (Dudeney, Sharpe, Jaffe, Jones, & Hunt, 2017). In addition, research indicated that the odds of a child with asthma meeting diagnostic criteria for an anxiety disorder, as measured by the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) were significantly higher compared to their counterparts of children without asthma (Katon, Richardson, Lozano, & McCauley, 2004). Results of this study demonstrated that approximately 30% of the children in the study were diagnosed with both asthma and an anxiety disorder. Compared to 8.6% of healthy children aged 11-17, 16.3% of children with asthma endorsed a major depressive disorder in their short lifetime (Katon et al., 2007).

In addition, maternal depressive symptoms have been shown to be strongly associated with child internalizing disorders (Feldman et al., 2011; Weissman et al., 2006), mostly depression and anxiety. In a study of predominantly Black and Non-Latino White children with asthma aged 7-17, maternal depressive symptoms were associated with child internalizing symptoms, as measured by the Children's Depression Inventory (CDI), the Child Depression Rating Scale (CDRS), the State-Trait Anxiety Inventory for Children – Trait Anxiety (STAIC-T), and the State-Trait Anxiety Inventory for Children, State Anxiety (STAIC-S) (Lim et al., 2008; Lim et al., 2011). Children with asthma and comorbid psychological impairment demonstrate increased severity and frequency of asthma symptoms (McCauley, Katon, Russo, Richardson, & Lozano, 2007; L. P. Richardson et al., 2006), school absences (Bender & Zhang, 2008), use of emergency services, and decreased pulmonary function (Fiese, Winter, Wamboldt, Anbar, & Wamboldt, 2010). In addition, in a study of predominantly Puerto Rican children,

anxiety was associated with over-perception of asthma symptoms with maternal depression as a risk factor for children having lower pulmonary function (Feldman et al., 2013).

There is minimal research available that directly addresses health-specific perceived self-efficacy and comorbid anxiety symptoms among children with medical illness. Self-efficacy research among children and adolescents with anxiety has been predominantly focused on the associations between child anxiety and social and academic-related self-efficacy. As indicated by the results of a study investigating college-aged business students, decreased perceived self-efficacy related to computer use was associated with a greater presence of anxiety symptoms (Fagan, Neill, & Wooldridge, 2004). Similarly, research on adolescents with Social Anxiety Disorder (SAD) indicated that changes in social anxiety symptomology were strongly associated with changes in perceived self-efficacy related to social situations (Gaudiano & Herbert, 2007).

Conversely, this topic has been explored among adult medical populations. In a predominantly white, middle-aged sample of adult females with asthma, worse asthma-related self-efficacy was associated with a diagnosis of an anxiety and/or depressive disorder (Lavoie, Boudreau, Plourde, Campbell, & Bacon, 2011). Similarly, in a predominantly Latino, middle-aged sample of New York City women with asthma, poor asthma-related self-efficacy was associated with an increase in depressive symptoms (Mancuso, Rincon, McCulloch, & Charlson, 2001).

Moreover, if child psychopathology can impact asthma-related self-efficacy, and child psychopathology can be impacted by maternal mental health, further investigation of the relationship between maternal depressive symptoms on the child's perceived self-efficacy in managing their own asthma is an additional, critical area of exploration. If associated, this

relationship will allow for the application of more robust analytical models assessing the role of maternal depression and child asthma management self-efficacy on asthma disease activity.

Maternal Depressive Symptoms, Medication Adherence, and Patient-Provider

Relationship:

Adherence to medication, or the degree to which the patient follows the medical advice of their provider (Glanz, Rimer, & Viswanath, 2008), is one of the most important aspects of asthma care to decrease asthma morbidity and mortality. The use of controller medication (e.g., inhaled corticosteroids) has been shown to be the most effective way to decrease asthma symptoms and prevent unfavorable asthma outcomes (Blais, Ernst, Boivin, & Suissa, 1998; Suissa & Ernst, 2001). Previous research indicates that when controller medication is taken as prescribed, patients experienced an increase in asthma-related quality of life and a decrease in asthma-related hospitalizations, ER and urgent care visits, and use of rescue medications (Barnes & Pedersen, 1993; Ernst et al., 1992). Although asthma is a life-threatening illness, poor adherence is prominent among the pediatric population (Bender, 2006). Research indicates that among children and adolescents with asthma, the average child demonstrated adherence to their controller medication 50% of the time (Bender, 2006), with over 50% neglecting the second refill of their medication (Bender et al., 2000). Additionally, disproportionately lower rates of ICS medication adherence are observed among Latino and Black children (McQuaid et al., 2012). The most profound underuse of ICS medication is observed in low-socioeconomic children living in urban environments (Halterman, Borrelli, Fisher, Szilagyi, & Yoos, 2008).

Previous research also suggests that adherence to asthma medications may be influenced by the responsibility placed on the child for taking daily asthma medications (Orrell-Valente, Jarlsberg, Hill, & Cabana, 2008). Orrell-Valente et al. (2008) indicated that in a sample of 4-19-

year-olds, child responsibility appears to increase with age, whereby children reported 50% responsibility for asthma medication use by age 11, 75% by age 15, and 100% by age 19. In addition, results of the study indicated that child age was significantly associated with medication adherence, with younger children reporting better adherence. This research reinforces this importance of considering the age of the child when addressing asthma outcomes such as medication adherence.

As a result of the association between adherence and child asthma outcomes, the impact of maternal depression on medication adherence is of importance. As mentioned previously, caregivers of children with asthma are responsible for a multitude of factors related to their child's asthma management, including health care provider interaction, maintenance of their child's use of daily medications, identification and avoidance of their child's triggers, and de-escalation of acute exacerbations (Klennert, Gavin, & McQuaid, 1997). The burden of responsibility is significant and this likely takes a toll on the quality of life, well-being, and mental health of the primary caregiver. For example, in a predominantly Black, urban sample of children with asthma, 47% of mothers endorsed clinically significant levels of depressive symptoms measured by the CES-D (Bartlett et al., 2001). Studies have consistently demonstrated a relationship between mothers with poor psychological functioning and an increase in reported non-adherence to their child's asthma regimen (Bartlett et al., 2004; Kaugars, Klennert, & Bender, 2004). Previous research additionally suggests that caregiver mental health was indicative of a decrease in compliance with the medical recommendations of their child's provider (Klennert, Kaugars, Strand, & Silveira, 2008). As adherence is an established predictor of asthma outcomes in children, it is important to assess factors that may impact adherence such as maternal depression.

Patient-Provider Relationship:

Similarly, the therapeutic partnership between the caregiver, the healthcare provider (HCP), and the child with asthma has been established as a critical component of adherence to asthma treatment (Gavin, Wamboldt, Sorokin, Levy, & Wamboldt, 1999). Among women with chronic illness, research demonstrated that a positive and connected relationship between these patients and their providers lead to an increased perceived sense of well-being and confidence related to the patient's ability to manage their own illness (Fox & Chesla, 2008). Previous studies indicate that better provider communication skills are associated with a decrease in a patient's missed appointments and an increase in their adherence to treatment, ability to internalize provider advice, and recall of provider's suggestions (DiMatteo, Lepper, & Croghan, 2000). It is important to note that communication skills include the language spoken during the appointment. When the provider and patient speak different languages, the exchange of necessary information needed to appropriately diagnose and form a strong patient-provider relationship may be easily compromised (Richardson, Babcock Irvin, & Tamayo-Sarver, 2003).

In a study of primary care practice, families and providers demonstrated increased similarity in the understanding of the causes of asthma, but decreased similarity in the understanding of asthma symptoms and asthma treatments (Pachter et al., 2002). As demonstrated by a meta-analysis of qualitative studies among individuals with asthma and their caregivers, patients were more likely to be adherent to their asthma treatment if they trusted their provider, were fond of their provider, and if they believed the provider took time to understand their subjective experience of asthma (Bender & Bender, 2005). Differences noted in the belief system between patient and provider and difficulties in communication have been associated with ineffective asthma treatment (Wilson, Mitchell, Rolnick, & Fish, 1993) and perpetuation of

conflict with the HCP. Among families with asthma, conflicts with the provider which include refusing medical treatment, resisting to follow medical advice, and disregarding the providers' recommendations, have been associated with an increased risk of death (Strunk, Mrazek, Fuhrmann, & LaBrecque, 1985). It has also been demonstrated that poor communication with providers has resulted in a parent's inability to accurately provide their child's asthma related history, symptoms, and prescribed medications (Wilson et al., 1993). Urban, ethnically-diverse minority parents reported that a poor relationship with their child's asthma provider defined by lack of trust, general dissatisfaction, and lack of continuity of provider, was a consistent barrier to treatment (Mansour, Lanphear, & DeWitt, 2000). Findings suggest that the most important factors that contribute to a strong patient-provider relationship are the trust of the provider, the continuity of care (seeing the same doctor at each visit), lack of provider judgmental attitudes towards individuals from low socioeconomic or diverse backgrounds, and a holistic approach to asthma care (Mansour et al., 2000).

As communication is a critical aspect of the parent-HCP relationship, it is likely that behaviors, thoughts, and feelings of mothers with high levels of depressive symptoms may perpetuate conflict among this relationship. Characteristics of depression include social isolation, withdrawal from social interactions, impairments in memory, and feelings of hopelessness and helplessness (APA, 2013). It is also common for individuals with major depressive disorder to demonstrate cognitive impairment, classified as deficits in memory, processing speed, and executive functioning (McDermott & Ebmeier, 2009). As a result, mothers who are experiencing high levels of depressive symptoms may be impacted in their ability to communicate with their child's physician, seek medical care, and understand, remember, and accurately track their child's asthma symptoms (Bartlett et al., 2004). Among adults with diabetes and comorbid

depression, research indicated that aspects of the patient-provider relationship were critical components of treatment adherence (Bauer et al., 2014). It was demonstrated that a lack of trust and lack of perceived shared decision-making between the provider and the patient impacted the adult's adherence to their medications (Bauer et al., 2014). The present study will be the first to look directly at this critical interaction, examining the role of maternal depressive symptoms on the parent-HCP relationship and medication adherence among Latino and African American families within the same model.

Study Rationale/Innovation

Asthma is the most commonly diagnosed chronic illness among the pediatric population and incommensurately affects Latino and Black children living in the Bronx. Although the disparities among ethnic and racial populations have been established, the underlying mechanisms behind them are largely unknown, making this an important area of research. In general, it has been noted that there is a lack of prospective research that addresses both mental health and objective measures of asthma (Goodwin, 2016), making the current study an area of interest. Limited existing research has investigated individual and family level factors which impact caregiver characteristics and child asthma outcomes. There is virtually no research that examines maternal depressive symptoms, asthma management self-efficacy, parent-HCP relationship, and asthma outcomes within a sophisticated model among this Latino and African American aged population. The current study hypothesized direct and indirect pathways of maternal depression to child asthma outcomes (child pulmonary function and medication adherence) through parent and child asthma self-efficacy and relationship with the healthcare provider. The current study additionally addressed the importance of examining child age as a moderator and incorporating how associations may differ on measures of perceived self-efficacy,

medication adherence, and the healthcare provider-patient relationship based on the age of the child and their assumption of responsibility. The study has the intention of deepening the available research on the role played by both ethnic minority parents and children in asthma outcomes, control and care. This research is additionally important as it is essential to better understand the impact of the mental health of ethnic-minority mothers on child disease activity. It is common for the majority of the asthma management burden to fall on the caregivers and these children hold the highest asthma prevalence, morbidity, and mortality rates. This will allow for more specifically informed individual and family-based screening tools and interventions for both parents and children with asthma individually and as a dyad.

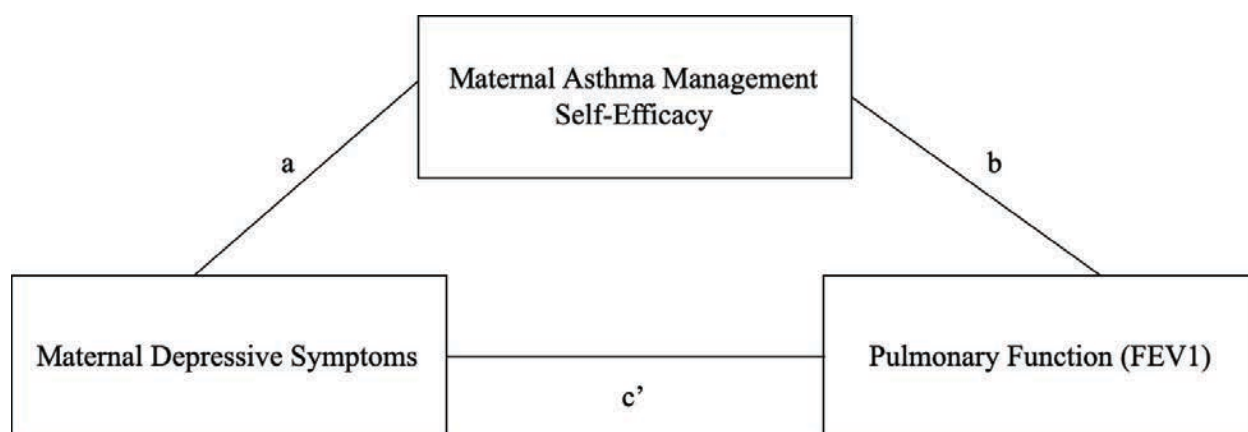
Specific Aims and Hypotheses

This study aims to further our understanding of asthma outcome disparities among Latino and African American children by assessing the role played by maternal depressive symptoms in child asthma outcomes. The role of the caregiver in childhood asthma is a critical component of care as the burden is significant and it may be unrealistic to expect a child aged 10 to 17 to take on full responsibility for their asthma care. As a result, the mental health of the mother can play a crucial role that can impact the mother's ability to provide asthma care to the child and for both the mother and child to feel confident and efficacious in their ability to provide care or manage their own care. Previous research has examined maternal depressive symptoms with self-efficacy, parent-provider relationship, and both objective and subjective measures of asthma outcomes independently but there are no previous studies that join them together in a model in a Latino and African American sample in the Bronx. The current study will fill an essential gap in the literature and make for innovative research as among these ethnic minority children and adolescents, asthma prevalence rates are very high.

The main aim of our study was to examine the relationships among maternal depressive symptoms and Latino and African American child asthma outcomes through parent and child-level factors. Specific Aim 1: The study sought to investigate if levels of maternal depressive symptoms would predict child pulmonary function through the asthma management self-efficacy of the mother. It was expected that higher levels of depressive symptoms observed in female caregivers would be associated with decreased pulmonary function in the child. It was also expected that increased levels of maternal depressive symptoms would be associated with decreased parent asthma-related self-efficacy, decreased self-efficacy would be associated with decreased FEV1, and ultimately that self-efficacy would mediate the relationship between maternal depressive symptoms and pulmonary function. It was additionally hypothesized that child age would moderate the relationship between maternal depressive symptoms and parent perceived asthma-management self-efficacy, with lower levels of maternal depressive symptoms associated with increased self-efficacy in parents of older children.

Figure 3.

Aim 1: Mediation Model

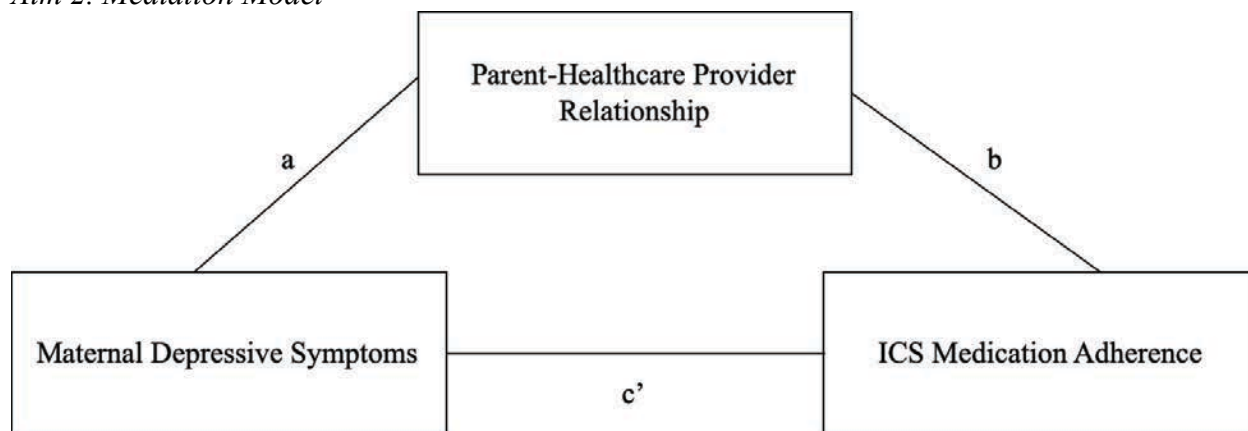


Specific Aim 2: The study additionally sought to investigate if levels of maternal

depressive symptoms would predict child ICS medication adherence through the relationship between the mother and the child's asthma provider. It was predicted that increased levels of depressive symptoms would be associated with decreased ICS medication adherence as noted by a self-report measure completed by parent and child together. It was also expected that increased levels of depressive symptoms would be associated with a worse parent-healthcare provider relationship, a worse parent-healthcare provider relationship would be associated with decreased ICS medication adherence, and lastly that the parent-healthcare provider relationship would mediate the relationship between maternal depressive symptoms and ICS medication adherence. It was additionally hypothesized that child age would moderate the relationship between maternal depressive symptoms and ICS medication adherence and between maternal depressive symptoms and the patient-healthcare provider relationship. It was expected that lower levels of maternal depressive symptoms would be associated with better medication adherence in older children and a better patient-health care provider relationship in older children.

Figure 4.

Aim 2. Mediation Model

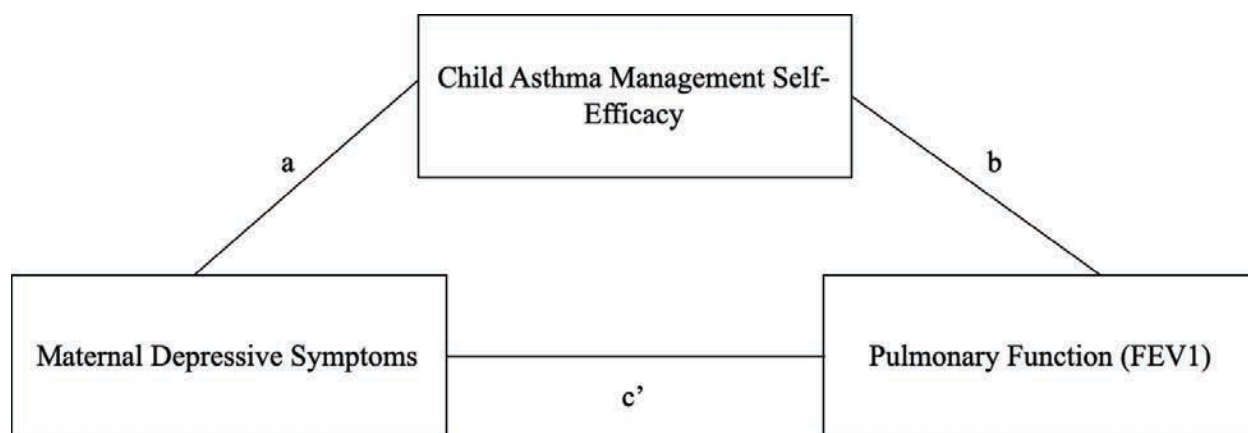


Specific Aim 3 set out to investigate if levels of maternal depressive symptoms would predict child pulmonary function through the asthma management self-efficacy of the child. It

was expected that similar to aim 1, higher levels of depressive symptoms observed in female caregivers would be associated with decreased pulmonary function on behalf of the child. It was also expected that increased levels of maternal depressive symptoms would be associated with decreased child asthma-related self-efficacy, decreased self-efficacy would be associated with decreased FEV1, and ultimately that child self-efficacy would mediate the relationship between maternal depressive symptoms and pulmonary function. It was additionally hypothesized that child age would moderate the relationship between maternal depressive symptoms and child perceived asthma-management self-efficacy, with lower levels of maternal depressive symptoms associated with increased self-efficacy in older children.

Figure 5.

Aim 3. Mediation Model

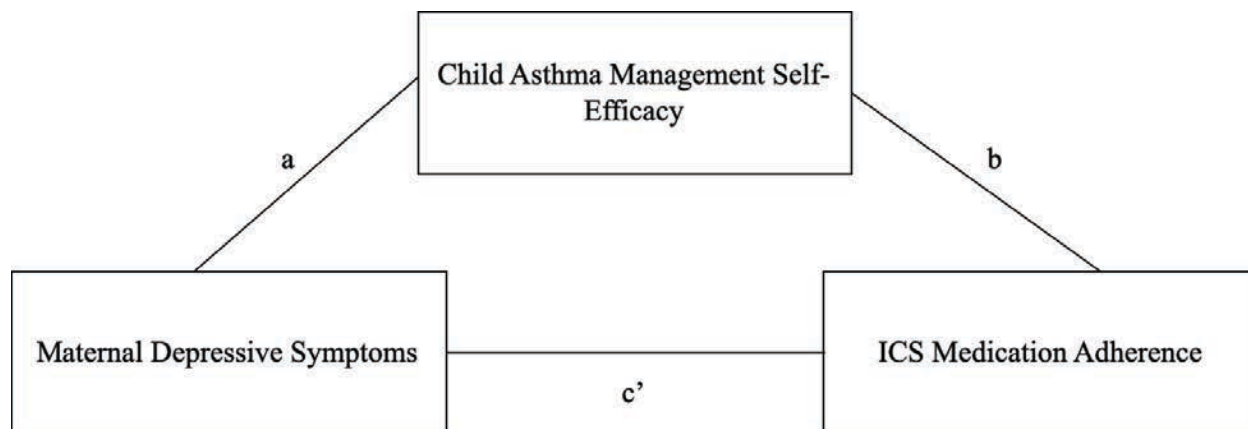


Specific Aim 4 sought out to examine if levels of maternal depressive symptoms would predict child ICS medication adherence through the perceived asthma management self-efficacy of the child. It was predicted that increased levels of depressive symptoms would be associated with decreased ICS medication adherence. It was also expected that increased levels of depressive symptoms would be associated with worse child asthma management self-efficacy,

worse child asthma management self-efficacy would be associated with decreased ICS medication adherence, and lastly that the asthma management self-efficacy of the child would mediate the relationship between maternal depressive symptoms and ICS medication adherence.

Figure 6.

Aim 4. Mediation Model



Methods

The current study conducted a secondary analysis of data from a larger, longitudinal, double-blind, multi-site study (The Childhood Asthma Perception Study 1R01HL128260; PI: Feldman), currently in its last year of data collection. The CAPS study is a randomized controlled trial (RCT) investigating the effectiveness of a manualized intervention to improve symptom perception among Latino and Black children/adolescents ranging from 10-17 years old. One treatment arm consists of an intervention utilizing personalized symptom perception feedback and the control arm provides positive feedback to the parent-child dyad. This study builds on previous research that Dr. Feldman and team has conducted on ethnic minority children with asthma living in the Bronx (Feldman et al., 2013). As the larger study consists of

nine time points, it is important to note that the current study uses data collected during the first sessions (Baseline) which was prior to randomization into the treatment arms. As a result, findings were not impacted by the treatment received by either of the groups in the study. The aim of the current study is to assess how maternal depressive symptoms are associated with child pulmonary function and ICS medication adherence through parent asthma management self-efficacy and parent-healthcare provider relationship. Built from the foundation of Dr. Feldman's research, the current study will be the first to look directly at mechanisms involving maternal depressive symptoms, parent and child asthma management self-efficacy, parent-provider relationship, medication adherence, and child pulmonary function among a generally Latino and African American sample in the Bronx.

Recruitment Procedures

Participants consisting of female caregiver-child dyads of self-reported Latino or African American ethnicity were recruited and screened for eligibility from primary and tertiary care facilities in the Bronx, New York by trained, graduate-level research assistants. Latino and Black children/adolescents and their primary caregivers were recruited from primary care and asthma and allergy specialty clinics at Jacobi Medical Center (JMC) and Montefiore Medical Center (MMC). The emergency room at these hospitals also provided an additional recruitment site. In addition, MMC clinics located inside of local school buildings were used as a recruitment site. Medical directors and key staff members were notified and in agreement with recruitment procedures and supported recruitment efforts. Physicians who previously agreed to partner with the study provided direct referrals for participants that would likely be eligible, sent physician-endorsed recruitment information through the mail, and conducted phone calls to families to inquire about interest. All recruitment materials and efforts were available in both English and

Spanish. When conducting screenings in person, informed consent/assent, HIPAA authorization, and a release of medical information was discussed and acquired before any information was shared. The same protocol was followed during phone recruitment, with consent acquired orally. Following the initial eligibility screen, asthma diagnosis and asthma controller medication use was confirmed through medical chart review. To enhance retention, a financial incentive of \$340 was offered for the completion of all 9 visits of the study and metro cards. Car service was offered on an as-needed basis. The current study looked at the baseline session only, where the family receives \$30.

Eligibility Criteria

Inclusion criteria for the current study included: 1) children and adolescents aged between 10 and 17 years old; 2) must have received a diagnosis of asthma from a physician which would be confirmed by medical chart review; 3) endorsement of breathing problems over the past 12 months; 4) prescribed an asthma controller medication; 5) at least one parent must self-identify as Latino or Black; 6) report of child/adolescent's race/ethnicity was Latino or Black OR the child/adolescent identifies as Latino or Black and 7) participating parent must identify her gender as female. For the larger RCT, there were no limitations related to parent gender.

Exclusion criteria for the current study included: 1) parent report of a cognitive or learning disability on behalf of the parent or the child if deemed to interfere with the ability to participate by consultation with the research team; 2) if the child and/or parent did not demonstrate the ability to complete study procedures and clinical structured interviews; 3) if the children/adolescents were not able to perform adequate peak expiratory flows as the objective measure of asthma is a primary outcome measure; 4) self-report of a race/ethnicity different than

Latino or Black and 5) the presence of an additional chronic pulmonary illness (e.g. cystic fibrosis).

In order to confirm that a participant had an asthma diagnosis that met criteria for our study, the diagnosis must have been provided to the family by a physician with an ICD-9/ICD-10 code noted in their electronic medical record (EMR). Additionally, the parent or child/adolescent needed to report breathing difficulties that had been present over the past 12 months.

Training of Research Assistants

Prior to the beginning of the study, clinical psychology doctoral students and research assistants from Dr. Feldman's Asthma Research Lab were mandated to asthma education training. This training was set up to provide the study team with an elevated understanding of asthma, along with the asthma symptoms, triggers, and medications that are used in treating pediatric asthma. To assess for proficiency, the research team completed yearly asthma assessments to ensure apt knowledge. The research team was additionally trained and supervised by respiratory therapists in conducting spirometry, which provided the current study with the objective measure of pulmonary function – FEV1.

Measures:

The current study focuses specifically on measures of depressive symptomology, asthma management self-efficacy, parent-provider relationship, child pulmonary function, and self-reported ICS medication use.

Basic Demographic Information: Parent and Child report:

The child/adolescent were asked to report on their age, sex, and ethnicity. Child ethnicity was provided by a standardized 16-item questionnaire that was designed for children on markers of ethnicity and race (Marks, Szalacha, Lamarre, Boyd, & García Coll, 2007). The primary

female caregiver was asked to report on their age, sex, years of education, race, and ethnicity. Ethnicity in this study was condensed to 5 categories, 1) Puerto Rican, 2) African American, 3) Dominican, 4) Other Latino, and 5) Other.

We also asked the parent to report on their cigarette smoking history using a brief (8-item) questionnaire designed for the CAPS study in order to determine if smoke exposure should be used as a covariate in the analytic models. Parents answered questions addressing child exposure to smoke in the home or alternate locations, and current use and history of lifetime smoking along with the use of hookah, cigars or cigarillos, e-cigarettes, handheld pipes and chewing tobacco.

Medication Checklist (Parent and Child Report):

The parent-child dyad was asked to report on which asthma medications the child was currently taking over the past 12 months, including controller medication, quick relief, and any steroid use. If the child was prescribed a medication in the past year but it was discontinued or the child was no longer taking it at baseline, that data was collected as well.

Predictor and Outcome Variables.

Center for Epidemiologic Studies Depression Scale (CES-D): Parent report:

A brief self-report questionnaire was administered to assess levels of depressive symptoms. This measure is among one of the most commonly used self-report measures of depressive symptoms in research in both the psychiatric and general populations. It has been used predominantly in studies of ethnic and racial minority health (Noh, Avison, & Kaspar, 1992) and is a strong predictor of major depressive disorder among low-income ethnic and racial minority women (Thomas, Jones, Scarinci, Mehan, & Brantley, 2001). It is available in English ($\alpha = .85$) and in Spanish (α range for subscales = .61-.87), and as established by confirmatory

factor analysis (CFA) is shown to have high internal consistency, test-retest stability, and concurrent validity in English, as well as internal consistency in both languages (Aneshensel, Clark, & Frerichs, 1983; Cosco, Prina, Stubbs, & Wu, 2017; Radloff, 1977). The CES-D has 20 items, with each item rated from 0 to 3 to demonstrate the level of difficulty experienced over the previous week (i.e., “I was bothered by things that don’t usually bother me”). Higher scores were correlated with a greater presence of depressive symptoms, where scores greater than or equal to the recommended clinical cutoff of 16 indicate “caseness” for depression (Goethe, Maljanian, Wolf, Hernandez, & Cabrera, 2001).

Medication Adherence Rating Scale (MARS): Parent and Child report:

A 10-item self-report questionnaire was administered to parent and child together to assess for ICS medication adherence. Among the adult population, this measure has demonstrated strong reliability and construct validity when administered to low-income, ethnic minority patients with asthma at inner-city clinics (Cohen et al., 2009). The measure demonstrated strong interitem reliability in English ($\alpha = .85$) and in Spanish ($\alpha = .86$) and good test-retest reliability overall ($r = .65$) (Cohen et al., 2009). It has not yet been validated among the pediatric population, including a sample where parents and children complete the measure together. Higher scores on the MARS are correlated with better adherence to asthma medications, with 4.5 noted as the established cutoff score for good adherence (Cohen et al., 2009).

Parent-Healthcare Provider Relationship (AIRS): Parent report:

The parent-healthcare provider relationship 10-item subscale was used to assess the strength of the parent-healthcare provider (HCP) relationship in the present study. This subscale originates from the 37-item Asthma Illness Representation Scale (AIRS) questionnaire available

in English (Sidora-Arcoleo, Feldman, Serebrisky, & Spray, 2010) and in Spanish (Sidora-Arcoleo, Feldman, Serebrisky, & Spray, 2010), covering aspects of the parent-HCP relationship including continuity of care, HCP communication of questions and concerns, and asthma medication use instructions. Caregivers are asked to respond to statements such as “When I call the doctor’s office, they understand my concerns,” or “I am sometimes reluctant to discuss my worries about asthma medicines with my child’s health care provider.” Measure items are rated using a 5-point Likert scale and responses are coded from 1 “strongly agree” to 5 “strongly disagree.” Good external validity and internal reliability were determined for the overall measure including the English ($\alpha = .82$) and Spanish ($\alpha = .77$) versions (Sidora-Arcoleo et al., 2010; Sidora-Arcoleo et al., 2010). Higher total scores indicate a better relationship with the child’s HCP.

Asthma Management Self-Efficacy (P-ASE & C-ASE): Parent and Child report

For the parent, a 13-item scale was administered to assess confidence in their own ability to manage their child’s asthma. The current study examined the P-ASE total score, which ranged from a 13 to a 65 (Bursch, Schwankovsky, Gilbert, & Zeiger, 1999). Examples of questions include “how sure are you that you can get your child to take his/her medications” and “how sure are you that you can help your child prevent a serious breathing problem,” with responses ranging from 1 “not sure at all” to 5 “completely sure.” This measure has demonstrated good construct validity and good reliability (0.77-0.87) (Bursch et al., 1999).

For the child, a 14-item scale ($\alpha=.87$) (Bursch et al., 1999) was administered to measure the child’s perception of their own ability to manage their asthma. The current study investigated the C-ASE total score, which ranged from a 14 to a 75. Examples of questions include “how sure are you that you can use your inhaler correctly?” and “how sure are you that you can learn the

skills you need to control your asthma?” The C-ASE has indicated good reliability (0.75-0.87) and construct validity (Bursch et al., 1999). Both the parent and child versions of this scale cover topics including asthma symptoms, asthma health status, and the impact of asthma on the family system. Both the parent and child versions of the measure are available in English and were translated, back-translated, and checked for cross-cultural equivalence (Bravo, 2003; Canino & Bravo, 1994) into Spanish for the current study.

Both the P-ASE and C-ASE contain two subscales embedded within the measure, Attack Management ($\alpha=.75$) and Attack Prevention ($\alpha=.82$) (Bursch et al., 1999). The attack prevention subscale targets asthma management behaviors with questions like, “How sure are you that you can slow yourself down to prevent serious breathing problems?” on the child version or “How sure are you that you can follow the directions for giving medication to your child?” on the parent version. The attack management subscale highlights asthma self-efficacy that is related to responding to acute asthma symptomology with questions like, “How sure are you that you can control a serious breathing problem yourself rather than go to the emergency room?” on the child version or “How sure are you that you can control a serious breathing problem at home rather than take your child to the ER?” on the parent version. The P-ASE total score, the C-ASE total score, and the attack management and attack prevention subscales of both the parent and child version were used in the study analyses.

Pulmonary Function:

The current study used spirometry to obtain an objective measure of lung function. Research Assistants who were thoroughly trained administered the spirometry testing to the child/adolescent participants using a handheld, portable spirometer, that accompanies a computerized incentive program (nSpire, Longmont, CO). Administration procedures and

equipment specifications strictly followed the benchmarks and guidelines published by the American Thoracic Society and reference values were found using piecewise polynomial model equations (Hankinson, Odencrantz, & Fedan, 1999). Per guidelines, there were at least three forced expiratory maneuvers completed until acceptable results were produced (noted as three “reproducible attempts” within the program). The current study looked specifically at the % predicted FEV₁ to define the child’s pulmonary function, which takes into consideration the child’s age, sex, height, weight, and race. Participants were informed that they were not allowed to take their quick-relief medication (e.g., Ventolin) or consume medicines or drinks containing caffeine or methylxanthines for 6 hours prior to their scheduled appointment. They were also notified to withhold from the use of long-acting bronchodilator and combination medications for 24 hours prior to testing, as these may affect objective pulmonary function. If a participant needed to take their medications in order to treat asthma symptoms, their appointment would be rescheduled to accommodate their presentation. As it had been previously determined that differences in FEV₁ vary across ethnicity, whereby African American individuals have been found to produce significantly lower values compared to their White counterparts of the same height and weight (Hankinson et al., 1999), the study enacted a 12% ethnicity-based adjustment to spirometry values for Non-Latino Black participants. Participants who identified as Black-Hispanic did not receive an ethnicity-based adjustment.

Asthma Severity:

Child asthma severity was determined by study-participating physicians according to NHLBI (2007) guidelines. The three categories of asthma severity included mild persistent, moderate persistent, and severe persistent. Physicians utilized the following factors to determine severity: 1) spirometry, the objective measure of lung function, 2) frequency of asthma

symptoms and 3) asthma medications. The child's overall asthma severity rating was determined by the category they received the most severe rating in among the three criteria.

Translation of Instruments

Study visits were conducted in either English or Spanish, per the request of the participant dyad. When a dyad requested Spanish, the self-report measures were administered by bilingual interviewers who were fluent in both Spanish and English. Measures that did not have a Spanish version available or lacked sufficient empirical support were translated and then back translated by the bilingual research staff utilizing the translation service at Einstein-Montefiore Institute for Clinical and Translational Research (5UL-1TR001073-02). Qualified staff was responsible for ensuring that wording was appropriate and common among the Latino subgroups that were represented among the sample.

Procedure

Caregiver-child dyads who had been screened, enrolled, and consented were then scheduled to participate in the baseline session of the CAPS study ($N=153$ dyads) IRB#2014-3257. The study was approved by the human subjects committee of Albert Einstein College of Medicine prior to participation. Parents provided consent to participate and assent was obtained from all participants who were under the age of 18. The current study adhered to all federal regulations as outlined by the guidelines for research among vulnerable populations and children.

The graduate-level research assistants (RAs) conducted the screenings, scheduling of patient appointments, administration of consent materials, and enrollment procedures in both English and Spanish, when necessary. Trained RAs completed the medical chart reviews to ensure asthma diagnosis. Supervision of RAs was conducted by Dr. Feldman. The baseline session ranged from 1-1.5 hours, Baseline session included the administration of a structured

interview for the mother and the child as a dyad, both individually. Spirometry was conducted with the child to assess pulmonary function. The questionnaire responses were administered electronically using Empirisoft's software, MediaLabv2016. Direct-entry software decreased time spent entering and checking data, resulting in a decrease in human error. Data was inspected by Dr. Feldman and backed up daily to a network drive.

Power Analyses:

Power analyses were conducted to uncover the likelihood of finding significant effects (Faul, Erdfelder, Buchner, & Lang, 2009).

Aim 1.

Sample size considerations were determined by a previous study investigating maternal depression and asthma management among an inner-city, pediatric population. Mothers with high levels of depressive symptoms were significantly more likely to report problems using their child's inhaler properly (OR: 5.0; 95% CI: 1.3-18.9), forgetting doses of medication (OR: 4.2; 95% CI: 1.4-12.4), and less confidence in their ability to control symptoms, less self-efficacy in their ability to cope with acute exacerbations, and less overall understanding of medication efficacy and use (OR: 7.7; 95% CI: 1.7-35.9) (Bartlett et al., 2004). Based on these findings, G*Power 3.1 was used to calculate the necessary sample size for the regression models with a medium effect size ($f^2=.15$) (J. Cohen, 1988), four predictors, set alpha levels of .05, and power of at least .80 required a sample size of 85.

Power analyses for the mediational analyses were conducted using MedPower (Kenny, 2017). For a medium effect at 80% power, $\alpha = .05$, and partial $r = .3$, a two-tail significance test for the indirect effect required 109 participants.

Aim 2.

As demonstrated through a meta-analysis of health-care provider communication and patient adherence to treatment among a diverse illness population, provider communication is positively correlated with patient medication adherence (Zolnierek & DiMatteo, 2009). The study found that provider communication was a key factor in patient adherence. They found that the odds of a patient adhering to treatment were significantly increased when providers had strong communication skills [OR=2.16, 95% CI [1.91, 2.35], $p < .001$] (Zolnierek & DiMatteo, 2009). Based on these findings, for the regression models, power analysis using G*Power 3.1 suggested that in order to conduct a hierarchical regression with a medium effect size ($f^2 = .13$) (J. Cohen, 1988), four predictors, set alpha levels of .05, and power of at least .80 required a sample size of 99.

Power analyses for the mediational analyses were conducted using MedPower (Kenny, 2017). For a medium effect at 80% power, $\alpha = .05$, and partial $r = .3$, a two-tail significance test for the indirect effect required 109 participants.

Aims 3 & 4.

A review of maternal depression and child perceived self-efficacy among children with asthma did not yield previous literature. The previous study that used child perceived self-efficacy and medication adherence and also utilized similar measures and procedures was Branstetter-Rost et al. (2010). This study utilized regression models to investigate relationships among child perceived self-efficacy and medication adherence (Branstetter-Rost, Berg, Rapoff, & Belmont, 2010). The results of the study indicated a moderate effect whereby higher asthma-related self-efficacy was associated with increased medication adherence ($r = 0.31$, $p < 0.05$). Given the current study aimed to utilize this scale among the same-aged population with similar outcome measures, we predicted a medium effect size. Power analysis using G*Power 3.1

suggests that in order to conduct a hierarchical regression with a medium effect size ($f^2=.15$), four predictors, set alpha levels of .05, and power of at least .80 requires a sample size of 85.

Power analyses for the mediational analyses were conducted using MedPower (Kenny, 2017). For a medium effect at 80% power, $\alpha = .05$, and partial $r = .3$, a two-tail significance test for the indirect effect required 109 participants.

Statistical Analyses; overview of approach:

All statistical analyses were conducted using IBM SPSS Statistics 24.0 and statistical significance was defined by a value of $p < .05$. Maternal depressive symptoms were used as a continuous score indicating level of depressive symptoms, whereby higher scores indicated higher levels of depressive symptoms. Data cleaning procedures were conducted before the main analyses were run. Procedures included screening for outliers, missing values, and abnormal values. Visual inspection of the data was also performed, including the use of frequency histograms to assess for normality of the outcome measure, and scatter plots to evaluate the bidirectional relationships between the variables. A review of descriptive statistics was conducted to inform the sample characteristics. To confirm that the data were appropriate for parametric data analysis, the data were examined to assess normality using skewness and kurtosis statistics. Pearson correlations, t-tests, and one-way ANOVA analyses were run to determine the significant covariates to be used in the models. Covariates were determined by examining the association between potential covariates/confounding variables (e.g., ethnicity, child/adolescent gender, years of education, maternal smoking history, asthma severity) and the mediators and/or outcome measures.

Hypothesis 1a-d:

Mediational analyses were conducted to examine the mediating role of parent asthma management self-efficacy (P-ASE total score) on the relationship between maternal depressive symptoms (CES-D total score) and child pulmonary function measured by FEV1. To test the indirect, direct, and interaction effects of child age, the PROCESS macro for SPSS (Model 4) was used: (1) Level of maternal depressive symptoms was regressed on parent self-efficacy (path a); (2) Child pulmonary function was regressed on parent self-efficacy while controlling for maternal depressive symptoms (path b); (3) Child pulmonary function was regressed on maternal depressive symptoms while controlling for parent self-efficacy (path c'); (4) The indirect effect, path ab, is the effect of maternal depressive symptoms on child pulmonary function through parent self-efficacy, quantified as the product of path a and b. The indirect effect was calculated following a bootstrapping approach published by Hayes and Preacher (Hayes, 2009, 2017).

Hypothesis 2a-d:

Mediational analyses were also conducted to examine the mediating role of the parent-health care provider relationship (AIRS subscale total score) on the relationship between maternal depressive symptoms (CES-D total score) and ICS medication adherence (MARS total score). To test the indirect, direct, and interaction effects of child age, the PROCESS macro for SPSS was used (Model 4): (1) Level of maternal depressive symptoms was regressed on parent-healthcare provider relationship (path a); (2) ICS medication adherence was regressed on parent-healthcare provider relationship while controlling for maternal depressive symptoms (path b); (3) ICS medication adherence was regressed on maternal depressive symptoms while controlling for parent-healthcare provider relationship (path c'); (4) The indirect effect, path ab, was the effect of maternal depressive symptoms on ICS medication adherence through parent-healthcare

provider relationship, quantified as the product of path a and b. The indirect effect was calculated following a bootstrapping approach published by Hayes and Preacher (Hayes, 2009, 2017)

Hypothesis 3a-d:

Mediational analyses were conducted to examine the mediating role of child asthma management self-efficacy (C-ASE total score and Attack Prevention and Attack Management subscales) on the relationship between maternal depressive symptoms (CES-D total score) and child pulmonary function measured by FEV1. To test the indirect, direct, and interaction effects of child age, the PROCESS macro for SPSS (Model 4) was used: (1) Level of maternal depressive symptoms was regressed on child self-efficacy (path a); (2) Child pulmonary function was regressed on child self-efficacy while controlling for maternal depressive symptoms (path b); (3) Child pulmonary function was regressed on maternal depressive symptoms while controlling for child self-efficacy (path c'); (4) The indirect effect, path ab, is the effect of maternal depressive symptoms on child pulmonary function through child self-efficacy, quantified as the product of path a and b. The indirect effect was calculated following a bootstrapping approach published by Hayes and Preacher (Hayes, 2009, 2017).

Hypothesis 4a-d:

Mediational analyses were also conducted to examine the mediating role of child asthma management self-efficacy (C-ASE total score and Attack Prevention and Attack Management subscales) on the relationship between maternal depressive symptoms (CES-D total score) and ICS medication adherence (MARS total score). To test the indirect and direct effects, the PROCESS macro for SPSS was used (Model 4): (1) Level of maternal depressive symptoms was regressed on child perceived self-efficacy (path a); (2) ICS medication adherence was regressed on child perceived self-efficacy while controlling for maternal depressive symptoms (path b); (3)

ICS medication adherence was regressed on maternal depressive symptoms while controlling for child perceived self-efficacy (path c'); (4) The indirect effect, path ab , was the effect of maternal depressive symptoms on ICS medication adherence through child perceived self-efficacy, quantified as the product of path a and b . The indirect effect was calculated following a bootstrapping approach published by Hayes and Preacher (Hayes, 2009, 2017)

Results.

Refusal to Participate.

Out of the 847 participant dyads that were approached for recruitment and screened as eligible to participate, 28.7% refused to participate. Refusal data were collected from the recruitment database, whereby research assistants documented their contact with potential participants. With respect to the age of the child, there was no significant difference between participants who enrolled in the study ($M = 13.31$, $SD = 2.27$) versus those who refused participation ($M = 13.52$, $SD = 2.23$), $t(779) = .463$, $p = .59$. Additionally, there were no significant differences revealed among participants who enrolled and those who refused participation related to child gender. The primary reasons participants refused participation in the study were lack of interest (58.0%) or lack of time (18.5%) or other reasons such as moving out of state or other caregiver stressors (23.5%).

Participants.

A total of 153 caregiver-child dyads participated in the baseline session. The average female caregiver was 42-years old ($M = 42.00$, $SD = 2.07$) and was born in the United States. The majority of female caregivers reported their ethnicity as Non-Latino Black (35.3%) or Puerto Rican (33.3%), were never married, and had an education of at least some college. Child

participants were on average 13-years old ($M = 13.31$, $SD = 2.27$), predominantly male (52.3%) and fell into the Moderate Persistent category of asthma severity ($N = 71$, 46.4%). Similar to the female caregivers, children predominantly reported their ethnicity as Non-Latino Black (37.3%) or Puerto Rican (34.6%). Thirty-five female caregivers were primarily Spanish-speaking and completed the study measures in Spanish, administered by a bilingual Spanish research assistant. Participating families endorsed relatively low monthly incomes (41.2% below or equal to \$1,000 per month), with a majority of the sample falling below the poverty threshold (75.8%). The majority of female caregivers reported that they had smoked at least one cigarette in their lifetime. Participant characteristics are presented in Table 1.

Table 1

Participant Characteristics

Variable	Total Sample (n=153)
Child Age (M (SD))	13.31 (2.3)
Child Gender (N (%))	
<i>Female</i>	73 (47.7)
<i>Male</i>	80 (52.3)
Child Race/Ethnicity (N (%))	
<i>Non-Latino Black</i>	57 (37.3)
<i>Puerto Rican</i>	53 (34.6)
<i>Dominican</i>	23 (15.0)
<i>Other</i>	20 (13.1)
Poverty Status	
<i>Below the Poverty Line</i>	116 (75.8)
<i>Above the Poverty Line</i>	37 (24.2)
Child Asthma Severity (N (%))	
<i>Mild-persistent</i>	32 (20.9)
<i>Moderate-persistent</i>	71 (46.4)
<i>Severe-persistent</i>	50 (32.7)
Female Caregiver Age (M (SD))	42.0 (2.1)

Female Caregiver Race/Ethnicity (<i>N</i> (%))	
<i>Non-Latino Black</i>	54 (35.3)
<i>Puerto Rican</i>	51 (33.3)
<i>Other</i>	25 (16.3)
<i>Dominican</i>	23 (15.1)
Female Caregiver Education (<i>N</i> (%))	
<i>Less than High School</i>	53 (35.1)
<i>High School</i>	33 (21.9)
<i>More than High School</i>	65 (43.0)
Female Caregiver Marital Status (<i>N</i> (%))	
<i>Married</i>	42 (28.0)
<i>Separated, Divorced, Widowed</i>	40 (26.7)
<i>Never Married</i>	68 (45.3)
Female Caregiver Total monthly income (<i>N</i> (%))	
<i>Below or equal to \$1,000/month</i>	63 (41.2)
<i>Above or equal to \$1,001/month</i>	90 (58.8)
Female Caregiver Smoking Status (<i>N</i> (%))	
<i>Smoked in Lifetime (at least 1 cigarette)</i>	141 (86.0)
<i>Never Smoked</i>	23 (14.0)

Maternal Depressive Symptoms.

In the current sample, the mean CES-D Total score was 15.0 with a standard deviation of 11.83, indicating that on average, female primary caregivers endorsed depressive symptomology that fell just below the cut-off score of 16 for clinical caseness of depression. Please see Table 2 for descriptive statistics on the CES-D Total score. CES-D results indicated that 33.33% of the female caregivers in the sample met criteria for the clinical cut off of depression (Goethe et al., 2001). CES-D total was not normally distributed, and a log transformation was conducted to create a normal distribution. The transformed CES-D total was used for all CES-D analyses.

Table 2

Descriptive Statistics for the CES-D

Variable	<i>N</i>	Mean	<i>SD</i>	Min	Max	Kurtosis	Skewedness
CES-D Total	153	15.00	±11.83	3	53	1.07	1.29

Center for Epidemiologic Studies Depression Scale (CES-D)

Parent Asthma-Related Self-Efficacy

The mean parent asthma self-efficacy (P-ASE) total score was a 51.99, with a standard deviation of 5.99. Descriptive statistics for the P-ASE are found below in Table 3. For qualitative purposes, when divided by 13 items, the average item response related to perceived asthma-related self-confidence was a 3.99, which falls between the response of “Fairly sure” (3) to “Quite sure” (4). As reported in a sample of adult caregivers of children with asthma, the average mean response on the P-ASE was 3.94 (Bursch et al., 1999), indicating that female caregivers in this sample endorsed commensurate rates of perceived self-efficacy related to caring for their child’s asthma.

Analyses were conducted to assess for associations among the demographic variables and parent asthma-related self-efficacy. Results of One-way Analysis of Variance (ANOVA) models indicated a statistically significant difference among parent ethnic groups on the total score of the P-ASE. [$F(3, 146) = 3.99, p < .01$]. Post hoc tests (Tukey) revealed that parent asthma-related self-efficacy was significantly higher in mothers who identified their ethnicity as Non-Latino Black ($M = 53.13, SD = 5.11$) or Puerto Rican ($M = 53.04, SD = 5.99$), compared to mothers who identified as Other ($M = 49.24, SD = 5.67$), which was largely comprised of mothers who identify as Mexican or other Latino. Given this finding, maternal ethnicity was entered as a covariate in the models of parent asthma-related self-efficacy.

Table 3

Descriptive Statistics for the P-ASE

Variable	<i>N</i>	Mean	<i>SD</i>	Min	Max	Kurtosis	Skewedness
P-ASE Total	150	51.99	±5.99	35	63	0.15	-0.61

Asthma Management Self-Efficacy Scale – Parent Version (P-ASE)

Child Asthma-Related Self-Efficacy

The mean child asthma self-efficacy (C-ASE) total score was a 52.29, with a standard deviation of 9.24. Descriptive statistics for the C-ASE are found below in Table 4. When examining the data qualitatively, divided by 14 items, the average item response related to perceived asthma-related self-confidence was a 3.73. This average item response again falls between the responses of “Fairly sure” (3) to “Quite sure” (4). As reported in a sample of 7-15 year-old children with asthma, the average mean response on the P-ASE was 3.70 (Bursch et al., 1999). These data indicate that the children in this sample perceived their confidence related to asthma management to be consistent with previous research.

Analyses were conducted to examine how participant variables were associated with child asthma-related self-efficacy. Child age was significantly correlated with C-ASE total score ($r = .273, p < .01$), indicating that older children demonstrated increased asthma-related self-efficacy. Given this finding, child age was entered as a covariate in the models of child asthma-related self-efficacy.

Table 4

Descriptive Statistics for the C-ASE

Variable	<i>N</i>	Mean	<i>SD</i>	Min	Max	Kurtosis	Skewedness
C-ASE Total	146	52.29	±9.24	24	68	0.02	-0.59

Asthma Management Self-Efficacy Scale – Child Version (C-ASE)

Medication Adherence.

As reported by the parent and child together, the mean response for medication adherence rating scale (MARS) was 3.81 with a standard deviation of .76. Descriptive statistics for the MARS are found below in Table 5. In the current sample, the average score of self-reported medication adherence fell below the previously established cut-off score of 4.5 for good adherence.

Covariate analyses were conducted to determine if there were associations between the demographic variables and self-reported medication adherence. Pearson correlations indicated that a child's age was significantly correlated with the MARS total score ($r = -.17, p < .05$), revealing that older children reported worse adherence to asthma medications. Independent samples t-tests indicated no significant differences on the MARS related to child gender, monthly income, poverty status, and smoking history. A one-way analysis of variance also revealed a statistically significant difference between groups of varying asthma severity in terms of total score on the MARS scale [$F(2, 149) = 5.943, p < .01$]. Post hoc tests (Tukey) revealed that participants with moderate persistent asthma reported significantly greater adherence to asthma medications ($M = 3.93, SD = .70$) as compared to children with mild persistent asthma severity ($M = 3.40, SD = .82$). Given these findings, child age and asthma severity status were entered as covariates in the models of medication adherence.

Table 5

Descriptive Statistics for the MARS

Variable	<i>N</i>	Mean	<i>SD</i>	Min	Max	Kurtosis	Skewedness
MARS Total	152	3.81	±.76	2	5	-0.55	0.43

Medication Adherence Rating Scale (MARS)

Parent-Healthcare Provider Relationship.

As reported by the parent, the mean response on the measure of the parent-healthcare provider relationship (PCP) was 3.42 with a standard deviation of .28. Descriptive statistics for the PCP are found below in Table 6. As previously indicated, the greater the score on the PCP, the greater the perceived relationship is between the asthma health care provider and the family of the child with asthma. As the max score is 4, it appears that this sample on average indicated a stronger relationship with the PCP.

The relationship between parent asthma-related self-efficacy and the patient-health care provider relationship was also explored. The parent attack prevention subscale was significantly correlated with the total score on the patient-health care provider subscale ($r = .239, p < .01$). This finding revealed that mothers who report a stronger relationship with their child's health care provider feel more confident in their ability to prevent asthma attacks.

Table 6

Descriptive Statistics for the PCP

Variable	<i>N</i>	Mean	<i>SD</i>	Min	Max	Kurtosis	Skewedness
PCP Total	153	3.42	±.28	2.64	4	.15	-0.34

Patient-Healthcare Provider Relationship subscale from the Asthma Illness Representation Scale (AIRS)

Child Pulmonary Function.

The mean value for child pulmonary function was 88.64% with a standard deviation of 8.36. Descriptive statistics for FEV1 are found below in Table 4. Following NHLBI guidelines, a clinical cutoff of 80% and above is typically used to indicate the absence of airway obstruction during spirometry testing. FEV1% ranged from 55% to 124%, indicating variation in levels of obstruction across the sample.

Analyses were conducted to investigate associations among the demographic variables and child pulmonary function. ANOVA models indicated a statistically significant difference between groups of varying asthma severity in terms of FEV1 score was revealed [$F(2, 140) = 3.097, p < .05$]. Post hoc analyses (Tukey) revealed that participants with mild persistent asthma blew a higher score ($M = 93.48, SD = 13.09$) on the objective measure of lung function compared to children with severe persistent asthma ($M = 85.70, SD = 14.67$).

Table 7

Descriptive Statistics for FEV1

Variable	N	Mean	SD	Min	Max	Kurtosis	Skewedness
FEV1, %	143	88.64	±13.40	55	124	-.30	0.04

Pulmonary function; % predicted FEV₁

Analyses:

Maternal ethnicity was included as a covariate in the mediation model for Aim 1. Child age and asthma severity were included as covariates for the mediation model Aim 2. Child age alone was included as a covariate for the mediation model in Aim 3. Finally, child age and asthma severity were included as covariates for Aim 4'. The analyses were also replicated after removing covariates from the final models in order to ascertain if the significant relationship persisted or no longer existed.

Aim 1.

The first mediation model examined the direct relationship between maternal depressive symptoms and pulmonary function, and the indirect relationship via mediation through maternal perceived asthma management self-efficacy. Table 8 includes the comprehensive mediation analyses statistics. 140 cases were included in the analyses. Maternal depressive symptoms were

not associated with parent asthma management self-efficacy ($a = -1.70, p = 0.22$). Parent asthma management self-efficacy was not associated with child pulmonary function ($b = 5.81, p = 0.08$). The direct effect of depressive symptoms on child pulmonary function was not significant, indicating that when controlling for parent perceived self-efficacy, maternal depressive symptoms did not predict child pulmonary function ($c' = 0.03, p = 0.89$). Although not significant, this non-significant trend indicated that the relationship was in the expected direction of higher parent asthma management self-efficacy and better child pulmonary function. As demonstrated through the indirect effect ($ab = -0.05, 95\% \text{ CI } [-0.88, 1.12]$), parent asthma management self-efficacy did not mediate the relationship between maternal depressive symptoms and child pulmonary function. Although the main effect of the model was not significant (Table 9), the interaction effect between maternal depressive symptoms x child age for parent asthma management self-efficacy was significant ($\beta = 0.26, p = 0.04$). For parents of younger children, as maternal depressive symptoms increased, parent perceived self-efficacy decreased ($\beta = -5.01, p = 0.03$).

Table 8

Mediation Model for Maternal Depressive Symptoms, Parent Perceived Asthma Self-Efficacy, and Child Pulmonary Function

Model		a			b			c'			Indirect Effect (ab)	
Predictor	Mediator	Coeff.	SE	<i>p</i>	Coeff.	SE	<i>p</i>	Effect	SE	<i>p</i>	Effect	95% C
CES-D	P-ASE	-1.70	1.38	0.22	5.81	3.30	0.08	0.03	0.20	0.89	-0.05	[-0.88,1.12]
Total												

Note: Covariates included in this model included maternal ethnicity

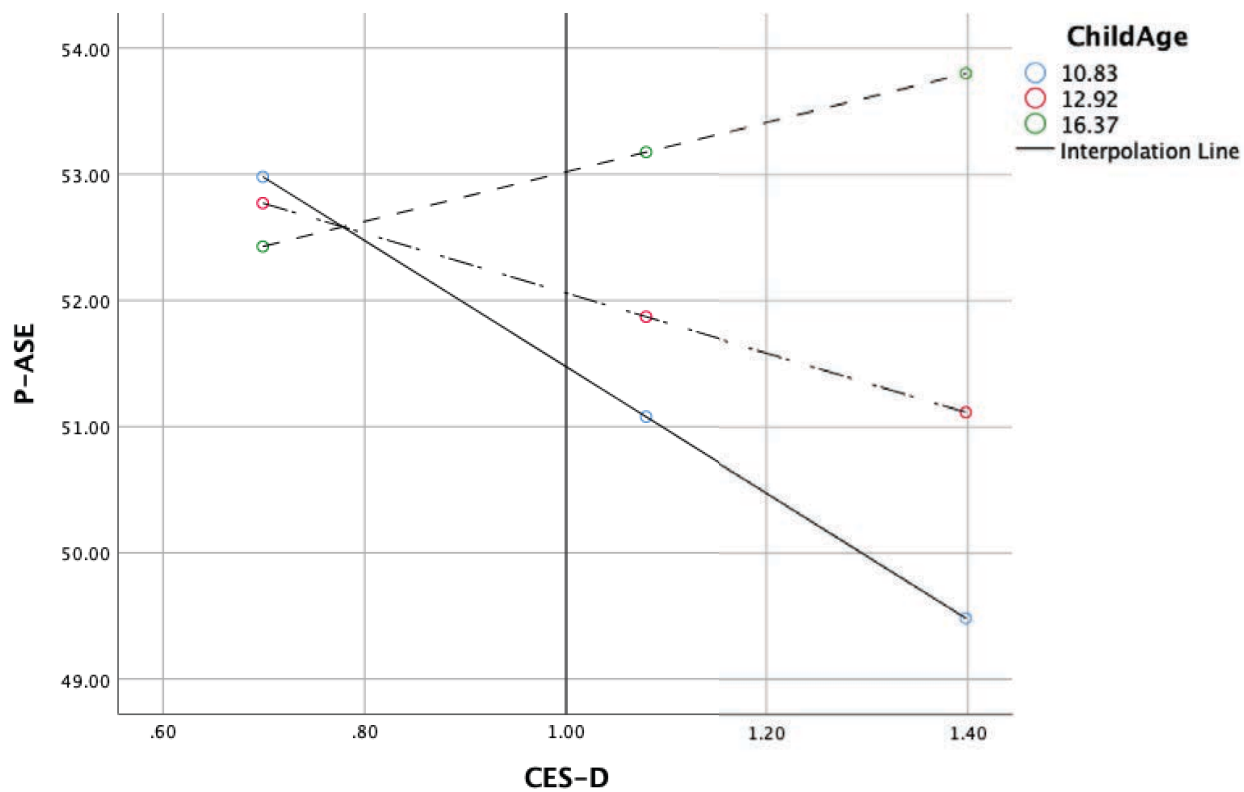
Table 9

Model Coefficients (CES-D)(Age) Analyses with Outcome Variable: Parent Perceived Asthma Self-Efficacy*

Model	Coeff.	SE B	<i>t</i>	<i>p</i>
<i>Outcome Variable = P-ASE</i>				
R ² = .05, F(3, 146) = 2.56, <i>p</i> = .06				
Constant	67.07	9.22	7.27	.000
CES-D	-18.61	8.46	-2.20	.05
Child Age	-0.98	0.66	-1.48	.14
CES-D * Child Age	1.26	0.61	2.06	.04*
Conditional Effects				
<i>M</i> - 1 SD	-5.01	2.22	-2.25	.03*
<i>M</i>	-2.37	1.47	-1.61	.11
<i>M</i> + 1 SD	1.97	2.17	.91	.37

Figure 7.

Interaction effect between Maternal Depressive Symptoms (CES-D) x Child Age for Parent Asthma Management Self-Efficacy (P-ASE)



Aim 2.

The second mediation model examined the direct relationship between maternal depressive symptoms and medication adherence, and the indirect relationship via mediation through the patient-healthcare provider relationship. Table 10 includes the comprehensive mediation analyses statistics. 152 cases were included in the analyses. Maternal depressive symptoms were not associated with the patient-healthcare provider relationship ($a = -0.06, p = 0.39$). The patient-healthcare provider relationship was not associated with medication adherence ($b = 0.21, p = 0.24$). The direct effect of depressive symptoms on medication adherence was not significant, indicating that when controlling for the patient-healthcare provider relationship, maternal depressive symptoms did not predict medication adherence ($c' = 0.43, p = 0.06$). Although non-significant, the trend towards significance was present. As demonstrated through the indirect effect ($ab = -0.02, 95\% \text{ CI } [-0.11, 0.034]$), the patient-healthcare provider relationship did not mediate the relationship between maternal depressive symptoms and asthma medication adherence.

For the moderation analyses, there were no significant main effects for maternal depressive symptoms on medication adherence or the patient-healthcare provider relationship (Table 11). There were also no significant interaction effects between maternal depressive symptoms x child age for medication adherence ($\beta = 0.10, p = 0.19$) or the patient-healthcare provider relationship ($\beta = -0.01, p = 0.66$).

Table 10

Mediation Model for Maternal Depressive Symptoms, Patient-Healthcare Provider Relationship, and Medication Adherence

Model		a			b			c'			Indirect Effect (ab)	
Predictor	Mediator	Coeff.	SE	<i>p</i>	Coeff.	SE	<i>p</i>	Effect	SE	<i>p</i>	Effect	95% C
CES-D	PCP	-0.06	0.06	0.39	0.21	0.18	0.24	0.43	0.22	0.06	-0.02	[-0.11, 0.03]
Total												

Note: Covariates included in this model included child age and asthma severity

Table 11

Model Coefficients (CES-D)(Age) Analyses with Outcome Variables: Medication Adherence and Patient-Healthcare Provider Relationship*

Model	Coeff.	SE B	<i>t</i>	<i>p</i>
<i>Outcome Variable - MARS</i>				
R ² = .21, F(3, 148) = 2.27, <i>p</i> = .08				
Constant	5.75	1.23	5.11	0.00
CES-D	-1.21	1.05	-1.15	0.25
Child Age	-0.16	0.08	-1.91	0.06
CES-D * Child Age	0.10	0.07	1.32	0.19
 <i>Outcome Variable - PCP</i>				
R ² = .01, F(3, 149) = 0.47, <i>p</i> = .70				
Constant	3.40	0.41	8.23	0.00
CES-D	0.11	0.38	0.28	0.78
Child Age	0.01	0.03	0.19	0.85
CES-D * Child Age	-0.01	0.03	-0.44	0.66

Aim 3.

The third mediation model examined the direct relationship between maternal depressive symptoms and child pulmonary function, and the indirect relationship via mediation through child perceived asthma management self-efficacy. The third model also investigated the child perceived self-efficacy subscales of attack management and attack prevention as independent mediators. 142 cases were included in the analyses. Maternal depressive symptoms were not associated with child asthma management self-efficacy ($a = -0.06, p = 0.38$). Child asthma management self-efficacy was not associated with child pulmonary function ($b = -0.23, p = 0.19$). The direct effect of depressive symptoms on child pulmonary function was not significant, indicating that when controlling for child perceived self-efficacy, maternal depressive symptoms did not predict child pulmonary function ($c' = -0.37, p = 0.09$). As demonstrated through the indirect effect ($ab = 0.02, 95\% \text{ CI } [-0.03, 0.11]$), child asthma management self-efficacy did not mediate the relationship between maternal depressive symptoms and child pulmonary function.

Higher maternal depressive symptoms were significantly associated with lower child asthma attack prevention-specific self-efficacy ($a = -3.07, p = 0.01$). The child attack prevention subscale was not associated with child pulmonary function ($b = 6.03, p = 0.08$). The direct effect of depressive symptoms on child pulmonary function was not significant, indicating that when controlling for the attack prevention subscale, maternal depressive symptoms did not predict child pulmonary function ($c' = -0.16, p = 0.50$). As demonstrated through the indirect effect ($ab = 0.49, 95\% \text{ CI } [-0.72, 2.04]$), the child asthma attack prevention subscale did not mediate the relationship between maternal depressive symptoms and child pulmonary function.

The same model was also utilized in investigating the asthma attack management subscale as the mediator. Significance was not found in path a ($a = -1.34, p = 0.12$), path b ($b =$

5.94, $p = 0.08$), path c' ($c' = -0.24$, $p = 0.47$), or through the indirect effect ($ab = 0.32$, 95% CI [-0.51, 1.50]). Table 10 includes the comprehensive mediation analyses statistics.

For the moderation analyses, the main effect for maternal depressive symptoms on child perceived self-efficacy was significant (Table 13), whereby increased maternal depressive symptoms were associated with decreased child perceived self-efficacy. There were no significant interaction effects between maternal depressive symptoms x child age for child perceived self-efficacy ($\beta = 0.26$, $p = 0.78$).

Table 12

Mediation Model for Maternal Depressive Symptoms, Child Perceived Asthma Self-Efficacy, and Child Pulmonary Function

Model		a			b			c'			Indirect Effect (ab)	
Predictor	Mediator	Coeff.	SE	<i>p</i>	Coeff.	SE	<i>p</i>	Effect	SE	<i>p</i>	Effect	95% C
CES-D	C-ASE	-0.06	0.07	0.38	-0.23	0.18	0.19	-0.37	0.22	0.09	0.02	[-0.03, 0.11]
Total												
	Attack Prevention	-3.07	1.19	0.01*	6.03	3.38	0.08	-0.16	0.24	0.50	0.49	[-0.72, 2.04]
	Attack Management	-1.34	0.85	0.12	5.94	3.33	0.08	-0.24	0.33	0.47	0.32	[-0.51, 1.50]

Note: Covariates included in this model included child age

Table 13

Model Coefficients (CES-D)(Age) Analyses with Outcome Variable: Child Perceived Asthma Self-Efficacy*

Model	Coeff.	SE B	<i>t</i>	<i>p</i>
<i>Outcome Variable = P-ASE</i>				
R ² = .08, F(3, 142) = 4.09, <i>p</i> < .001*				
Constant	38.94	14.02	2.78	0.006
CES-D	-1.84	12.86	-0.14	0.89
Child Age	0.87	1.00	0.87	0.39
CES-D * Child Age	0.26	0.93	0.28	0.78

Aim 4.

The fourth and final mediation model examined the direct relationship between maternal depressive symptoms and medication adherence, and the indirect relationship via mediation through the child perceived asthma management self-efficacy. The fourth model also investigated the child perceived self-efficacy subscales of attack management and attack prevention as independent mediators. 145 cases were included in the analyses. Maternal depressive symptoms were not associated with child perceived asthma self-efficacy ($a = 1.43, p = 0.51$). Child perceived asthma self-efficacy was not associated with medication adherence ($b = 0.18, p = 0.31$). The direct effect of depressive symptoms on medication adherence was not significant, indicating that when controlling for child perceived asthma self-efficacy, maternal depressive symptoms did not predict medication adherence ($c' = 0.01, p = 0.21$). As demonstrated through the indirect effect ($ab = 0.01, 95\% \text{ CI } [-0.03, 0.08]$), child perceived asthma self-efficacy did not mediate the relationship between maternal depressive symptoms and asthma medication adherence.

Higher maternal depressive symptoms were again, significantly associated with lower child asthma attack prevention-related self-efficacy ($a = -3.44, p < 0.01$). The child attack prevention subscale was not associated with medication adherence ($b = 0.18, p = 0.33$). The direct effect of depressive symptoms on medication adherence was not significant, indicating that when controlling for the attack prevention subscale alone, maternal depressive symptoms did not predict medication adherence ($c' = 0.02, p = 0.08$). As demonstrated through the indirect effect ($ab = -0.07, 95\% \text{ CI } [-0.20, 0.009]$), the child asthma attack prevention subscale did not mediate the relationship between maternal depressive symptoms and medication adherence.

The same model was also investigated utilizing the asthma attack management subscale as the mediator. Significance was not found in path a ($a = -1.33$ $p = 0.12$), path b ($b = 0.14$, $p = 0.43$), path c' ($c' = 0.004$, $p = 0.99$), or through the indirect effect ($ab = 0.0005$, 95% CI [-0.05, 0.06]). Table 11 includes the comprehensive mediation analyses statistics.

Table 14

Mediation Model for Maternal Depressive Symptoms, Child Perceived Asthma Self-Efficacy, and Medication Adherence

Model		a			b			c'			Indirect Effect (ab)	
Predictor	Mediator	Coeff.	SE	<i>p</i>	Coeff.	SE	<i>p</i>	Effect	SE	<i>p</i>	Effect	95% C
CES-D	C-ASE	1.43	2.14	0.51	0.18	0.18	0.31	0.01	0.01	0.21	0.01	[-0.03, 0.08]
Total												
	Attack Prevention	-3.44	1.15	0.003*	0.18	0.18	0.33	0.02	0.01	0.08	-0.07	[-0.20, -0.009]
	Attack Management	-1.33	0.85	0.12	0.14	0.18	0.43	-0.004	0.02	0.99	0.0005	[-0.05, 0.06]

Note: Covariates included in this model included child age and asthma severity

Discussion

Hypotheses and Findings

The purpose of the current study was to examine associations among maternal depressive symptoms and child asthma outcomes of child pulmonary function and medication adherence through asthma-related perceived self-efficacy and the parent's reported relationship with the child's healthcare provider. Overall, the mediational models employed in the study did not yield significance. One of the most critical findings of the present study revealed that higher levels of depressive symptoms observed in mothers of children with asthma were associated with children who reported less perceived self-confidence in preventing their acute asthma exacerbations. This finding is consistent with the BBFM, whereby the negative emotional climate of the mother was associated with child-level asthma-related outcomes.

The results of the study indicated several null results. More specifically, mediation was not found to occur when investigating parent perceived asthma management self-efficacy as the mediator between maternal depressive symptoms and child pulmonary function, in addition to child perceived asthma management self-efficacy as the mediator between these variables. Similarly, mediation did not occur when examining the patient-healthcare provider relationship as the mediator between maternal depressive symptoms and ICS medication adherence. When child perceived asthma management self-efficacy was added as the mediator in the model with these same variables, mediation did not occur.

There are a variety of potential explanations for the lack of significant findings. These lack of associations may have been a result of the fact that this was not a clinical sample of depressed mothers. Although the mean score on the measure of depressive symptomology was just below the cutoff for clinical "caseness" of depression, indicating that the presence of

depressive symptoms was relatively high, these were not mothers that carried a clinical diagnosis of depression. It is possible that if the sample was more representative of mothers with clinically diagnosed depression, the findings may have been different. In addition, previous research suggests that a parent's perceived self-confidence related to their child's asthma management may not be a sufficient indicator of child asthma outcomes, including the way the child is objectively engaging with and utilizing ICS and quick-relief asthma medications (Branstetter-Rost et al., 2010). The current study highlights the reality that a parent's perceived self-efficacy may not be the most accurate predictor of how the child objectively engages with asthma medication adherence, ultimately impacting pulmonary function.

This lack of significant findings related to perceived asthma management self-efficacy and asthma outcomes were also replicated for the child. It is important to consider that there are additional contributing factors outside of self-efficacy that contribute to the child engaging in sufficient asthma management. These factors include external systems such as the environment, the medical system, and personal preference (Bender, 2000). These barriers to children adhering with their medication regimen include children forgetting to take medications, not fully understanding their medication regimen, and avoiding taking their medications intentionally to avoid the potential side-effects that can arise. In addition, it was found that a child's asthma severity, understanding of their need for asthma treatment, and lack of confidence in the efficacy of their medication also impacted adherence (Bender, 2000), which is likely to ultimately impact pulmonary function. Moreover, there a number of external barriers outside of child perceived self-efficacy that may arise which may impact asthma medication adherence and ultimately pulmonary function, supported by previous research.

Interpretation

Although the mediational models as a whole were not significant, the results of the present study demonstrated significance in individual pathways. The results of the present study revealed that higher levels of maternal depressive symptoms were associated with lower child perceived self-efficacy related to preventing their asthma attacks, specifically. As previously stated, there has been no prior research to date that has focused on maternal depressive symptoms and child asthma management self-efficacy among ethnically diverse families. These findings highlight the importance of considering the child's perceived asthma related self-efficacy when examining the impact of maternal depressive symptoms on child asthma outcomes. In addition, it was noted that maternal depressive symptoms were significantly related to child perceived self-efficacy in terms of asthma attack prevention. Attack prevention is measured by the individuals understanding of asthma medications, perceived medication adherence, trigger avoidance, and confidence related to the skills needed to control asthma. This significant finding elucidates the importance of considering the child's specific perceived self-efficacy related to preventing (as compared to responding in the moment) acute asthma exacerbations.

Previous studies have indicated the importance of considering the impact that a child with a chronic illness like asthma has on the primary caregiver (Pak & Allen, 2012). Parents of children with asthma are responsible for overseeing the myriad of factors that are related to asthma management, including interaction with providers, maintenance and refill of child's daily medications, support in identification and avoidance of their child's triggers, and de-escalation of acute asthma exacerbations. As a result, the level of responsibility is profound and can likely impact a mother's well-being and mental health.

Mothers with depressive symptoms additionally may experience the prominent depressive symptom of cognitive impairment, which can impact their executive function, problem-solving skills, and ability to stay on top of the needs of their children with asthma. As outlined by previous research, Social Learning Theory, which emphasizes the importance of modeling in child development and how the impact of behaviors, attitudes, and emotional reactions of parents can influence the way in which a child internalizes these concepts, can play a significant role in a child's development (Bandura & Walters, 1977). A previous study revealed that not only did the parenting behaviors of the single mother impact child outcomes but that the mother's perceived self-efficacy related to parenting was also a contributing factor (Jackson & Scheines, 2005). If a child observes their mother has disorganized, non-adherent, and lacking the confidence for the implementation of positive adherence behaviors to the child's asthma regiment, it is likely that the child may also internalize this lack of structure which may lead to a lack of self-confidence. Findings of the current study further this likelihood, whereby compared to mothers with high levels of depressive symptoms, mother's with lower levels of depressive symptoms have reported the ability to stay on top of their child's asthma-related needs (Pak & Allen, 2012).

In terms of the association between and potential impact of mothers with increased levels of depressive symptomology on children and their asthma-related perceived self-efficacy, it is possible that as a result of these depressive symptoms, these mothers played a more passive, withdrawn role during their children's development. As a result, children were not equipped with the necessary tools to assume responsibility for their own care in the absence of their mother's guidance. As noted through the results of previous research, mothers with increased levels of depressive symptomology have been shown to misunderstand the functionality of their child's

medications, feel less capable to cope with asthma-related challenges, and were more likely to misinterpret asthma symptoms (Bartlett et al., 2004). Research also indicates that parental attitudes towards medications and respective relationships to self-reported medication adherence is an important factor in teaching children to adapt similar medication-related behaviors. As established through a study of children on psychiatric medications, the parents' attitudes toward and understanding of their child's medication regimen played a critical role in the adaptation of accurate understanding and strong medication adherence behaviors in their children (O'Brien, Crickard, Lee, & Holmes, 2013). In addition, child perceived self-efficacy has been shown to be related to their self-reported adherence to asthma treatment (Zebracki & Drotar, 2004).

Results of the current study also indicated that for mothers of younger children, as maternal depressive symptoms increased, parent perceived self-efficacy decreased. This finding highlights an important consideration related to child age when assessing asthma-related outcomes. It has been supported that for younger children, parents play a more active role in asthma care and assume a larger responsibility for their child's asthma management (Orrell-Valente et al., 2008). As a result, it makes sense that since the burden of responsibility is increased for mothers of younger children with asthma, when depressive symptoms increase, the mother's perceived self-efficacy and confidence related to their child's asthma management decreases.

The results of the present study also highlighted an important distinction in the child asthma perceived self-efficacy subscales whereby higher levels of maternal depressive symptoms were associated with significantly lower levels of self-confidence in the child in preventing their own asthma attacks, but not managing them. This is an important finding in highlighting the difference between prevention (avoiding allergens, adapting positive asthma self-management

skills) and management (problem solving during asthma symptom exacerbations and choosing which medications to use, controlling attacks at home rather than reporting to emergency room). Findings from a similar study revealed consistent results, whereby child perceived self-efficacy was related to asthma management and prevention together (C-ASE total score) but not related to the asthma self-management alone (Zebracki & Drotar, 2004). Attack prevention requires children to think critically, establish a routine, and respond appropriately. Mothers with increased levels of depressive symptoms who may experience increased levels of stress and impairments in executive function promote a household with less organization, consistency, and routine (Hur, Buettner, & Jeon, 2015), factors which children likely internalize and negatively impact confidence related to attack prevention. As a result, children of mothers with an increase in depressive symptomology have likely a more difficult time in replicating appropriate asthma attack prevention behaviors and feel less confident in the ownership of this role within their own asthma care. Although the child may perceive deficits in the ability to plan in advance (attack prevention), it is possible that they feel more confident in responding appropriately in the chance of a flareup or asthma-related emergency (attack management), whether that be individually or in consultation with their family system.

The results of the study also indicated that the parent asthma attack prevention subscale of the perceived asthma-related self-efficacy measure was correlated with the patient-healthcare provider relationship. This finding stated that mothers who felt an increase in asthma management self-efficacy also felt an increased bond in their perceived relationship with their child's health care provider. This additionally highlights the importance of considering the role of the patient-healthcare provider relationship in child asthma care. As mentioned, considering the partnership between the caregiver, healthcare provider, and the child with asthma is an

essential component of care and has been shown to be a predictor of adherence to treatment (Gavin et al., 1999). As previous research demonstrates, a strong patient-provider relationship results in an increase in adherence to treatment, decrease in missed appointments, and ability to adopt and enact the advice of medical providers (DiMatteo et al., 2000). This finding emphasizes the critical nature of patient-provider interaction in parent perceived self-efficacy, whereby there is potential for the relationship itself to impact child asthma outcomes. If mothers leave an appointment or interaction with their child's asthma provider feeling respected, empowered, and communicated with in a way that is effective, results of the present study suggest that this may lead to them also feeling confident and efficacious in preventing their child's asthma attacks. Conversely, if at a baseline the mother feels less confident in preventing asthma attacks, this may impact the relationship with the provider and cause them to view this relationship in a more negative, judgmental, and less trusting manner. As a result, it is possible that this negative perception may also then impact the way the mother cares for their child and most importantly, their child's asthma-related outcomes. Moreover, the study was cross-sectional, and it is possible for this association between the patient-healthcare provider relationship and parent asthma-related self-efficacy to be swayed in either direction.

There are also alternate possible explanations as to why an association among maternal depressive symptoms and asthma management self-efficacy occurred in the present study. Maternal depressive symptoms are also strongly associated with child internalizing disorders, mainly depression and anxiety (Feldman et al., 2011). In addition, Katon et al. (2004) proposed that anxiety, along with the burden of disease that is present with a chronic illness such as asthma, may decrease asthma management self-efficacy. Moreover, as previous research has established associations among maternal depressive symptoms, child anxiety, and asthma

management self-confidence, it is possible that in the current study, child anxiety may have played a role in this significant result. As the BBFM posited, the presence of a negative emotional climate in the family system of the child with asthma, including parental psychopathology, was associated with child internalizing disorders and poor asthma outcomes (Lim et al., 2011). It is possible that in the current study, child psychopathology may have also played an influencing role, whereby participants reported themselves as less efficacious as a result of the child's symptoms of anxiety. Albeit limiting, child anxiety was not assessed for in the current study, so finite conclusions cannot be drawn.

In addition, the association between maternal depressive symptoms and perceived self-efficacy may also be impacted by problem-solving skills, a component of executive function which was also not assessed for in the present study. As previously stated, it is common for individuals with symptoms of depression to experience cognitive impairment, classified as deficits in memory, processing speed, and executive functioning, which includes the ability to solve problems (McDermott & Ebmeier, 2009). Previous research indicated that decreased problem-solving skills in caregivers of children with asthma were related to subpar asthma treatment management which ultimately led to an increase in asthma morbidity and severity (Wade, Holden, Lynn, Mitchell, & Ewart, 2000). As such, a mother's ability or inability to problem-solve may have also been an important contributing factor in the present study related to both the caregiver and the child related to internalizing a sense of self-confidence and efficacy related to asthma management.

Sample Characteristics. The ethnic characteristics of the female primary caregivers in our study were diverse and well representative of the greater population within which the study recruited from. The participating female caregivers comprised a predominantly Non-Latino

Black and Puerto Rican sample, but also included mothers of Dominican, Mexican, and other Latino descent. Mothers who identified as Non-Latino Black or Puerto Rican reported greater confidence in their perceived asthma-related self-efficacy as compared to the “Other” group, which was largely comprised of mothers from Mexico, El Salvador, and Honduras, and other Spanish-speaking countries. A large majority of the research base in pediatric asthma is focused on White families, so there is no literature base to provide support for this association found in the present study. Although there has been research on ethnic disparities in asthma (Canino et al., 2008), it is minimal and is mostly focused on minority groups including Puerto Rican, African American, Cuban, and Mexican American families. At this time, the research related to Latino subgroups is not as robust in comparison. As the current study recruited from the Bronx and the study population was mostly comprised of Non-Latino Black and Puerto Rican individuals, the potential for recognizing Latino subgroup differences among ethnic minority populations was not addressed. It is important to address these groups where the burden of disease is high (Canino et al., 2006), and future research and intervention may want to additionally focus on addressing cultural differences among these groups that likely attribute to the mothers sense of asthma-related perceived self-efficacy.

Older children reported decreased adherence to ICS medication yet increased asthma-related self-efficacy. The finding related to self-efficacy may appear intuitive in nature, as it would be expected that the older children get, the more efficacious they feel and the more responsible they become in managing their own asthma. As explored by various studies among children with chronic illness, research states that as children age, they internalize the responsibility of their asthma management and act effectively (McQuaid, Kopel, & Nassau, 2001). Conversely, there is also previous research that suggests the opposite, whereby older

children are actually less adherent with their medications compared to younger children (Bender et al., 2000). It is important to consider that this reported increase in asthma-related perceived self-efficacy and decrease in asthma medication adherence may have been attributed to an inflated sense of self-confidence on behalf of the child. It is possible that children perceived or reported their sense of self-efficacy as stronger than it actually was, portraying a sense of false self-confidence. This may have resulted in desirable responding in an attempt to exhibit a greater sense of competence and awareness related to managing their asthma. Previous research indicates this trend among pediatric asthma populations, whereby children and their mothers reported an increase in their medication adherence to research assistants, but the computer-tracking devices which objectively measured the adherence demonstrated a significantly lower percentage of usage (Bender et al., 2000; McQuaid, Kopel, Klein & Fritz, 2003). It was inferred from the findings that this may also be due to mode of reporting (computer tracking versus self-report to research assistant). Existing but limited research in pediatric asthma suggests that additional research is necessary to draw informed conclusions (Bender, 2007).

It is suggested that as children get older and increase their assumption of responsibility, parents also increasingly withdraw their responsibility and oversight of management. As a result, children do not always effectively internalize the strategies set forward by their parents which can lead to ineffective management on behalf of the child of their illness. It is likely that culture may play a role here, as depending on the belief system of the culture, parents may have taken a more active versus passive approach during their child's development, especially related to their health and well-being. Previous research states that parenting self-agency (similar to self-efficacy, defined as the parent's perception of their own confidence, ability, and effectiveness in accomplishing tasks), parent's ability to cope, and practices among parenting in general differs

based on ethnicity, SES, experiences of immigration and discrimination, acculturation, and predominant language used (Dumka, Stoerzinger, Jackson, & Roosa, 1996). This study revealed that the socioeconomic status of parents was associated with parenting-self agency, as defined as the parent's perceived self-confidence related to successfully adapting the parental role. As such, parents from lower SES also endorsed reduced confidence and competence in their ability to accomplish parenting-related activities. As previously established, it is essential to consider cultural differences and understandings of illness when addressing health disparities in ethnic minority children (Canino et al., 2008).

In addition, it is essential to consider that medication adherence was reported on together, whereby both child and mother had an opportunity to confer and then provided a mutually agreed upon decision. It is possible that adherence may have been under-reported or over-reported, depending on the perception of both the child and mother as individuals and as a dyad. Previous research revealed that among parent-child dyads of children with HIV, dyads that disagreed with perceived medication adherence included older children who more commonly reported increased responsibility to manage their own medications (Dolezal, Mellins, Brackis-Cott, & Abrams, 2003). These findings further established the need for multiple measures of adherence to most accurately assess for pediatric medication adherence, and future research on the topic should utilize both objective and subjective measures.

There was also a statistically significant difference found related to asthma medication adherence and asthma severity. Children who were labeled with moderate persistent asthma as determined by their doctor demonstrated better adherence to their daily asthma medications compared to children with mild persistent asthma. In the current study, ethnic minority children with more severe asthma appeared to be more adherent to their medications, which may be a

result of these children internalizing an understanding that their illness is more severe, which leads them to an increase their reported adherence.

Although this finding may be perceived as counterintuitive clinically, as it would be predicted that a child's asthma would be assessed as less severe if they are better at remaining compliant with their asthma medications, previous research demonstrates variability related to this outcome. In fact, in a predominantly white sample of 8 to 16 year old children with asthma and their primary caregivers, findings determined that adherence to asthma controller medications did not differ by asthma severity (McQuaid, Kopel, Klein, & Fritz, 2003) . In addition, there are many factors that contribute to the physician ratings of asthma outside of pulmonary function and medication adherence that can influence severity ratings. Some of the factors, including frequency of nighttime awakenings and emergency room visits can be influenced by elements or potential triggers in the child's environment that are hard to control such as pollution, garbage, mold, dust, or animal hair. If a child is exposed to an increase in triggers prior to their initial visit with a doctor to establish an asthma diagnosis and be provided with a severity rating, this may impact the rating the child is provided with as a baseline. Although asthma severity is not constantly changing, it is important to consider the contributing factors that may impact the baseline severity rating.

Limitations:

The current study has several limitations that should be considered when interpreting the results. The larger RCT from which the current study is based on enacts a longitudinal design. The study utilized an observational, cross-sectional analysis of the data which eliminates the ability to examine causality. Although this is considered a limitation, the cross-sectional nature will allow for further investigation among maternal depressive symptoms, asthma management

self-efficacy, patient-provider relationship, and medication adherence and the pathways and mechanisms they employ, to inform future predictive approaches.

Generalizability of the findings can pose a limitation on a variety of factors. One, the population consisted of primarily inner city, low SES, ethnic minority families which is an important population of interest, yet the findings cannot be easily generalized to the larger population as there was not a Caucasian comparison group. Two, the design employs the use of a clinic-based sample instead of a population-based sample, as all of the participants in the study were recruited from hospitals and clinics. Three, medication adherence was measured using self-report in place of an objective measure (i.e., medication tracking device). Although this measure is deemed reliable and valid in the population of interest, self-reported adherence is likely to be biased and may be impacted as a result of maternal depressive symptoms (Lim et al., 2008). In addition, the measure used to assess for self-reported adherence has not yet been validated among the pediatric population. In addition, the present study was the first to utilize this measure with combined reporting, whereby the parent and the child were responsible for coming up with a mutually agreed upon answer.

Another limitation of the present study is that the study looked at maternal depressive symptoms only and not caregiver depressive symptoms, which makes it difficult to generalize beyond female-identified caregivers. The measure of depressive symptoms also relied on self-report, which can be confounded for a variety of reasons including mental health stigma among the population of interest, or the lack of privacy due to a research assistant administering the questionnaire. These factors may induce feelings of judgement on behalf of the participant and could also be considered intrusive. It is possible that participants were not forthcoming with their report if they truly experienced more elevated levels of distress. Additionally, the present study

did not assess for current psychotropic medication use of the mothers, including anti-depressants or if the mother was currently in psychotherapeutic treatment. If a mother was prescribed and consuming an antidepressant or a psychotropic medication that impacted mood symptoms or was receiving psychotherapy, then their pre-existing symptoms of depression that were then treated would not be reflected at the baseline session of the study. As the study did not assess for previous psychotherapeutic or psychotropic treatment, this was not a variable that was controlled for in the models.

Finally, a limitation of the present study is that it did not assess for child internalizing disorders or the presence of symptoms of anxiety or depression. As it has been established that child anxiety and depressive symptoms can impact asthma management self-efficacy and asthma outcomes, not assessing for the presence of these symptoms in the current study was a major limitation. It is possible that the presence of child anxiety or child depressive symptoms could have contributed to decreased reported medication adherence or perceived child asthma related self-efficacy, independent from maternal depressive symptoms.

Clinical Implications:

The findings of the current study highlight the great importance of maternal mental health on child asthma outcomes. Although the child is the one who bears the burden of the chronic illness, the mother plays a critical role in asthma management, specifically in the way in which the child learns to care for their own illness. As proposed by the Guidelines for the Diagnosis and Management of Asthma (2007) outlined by the U.S. Department of Health and Human Services, National Heart, Lung, and Blood Institute's National Asthma Education and Prevention Program (NAEPP) Expert Panel Report 3, in addition to providing caregivers with the standards of asthma management and care, caregivers of children with asthma with depression should require

additional support on behalf of the provider related to asthma guidelines, action/management plans, and appropriate medications due to the interfering impact of depressive symptoms on cognition (Pak & Allen, 2012). As outlined, providers of pediatric health should focus on 1) providing an increase in the depth and delivery of asthma education, 2) scheduling more frequent follow up visits (which may include phone follow-up) with the family to reinforce asthma education and address or praise any maladaptive or positive management behaviors, respectively, and 3) discussing the health care system and guiding the family in primary and mental health care utilization so that appropriate resources can be taken advantage of (Pak & Allen, 2012).

In regard to assessing for and encouraging increased asthma management self-efficacy and confidence, it was demonstrated through the present study that maternal depressive symptoms were associated with asthma management self-efficacy, specifically attack prevention. First, this finding reveals an important discrepancy between attack prevention and attack management, whereby providers should pay attention to ensuring their families understand and feel efficacious in both preventing and managing acute asthma exacerbations. Second, as depression is known to impact concentration, learning, and decision making (APA, 2013), there is a critical need for pediatric care providers to spend additional time collaboratively determining an asthma management regimen that children and caregivers feel comfortable with. As outlined by a study investigating the optimization of ADHD medication adherence in children, results indicated that shared decision making among the provider, the parent, and the child are essential in improving asthma outcomes (Charach & Fernandez, 2013). If pediatric asthma providers consider the perceptions of the caregiver and child, along with the medical recommendations, the likelihood for a mutually agreed upon and understood asthma management plan is increasingly likely, along with the potential for increased self-confidence related to the plan.

To continue in this vein, it has been established through the present study that the perceived self-efficacy of both the mother and the child are critical components of asthma care. As similarly revealed by the results of a previous study on low-income, Non-Latino Black families with children with high-risk asthma, caregivers were found to lack the adequate knowledge related to managing the treatment of a child with asthma and also endorsed unavoidable exposure to asthma triggers in their experience of living in low-income housing (Bellin et al., 2017). Not only do these findings highlight the importance of ethnic disparities in asthma management, this highlights the need for targeted asthma education delivered by healthcare providers to ensure that both caregivers and children feel increasingly efficacious in their ability to manage a chronic illness like asthma. It is essential that providers take as much time that is possible in assuring that these individuals have a sufficient understanding of asthma as an illness and what is required in managing an illness such as asthma with a variety of components. In addition, as there was a lack of significant findings between parent and child perceived self-efficacy and asthma outcomes, it is important for asthma education to not only focus on parents and children feeling efficacious and confident, but also addressing the other potential environmental and systemic barriers that may impact engagement with asthma treatment. Results of the current study indicate that self-efficacy may not be enough to ensure good medication adherence and other asthma outcomes.

As it is common for providers to have time limitations and restrictions related to how much time can feasibly be dedicated to spending with a patient, the inclusion of asthma educators in pediatric clinics would be essential in filling this gap. Previous research indicates that asthma education is spreading outside of the clinic setting and into home visits and (Anderson, Zajac, Thanik, & Galvez, 2020) online resources, including asthma education

webinars for parents (Sawicki & White, 2020). In addition, previous research indicated that techniques such as psychoeducation specific to managing asthma, cognitive restructuring, and problem-solving specific barriers related to a family's ability to manage asthma have been helpful in increasing asthma-related management self-efficacy (Bruzzese et al., 2016; Put, Van den Bergh, Lemaigre, Demedts, & Verleden, 2003).

It is also necessary to consider the cultural factors that play a role in both the parent and the child's ability to feel asthma-related self-confidence. The results of the current study highlighted that even within Latino communities, there are essential differences among Latino subgroups that may have impacted perceived self-efficacy. Future research should focus on exploring differences in asthma-related self-efficacy among Latino subgroups. In addition to ethnicity, it is also important to consider the other cultural systems that may impact outcome measures and are associated with the larger social context. These external variables include environmental factors, quality of housing, and healthcare utilization. The current study was conducted in the Bronx, NY, which is home to increased rates of pollution, garbage, rodents, decreased living conditions, and public hospitals with a large patient population and limited resources (Dhala, Pinsker, & Prezant, 2004; Maciejczyk et al., 2004; Warman, Silver, & Wood, 2009). It is essential to consider these factors when interpreting the findings from the present study, especially in consideration with how they may impact study measures. Additionally, it is recommended that pediatric clinics consider these important characteristics when caring for children and families from these vulnerable populations. It would be helpful for clinics to incorporate training and supervision in cultural competency, with a focus on how these systems impact their patients and their course of illness.

Clinical interventions families of children with asthma should be sure to include assessment of the mental health of the primary caregiver at doctor's visits, and this should be something that is followed over time. If depressive symptoms of mothers of children with asthma are addressed, the well-being and quality of life of both these mothers and their children may be enhanced (Pak & Allen, 2012). As established through previous research, screening tools including the two-item Patient Health Questionnaire (PHQ-2) have been easy to use and implement in urban, pediatric primary care clinics (Dubowitz et al., 2007). Previous research also indicated that mothers reported feeling open towards discussing their mental health with their child's health care provider and having the provider follow-up on next steps in their own mental health care as well as their child's (Kahn et al., 1999). As a result, pediatric asthma providers should consider implementing these actions into their practice and incorporating these steps into their standard of care. As previously mentioned, outcomes of mental health treatment of these mothers have the potential to strengthen the patient-provider relationship, medication adherence and asthma management, perceived self-efficacy, and possibly the child's pulmonary function.

Future Directions:

Future research is necessary to continue to strengthen our understanding of the mechanisms by which maternal depressive symptoms, maternal and child asthma management perceived self-efficacy, patient-provider relationship, medication adherence, and child pulmonary function interact among ethnic minority communities. Although the current study provided findings that contribute to the existing body of research, these results lay the foundation for further studies to be built upon. Future research should be designed to assess the extent to

which each of the factors work alone and together within analytical models and contribute to asthma inequalities observed in this critical group of interest.

In the present study, neither child psychopathology nor child stage of development was assessed for. As previously mentioned, child psychopathology or the presence of an internalizing disorder such as depression or anxiety in children can greatly impact child health outcomes. In addition, although behavioral and development disabilities were asked about in the screening process, there was no official measure of child developmental outcomes employed. It would be helpful for future research on the topic to include measures of both child psychopathology and child development, to explore the associations among these variables and child asthma outcomes. In addition, neither parent nor child problem-solving skills were formally assessed for in the current study, which can be impacted by or associated with child and parent psychopathology. As problem-solving skills are highly associated with mental health diagnoses such as anxiety and depression, future studies may want to explore this specific association and its potential contribution to outcome measures.

As the present study was part of a larger, ongoing RCT, additional subjects have now completed the baseline session. As a result, additional participant data have been added to the database and the analyses from the present study could be re-run to replicate findings in a larger sample. If the total sample size of the present study increased, the statistical power of the study would increase and possibly the findings could produce varied results. Given the importance of the patient-healthcare provider, it would also be beneficial to assess for the pediatric asthma provider's perspective in future studies. More specifically, it would be interesting to investigate perceived differences in self-efficacy. If a parent perceives themselves as very efficacious but the

provider feels differently, this difference may shed light on important aspects of delivering and receiving asthma education which may be currently overlooked.

Additionally, an investigation of these variables over time in a longitudinal design would provide more detailed insight into the impact of variables from the larger RCT on measures such as maternal depressive symptoms, child and parent perceived self-efficacy, the patient-provider relationship, and reported medication adherence. The larger study included the delivery of asthma education and the clinical interventions delivered to the dyad (motivational interviewing and problem-solving therapy), and it would be interesting to follow the impact of these interventions on the outcome measures. These more robust data would prove helpful in informing clinical interventions and tailoring intervention programs to caregivers of children with asthma who endorse high levels of depressive symptomology, low levels of perceived self-efficacy, and poor patient-provider relationship. As such, these informed individual and family-based assessments and interventions which include the parent-child dyad could likely be helpful in improving child asthma outcomes. In addition, the current study promotes the need for continued investigation into examining integrative theories that include parent risk factors, and child physical health outcomes in an ethnic-minority, underserved population where asthma is disproportionately prevalent.

Conclusions:

The present study set out to explore the underlying mechanisms behind maternal characteristics and child asthma outcomes. Given the implications that maternal mental health has on the mother, child, and larger family system, it was critical to investigate the factors associated between maternal depressive symptoms and child asthma outcomes. The current study investigated associations among maternal depressive symptoms, parent and child asthma

management self-efficacy, patient-health care provider relationship, asthma medication adherence, and child pulmonary function. The study was also quite innovative in exploring these variables, including an objective measure of asthma outcome (pulmonary function) among an ethnically diverse, marginalized population. The study was also one of the first to examine the association between maternal depressive symptoms, perceived self-efficacy, parent-HCP relationship, and asthma outcomes within a sophisticated model among this mostly Non-Latino Black and Latino aged population.

It was expected that parent and child asthma management self-efficacy would mediate the relationship between maternal depressive symptoms and child pulmonary function, but a mediating effect was not found in the current study. Although the impact of maternal depressive symptoms on child asthma outcomes was not shown to be mediated by child and caregiver-level variables as explored by the adapted BBFM (Lim et al., 2011), significant associations between these variables indicated in the present study were consistent with previous research. Along with this model, negative family climate (as measured by maternal depressive symptoms in the present study) was shown to be associated with child-level factors including their perceived self-efficacy. Mothers who reported increased depressive symptoms also had children who felt less efficacious in preventing their own asthma attacks, which highlighted an important discrepancy between a perceived ability to prevent an asthma attack as opposed to managing and responding to an acute attack in the moment. Alternatively, increased levels of asthma management self-efficacy as reported by the mothers in the study were associated with a more positive relationship with their child's asthma provider.

In addition, it was also expected that the patient-health care provider relationship and child asthma management self-efficacy would mediate the relationship between maternal

depressive symptoms and asthma medication adherence, but that mediating effect was additionally not found in the present study. Although the presence of depressive symptoms reported by the participating maternal caregivers approached caseness for depression, the lack of mediation may have been a result of the reality that the study sample was not comprised of mothers with clinically diagnosed depression. This also may have been due to the nature of self-report for the measure of maternal depressive symptomology, maternal and child asthma management self-efficacy, and medication adherence, whereby how they subjectively view themselves and their behaviors may differ from their objective experience or ability to implement certain behaviors. The current study also revealed differences among demographic variables, including child age, child asthma severity, and maternal cigarette smoking history. It additionally highlighted differences among ethnic groups and more specifically, Latino subgroups other than Puerto Rican and Dominican individuals, which may highlight important gaps in the current literature base.

In terms of clinical implications, this study strengthened the support related to the importance of considering maternal mental health in pediatric asthma care. When working with mothers who endorse depressive symptoms, it is essential for pediatric care providers to increase the attention paid towards a discussion of asthma management and assessing the potential barriers to efficacious asthma care. In increasing the resources and psychoeducation provided, screens administered, and collaborative, team-driven nature of the child, caregiver, and provider, it is possible to see improvements in the lives of ethnic-minority families with asthma.

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