Factors affecting asthma in minorities: African-Americans, Puerto Ricans, and Mexican-Americans

Fouad Malik
The University of Toledo

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# Table of Contents

Introduction ......................................................................................................................................1  
Etiology ............................................................................................................................................1  
Triggers ............................................................................................................................................3  
Problem Statement ...........................................................................................................................4  
Purpose .............................................................................................................................................6  
Research Questions ..........................................................................................................................6  
Design ..............................................................................................................................................7  
Literature Review .............................................................................................................................8  
African-Americans ...........................................................................................................................8  
Latinos ...........................................................................................................................................18  
Puerto Ricans ....................................................................................................................................18  
Mexican-Americans .......................................................................................................................22  
Discussion ......................................................................................................................................26  
Conclusions ....................................................................................................................................31  
Future Research .............................................................................................................................34  

Figures

Figure 1: Race among all asthmatics in the United States in 2001

Figure 2: Prevalence of asthma within each race in 2001

Figure 3: Overweight females, by race

Figure 4: Comparison of asthma prevalence for racial groups to the national average

Figure 5: Poverty, by race

Figure 6: FEV$_1$ response, following bronchodilator use, in those with an FEV$_1$ less than 80%, by race
Introduction

Asthma is a chronic, or frequently recurring, condition of the lungs that can affect anyone of any race, gender, or age. It is characterized by inflammation of the respiratory tract, with hyperresponsive bronchoconstriction due to specific irritants that would not occur in normal subjects. Finally, there are recurrent episodes of obstruction in the airway, due to inflammation and hyperresponsive bronchoconstriction, that resolve spontaneously or with treatment (Goldman & Ausiello, 2008). These irritants include pollen, dust, animal dander, pollution, exercise, cigarette smoke, cold, and stress among others. According to the American Lung Association (ALA), Asthma is the leading chronic illness of children in the US. Analysis of data from the Centers for Disease Control (CDC), by the ALA in 2007, shows that approximately 34.1 million people have, at some point in their lives, been diagnosed with asthma. This problem has been on the rise since the early 1980s (American Lung Association, 2008). In the US, between 1982 and 1996, asthma prevalence increased by 59% (American Lung Association, 2008). Since 2001, asthma prevalence has increased by six percent (American Lung Association, 2008). It’s estimated that in 2007 the direct cost of asthma, including hospital care, physician services, prescription drugs, home health care, and nursing home care amounted to $14.7 billion. That figure rose to $19.7 billion with the addition of other indirect costs of asthma, such as lost productivity (National Heart Lung and Blood Institute, 2007).

Etiology

According to Fauci, Braunwald, et al., risk factors for asthma can be broken down into two categories. Endogenous factors such as atopy, airway hyperresponsiveness, gender, genetic predisposition, and ethnicity can increase susceptibility for asthma. Exogenous or environmental
factors including indoor and outdoor allergens, passive smoking, respiratory infections, and occupational sensitizers increase susceptibility to asthma. Obesity and early viral infections are possible exogenous factors that increase susceptibility to asthma (Fauci et al., 2008, pp. 1596-1597).

Atopy, a major endogenous risk factor, is characterized by allergic reactions to environmental triggers, such as dust mites, animal fur, cockroaches, grass and tree pollen, which cause an increase in IgE. In susceptible individuals this increase in IgE leads to eczema, allergic rhinitis, or asthma. Studies have shown that only a portion of those with atopy develop asthma, suggesting that among those with atopy, other genetic or environmental factors predispose many to asthma. Genetics is suggested to be a factor in the presence of asthma as well as severity of the disease (Sarafino & Goldfedder, 1995). Many genes have been implicated in the onset of asthma; according to Fauci, Braunwald, et al., genes for Interleukins (IL) 4, 5, 9, and 13 of T helper 2 (Th2) cells have been associated with atopy, and eventually asthma. Genes that are directly thought to be responsible for asthma include DPP-10, GPRA, ADAM-33, and ORMDL3 (Fauci et al., 2008, p. 1597; Galanter et al., 2008).

Among environmental factors, viral infections are thought to be a risk factor for the onset and exacerbations of asthma (Heymann et al., 2004). A 2004 study looked at children two to eighteen years of age that were hospitalized for wheezing. For those under the age of three, viral infections where shown to be the major risk factor for wheezing (Heymann et al., 2004). Two such viruses are thought to be respiratory syncytial virus (RSV) and rhinovirus (RV) (Hansbro, Horvat, Wark, & Hansbro, 2008). Air pollution is an important factor in exacerbations of asthma, but its role as an etiology of asthma is much less certain. Cities with higher levels of ambient traffic pollution have about the same prevalence of asthma as rural areas, which have
lower levels of pollution (Fauci et al., 2008, p. 1597). Stress has also been linked to asthma, as evident in a study that showed increased morbidity from asthma in an inner-city neighborhood with an increased level of community violence (Wright, Mitchell et al., 2004). Other environmental agents, such as occupational agents, inhaled allergens, age of mother, duration of breast feeding, premature birth or low birth weight, and inactivity, have been associated with asthma (Fauci et al., 2008, p. 1597).

Understanding the etiology of asthma is paramount in attempting to lower its burden. Prevention of potential etiologies could help lower asthma morbidity or exacerbations. Reducing maternal smoking, while pregnant and post-partum, as well as lowering air pollution or allergens in the home due to animals could all potentially lower the morbidity of asthma. Though gender, ethnicity and genetic predisposition are etiologies that cannot be controlled, the burden of asthma can be reduced by understanding their role in asthmatics. Based on variations of the gene ADRβ2, African-Americans do not respond well to β2-agonists, a mainstay in the treatment of asthma, thus another treatment should be considered (Hawkins et al., 2006).

**Triggers**

Triggers that lead to bouts of asthma vary. Allergens, like house dust mites, cats, cockroaches, grass pollen, and tree pollen, lead to activation of mast cells, releasing bronchoconstriction mediators. Pharmacological agents such as β-blockers, used for hypertension and arrhythmias, are often triggers for asthma. Aspirin is another pharmacological agent that can act as an asthma trigger. Aspirin induced asthma (AIA) is a condition which includes asthma, chronic rhinosinusitis, and nasal polyps (Berges-Gimeno, Simon, & Stevenson, 2002). Hyperventilation, which occurs during exercise, causes changes in osmolality of the fluid
lining the airway. These changes activate mast cells, inducing bronchoconstriction through chemical mediators. Cold air can induce asthma attacks by this same mechanism. Hormones play a part in triggering asthma in females, possibly due to a fall in progesterone levels prior to menstruation (Fauci et al., 2008, p. 1601). Viral infections, like RSV and RV, air pollution, and occupational exposures are possible etiologies for asthma but are also triggers in susceptible asthmatics.

**Problem Statement**

Asthma is a chronic disease that has many consequences. In 2003, it accounted for 12.8 million missed school days (Akinbami, 2006). A study of almost 500 asthmatics showed that sleep quality was impaired substantially in even mild-moderate asthmatics with asthma control improving sleep quality (Mastronarde, Wise, Shade, Olopade, & Scharf, 2008). Reduced sleep lowered the quality of life for asthmatics more than their asthma symptoms alone. Additionally, metastases of skin, colorectal, and breast cancer to the lungs have been associated with allergic respiratory inflammation (Taranova et al., 2008). In a study of over four hundred pregnancies, asthma exacerbations in the first trimester were found to significantly increase the risk of having a child with congenital malformations (Blais & Forget, 2008). Blais and Forget believe that maternal hypoxia and respiratory alkalosis, seen in acute asthma attacks, can decrease delivery of blood oxygen to the fetus, leading to malformations (Blais & Forget, 2008). Further, uncontrolled asthma will cause damage to the lungs and worsening of symptoms, leading to more severe symptoms, hospitalization from asthma attacks, or even death. It is estimated that about one in every two hundred fifty deaths worldwide is due to asthma (Masoli, Fabian, Holt, & Beasley, 2004).
Asthma affects people of all races, gender, and age; it is more common in African-Americans and Puerto Ricans (American Lung Association, 2007). In 2001, white Americans represented 72.10% of all asthmatics and African-Americans comprised only 13.47% (figure 1). However, CDC data analysis by the ALA, shows that African-Americans have a higher prevalence of asthma than the majority white population (American Lung Association, 2007), as demonstrated by white Americans having a 10.69% prevalence of asthma and African-Americans having 12.19% asthma prevalence (figure 2). Hispanics, in general, have a lower prevalence of asthma than the white population. Mexican-Americans have the lowest prevalence of asthma when compared to all races, with only Asian-Americans having a lower prevalence of asthma. Puerto Ricans have a higher prevalence of asthma, at 24.5% (figure 2), than even African-Americans (American Lung Association, 2007).

African-Americans and Puerto Ricans often suffer from a more severe form of asthma (Bai, Hillemeier, & Lengerich, 2007). African-American children hospitalized for asthma in Pennsylvania were found to have severe asthma more often than hospitalized white children (Bai et al., 2007). Hispanic children had fewer cases of severe asthma than white children, though Hispanic children only accounted for 1.5% of the study sample (Bai et al., 2007). Analysis of data from the 1994-1995 National Health Interview Survey, by Newacheck and Halfon, found a three-fold increase in disability, for children, due to asthma in the past quarter century. African-American children had a higher incidence of disability due to their asthma than white children, even after controlling for sociodemographic variables such as family income or family structure (Newacheck & Halfon, 2000). According to CDC data, from 2001 through 2003, African-Americans had higher death rates due to asthma than whites (Moorman et al., 2007). This held true for both genders and all age groups (Moorman et al., 2007).
Mexican-Americans have among the lowest prevalence of asthma of any minority in the U.S. (American Lung Association, 2007). Yet, it has been shown that those born in the U.S. have a higher prevalence of asthma than those born in Mexico (Eldeirawi, McConnell, Freels, & Persky, 2005).

**Purpose**

The purpose of this paper is to point out some of the etiologies of asthma, genetic and environmental factors, and differences in diagnosis and/or treatment in African-Americans, Puerto Ricans, and Mexican-Americans. This paper correlates the etiology, genetics, environmental factors, and differences in diagnosing and/or treating asthma, with asthma prevalence, hospitalizations, morbidity, mortality, and severity of symptoms in these select minorities.

**Research Questions**

What role does genetics play in the development or triggering of asthma in African-Americans, Puerto Ricans, and Mexican-Americans?

What role does an individual’s environment play in development or triggering of asthma in African-Americans, Puerto Ricans, and Mexican-Americans?

Is asthma diagnosed or treated differently in African-Americans, Puerto Ricans, or Mexican-Americans?
Design

To accomplish this, a review of literature, from 1993 through 2008 will be utilized, plus select sentinel articles. Search terms used: African-Americans and asthma, asthma and Latinos, Hispanic Americans and asthma. Databases used: PubMed, OhioLINK Database, and Wayne State University Online Journals.
Literature Review

African-Americans

In 2004, over fourteen million adults and six million children in the United States had asthma. A disproportionally large number of these asthmatics were African-American. According to ALA calculations of data from the National Health Interview Survey (NHIS), in 2004, African-Americans had an 11.5% higher prevalence of asthma than whites (American Lung Association 2007). While African-Americans represent only 12.1% of the population of the United States, they represent 25% of the asthmatic deaths. In 2007, African-American children were nearly four times more likely to be hospitalized for asthma than white children (US Department of Health and Human Services, 2007). African-Americans also have higher rates of death due to asthma than whites, who make up the majority of the population of the United States (US Census Bureau, 2007), in all gender and age categories (Moorman et al., 2007).

According to many researchers, asthma has an effect on pregnant African-Americans. Carroll, Griffin et al. found that all pregnant, low-income women required emergency department (ED) visits, needed rescue corticosteroids, and were hospitalized due to their asthma more often than other pregnant women (Carroll et al., 2005); this relationship continued for low-income pregnant African-American women when compared to low-income pregnant white women (Carroll et al., 2005). Asthma during pregnancy does not only affect the mother, but it can affect the child as well (MacMullen, Tymkow, & Shen, 2006). Ehrenthal, Jurkovitz et al. found that pregnant African-American women had higher rates of premature birth and low birth weight (LBW) babies when compared to all others ethnicities (Ehrenthal, Jurkovitz, Hoffman, Kroelinger, & Weintraub, 2007). In the preceding study, asthma and black race were risk factors
for premature birth, yet asthma and black race, along with other health problems, could not fully account for higher rates of prematurity and LBW (Ehrenthal et al., 2007).

It is thought that the environment plays a large role in asthma and controlling environmental factors can help in managing asthma (American Lung Association, 2008). An environmental factor, for African-Americans, that contributes to asthma is place of residence, meaning urban vs. non-urban housing, and the conditions of the neighborhood in which one lives (Friedman & Rosenbaum, 2004). Friedman found that throughout the U.S., African-American houses are often of lower quality than white American houses (2004). In New York City, the highest rates of asthma were seen in African-American and Puerto Rican families (Rosenbaum, 2008). After controlling for deteriorating housing conditions and perceptions of low social cohesion, prevalence of asthma in African-Americans and Puerto Ricans was similar to that seen in whites (Rosenbaum, 2008), showing that environmental factors such as deteriorating housing conditions and perceptions of low social cohesion increase incidence of asthma in these groups. Rosenbaum suggests that in addition to environmental factors associated with deteriorating housing conditions, stress from “discrimination in the housing market” also contributes to higher levels of asthma in African-Americans and Puerto Ricans (Rosenbaum, 2008). In urban settings, such as Harlem, asthma is more prevalent and more severe (Nicholas et al., 2005). In 2005 Nicholas et al. reported that children in Harlem had four times the prevalence of asthma as the national average.

The effect of socioeconomic status (SES) has often been studied in association with asthma. In the Jackson Heart Study, a study of only African-Americans, prevalence of asthma was lower than the general African-American population (Hickson, Wilhite, Petrini, White, & Burchfiel, 2009). Hickson’s explanation for the lower prevalence of asthma in the Jackson Heart
Study was that the subjects generally had a higher SES. Women, in the Jackson Heart Study were found to have a higher prevalence of asthma than men (Hickson et al., 2009). This disparity was attributed to higher amounts of stress, worse perceived general health, and lower education attainment, which could be factors of low SES (Hickson et al., 2009). In looking at mortality rates from asthma in the U.S., Grant et al. found that African-Americans had higher asthma related mortality than whites, that low education led to higher asthma mortality than higher education, and that low income was associated with higher asthma mortality than higher income (Grant, Lyttle, & Weiss, 2000). The previous study showed that black race/ethnicity was associated with higher asthma mortality, independent of SES (Grant et al., 2000); yet, Grant et al. concluded that both black race/ethnicity and low SES were independently associated with high asthma mortality (Grant et al., 2000). Smith et al. have also shown a potential for SES being associated with asthma in African-Americans (Smith, Hatcher-Ross, Wertheimer, & Kahn, 2005). African-American children have a greater risk of asthma than white children, but only among the very poor, showing that environmental factors, such as SES, have a greater impact on asthma than genetics (Smith et al., 2005).

Roberts showed that African-American children, one to five years old, had a higher prevalence of asthma and hospitalization from asthma than whites and Mexican-Americans; yet income, a factor of SES, did not have much impact on the higher prevalence of asthma (Roberts, 2002). Like Roberts (2002), Stingone and Claudio also demonstrated higher rates of ED visits and hospitalizations due to asthma in African-Americans when compared to whites (2006). Stingone and Claudio, as well as Erickson et al., found no correlation between these increased rates of ED visits and hospitalizations and SES (2006: 2007). While studying cohorts of African-American and white subjects on similar healthcare plans, Erickson et al. found that
African-American subjects, typically, were hospitalized more often and had more ED visits due to asthma than their white counterparts (2007). These differences were not explained by SES, asthma severity, and asthma therapy though Erickson et al. state that there may have been other socioeconomic factors that they did not take into account (Erickson, Iribarren, Tolstykh, Blanc, & Eisner, 2007).

Stevenson et al., in a study of indoor allergen sensitivity among children in the US, found that African-American children are more likely to be sensitive to allergens, than white children, showing that disparities in allergen sensitivity were consistent with disparities in asthma morbidity between African-Americans and whites (2001). African-American children were more than twice as likely to be sensitive to *Alternaria alternata*, an opportunistic pathogen and asthma-causing indoor allergen, as white children (Stevenson et al., 2001); African-American children were more likely to be sensitive to dust mite allergen, and cockroach antigen, all of which have long been associated with allergic asthma (Kang, 1976), than white children (Stevenson et al., 2001).

Stress is another potential factor that predisposes African-Americans to asthma (Wright, Mitchell et al., 2004). While studying the effect of community violence on asthma morbidity, in 2004, Wright et al. found inner-city families to have a higher prevalence of exposure to violence, stating that “exposure to violence was independently associated with asthma morbidity.” The effect of neighborhood violence on asthma morbidity was at least partly due to stress (Wright, Mitchell et al., 2004). Caretaker behaviors such as keeping children indoors, smoking, and skipping medications are often exhibited during stress and are partly to blame for the morbidity of asthma (Wright, Finn et al., 2004). One explanation of why chronic caregiver stress increases asthma morbidity is higher levels of total IgE expression, leading Wright et al. to believe that, in
susceptible children, stress during early life can result in changes in immune reactivity, which can initiate an immune response. This increase in IgE levels occurs during a time of T-cell maturation, when exposure to allergens and the environment can have a large influence on a child’s atopic phenotype (Wright, Finn et al., 2004). The correlation between asthma and IgE expression is supported by Wright et al, who associated caregiver stress, early in a child’s life, with risk of wheezing (Wright, Cohen, Carey, Weiss, & Gold, 2002). This association persisted even after adjusting for maternal smoking, lower respiratory illnesses, allergen levels, and breast-feeding (Wright et al., 2002). A possible alternative explanation is that chronic stress leaves an individual at a higher susceptibility for respiratory infections from agents such as RV (Cohen et al., 1998).

In the United States, Mexican-American and African-American adolescents have a high prevalence of overweight (Ogden, Flegal, Carroll, & Johnson, 2002). Being overweight, these Mexican-Americans and African-Americans are more susceptible to conditions associated with obesity, such as asthma. Rodriquez et al. associated obesity with asthma (2002), finding that children with a BMI greater than the 85th percentile had 1.94 times the likelihood of having a current asthma diagnosis than those with BMI’s less than the 85th percentile (Rodriguez, Winkleby, Ahn, Sundquist, & Kraemer, 2002).

Overweight and obesity are also more common in African-American women; from 2001 through 2004, the CDC found that 79.5% of African-American women over the age of 20 were overweight or obese versus 57.1% of non-Hispanic white women (figure 3). Coogan et al., hypothesized that body mass index (BMI) was positively associated with adult-onset asthma in African-American women (Coogan, Palmer, O'Connor, & Rosenberg, 2009); they then tested this hypothesis by following a large cohort of African-American women, 21 to 69 years old, for
ten years (Coogan et al., 2009). Questionnaires elicited information about participant demographics and lifestyle factors, height and weight, diet, reproductive history and medical conditions at baseline, in 1995. Participants also completed a follow-up questionnaire every second year for five cycles. After excluding participants with previous bariatric surgeries, lung cancer, diagnosis of asthma prior to 1996, pregnancy at baseline, any cancer in the follow-up period, or missing information about smoking or BMI at baseline, 46,435 women remained. Researchers, in this study, relied on questions asking about physician-diagnosed asthma and use of asthma medications to determine asthma status. These questions are a perfectly suitable method of determining asthma status, instead of examining each patient clinically, as questionnaires have been recommended as the preferred assessment of asthma in such large cohort studies and have been used in most similar studies (Burr, 1992). Results showed that BMI was associated with asthma in all groups and subgroups of age, energy intake, energy expenditure, presence of sleep apnea, smoking history, parental history of asthma, and BMI at eighteen years old. Severely obese (BMI > 40) women had nearly a three-fold greater incidence of asthma than women with a BMI of 20 to 24 (Coogan et al., 2009). More importantly, asthma risk increased in association with increases in BMI (Coogan et al., 2009). Change in weight from eighteen years old was positively associated with risk of asthma, especially in those who gained fifteen kilograms or more (Coogan et al., 2009). Data from the Third National Health and Nutrition Examination Survey showed similar increases in asthma prevalence with increases in BMI, in those four to seventeen years old, even after controlling for gender, age, ethnicity, smoke exposure, household size, birth weight, and whether they were breast-fed. Ethnicity or gender did not change the association between asthma and BMI (von Mutius, Schwartz, Neas,
Dockery, & Weiss, 2001). Von Mutius et al. suggest that lower tidal lung volumes in overweight individuals may be responsible for this increase in asthma (2001).

African-Americans have been shown to report asthma symptoms differently than the general population (Troichtenberg, BeLue, Piphus, & Washington, 2008). African-Americans are less likely to report night-time asthma symptoms and are also less likely to complain of dyspnea, which is an indicator of asthma control (Troichtenberg et al., 2008). Inadequately reporting symptoms can lead to potential consequences, such as under-treatment or increased morbidity and mortality of asthma in this minority (Troichtenberg et al., 2008). By not reporting or perceiving nocturnal asthma symptoms or dyspnea, African-Americans are misdiagnosed as being stable asthmatics while their asthma is actually unstable (Troichtenberg et al., 2008). According to Troichtenberg et al., this might help to explain some disparities in asthma treatment and asthma outcomes that are seen in African-Americans.

When African-Americans and whites visit the ED with asthma exacerbations of similar severity, similar doses of anti-inflammatory medications were prescribed, even though African-Americans had higher rates of ED visits (Boudreaux, Emond, Clark, & Camargo, 2003). Further, Boudreaux et al. found that, though whites and African-Americans were prescribed the same anti-inflammatory medications, African-Americans were found to use these less frequently before going to the ED (2003), which would lead to worse asthma outcomes. However, Wright demonstrated the opposite in studying medication use in asthmatic children in California, by showing an association between black race and use of prescription medication (2007). In this study, African-Americans were twice as likely to report having taken prescription medications for asthma (Wright, 2007). Yet others have seen no association between medication use and race/ethnicity (Erickson et al., 2007). No matter how much African-Americans use medications
to control asthma they often do not see much benefit from these medications. For Mexican-
Americans and Puerto Ricans, use of inhaled corticosteroids increases their responsiveness to
short acting β-agonists (Naqvi et al., 2008). African-Americans did not receive these same
benefits from inhaled corticosteroids (Naqvi et al., 2008).

Another potential reason for higher prevalence of asthma in African-Americans is
overdiagnosis (Roberts, 2002). In one study, African-Americans had a 76% greater chance, than
whites, of being diagnosed with asthma versus possible asthma (Shalowitz, Sadowski, Kumar,
Weiss, & Shannon, 2007). Roberts also showed that African-Americans were overdiagnosed
with asthma, even when presenting with similar symptoms as other children (Roberts, 2002).

African-Americans are more likely to have severe asthma, a lower quality of life due to
their asthma, problems controlling asthma, greater number of ED visits due to asthma and be
prescribed three or more long-term controllers (Haselkorn, Lee, Mink, & Weiss, 2008; Vargas et
al., 2006). Although factors such as health coverage, treatment settings, IgE levels, and BMI
influenced severity of asthma, they do not fully explain disproportionate levels of asthma in
African-Americans (Haselkorn et al., 2008). In the Study of African Americans, Asthma, Genes,
and Environments (SAGE), based on pre- FEV₁ or baseline FEV₁, Tsai et al. showed that
African ancestry was associated with more severe asthma (Tsai et al., 2006). Analysis of
National Health Interview Survey data from 1997 through 2003 showed that African-American
children had more ED visits for asthma than comparable white children (McDaniel, Paxson, &
Waldfogel, 2006). McDaniel et al. suggest that the reason for this is due to more severe asthma

Multiple genes within the human genome are associated with asthma (Barnes, Grant,
Hansel, Gao, & Dunston, 2007). One such gene, CASP10, has been shown to modify airway
obstruction in African-American and white Americans with asthma (Smith et al., 2008). Associated with a severe form of asthma in African-Americans, Myosin Light Chain Kinase (MLCK), encoded by the MYLK gene, plays a key role in contractions of endothelium and smooth muscle (Flores, Ma, Maresso, Ober, & Garcia, 2007). In a study of 302 unrelated asthma cases, seventeen alleles of this gene were found (Flores et al., 2007). One of these alleles, Pro147Ser, is common in African Americans but not other races or ethnicities, and is associated with an increased susceptibility for severe asthma in African-Americans (Flores et al., 2007). Another gene that has been shown to play a role in asthma in African-Americans is the KCNMB1 gene, which controls voltage-gated $K^+$ (BK) channels in airway smooth muscle. The 818T allele of this gene, which is specific to African-Americans, was associated with a 13% decline in FEV$_1$. This decline in FEV$_1$ only occurred within males in the sample. The authors of the previous study believe that estrogen and estradiol afford protection, via upregulation of BK channels, to females with this allele (Seibold et al., 2008). ICAM-1, or Intercellular adhesion molecule-1, is yet another gene involved in airway hyperresponsiveness and airway inflammations (Li et al., 2005). Li et al. associated variations of this gene with a lower risk of asthma in whites, African-Americans, and Hispanics (2005).

Not only is genetics an important factor in predicting the severity of asthma in African-Americans (Hawkins et al., 2006), but it also influences treatment of asthma. Hawkins et al. found differences in lung function and $\beta_2$-agonist responsiveness based on variations in the ADR$\beta_2$ gene, especially in African-Americans (2006). It is suggested by Hawkins et al. that these variations in ADR$\beta_2$ may also be responsible for possible adverse effects associated with chronic use of $\beta_2$-agonists, such as death (2006).
It is clear that African-Americans suffer from higher asthma prevalence, hospitalizations, morbidity, and mortality than the general population of the United States (American Lung Association, 2007). Environmental factors, the way asthma is diagnosed and/or treated, quality of care, and genetic factors all influence asthma in African-Americans.
**Latinos**

As in African-Americans, asthma is a problem in Latinos living in the United States; however, unlike African-Americans, Latinos have a lower prevalence of asthma than white Americans (American Lung Association, 2007). Two subgroups from the Latino minority population are of special interest. Puerto Ricans have the highest prevalence of asthma in the US. Conversely, Mexican-Americans have the second lowest prevalence of asthma in the US, with only Asian-Americans being lower (American Lung Association, 2007). Puerto Ricans have 56% higher prevalence of asthma than the general population, while Mexican-Americans have 62% lower prevalence of asthma than the general population (figure 4). Among Puerto Ricans and Mexican-Americans, genetics may play a different role in asthma. According to the Collaborative Study on the Genetics of Asthma, different genes influence asthma in specific races ("A genome-wide search," 1997). This genetic variation between races may help to explain differing rates of asthma in these populations ("A genome-wide search," 1997).

**Puerto Ricans**

Puerto Ricans have the highest prevalence of asthma in the US (American Lung Association, 2007; Rose, Mannino, & Leaderer, 2006), and have higher mortality - from asthma than other Latinos, African-Americans, and whites (Homa, Mannino, & Lara, 2000). Puerto Ricans, when compared to African-Americans are more likely to have severe asthma, yet have less lengthy hospital stays resulting from asthma exacerbations (Cohen et al., 2006). Cohen, Celedon et al. also found that Puerto Ricans were more likely to see a physician for their asthma than African-Americans, suggesting that more outpatient physician visits would make Puerto Ricans less likely to have severe asthma exacerbations (2006).
As with asthma in the general population, environment plays a role in asthma for Puerto Ricans. According to CDC statistics, Puerto Ricans have higher rates of smoking than the general population ("Prevalence of cigarette use," 2004). Among fourteen race/ethnic populations studied, Puerto Ricans had the second highest rates of smoking, with only American Indian/Native Americans having higher rates ("Prevalence of cigarette use," 2004). Though Puerto Ricans had marginally higher rates of smoking than other races, it remains a possible contributor to increased prevalence of asthma in Puerto Ricans ("Prevalence of cigarette use," 2004).

Latinos often have lower SES than the general population. In 2001, 21.4% of Latinos lived below the poverty line, compared to 7.8% of the white population (figure 5). Of these Latinos, Puerto Ricans had the highest rate of living below the poverty line, at 26.1% (Roberto R. Ramirez & G. Patricia de la Cruz, 2003). The impact of SES on asthma in Puerto Ricans is debatable. A study of ten racial/ethnic groups in New York City showed that perceptions of low social cohesion and deteriorating housing conditions were responsible for increased prevalence of asthma in Puerto Ricans (Rosenbaum, 2008). Beckett et al. (1996) and Claudio et al. (2006) showed that SES does not have a significant effect on asthma in Puerto Ricans. According to Claudio et al., children in New York City, living in areas of lower SES, had a 70% greater chance of having asthma than comparable children living in areas of higher SES; this was true for all races except Puerto Ricans (2006). Puerto Ricans had increased rates of asthma regardless of high or low SES (Claudio, Stingone, & Godbold, 2006). Lara et al. found that Puerto Rican children had similar socioeconomic characteristics to African-American children (2006). Yet, prevalence for asthma was still higher for Puerto Ricans than African-Americans (Lara, Akinbami, Flores, & Morgenstern, 2006).
Findley et al. found that more Puerto Rican families had very low income than any other ethnicity; however, income and socioeconomic status were not associated with asthma in this study (2003). Unlike the rest of the study subjects who were sensitive to cockroach antigen, there was no association seen between cockroach antigen and asthma for Puerto Rican children despite Puerto Ricans having higher reports of cockroaches in the home (Findley et al., 2003). Findley et al. admit that Puerto Ricans may report cockroaches in the home differently than others, due to cultural differences. However association was seen between rats and mice in the home and asthma in the Puerto Rican sample (Findley et al., 2003). Others have also associated mold in the home, environmental tobacco smoke, pesticides, and cockroaches with asthma diagnosis (Freeman, Schneider, & McGarvey, 2003a).

Interestingly, prevalence of asthma and hospitalizations from asthma are lower for Puerto Ricans living on the mainland than those living on the island of Puerto Rico (Cohen et al., 2007; Lara et al., 2006). A possible explanation cited by Cohen et al. is that temperature, air pollution, humidity, and exposure to *Blomia tropicalis*, a dust mite, have a large influence on asthma in tropical locations such as Puerto Rico (Arruda et al., 1997). Another explanation cited by Cohen et al. is a genetic predisposition for severe asthma among all Puerto Ricans (Choudhry et al., 2005). Conversely, others have found that Puerto Ricans born on the mainland had a similar prevalence of asthma as island born Puerto Ricans (Dumanovsky & Matte, 2007).

Genetics exerts a large influence on asthma in Puerto Ricans as evidenced by responsiveness to albuterol. In comparing bronchodilator responsiveness among African-Americans, Mexican-Americans, and Puerto Ricans, Naqvi et al. showed that African-American children with moderate-to-severe asthma, and Puerto Ricans of all ages, had among the lowest responsiveness to bronchodilators (2007). Puerto Ricans had an FEV$_1$ improvement of 4.8%
after bronchodilator use, whereas African-Americans had an improvement of 7.0% (Naqvi et al., 2007). In asthmatics with an FEV₁ of less than 80%, Puerto Ricans had an FEV₁ improvement of 8%, while African-Americans had an improvement of 14.7% (figure 6). Naqvi et al. found that ethnicity was a more significant factor than socioeconomic status or medication use in lower response to albuterol (Naqvi et al., 2007). Potential explanations for this could be that asthma in Puerto Ricans might not involve as much bronchospasms, which would reduce the effectiveness of albuterol (Burchard et al., 2004). Burchard et al. propose that asthma in Puerto Ricans could be associated with more impairment in relaxation of airway smooth muscle, greater airway remodeling, greater downregulation of β₂-receptors, or other differences in polymorphism of proteins that are involved in the β₂-receptor pathway (2004).

Akinbami et al. examined whether asthma was underdiagnosed among minority children and came to the conclusion that minority children with asthma symptoms were not underdiagnosed (2005). In the previous study it is reported that Puerto Ricans have much higher rates of asthma diagnosis than most other nationalities (Akinbami, Rhodes, & Lara, 2005). Analyzing the previous study, Hunningshake et al. hypothesize that greater rates of asthma diagnosis could be due to differences in severity of asthma between Puerto Ricans and non-Hispanics (2006). Hunningshake et al. also state that the possibility of overdiagnosis in Puerto Ricans cannot be ruled out (2006).
**Mexican-Americans**

Among minorities, Mexican-Americans have among the lowest rates of asthma in the US (American Lung Association, 2007; Davis, Kreutzer, Lipsett, King, & Shaikh, 2006). Mexican-Americans are similar to Puerto Ricans in that both have mainly European, African, and Native American ancestry (Salari et al., 2005). For Mexican-Americans, ancestry consists of 51.7% Native American, 44.9% European, and 3.4% African ancestry (Salari et al., 2005). Analysis of the GALA study by Salari et al. showed that European ancestry was associated with more severe asthma (Salari et al., 2005). Risk for severe asthma increased by 37% with each 10% increase in European ancestry (Salari et al., 2005). Conversely, Native American ancestry was associated with milder asthma (Salari et al., 2005). Also, no association was seen, in this study, linking African ancestry and severity of asthma (Salari et al., 2005). Is there then a single gene that leads to susceptibility to asthma in this population? It seems unlikely (Holberg, Halonen, Wright, & Martinez, 1999). Holberg et al. investigated the inheritance of asthma in Latinos and whites in Tuscon, AZ and were not able to find a single locus, two-allele gene that was responsible for asthma (Holberg et al., 1999). Holberg et al. hypothesized that inheritance of asthma was based on a polygenic or oligogenic mode of inheritance (1996; 1999). This mode of inheritance was seen for both Mexican-Americans and whites (Holberg et al., 1999).

Despite a low prevalence of asthma, Mexican-Americans born and raised in the US are diagnosed with asthma more frequently than those born in Mexico (Martin et al., 2007). Salari et al. showed that this could possibly be due to the genetic background of those born the in the US (2005), while Cagney et al. proposed that it could be due to stress (2007). While studying asthma in Chicago neighborhoods, Cagney et al. found that the lower level of asthma in foreign-born Latinos was dependant on community-level factors (2007). In his previous study, Cagney
et al. showed that when living in a neighborhood with a high presence of foreign-born Latinos, asthma prevalence was lower (Cagney, Browning, & Wallace, 2007). An earlier study by Cagney and Browning found that collective efficacy, a measure of neighborhood trust and attachment, was associated with lower levels of asthma and other respiratory illnesses (2004).

Analysis of data from the Third National Health and Nutrition Examination Survey found that Mexican-Americans and African-Americans were more likely to be sensitized to indoor allergens such as dust mites, cockroaches, and *Alternaria alternata* (Stevenson et al., 2001). Other environmental factors associated with asthma in Mexican-Americans are mold in the home and environmental tobacco smoke (Freeman et al., 2003a).

Acculturation, the process by which immigrants adopt the culture and way of living of another group, may have a large influence on asthma in Mexican-Americans (Martin et al., 2007). Despite having a lower SES, first-generation Mexican-Americans eat healthier than second-generation Mexican-Americans (Gold & Acevedo-Garcia, 2005; Krebs & Jacobson, 2003). First-generation Mexican-American women have more proteins, Vitamin A and C, calcium, and folic acid in their diets than second-generation Mexican-Americans (Guendelman & Abrams, 1995). By adopting, an ‘American’ culture, Mexican-Americans may make bad dietary decisions, such as consuming more fast food and soda, leading to obesity and the consequences of obesity (Guendelman & Abrams, 1995). The diet of second-generation Mexican-American women is closer to that of non-Hispanic white women than the diet of first-generation Mexican-Americans women (Guendelman & Abrams, 1995).

Mexican-American adolescents have higher rates of being overweight than the general public (Ogden et al., 2002). This makes them more likely to have an asthma diagnosis (Rodriguez et al., 2002). Rodriguez et al. found a strong association between BMI greater than
the 85th percentile and asthma, though only for children and adolescents (Rodriguez et al., 2002). For adults forty years or older, prevalence of obesity was as high as fifty percent in one study of Mexican-Americans living in Los Angeles (Torres, Azen, & Varma, 2006). Obesity in these adults was also associated with asthma, hypertension, heart failure, angina, arthritis, back pain, and diabetes (Torres et al., 2006).

Smoking, a suspected etiology of asthma, is associated with acculturation. According to Unger et al. English language use, an indicator of acculturation was associated with an increased lifetime risk of smoking among Hispanics (Unger et al., 2000). Those that spoke only English in the home had two times the risk of smoking as those speaking primarily, or only speaking, a different language (Unger et al., 2000).

Though US-born Mexican-Americans generally have better education, prenatal care, and socioeconomic indicators, they are at a greater risk for preterm deliveries than Mexican-born Mexican-Americans (Crump, Lipsky, & Mueller, 1999) because new immigrants tend to have better birth outcomes than immigrants that have lived longer in the US (Crump et al., 1999). An explanation for this is due to an earlier age of pregnancy, increased smoking or alcohol consumption, or losing social support structures for U.S.-born Mexican-Americans (Crump et al., 1999). With time, though, any protective advantage fades (Crump et al., 1999).

It stands to reason that U.S.-born Mexican-Americans would be more proficient English speakers than Mexican-born Mexican-Americans. English proficiency should lead to lower rates of asthma diagnoses because patients can better communicate their symptoms. The opposite is also a possibility; that Mexican-born Mexican-Americans, who would prefer to speak Spanish, may be underdiagnosed because of an inability to correctly communicate asthma symptoms (Shalowitz et al., 2007). It is also possible that newer immigrants, those that prefer to speak
Spanish, do not have equal access to healthcare as those that prefer to speak English (Shalowitz et al., 2007).

Children, of all races, with health insurance are more frequently diagnosed with asthma than those without insurance, found one study (Freeman, Schneider, & McGarvey, 2003b). Mexican-American children generally have lower rates of health insurance than other children (Freeman et al., 2003b; Wright, 2007); however, as insurance status improved for this group, so did the diagnoses of asthma (Freeman et al., 2003b). Due to insufficient data, however, this hypothesis could not be proven (Freeman et al., 2003b).

Martin et al. also found an association between acculturation and asthma prevalence in Mexican-Americans, yet the effects of acculturation were not mediated by time spent in the U.S. or language usage by Mexican-Americans (Martin et al., 2007). The effects of acculturation were mediated more by birthplace in Mexico versus the U.S., caregiver education and marital status, child insurance status, life stress, and social support (Martin et al., 2007).
Discussion

For African-Americans, housing conditions, living in an urban neighborhood, indoor allergen sensitivity, perceived caregiver stress, neighborhood violence, maternal smoking, and obesity have been shown to be associated with asthma. These variables are not independent of each other; in many instances it is difficult to separate these variables. Housing in these urban areas, often substandard, increases the likelihood of exposure to many asthma triggers, including dust mites and cockroach antigen. Substandard conditions can increase caregiver stress. While stress itself is associated with an increase in IgE levels (Wright, Finn et al., 2004), it has many other consequences, possibly increasing the incidence of smoking among caregivers, which is associated with asthma.

Asthma is more prevalent in the inner-city and in those that generally have a lower SES (Nicholas et al., 2005). Even in middle-class asthmatics, a disparity remains in the prevalence of asthma between African-American children and white children (Weitzman, Byrd, & Auinger, 1999). This disparity would suggest that race and genetics are contributing risk factors for asthma in African-Americans.

The debate of how much SES impacts asthma in African-Americans is complex. Some studies claim that that SES has a major impact on asthma disparities between African-Americans and whites, while other studies find no evidence of an association between asthma and SES in African-Americans. Often, researchers will find no correlation between disparities in asthma and family income, a factor of SES. Though income may not have any effect on asthma, an association between SES and asthma cannot be ruled out. Other factors associated with low SES, such as an urban setting or stress, may have an effect. Those with low SES often live in an urban, inner-city setting, which has been associated with asthma. The stress associated with a
low SES, such as neighborhood violence or low income has also been associated with asthma. Though there is an influence of genetics on sensitivity to allergens, living in an urban setting could lead to increased exposure to indoor allergens, which could lead to increased sensitization to these allergens, promoting exacerbations of asthma. Lower SES might lead to an unhealthy diet and to limited food selection. Unhealthy diets often lead to obesity, again associated with a higher prevalence of asthma.

Cohen et al. claim that island Puerto Ricans suffer from asthma more than Puerto Ricans living on the mainland U.S. (2007). Mainland Puerto Ricans have lower SES, higher rates of premature birth, and higher rates of prenatal tobacco smoke exposure when compared to those on the island. Yet prevalence of asthma and hospitalizations from asthma are lower for mainland Puerto Ricans than island Puerto Ricans (Cohen et al., 2007). It is important to make the distinction between mainland Puerto Ricans and island Puerto Ricans; often, studies will group the two together, which could mask potential causes or triggers of asthma.

For Puerto Ricans, the association between SES and asthma is even more unclear than in African-Americans. An association between these factors is often difficult to ascertain. Both island and mainland Puerto Ricans often live in areas of low SES. Since little comparison can be made between low and high SES, this would hide any impact low SES has on asthma. Since genetics has such a large influence on asthma in Puerto Ricans, it could make the role of SES seem insignificant.

Overall foreign-born Latinos often suffer from a lower prevalence of asthma than those born in the U.S, possibly due to acculturation (Dumanovsky & Matte, 2007). However, this is not true for Puerto Ricans, who have a high prevalence of asthma. Since, Puerto Ricans are already U.S. citizens, whether they live on island Puerto Rico or the mainland U.S., they do not
have to go through the process of acculturation. Dumanovsky et al. explain that Puerto Ricans are already “acculturated to dominant American institutions, practices, and habits and have the same access to health care and social services” (2007).

Mexican-Americans struggle with the consequences of asthma just as Puerto Ricans or African-Americans do. Because living in close proximity to other immigrants often lowers much of the stress of moving to a new country, learning a new language, and finding a new source of income, Cagney and Browning believe that rates of asthma are lower in immigrants living near other immigrants (2004). Stressful situations often lead to health consequences, such as asthma. Acculturation can lead to increased rates of asthma for Mexican-Americans (Martin et al., 2007). With time, Mexican-Americans begin to emulate those around them, beginning to adopt the regional belief and way of living, leading to smoking, making bad dietary decisions, increased risk for preterm deliveries, and increasing the incidence of asthma. Country of birth and acculturation are often cited as factors associated with asthma in Mexican-Americans, as they are closely tied together and those born and raised in the U.S. should be more acculturated than those born outside the U.S. U.S.-born Mexican-Americans have more exposure to the beliefs and the living style of Americans than those born outside the U.S. Thus, it is possible that country of birth contributes to acculturation and is not just associated with it.

In categorizing all Latinos into one group, distinctions between these minorities cannot be made. These Latinos differ by race in prevalence of asthma, severity of asthma, and severity of asthma exacerbations. Prevalence of asthma differs by race, even when these Latino minorities live in close proximity to each other (Schneider, Freeman, & McGarvey, 2004). In categorizing them into one group, it is difficult to ascertain whether conclusions derived from research hold true for the different Latino minorities.
Mosnaim et al. suggest that underdiagnosis of asthma, based on parental language preference, may lead to lower estimates of asthma in Hispanic families (2007), and found that children whose parents preferred to answer the survey in Spanish were more likely to have undiagnosed asthma (Mosnaim et al., 2007). Those, whose parents prefer speaking Spanish also have better diet, are less likely to smoke, and have better outcomes because they are not yet acculturated. This means that Mexican-born Mexican-Americans may genuinely have lower rates of asthma than their U.S.-born counterparts.

Genetics exerts an effect on many diseases in humans, and genetic variations can lead to a higher predisposition for asthma in certain populations. For African-Americans and Puerto Ricans, genetics seems to lead to higher rates of asthma, more severe forms of asthma, or lowered response to medication. It is interesting that genetics has the opposite effect on Mexican-Americans.

Interactions between genetics and the environment likely result in asthma. This possibility explains why people living in the same city don’t all develop asthma. For example, though all races are likely sensitive to cockroach allergen, the level of sensitivity varies. Cockroach allergen is highly associated with asthma in African-Americans but not in Puerto Ricans and Mexican-Americans (Findley et al., 2003). Though they may live in the same neighborhood and have the same level of exposure to cockroaches, genetics may determine sensitivity.

It is difficult to determine where the effect of genetics ends and the effects of the environment begin; it seems certain thought, that both influence asthma. Proof for the effect of genetics can be seen in middle class African-Americans who have higher rates of asthma than their white counterparts. The effect of the environment can also be seen with Mexican-
Americans born and acculturated in the United States.
Conclusion

Asthma is a disease of great significance and reducing the burden of asthma begins with knowledge of the etiologies, risk factors, treatments, etc. It may be difficult to eradicate some of the social inequalities that lead to higher rates of asthma in some minorities; however, knowledge that these inequalities have an effect on asthma is one of the first steps in diminishing it.

It is important to study asthma in these select minorities, since they often have a higher frequency of asthma diagnosis or may suffer from a more severe form of asthma. Finding answers for why one racial minority has increased rates of asthma is not easy. Sometimes, it is purely due to noncompliance (Ortega et al., 2002). According to a study by Ortega, et al., 73% of white asthmatics did not use inhaled corticosteroids in the past year, compared with 94% of Hispanics (2002). Another problem arises in treating asthma in Puerto Ricans, where Burchard et al. found that Puerto Ricans do not respond as well to albuterol, a $\beta_2$-agonist, as Mexican-Americans (2004). This lack of response somewhat reduces the usefulness of albuterol. Lack of use and ineffectiveness of these medications, which are staples of asthma treatment, have consequences. Those, whose asthma would normally be controlled on these medications, now suffer needlessly from asthma exacerbations, which can damage the lungs, leading to even more severe asthma exacerbations.

Genes such as ORMDL3, DDP-10 and GPRA are associated with asthma in the general population. However, other genes are associated with asthma in specific populations; MYLK and KCNMB1 are associated specifically with severe asthma in African-Americans. Other genes, such as those on regions 5p15 and 17p11.1-q11.2 are associated with asthma in African-Americans, while genes on regions 2q33, 21q21, and 5q23 have been associated with asthma in
Hispanics (Choudhry et al., 2008; "A genome-wide search," 1997). No single gene has been found to be responsible for asthma in white Americans, Latinos (Holberg et al., 1996), or African-Americans. An explanation for this may be that an interaction exists between genes that can lead to asthma. In discussing their findings from the Collaborative Study on the Genetics of Asthma, Blumenthal et al. suggest that several regions of the human genome “may harbor genes contributing to the risk for atopy and these may interact with one another in a complex manner” (2004)

Herein lays a weakness of this paper and many others. It is extremely difficult to determine how prevalent particular genes may be. While small samples of populations may show associations between particular genes and asthma, it is difficult to determine if mutations or variations of this gene are responsible for asthma in the entire population. Another potential weakness of this paper is the breadth of research that has already been performed. For this reason, search terms were kept to a minimum and studies with less than 500 asthmatic participants were discarded, however, exceptions were made for studies which concentrated on genetics. Since it is probably less expensive and less time consuming to analyze questionnaires than doing genetic analysis, genetics studies often have fewer participants.

It is still not fully understood why one group has higher rates of asthma than another. In many cases, SES is involved, either directly or indirectly. The stress of a low SES can lead to higher rates of asthma. Low SES can lead to increased exposure to environmental agents associated with asthma. For example, poor housing may increase exposure to asthma allergens such as cockroaches, rodents, or molds. Housing can be in areas of poor air quality or higher crime, leading to increased stress or fewer opportunities for outdoor activities, which can lead to obesity. Better understanding the effect of SES on asthma could potentially help to prevent
asthma. By reducing the inequalities of SES, inequalities of asthma could also be reduced.

However, this is easier said than done, as these inequalities have existed for decades to centuries in the U.S. and are not eradicated easily.
Future Research

An immense amount of research has already been done on asthma. One need only search PubMed and will find monumental amounts of data. Yet, there is still much that is not known. Future research in asthma should be aimed at one goal: to reduce the burden of asthma for those who are most afflicted. Satcher and Rust suggest a three-dimensional model of how to reduce disparities in lung disease, by tracking trends in prevalence, incidence, and adverse outcomes, saying that this would give researches the ability to measure disparities at a baseline and assess the impact of interventions on disparities (2006). They suggest researching potential causes, cures, or interventions that may eliminate health disparities (Satcher & Rust, 2006). Though there is significant research on causes and interventions for asthma, further research will help to uncover other potential causes and interventions of asthma. Satcher and Rust support developing a balanced research agenda in laboratory bench research, which would provide more information on variables such as the pathophysiologic mechanism behind airway inflammation in asthma (2006). A balanced research agenda is also needed with clinical trials and newer drug therapies, and should involve the real-world primary care setting (Satcher & Rust, 2006).

Many environmental factors that affect asthma in African-Americans, such as housing conditions, stress, and exposure to allergens, may be closely associated with socioeconomic status. A point of future research could indicate how much effect each variable has on asthma when it is isolated from other variables. Though, there is already some research comparing mainland U.S. Puerto Ricans with island Puerto Ricans, future research could concentrate on comparing the two groups to better understand some of the etiologies of asthma for Puerto Ricans.
Mexican-Americans are unique among these three minorities. They have one of the lowest rates of asthma among any minority in the U.S. Comparing asthmatics living in Mexico with first and second generation Mexican-Americans may help in determining why new immigrants have higher rates of asthma than their counterparts in Mexico.

For Mexican-Americans, there are large communities in California, Texas, and Illinois. Future research should separately look at prevalence, causes, and treatment for asthma in Mexican-Americans living in these different regions. Perhaps there are differences in the prevalence of asthma and causes of asthma depending on the region of the U.S.

Research in African-American asthmatics could look at racial background to see proportions of African, European, or American Indian ancestry, and try to correlate ancestry with asthma. Also, future research could define which parts of Africa modern African-Americans trace their ancestry. Asthmatic African-Americans could then be compared with asthmatics from these parts of Africa. This could potentially help in determining genetic influences on asthma in these populations.

Future research of asthma in these minorities should include the genetics of asthma. Population-wide search for genes that are universal to all or most asthmatics of particular minorities could help in reducing the burden of asthma. Studies of twins have been very helpful in determining the genetic component of asthma and other related phenotypes (Los, Postmus, & Boomsma, 2001). Many genes have been found to be associated with asthma through these studies. Research of twins can be helpful in further discovering new genes associated with asthma. Future research can help to determine how knowledge of the genetic component of asthma can help in reducing rates of asthma and exacerbations of asthma (Hakonarson & Halapi, 2002).
Abbreviations

AIA – Aspirin induced asthma
ALA – American Lung Association
BMI – Body mass index
CDC – Centers for Disease Control
ED – Emergency Department
FEV – Forced expiratory volume
GALA – Genetics of Asthma in Latino Americans
LBW – Low birth weight
NHIS – National Health Interview Survey
RSV – Respiratory Syncytial Virus
RV - Rhinovirus
SAGE - Study of African Americans, Asthma, Genes, and Environments
Definitions

Albuterol – a pharmacological agent used to provide temporary relief of asthma symptoms

Hispanic – a person of Latin-American descent or Spanish descent

Latino - a person of Latin-American descent
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**Figures**

*Figure 1: Asthmatics, by race, in the United States in 2001 (does not equal 100%)*

Sources:

*Figure 2: Asthma prevalence within populations in 2001*

Sources:
**Figure 3: Overweight, by race (females only)**

Sources:

**Figure 4: This figure compares prevalence of asthma for racial groups to the national average (computations based on data reported by the National Health Interview Service, 2001)**

Source:
**Figure 5:** This figure compares rates of poverty, by race

Source:


**Figure 6:** This figure compares FEV\textsubscript{1} response, following bronchodilator use, in those with an FEV\textsubscript{1} less than 80\%, by race

Source:
Abstract

Objective: To review some of the etiologies, genetics, environmental factors, and differences in diagnosis and/or treatment of asthma and correlate them with asthma prevalence, hospitalizations, severity, morbidity, and mortality in African-Americans, Puerto Ricans, and Mexican-Americans.

Method: A review of literature was performed, from 1993 through 2008, plus select sentinel articles found through PubMed. Search terms used were: African-Americans and asthma, asthma and Latinos, and Hispanic Americans and asthma.

Results: From these search terms, 274 articles were found. Many were discarded based on number of asthmatic participants, race of participants, year in which the study was conducted, and subject matter of the article. Sentinel articles and reports were also included in the review.

Conclusion: Asthma is a complex disease which involves interplay of genetics and environmental factors. Depending on race, there can be differences in diagnosis or treatment of asthma, environmental factors that affect asthma, and influence of genetics.