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Correlates of Asthma among the Minority Population in South Bronx,New York

Veronica Chibumma Uwanaka
Walden University

Walden University

College of Health Sciences

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Veronica Uwanaka

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Eric Riedel, Ph.D.

Walden University
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Abstract

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MA, Columbia University, 2004

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Dissertation Submitted in Partial fulfillment

Of the Requirements for the Degree of

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Abstract

Asthma among children has become an inherent problem in many communities in the United States, especially among the minority population. The South Bronx has a large minority population and a high prevalence of asthma. However, no study to date has explored the factors associated with this high prevalence rates in this population. Drawing from theories of social ecology and environmental health, the objective of this quantitative cross-sectional study is to investigate the correlates of asthma among children in the South Bronx by studying the sociodemographic and environmental risk factors, including parental occupation; neighborhood and housing characteristics, air quality, and poverty. Study participants included parents of 400 children, aged between 4 and 16 years residing in Districts 9 and 10 in the South Bronx. Descriptive, Chi-square statistics, and logistic regression analysis were used to determine the association between exposure constructs and asthma in children. Hypotheses 2 and 3 examined environmental conditions both inside and outside the homes of study participants and determined one factor, the structure of the home to be significantly associated with asthma, while absence of extractor fan when cooking, showed a strong association. This result suggests that only some of the factors indicating conditions inside the homes have a positive association to asthma. This suggests that asthma is not a combined action of both socioeconomic and environmental factors but a result of conditions in the homes. The implication here is that any intervention to asthma has to start in the homes since most children spend their time indoors. This includes creating awareness to risk factors to help develop community based intervention programs that will help reduce occurrence of asthma.

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Dedication

I would like to dedicate this dissertation to my late father, Marcellinus Nwosu, whose love of education encouraged me to aspire to greater heights; my husband, Francis Uwanaka, whose medical background was an asset throughout the doctoral program; and to my children, Chima, Ogechukwu, Ifeanyichukwu, Ekenedilichukwu, and Uchechukwu, who despite their young ages, demonstrated an immense maturity, understanding, and patience while I spend endless time on the computer and in books.

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Chapter 1: Introduction to the Study

Introduction

Asthma is a serious health problem worldwide with the potential to affect individuals at all levels of the society. In the United States, asthma and wheezing combined are considered the tenth most frequent reason for visits to pediatricians accounting for approximately 2.2 million visits in 1981 (Gergen, Mullally, & Evans, 1988). Data from the 1980 to 2004 National surveillance for asthma in the United States show that on average, there are 20 million cases of asthma among children and the adult population, with a current asthma prevalence of 7.2% (Subramanian & Kennedy, 2009). Similarly, in a study examining the efficacy of a school-based program to prevent exacerbation of asthma symptoms and manage asthma in school children in Dallas, Texas, McEwen, Johnson, Neatherlin, Millard, and Lawrence (1998) wrote that asthma affects approximately 5% of the U.S. population, including an estimated 4.8 million children. The number of asthmatics in the United States has been estimated at more than 12 million with the number of hospitalizations for asthma increasing in virtually all occidental countries, thereby reflecting a real increase in the morbidity of the disease and a rise in mortality in some countries (Demoly et al., 1997). The severity and persistence of asthma has led to its description as a chronic disease by many authors (Jenkins, 2003; Karger & Basel, 2000; McGhan, Reutter, Hessel, Melvin, &Wilson, 2002; Prosser, Carleton, & Smith, 2008).

In the past 3 decades, there has been a considerable increase in the prevalence of asthma and allergic diseases worldwide (Crane, 2001), with Australia, the United

Kingdom, New Zealand, and the Republic of Ireland registering the highest asthma rates in the world (Jenkins, 2003). For example, Jenkins (2003), in an update on asthma management, stated that asthma is still a major cause of morbidity in the Australian community, despite enhanced strategies and interventions for achieving optimal outcomes. This conclusion is evident in the data from Australia that suggests that asthma is presently the sixth most frequent problem managed by general practitioners (GPs; 28 cases per 1,000 patient encounters) accounting for 2% of problems managed in 2000 and 2001 and making it the most common chronic childhood disease in Australia and one of the most common reasons for emergency department admissions (Jenkins, 2003). Due to the enormous number of asthma cases internationally, asthma is now characterized as an epidemic (Crane, 2001).

Asthma is known to affect the lives of patients in many ways, including interference with education and work (Karger & Basel, 2000). Parents of children with asthma are constantly being called from their jobs or absent from work to care for their sick children. Most of all, children with asthma are constantly absent from school, thereby lagging behind in class work and other school activities. According to Levy, Heffner, Stewart, and Beeman (2006), asthma is a leading cause of school absenteeism, accounting for more than 14 million missed days annually, a 40% increase from the 10 million days estimated a decade earlier. Nocon (1991), in studying the social and emotional impact of childhood asthma, recognized the devastating impact of diseases such as asthma on the children and their parents. Nocon (1991) stated that any disease has the potential to affect the social and emotional lives of its sufferers and those who

take care of them. This is because the underlying presence of the disease can cause distress and concern. Moreover, Nocon (1991) argued that the prevention, avoidance, and management strategies of a disease can themselves create difficulties in people's everyday lives.

New York City has one of the highest asthma rates in the country with more than 300,000 New York City children suffering from asthma. Asthma is the leading cause of school absences and the most common cause of hospitalization in the city. The highest incidence of asthma has been observed among the low income population. For instance, children from poor socioeconomic backgrounds have been identified as a population with the greatest number of asthma cases, and most of them are racial ethnic minorities. According to one report, approximately 22% of children in low income neighborhoods in New York City have asthma compared to 14% in high income neighborhoods. Included in this 22% is low income Latinos, who have been identified as being more at risk of asthma than any other group in the city (Bradley, 2009).

Background of the Study

Asthma is a severe and persistent problem, especially among people living in inner cities and urban areas. Despite the advances in the understanding of asthma pathogenesis and treatment in recent years, it remains a significant public health concern with its considerable morbidity and mortality worldwide. As a leading chronic disease, it has been associated with a substantial burden on children and their families (Abu-Ekteish, Otoom, & Shehabi, 2009) and can lead to remodeling, permanent changes in the

airways, which can make the reversible obstruction of asthma permanent or irreversible (Wray & McCann, 2003).

Asthma can manifest as a disease of intermittent wheeze to one of frequent and persistent symptoms. Children with the more severe form of the disease experience significant activity limitations and are at high risk for hospitalization. The recognition of the fact that asthma can influence school absenteeism and participation in activities (McGhan et al., 2002) has led to the development of asthma policies in schools. In order to justify the need for this policy, McGhan et al. (2002) reiterated information from Health Canada 1998, which showed that 65% of Canadian children with asthma missed at least 1 day of school due to asthma in the previous year. Secondly, a typical Canadian classroom has an average of three to five children with asthma.

Among the many problems of asthma are its psychopathology, psychological effect, and attendant expenditure. As stated in Carr, Zeitel, and Weiss (1992), asthma is often associated with long-term psychological and financial burdens and is a leading reason for the utilization of health services. For instance, in 1999 in the United States, asthma accounted for an estimated 1,997,000 emergency department visits, 478,000 hospitalizations, and 4,657 deaths (Mannino et al., 2002). Among diseases commonly seen in outpatient departments, asthma was the fifth most frequent in 1992 (National Institutes of Health, National Heart, Lung, and Blood Institute, 1996) despite the fact that Boss et al. (2003) found that children with asthma miss an average of twice as many school days as other children. According to Boss et al., (2003) in one study population, 21% of children with asthma missed more than 2 weeks of school per year because of

asthma. In a large, international family-based study, that was carried out to find linkage to asthma, Pillai et al. (2006) estimated the cost of treating asthma to be approximately $6 billion per annum in the United States. Substantiating this claim is Jenkins (2003), who previously reported that due to treated and untreated diseases, the burden of asthma in Australia is significant, with direct and indirect costs totaling in excess of $A700 million per year. According to this author, more than 60,000 Australians are admitted to hospitals annually due to asthma. This statement is based on 1997–1998 data, which showed that asthma was the principal diagnosis in 60,280 hospital separations, or 1.08% of all hospital separations, with an average length of stay of 3.5 days. In the United States, asthma is among the most common chronic conditions affecting an estimated 14.6 million people in 1996 and with the prevalence significantly higher among children than adults and among African-Americans than other racial groups (Boss et al., 2003).

Asthma has been found to cause increased risk of behavioral and emotional problems (Collins et al., 2008) including anxiety and higher negative peer sociability (Calam, Gregg, Goodman, 2005; Halterman et al., 2006). Children with asthma also appear to be at higher risk for difficulties in behavioral adjustment than their healthy peers (McQuaid, Kopel, & Nassau, 2001) and at a greater risk of emotional and behavioral problems (Reichenberg & Broberg, 2004). Specifically, it has been suggested that children with asthma internalize behaviors, meaning they are more socially withdrawn and anxious than children without asthma (Alati et al., 2005; Klinnert, McQuaid, McCormick, Adinoff, & Bryant, 2000; Millikan, Wamboldt, & Bihun, 2002 ;).

A salient but unrecognized problem of asthma, as suggested in Browne and Wilkins (2003), is the inability to create an all-encompassing definition of asthma. Corvalán, Amigo, Bustos, and Rona (2005) identified heterogeneity in asthma definitions as one of the major problems of asthma. Boers et al. (2008) also noted the inconsistencies in asthma definitions and control as a major problem hindering asthma diagnosis and treatment. Because of the lack of standard definition, the prevalence of asthma has been found to range from as low as 2% to as high as 30%, depending on the country (Boers et al. 2008).

Jenkins et al. (1996) highlighted the problem with reliance on using questionnaires as a main source of obtaining information on asthma cases. According to them, the complexities of the wide range of severity, triggers, and lack of medical knowledge among the general public is a hindrance to formulating an entirely reliable questionnaire. From the findings of these authors, questions thought to be most reliable in diagnosing asthma were those that include symptom-based components such as wheeze or tightness in the chest. Therefore, they suggested that physician assessment of current asthma may be the nearest to a gold standard among available measures. The authors compared self-reported asthma with the diagnosis of a respiratory physician and found that asthma questionnaire items determining wheeze are valid instruments for measuring current asthma in children and adults in epidemiological surveys.

Problem Statement

In as much as the problem of asthma is a worldwide issue, some communities have more of the burden than others. Reports from studies (Basagaña et.al., 2004; Ernstet

al., 1995; Goodman, Stukel, & Chang, 1998; Halfon & Newacheck, 1993; & Persky et al. 1998.) have shown that the minority population and those from poor socioeconomic backgrounds have been more greatly affected by asthma than others. For instance, African American men and women in the United States are disproportionately affected with asthma compared to other groups (Sobel et al., 2009). Similarly, data from the Centers for Disease Control and Prevention (CDC) has shown that between 1998 and 2006, African Americans experienced higher rates of asthma than any other race/ethnic groups in the United States (Sobel et al. 2009). These disparities were attributed to a number of sociodemographic factors including poor living conditions and presence of known triggers such as dust and environmental pollutants. Substantiating this statement is Krieger and Higgins (2002) who wrote that exposure to substandard housing is not evenly distributed across populations: people of color and people with low income are affected disproportionately. For example, the black population and low-income people are 1.7 times and 2.2 times more likely, respectively, to occupy homes with severe physical problems including overcrowded, too cold, or too warm homes compared with the general population (Krieger & Higgins, 2002). In addition, the authors found that the inability of this group of men and women to self manage their disease worsens the situation.

Poor living conditions, which are products of a poor socioeconomic status, have been associated with numerous diseases including asthma. Kohler and Soldo (2005) reported the works of Smith and others who described a more generalizable lifecycle epidemiology framework that allows for shocks in multiple critical periods when

susceptibility to health damage is thought to be high, including childhood as well as other periods (Beebe-Dimmer et al., 2004; Galobardes, Hart & Smith, 2003; Lynch, &Smith, 2004; Kuh et al., 2003; Kuh & Ben-Shlomo, 2004; Lynch, Kaplan, & Salonen, 1997; Marmot, Kogevinas, & Elston, 1991; Smith, 2003.) The effects of exposures accumulate over time and across life-cycle stages and may exacerbate chronic disease risk by simply increasing the absolute number of exposures and their duration, initiating chains of risk or raising the cumulative pathogen burden of multiple exposures (Ben-Shlomo & Kuh, 2004; Brown et al., 2004; Kohler & Soldo, 2005).

In addition to injuries that occur more commonly in low-income households because of substandard living conditions and a lack of resources to repair them, disparities in asthma morbidity may be attributable, in part, to disproportionate exposure to indoor environmental asthma triggers associated with living in substandard housing (Krieger & Higgins, 2002).

To determine the correlates of asthma inherent in the South Bronx that are predisposing minority children to asthma, I conducted a cross-sectional study in the South Bronx area of New York City. Although the socioeconomic and environmental factors that are the focus of this study have been explored in national population based studies, the results may not necessarily translate into community level actions. Hence, smaller community level studies are needed to explore local determinants of asthma so that effective intervention plans can be developed and implemented at the local level.

Purpose of the Study

The purpose of this cross-sectional study is to explore the quantitative relationship between several sociodemographic factors such as parental education, occupation, household income and wealth, poverty level, neighborhood characteristics, and environmental factors such as ambient air pollution, smoking, and substandard housing with asthma prevalence in the South Bronx community. Despite the persistently higher rates of asthma in this community, to date, there has not been any study specifically addressing the risk factors of asthma in the South Bronx (Whu et al., 2007). Therefore, this study seeks to identify the correlates of asthma among the minority population in the South Bronx. The findings from this research will provide the decision makers, community leaders, and other stakeholders in the study community with objective data that will help develop future intervention strategies to reduce asthma occurrence in this population.

Nature of the Study

This is a community based study using a cross sectional research design and primary collection and analysis of data. Participants were enrolled into the study through personal contacts in Districts 9 and 10. These contacts obtained addresses of participants. Questionnaires and consent forms were both hand delivered to mailboxes and mailed to addresses identified inviting parents with children to participate in the study by completing and returning the questionnaires and consent forms. Based on sample size calculation of approximately 400, I distributed 800 questionnaires with the expectation that at least 400 questionnaires would be completed by parents of children between the

ages of 4 and 16 (See Chapter 3 for more details). A total of 530 questionnaires were returned, but 130 did not meet the required criteria for inclusion.

Research Questions and Hypotheses

The following three primary research questions and hypotheses guided this study:

Research Question #1: Does parental socioeconomic status as indicated by parental income and wealth, education, occupation, and neighborhood characteristics contribute to the development of asthma in minority children?

Hypothesis 1. Null Hypothesis (*H*o1): There is no association between parents' socioeconomic status, as measured by education, income and wealth, neighborhood characteristics, occupation, and the development of asthma in minority children. Alternative Hypothesis (*H*a1): There is an association between parents' socioeconomic status as measured by education, income and wealth, neighborhood characteristics, occupation, and the development of asthma in minority children.

Research Question #2: Do factors in the ambient environment (like smoking, traffic exhaust, and presence of industries close to neighborhoods) predispose minority children to asthma?

Hypothesis 2. Null Hypothesis (*H*o2): There is no association between exposure to factors in the ambient environment such as smoking, traffic exhaust, and presence of industries close to neighborhood and development of asthma in minority children.

Alternative Hypothesis (*H*a2): There is an association between exposure to factors in the ambient environment such as smoking, traffic exhaust, and presence of industries close to neighborhoods and development of asthma in minority children.

Research Question #3: To what extent do conditions in the home such as overcrowding, poor ventilation, and presence of mold and other allergens contribute to the development of asthma in minority children?

Hypothesis 3. Null Hypothesis (*H*o3): Conditions in the home such as overcrowding, poor ventilation, presence of mold and other allergens do not contribute to asthma in minority children.

Alternative Hypothesis (*H*a3): Conditions in the home such as overcrowding, poor ventilation, presence of mold and other allergens greatly contributes to asthma in minority children.

Data generated from these questions and hypothesis provided clarification on the problem of asthma among the minority population as well as necessitating the much needed intervention to bring social change in the study community.

Guiding Theories

In addition to reports of studies on asthma, socioeconomic status, and minority children, are theories supporting the association between asthma and environmental factors. For this study, the social ecological model and the environmental health theory are used as the conceptual framework. These theories have been suitably applied to different studies. Bronfrenbrenner (1979) used the social ecological model to show how an individual is affected and influenced by what happens in his/her environment. Brownson, Remington, and Davis (1998) used it as a model for behavior change, while Stokols (1996) used it in explaining the guidelines for community health. In the same way, the environmental health theory, which seeks to assess and control factors in the

environment that can adversely affect the health of an individual have been effectively used in studies of the germ theory of disease and various works on infectious diseases. The merging and application of these two models in this study stems from the fact that environmental health, ecology and health, and human ecology each provides constructs applicable to public health interventions at different scales of temporal, spatial, and conceptual complexity (Parkes, Panelli, &Weinstein, 2003). According to studies, hazards in the physical environment remain disproportionately the burden of individuals, households, and societies that also face inequalities in terms of socioeconomic discrimination and/or psychosocial stress from their social environment (Institute of Medicine, 1999; McMichael et al., 2000; Stephens, 1998). Secondly, the roles of social and economic development, as both drivers and mediators of hazardous environmental exposures, and the need for an ecologically sustainable development are increasingly important challenges in environmental health (McMichael, 2002; Shahi et al., 1997; Woodward et al., 2000).

Therefore, this study used the socioecological model and theory of environmental health to identify the correlates of asthma among the minority population in the South Bronx of New York City. The decision to use these two theories is based on the fact that the theories offer a clarification on the relatedness of the environment and human existence. As mentioned earlier, the theories have been used by past researchers to show that what happens in the environment directly or indirectly affects humans and their well being (see Chapter 2 for more details).

Definition of Terms

Ambient air: The surrounding air in a specific environment or open air or outdoor air. Ambient air is a blanket of gases surrounding the earth. At ground level, air is a mixture of invisible and odorless gases, mostly nitrogen and oxygen, with smaller amounts of water vapor, argon, carbon dioxide, neon, helium, and hydrogen (www.hartford.gov/HealthyHartford/OutdoorAir_Quality/OAQGl…)

Association: A statistical dependence between two or more events, characteristics, or other variables. An association is present if the probability of occurrence of an event or characteristics, or the quantity of a variable, depends upon the occurrence of one or more other events, the presence of one or more other characteristics, or the quantity of one or more other variables (Last, 2001)

Asthma: A common disorder in which chronicinflammation of the bronchial tubes (bronchi) makes them swell, narrowing the airways. Asthma involves only the bronchial tubes and does not affect the air sacs (alveoli) or the lung tissue (the parenchyma of the lung) itself (www.medterms.com).

Asthmatics: Persons with asthma (www.medterms.com).

Etiology: Etiology is a word mainly used in medicine, meaning the study of the causes or origin of diseases. Etiology refers to the factors which produce or predispose toward a certain disease or disorder (www.medterms.com).

Exposure: Proximity and /or contact with a source of a disease agent in such a manner that effective transmission of the agent or harmful effects of the agent may occur (Last, 2001)

Environment: All that which is external to the individual human host. This includes the physical, biological, social, cultural etc. that can influence health status of a population (Last, 2001.)

Environmentally inclined: An indication that the problem of asthma is mainly caused by factors in the environment.

Epidemiology (descriptive): A general observation concerning the relationship of disease to geographic location and basic characteristics such as age, sex, race, occupation, and social class (Last, 2001).

Genetics: The branch of biology dealing with heredity and variation of individual members of a species (Last, 2001).

Genetically inclined: An indication that the problem of asthma is mainly caused by genetics.

Income: Money made through business or labor (dictionary .reference.com)

Indicators: Measures of health status or health outcomes (Turnock, 2004, p. 392).

Minority: Groups in the society with little or no control of resources which are always in danger of being exploited or discriminated against. A group considered as inferior to others, for example by the majority group. Based on Schaefer (1993), it is a group that experiences a narrowing of opportunities (such as success, education, and wealth) that is disproportionately low compared to their numbers in the society (Schaefer, 1993).

Neighborhood characteristics: These are the distinctive features of a neighborhood (neighborhood.mchb.hrsa.gov). .

Negative association: When the occurrence of higher values of one variable is associated with lower values of the other variable, the association between them is described as negative (Last, 2001).

Overcrowding: This is a sociodemographic term with various definitions. According to the U.K. office of population census and survey, it is the number of persons in private households living at a density greater than one person per room, as a proportion of all persons in private households (Last, 2001).

Occupation: An activity that serves as one's regular source of livelihood (www.thefreedictionary.com/occupation)

Pest infestations: The invasion of a living environment by a pathogenic agent such as pests. It is the occurrence of one or more pest species in an area or location where their numbers and impact are currently or potentially at intolerable levels. (http://www.eionet.europa.eu/gemet/concept).

Population: All the inhabitants of the study area or all the inhabitants of a given area (Last, 2001).

Poor ventilation: When there is not enough air coming into a house, the house is said to be poorly ventilated. It can also be described as the replacement of fresh air with stale and obnoxious air (www.thefreedictionary.com/ventilation).

Positive association: When higher values of a variable is associated with higher values of another variable, the association between the two variables is described as positive (Last, 2001.).

Poverty: Poverty is now widely viewed in terms of capability deprivation. The income approach views poverty simply as lack of income (or consumption). Poverty exists when some persons in the society have so little income that they cannot satisfy socially defined basic needs. However, lack of income is not the only kind of deprivation people may suffer. Indeed, people can suffer acute deprivation in many aspects of life, beyond those defined as basic needs, even if they possess adequate command over commodities (for example, ill health or lack of education and so on; Kawani, 2006).

Predispose: To render susceptible (Medterms.com. Retrieved from http://www.medterms.com/script/main/art.asp?articlekey=25591).

Prevention: Actions aimed at eradicating, eliminating, and minimizing the impact of disease and disability or retarding the process of disease and disability (Last, 2001.).

Risk factor: An aspect of personal behavior or lifestyle, an environmental exposure, or an inborn or inherited characteristic, that, on the basis of epidemiological evidence, is known to be associated with health-related condition(s) considered important to prevent (Last, 2001).

Socioeconomic status (SES): A descriptive term for a person's position in the society which may be expressed on an ordinary scale using such criteria as income, educational level attained, occupation, and value of dwelling place. (Last, 2001.) .

Smoking: Smoking refers to the inhalation and exhalation of fumes from burning tobacco in cigars, cigarettes and pipes (smoking.ygoy.com).

Status: One's position in a group or society.

Substandard housing: Houses that is not conducive for living or houses that do not meet the standard living requirement/condition. According to the California Substandard Housing, this is property in violation of the state or local health and safety codes as determined by city or county regulatory agencies. Retrieved from http://www.ftb.ca.gov/forms/misc/960.pdf).

Syndrome: A symptom complex in which the symptoms and /or signs coexist more frequently than would be expected by chance on the assumption of independence (Last, 2001).

Toxic substances: Chemicals with the potential of causing harm, producing a harmful effect on living organisms and ecosystems, or that inhibits another substance or a reaction. This means that any chemical whether taken internally or applied externally that is injurious to health or dangerous to ehttp://medical-dictionary.thefreedictionary.com/Toxic+Substances). (

Wealth: Possession of money, many valuable material resources or assets (Webster medical new world dictionary, 2003).

Assumptions

In as much as numerous works have been done on asthma and socioeconomic status, asthma is still a major cause of morbidity and mortality in children. This has led to the assumption that there may be more problems than just socioeconomic ones. Therefore, based on the persistence and high rate of asthma in the South Bronx, it is assumed that asthma is not just the product of socioeconomic status, but a result of an interactive effect of poor socioeconomic status and environmental factors. In other words, this study intends to establish that in addition to socioeconomic status, factors in the home, ambient air pollution, neighborhood characteristics, and poverty contribute a great deal to the development and persistence of asthma in the minority population, thereby justifying the need for a study of this nature.

Limitations

- Due to limited resources, I did not collect data from other parts of the Bronx where the minority population with better socioeconomic status and environment resides.
- Two school districts may not be a good representation of all asthmatic children in the South Bronx and therefore will not be able to identify all of the asthmatic children in the study community.
- Some parents may forget or refuse to complete and return the survey.
- There is no way of substantiating the accuracy of the information provided by the parents.

- Since information on child's exposure and asthma status is based on parents' self-report, there may be misclassification of exposure and /or outcome.
- Concern for personal protection may be a determent in revealing socioeconomic or health status.

Significance of the Study.

This study helped to identify factors contributing to higher asthma rates in the South Bronx community of New York City. South Bronx has experienced persistent higher asthma rates than the national average. However, there is lack of local community data to evaluate the determinants of asthma and formulate any effective intervention strategy to reduce the burden of disease in this population.

Karger and Basel (2000) found that the current prevalence of childhood asthma is about 6%. This shows a 5% increase from what it was 30 years ago. A similar trend is noted in the United Kingdom (U.K) and other countries, where the prevalence of diagnosed asthma and symptoms strongly suggestive of asthma in children has increased at a rate of about 5% a year (Pillai et al., 2006).

Asthma is a source of despair in most families in the United States, schools, and the society at large. Periodic attacks of asthma have contributed to numerous emergency visits, family expenditure, and distress. The cost of caring for asthmatics has continued to increase. Data from the National Center for Health Statistics NCHS showed that there are at least 21 million patients with asthma in the United States, 6 million were children under 18 years of age (Conboy-Ellis, 2006). This number does not include those with

under diagnosed and undertreated asthma. In addition, there were 1.9 million emergency department visits for asthma and 465,000 hospital admissions in the United States. Among this number are 214,000 children, ages 1 to 17 years with a healthcare cost estimated at more than $11 billion a year. Asthma was also found to be responsible for 8 million lost workdays in the United States (Conboy-Ellis, 2006). Among 14.4 million outpatient asthma visits to primary care providers' offices and hospital clinics in 2002, African Americans have 40% higher office visit rate than European Americans (Conboy-Ellis, 2006).

Reports from The International Study of Asthma and Allergy in Children (ISAAC) indicated that 8% of 6 to 7 year olds and 12.2% of 13 to 14 year olds have >12 episodes of asthma attacks per year, while 11.2% of 6 to 7 year olds and 9.8% of 13 to 14 year olds experience sleep disturbance ≥1 nights/week due to asthma. Based on the literature reviewed, I found that contrary to the widespread beliefs that access to medical care, health insurance, and continuity of care are the major barriers to quality asthma care, the barriers most frequently reported by parents were related to patient and family characteristics, health beliefs, or to their social and physical environment (Mansour, Lanphear, & DeWitt, 2000). This makes it pertinent to examine the child in his /her immediate environment in order to identify the correlates of asthma that are predisposing children to the disease in this population. Therefore, the current study focuses on identifying the major environmental and socioeconomic correlates responsible for asthma prevalence among minority children in the South Bronx.

Rationale

In as much as the problem of asthma is an age long issue and has been extensively researched, no study has focused on the correlates of asthma on the community level. Supporting this statement is Ortega and Calderon (2000) who stated that empirical studies have yet to demonstrate a definitive cause for the high risk and severity of asthma among minority children in addition to an earlier agreement that minority children in the United States are at higher risk for asthma and related hospitalizations than children from the majority population, and their asthma tends to be more severe. In other words, no study exists on the correlates of asthma among the minority population in the South Bronx of New York City. Moreover, since South Bronx is not the only community with minority population and poor socioeconomic status, there must be other explanations for the high rate and persistence of asthma in the community. Therefore, there is a need for a study that focuses on the minority population in the South Bronx for possible explanations on persistently higher rates of asthma in this community more than other communities with equal minority and socioeconomic status.

Based on articles reviewed, there have been contradictory reports on the reason why asthma is prevalent among minority children. While some have attributed it to genetics, others have focused on socioeconomic factors. For instance, Mansour, Lanphear, and DeWitt (2000) wrote that the prevalence and morbidity from asthma are increasing, especially among underserved, minority children despite improved treatment regimens for asthma. However, none has really examined the correlates of asthma in this community. For instance, contrary to the widespread beliefs that access to medical care,

health insurance, and continuity of care are the major barriers to quality asthma care, the barriers most frequently reported by parents were related to patient and family characteristics, health beliefs, or to their social and physical environment (Mansour, Lanphear, & DeWitt, 2000). This makes it pertinent to examine the child in his/her immediate environment in order to identify the correlates of asthma in the environment that are predisposing children to the disease.

Implication for Social Change

The development of asthma is multifactorial, but some of its risk factors are known to be preventable. Among these preventable risk factors are those found in the environment such as allergen exposure, environmental tobacco smoke, nutrition, low birth weight, history of infections, and ambient levels of air pollution (D'Amato, 2002).

The Bronx, especially the South Bronx, being one of the economically disadvantaged counties in New York City, has been associated with the highest rate of asthma mostly because of conditions in the environment such as smoking and other air pollutants. Asthma has been linked to a number of pollutants among other factors, which are mostly found in poor neighborhoods. Some of the most commonly studied among these pollutants are the criteria pollutants (carbon monoxide [CO], nitrogen dioxide [NO2], sulfur dioxide [SO2], ozone [O3], particulate matter [PM10 and PM2.5] and lead [Pb)]), which are regulated in the United States by the Clean Air Act (D'Amato, 2002).

D'Amato (2002) also reported that Bronx County has some of the highest rates of asthma in the United States, with rates of death from asthma about three times higher than the national average and hospitalization rates about five times higher. In some

neighborhoods in the Bronx, it is estimated that 20% of the children have asthma (Ruppel, 2000). Within New York City, the disparity in asthma hospitalization rates is very pronounced. According to Stolberg (1999), hospitalization rates for asthma in Bronx County and East Harlem are 21 times higher than those of affluent parts of the city.

The result of this study will be communicated to the residents of the South Bronx community as a method of educating them on the risk factors for asthma in their environment that are affecting their well being. In other words, this study will act as a catalyst for change by creating social and economic awareness in the South Bronx. In addition, it will provide knowledge useful for program developers, educators, psychologists, and other researchers who are searching for ways to improve the environment and protect the health of the masses especially children.

Summary

Asthma is a global age long disease that has the capability of affecting young and old, rich and poor alike. Nevertheless, some communities have more of the burden than others and as such have experienced more morbidity and mortality among its residents due to asthma. Data from 1999 show that *Bronx* in New York City had the highest prevalence of asthma (15.5%) among children aged 4 to 5. To show the magnitude of the problem in New York City, for instance, many organizations have been formed with the goal of reducing asthma among children. One such organization is The New York City Department of Health and Mental Hygiene's Childhood Asthma Initiative (NYCCAI), a public health effort to reduce asthma morbidity among children 0 to 18 years of age. The goal of this group is to reduce hospitalizations, emergency department visits, and school

absences due to asthma, and related improvements in the management of childhood asthma among families (Asthma Facts, 2003). Identifying the factors responsible for the high prevalence of asthma in communities such as the Bronx will help reduce the burden by devising effective intervention strategies in the local communities. Chapter 2 reviews existing literature that provides further evidence in support of the research questions and hypothesis presented in Chapter 1. Relevant literature related to sociodemographic and environmental determinants of asthma are also reviewed. Chapter 3 describes research methods, sample size calculation, description of variables, data collection and data analysis. Chapter 4 is the analysis of data, while Chapter 5 is the discussion of the results and recommendations.

Chapter 2: Literature Review

Introduction

Humankind has always been subject to one disease or another. Among them is asthma, a global life-threatening respiratory disease. The menace of asthma in certain areas of the world has attracted the attention of health researchers –both clinicians and public health workers. A quick glance at the disease registries and results of several case studies proved that asthma is an inherent problem in the United States and the world at large. Due to the increasing number of asthmatics, many researchers have identified asthma as one of the public health concerns, especially among children in the United States (CDPH, 2000; Lara et al., 2002; Lung Association, 2002; Mann, 2000). In 2001, Bair, García, Romano, Siefkin, and Kravitz found that asthma affects approximately 17 million persons in the United States and generated approximately 433,000 hospital admissions in 1997, making it one of the nation's most common and costly chronic diseases. This is no longer the situation because Rob (2003) stated that more than 20 million Americans have asthma and about 5,000 people die from asthma each year; therefore, the problem of asthma is still increasing. According to surveys from the National Center for Health Statistics (NCHS), asthma prevalence among persons aged 0 to 17 years increased approximately 5% each year during 1980 to 1995. In 2001, 73 people per 1,000 or 20.3 million people had asthma, with the prevalence higher for children than adults; 87 per 1,000 children 0 to17 years (6.3 million children), compared to 69 per 1,000 adults 18 years and over (14 million adults; Rob, 2003).

The information for this literature review was drawn from books used in the course of my master's and doctoral studies and electronic articles within Walden University library databases. Some of the books used are from psychology, epidemiology, and community health backgrounds while the electronic searches were mostly within EBSCO, ProQuest, Google scholar, SAGE, Medline and Pub Med. Articles were selected on the basis that the information they provide are related to one of the subheadings in this review. Search terms included asthma, etiology, epidemiology, socioeconomic status, diseases, health, risk factors, genetic risk factors, environmental risk factors, socioecological theory, environmental theory, minority children, smoking, poverty, indicators of socioeconomic status, and air pollution.

The noted prevalence of asthma worldwide has led to the description of asthma as a substantial health problem among children and adults, with high and increasing prevalence rates in many countries, a substantial morbidity reflected in hospital admission rates, use of medical services, drug use, and worrying trends in mortality rates in some countries (Sears, 1997).

Some communities have been identified as having the greatest number of asthma cases. This is evident in Carr, Zeitel, and Weiss's (1992) statement which suggest an uneven increasing trend in asthma hospitalizations and mortality across the United States. Children from minority groups are disproportionately affected by asthma (McEwen, Johnson, Neatherlin, Millard, & Lawrence, 1998). African American children have approximately 2.5 times as much asthma as European American children, but are 2 to 5 times more likely to be admitted to the hospital for asthma than European American

children. Hospitalization and death rates among Black and Hispanic population were also found to be 3 to 6 times those of White population (Carr et al., 1992). In a community based participatory study with preschool children, Nelson, Awad, Alexander, and Clark (2009) commented on the disproportionate effect of asthma on low income minority children who reside in large urban areas, another important factor contributing to the devastating effect of asthma among minority children.

In consideration of the social and physical aspects of the urban environment as factors that may contribute to the effect of asthma on city-dwelling children, Nelson et al. (2009) stated that children with asthma who also reside in economically disadvantaged urban areas have the tendency of developing more severe asthma and poorer outcomes over the course of the illness. Supporting their assumption was a survey distributed to 4,200 caretakers of Detroit Head Start children in six agencies, which concluded that asthma remains a significant problem in this population, especially for African Americans. This was evident in the high levels of undiagnosed children with persistent symptoms and questions regarding the care they receive. This conclusion, therefore, became the basis of an argument on the seriousness of asthma among young children from low-income families, especially African American children.

One community with a disparity in the occurrence of asthma is the south Bronx in New York City, which has a predominantly minority population. News reports and researchers have shown that South Bronx has the greatest prevalence and mortality rate of asthma disease among children, from prekindergarten to middle school age, than most of her neighboring communities in New York City. An example is in D'Amato (2002)

who stated that Bronx County has the highest pediatric asthma (children 0-4 years) hospitalization rates in the New York area.

Other examples are from surveillance reports which describe an increase in asthma prevalence and cite New York City as an area of excessive asthma mortality. Included in these reports are the assessment of trends and the influence of geography, race, and ethnicity on hospital admission rates for asthma between 1989 and 1991, and data reviewing all admissions for asthma to New York City hospitals. Results showed that the average citywide annual hospital admission rate was 681 per 100,000 population, and the racial and ethnic distribution was 1,003 per 100,000 Hispanic patients, 810 per 100,000 for black patients, and 242 per 100,000 for white patients ($p<0.0001$), with Bronx and Manhattan registering the highest admissions rates (De Palo, Mayo, Friedman, & Rosen, 1994). The Centers for Disease Control (CDC) reports also showed that more than 4.8 million children under 18 in the United States, or approximately 6.9%have asthma, making it one of the most common chronic conditions of childhood, with New York City bearing most of the burden because of the growing number of asthmatics in the city (Sze, 2004). According to a 2003 report, the New York City Department of Health estimated that over 700,000 adults and 300,000 children in the city have been diagnosed with asthma sometime in their lives. This article also reported Stevenson's (2000) finding that low income children have a rate 3.5 times greater than higher income children (Sze, 2004).

The effect of this situation on the developmental rate and growth of these children have also been the focus of most researchers. From general observation and

comparative analysis, stagnation and failure can be seen among these children in measuring up with various aspects of life activities when compared to children of the same age limit in other neighboring communities. South Bronx is not the only community in New York City where there are minority groups, yet it has registered the highest population of asthmatic children. The questions that remain to be answered are as follows:

1. Why are minority children in this population susceptible to asthma?
2. Could poor socioeconomic status and environmental factors be responsible for this high rate of asthma in the South Bronx?
3. What are some of the factors associated with the environment and socioeconomic status that exist in this community and which can contribute to the development of asthma?
4. Are there any other factors that may directly or indirectly predispose these children to asthma?

In as much as teams of health professionals have delved into exploring the factors inherent in the society that are predisposing children to asthma in different parts of the United States and the world at large, none has studied this community of interest in isolation or explored factors such as demographic and environmental factors that may be associated with asthma in this community. A look at the socioeconomic status of people in the South Bronx, for example, reveals poverty and substandard living. According to an August News report, 90% of the children in the South Bronx of New York City live in poverty (USA Today, 2007). Researchers have confirmed that poor children tend to

perform worse on a variety of measures when compared with children from more economically secure families (Wagmiller Jr., Kuang, Aber, Lennon, Alberti, 2006). According to these authors, poor children have higher infant mortality rates (Klerman 1991), more asthma (Castro et al., 2001), more physical and mental health problems, and worse health generally (McLoyd, 1998). They are less well adjusted (Conger, Conger, & Elder, 1997) and report lower self esteem (Axinn, Duncan, &Thornton, 1997).

The overall goal of this study is to identify the sociodemographic and environmental factors that may predispose minority children in the South Bronx to asthma with a special emphasis on socioeconomic status and other major environmental factors such as pollution, poverty, substandard housing, and smoking. To address this research question, this study has utilized the social ecological model of health behavior change and the theory of environmental health as a guide in establishing the extent of the effect of sociodemographic and environmental factors on asthma in minority children.

Theoretical Framework

Past studies and researchers have revealed a rich theoretical basis for the association between socioeconomic status, a major sociodemographic factor, environmental factors, and diseases both in the general and minority populations. The understanding of a theory is that it is organized with a definite pattern and is derived from concepts that have already been tested by applying them to many situations. Sayer (1992) described it as an ordering framework, a conceptualization, or an explanation. In other words, every theory is based on hypothesis and supported by evidence that can be tested in different situations. This means that a theory presents a concept or idea that can

be tested, showing that it is not a guess but a fact based framework for describing a phenomenon especially in science.

Among the theories that have been used to substantiate the association between sociodemographic, environmental factors, and adverse health conditions include the extant theory, the positive association theory, the theory of fundamental social causes, the social causation, and social selection theories. Therefore, the suggestion that sociodemographic and environmental factors may be instrumental to the development of asthma in minority children is not unfounded, making it very pertinent to employ these theories in establishing the rationale for the association between asthma, environmental and sociodemographic factors.

Medical sociology as a discipline has identified the rich and persistent association between indicators of socioeconomic status, morbidity, and mortality. Therefore, in order to deepen an understanding of this association, medical sociologists and social epidemiologists have posited theories that might explain this association. One such theory is the extant theory in medical sociology and social epidemiology, which proposes that this robust association arises because SES affects the distribution of stress, influences the development of healthy lifestyles, or provides resources that allow people to avoid risks and adopt protective strategies (Link, Phelan, Miech, & Westin, 2008).

Warren and Hernandez's (2007) explanation of Link and Phelan's (1995, 1996) theory of fundamental social causes traced the relationship between socioeconomic status and diseases from the early 20th century with the observation that the mechanisms or risk factors that account for socioeconomic gradients in morbidity and mortality rates change

over time. Initially, it was just about issues like sanitation, water quality, and food safety that were identified as the key mechanisms linking SES and health, but now researchers focus more on factors like smoking, obesity, and access to care. In as much as there have been changes over time in the intervening mechanisms, these authors still contend that the associations between SES and aggregate morbidity and mortality rates have nonetheless persisted. This proposition is evident in the statement made in Link and Phelan (2000), which stated that these resources associated with SES help individuals avoid exposure to deleterious health effects

In support of the theory of fundamental social causes, Phelan and Link (2005) argued that SES disparities in mortality arise because people of higher SES use flexible resources to avoid risks and adopt protective strategies. An example is a statement by Johnson and Cohen (1999), which used considerable evidence to establish the fact that low socioeconomic status (SES), assessed using measures of educational attainment, income, and occupational status, tends to be associated with a high prevalence of psychiatric disorders among children, adolescents, and adults. According to these authors, two major theories have been advanced to explain this association. First is the social causation theory, which hypothesizes that environmental adversity, disadvantage, and stress associated with low SES contribute to the onset of psychiatric disorders. Next, is the social selection theory, which hypothesizes that constitutional and environmental factors contribute to the onset of psychiatric disorders, which in turn cause individuals to experience downward drift in SES or to fail to rise out of low SES. These two theories have been associated with sequences of events occurring over an extended period of time,

and findings have indicated that a combination of social causation and social selection processes may account for the association between SES and psychiatric disorders for example. It is very important to note that psychiatric disorder is only used as an example here and not that the effect of SES is limited to only one disease.

With regard to the main focus of this study, which is an investigation into the sociodemographic and environmental factors contributing to the development of asthma in minority children, two theories are important: the social ecological model and theory of environmental health.

The social ecological model. The social ecological model is an offshoot of the ecological model proposed by Bronfenbrenner and others. In Bronfenbrenner (1990) ecological model, ecology is seen as an instrument that investigates the complex system of interlaced and interdependent relationships between the biological organism and the social/physical setting which forms the organism (Muuss, 1996, p.312). The science of ecology as explained in Odum (1971) is said to aim at understanding the networks of interactions among individuals, populations, communities, and their environments, often in the context of food webs or energy cycles and can be applied to a number of environmental health issues (Parkes & Panelli, 2003). For the proper understanding of ecology as it applies to human beings and their environment, Parkes and Panelli (2003) defined human ecology as involving the study of human–environment interactions. They extended the notions of ecology and health by explicitly traversing boundaries between nature and culture and environment and society. In keeping with distinctions between the biophysical and social environment and environmental and socioeconomic determinants

of health, these authors characterized the definitions of human ecology with biophysical and sociological interpretations of the term ecological.

In Bronfenbrenner (1990) development does not take place in a vacuum, but is always embedded and expressed through behavior in a particular environment. He advised that we must expand our perspectives beyond any single setting, to the examination of multiperson's systems of interaction, while taking into account aspects of the environment beyond the immediate situation containing the subject. Development, according to him, results from the changes over time in the way that a person matures, perceives, and interacts with the immediate environment (Muuss, 1996).

Social ecology is, therefore, viewed as an overarching framework or set of theoretical principles for understanding the interrelations among diverse personal and environmental factors in human health and illness (Stokols, 1996).This explanation implies that there are personal and environmental factors that lead to the development of diseases. The social ecological model was developed based on the need to integrate individual level factors with community and social context factors. An ecological framework recognizes that behavior is affected by multiple levels of influence including intrapersonal factors, interpersonal processes, institutional factors, community factors and public policy. It is known to address multiple levels of influence on behavior, while providing a mechanism for broadening theoretical developments (Berkman & Kawachi, 2000.). The figure below shows the interrelatedness of the different systems in the environment and how everything in a child and the child's environment affects the child and his/her development.

Figure 1. Socio ecological model showing the interwoven relationships that exist between the individual and the environment. Adapted from Moore, J. Socioecological Model. Retrieved from www.balancedweightmanagement.com/TheSocio-EcologicalModel.htm

The socioecological model proposes that despite the fact the individual may be responsible for instituting and maintaining the lifestyle changes necessary to reduce risk and improve health, an individual behavior is determined to a large extent by the social environment e.g., community norms and values, regulations and policies. This means that any obstacle to healthy behavior is shared within the community as a whole.

Theory of environmental health. According to the World Health Organizations (WHO) 1993, environmental health encompasses the theory and practice of assessing and controlling factors in the environment that can potentially affect adversely the health of present and future generations. In a

description by the Institute of Medicine, (IOM) 2001, environmental health theory is a science that has been traditionally grounded in medicine, epidemiology, toxicology, chemistry, ecology, and physics, with an associated focus on protection through regulation and standards. Therefore, the general concern among environmental health practitioners is with the more direct biophysical effects of the environment on human health (Parkes & Panelli, 2003). According to these authors, the environmental health theory, which began with John Snow's "germ theory"(though, it was not called the germ theory until Koch presented it as the germ theory) progressed to provide the agent – host – environment triad as a basis for conceptualizing environment and health relationships, highlighting complex interrelationships between the triad components that extend beyond linear cause–effect mechanisms due to an increased understanding of the infectious diseases. Based on these two theories, it is clear that the present study and its expected outcome is not unfounded. This study is not the first of its kind, but a continuation of previous researches on an existing and persistent problem.

Application of the Theories of Social Ecology and Environmental Health to the Present Situation

The present study requires the examination of sociodemographic and environmental factors that cause children to develop asthma. In order to do this, there is a need to examine the child and his/her immediate environment. According to these theories, the environment can promote or hamper the development of the child. The

existence of every individual is believed to begin in the Microsystems (the immediate social and physical environment) and proceeds to the Mesosystem (an interaction of several Microsystems), then the exosystem (the structure of the larger community, especially its decision-making, political and business bodies; and comprises the linkage and processes taking place between two or more settings.), and finally the Macro system (a collection of the overarching pattern of micro, meso, and exosystems characteristics of a given culture, subculture, or other extended social structure with particular reference to the developmentally instigative belief systems, resources, hazards, lifestyles etc. that are embedded in such overarching systems) (Muuss, 1996, p.322-330). These systems affect the child, either directly or indirectly. For instance, in the exosystem, one of the settings does not contain the developing person because it defines the larger social system in which the child does not function directly (Berk, 2000), yet events that occur in the system indirectly influence processes within the immediate setting in which the developing person lives. An example is the parents' world of work and their work conditions, of which the child is not a part but which may have a profound impact on the conditions under which the child lives (Muuss, 1996, P. 328). This example helps to substantiate the fact that parents' socioeconomic status, an important socio-demographic factor, plays a role, either directly or indirectly in the development of the child. As this literature review continues, these factors will be examined to identify the extent of their contribution to the development of asthma in minority children.

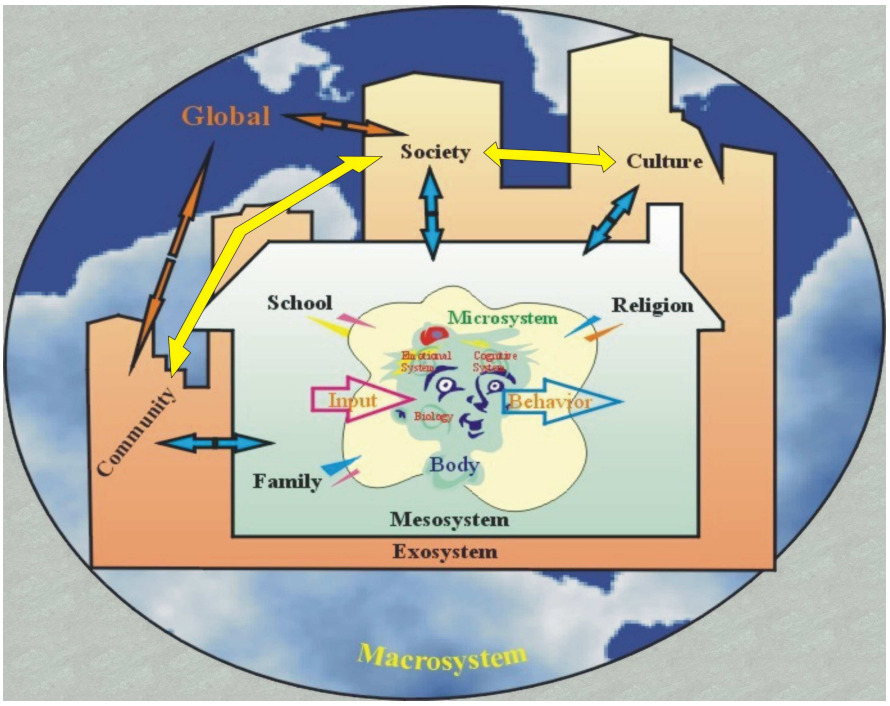

Figure 2. Bronfenbrenner's structure of the environment. Adapted from Bronfenbrenner's Ecological Systems Theory. Retrieved from Bronfenbrenner, U. (1990). Discovering what families do. In Rebuilding the Nest: A New Commitment to the American Family. Family Service America [web site] <http://www.montana.edu/www4h/process.html>

According to Bronfenbrenner, this theory looks at the child's development within the context of the system of relationships that form his or her environment. He defines complex layers of the environment, each having an effect on a child's development (Bronfenbrenner, 1990). In other words, the theory recognizes that the environment has different layers, and each exerts an effect on the growing child. Therefore, whatever happens in any of the layers has the ability to affect the child in different ways.

In describing the ecological systems theory, which recognizes the relationship between the biology of an individual and the environment, Bronfenbrenner (1990) stated that the interaction between factors in the child's maturing biology, his immediate family/community environment, and the societal landscape are factors that necessitate and gingers his development. In other words, changes or conflict in any one layer has the tendency of affecting other layers. This means that in order to understand a child's problem, his immediate environment as well as the interaction of the larger environment should be taken into consideration. Bronfenbrenner's focus on the quality and context of the child's environment suggests that an individual's environment is instrumental to his good or bad health, thereby justifying the theoretical basis of the present study.

The Asthma Syndrome

Due to the severity of asthma, and in order to gain a proper understanding of the disease, many researchers and healthcare providers have studied the problem of asthma and as such have come up with many and varied definitions. The works of these professionals have created much awareness on the subject of asthma, thereby enabling a common understanding of the disease amidst varied definitions used in describing its nature, signs, symptoms, causes, effects, etc. and for proper understanding of these definitions, I have tried to group these definitions with respect to how they describe asthma. The definitions of these professionals will also serve as an indication on the part our environment or socio-demographic factors have to play in the development of asthma.

The common understanding among the majority of people who have been directly or indirectly affected by asthma is that asthma is a respiratory disease that causes an obstruction in the breathing passages thereby creating difficulty or cessation of breathing. But among our professionals and those who have researched the problem of asthma, there is much more to that breathing problem associated with asthma. Generally, among its many professional definitions are its portrayal as a chronic inflammatory disorder/disease of the human respiratory system (Moorman et al. 2007; Browne & Wilkins, 2003; Prosser, Carleton, & Smith, 2008) that is typified by airway hyper reactivity and obstruction producing variable airway resistance with a reduction in air flow of the airways (Browne & Wilkins, 2003); characterized by episodic and reversible airflow obstruction and airway hyper-responsiveness(Moorman et al. 2007); or by recurrent exacerbations of symptoms that include coughing, wheezing, and shortness of breath (Prosser, Carleton, & Smith, 2008). Asthmatics are said to be known for their wheezing, coughing and shortness of breath (Browne & Wilkins, 2003), increased difficulty breathing that may be accompanied by cough, wheezing, chest tightness or other symptoms (Bair, García, Romano, Siefkin, & Kravitz, 2001).

Despite the fact that there are several inconsistencies in the definition of asthma, some researchers have found that there has been an agreement through the years that the symptoms of paroxysmal reversible airway obstruction, which manifests as apnea (wheezing and shortness of breath) define asthma (Wray & McCann, 2003). In a research study to identify the accuracy of symptom perception in asthma and illness severity, Rietveld, Prins, and Colland (2001) explained childhood asthma as a chronic respiratory

disorder characterized by recurrent episodes of airway obstruction and dyspnea (breathlessness). This definition is in line with Becker et al. (2005) description of asthma as a disease characterized by paroxysmal or persistent symptoms, such as chest tightness, wheezing, sputum production and cough associated with variable airflow limitation and airway hyper-responsiveness to endogenous or exogenous stimuli. To explain, the severity of asthma, Becker et al. (2005) described asthma as a chronic disease that is a major cause of disability for many persons and a cause of death for some.

Vianna, García, Bettiol, Barbieri, and Rona (2007) recognized that most definitions of asthma emphasize variable airflow obstruction and highlight inflammation as essential elements of the condition. These authors are of the opinion that these characteristics do not translate into an unambiguous definition to separate asthmatics and non asthmatics in surveys. Therefore, to assess the value of asthma score in comparison with other definitions of asthma in another population setting, they used bronchial hyper-responsiveness (BHR) to methacholine in diagnosing asthma, and the association of these definitions to known risk factors of asthma as criteria for recognizing asthmatics. They found that the Positive likelihood ratio increased with asthma scores, but the prevalence with higher scores was too low for useful analysis. The authors' definition of this result is that the asthma score was slightly better for identifying associations from a set of known risk factors than the other two approaches. The authors concluded that there is little support for a greater validity of asthma score over other asthma definitions, and only marginal advantage for identifying risk factors. Sunyer et al. (2007) also assessed the predictive ability of an asthma score against the occurrence of different asthma-related

outcomes and the risk factors identified when using an asthma score with a random selection of the European community Respiratory Health study II. Their finding showed that asthma score at baseline has a linear relationship with incidence of asthma, the occurrence of asthma attacks, use of asthma medication and bronchial reactivity at the end of the follow-up.

Based on the above defined symptoms of asthma, Wray and McCann (2003) defined it as a disease of the lung airways that causes difficulty in moving air into and, especially, out of the lungs (dyspnea) with acute attacks that cause cough, wheezing sounds, and troubled labored breathing. Nevertheless, the classic diagnosis of asthma promulgated by the American Thoracic Society many years ago, as noted in Pesola, Dogra, & Coelho-D'Costa (2002) described asthma as "a disease characterized by an increased responsiveness of the trachea and bronchi to various stimuli and manifested by a widespread narrowing of the airways" that "changes in severity either spontaneously or as a result of therapy." But Pillai et al. (2006), described it as a complex disease involved in an intricate interplay between genetic and environmental factors, which underlies the overall phenotype of the disease.

An all embracing explanation is in the words of Swineford Jr. (1962), who described asthma as a common disorder steeped in antiquity, prevalent, but with no known true incidence. His portrayal of asthma is that of an extremely complex syndrome in which allergy is one of its many important facets. His explanation is that asthma is a form of lung failure in which wheezing is the only invariable distinguishing characteristic. He argued that asthma is not a disease, but a complex syndrome, which

may be mild or severe, acute or chronic, seasonal or perennial, of single or multiple etiologies, simple or complicated, symptomatic or asymptomatic. Supporting this notion of asthma is Van Bever, Desager, and Hagendorens (2002), where asthma was also described as a syndrome. These authors are convinced that childhood asthma is made up of different phenotypes and therefore suggested that childhood asthma should be regarded as a syndrome (the asthma syndrome). In consequence, they proposed a definition of different types of asthma, even though the definitions overlap and the various asthmatic phenotypes can occur in the same patient, depending on their age and season of the year, and described childhood asthma as constituting a spectrum of different conditions that are manifested by recurrent symptoms of bronchial obstruction, i.e. recurrent symptoms of wheezing and/or cough.

These definitions suggest that asthma as a disease is very complicated and will require an epidemiological explanation and identification of its risk factors before deciding which part environmental factors have to play. More important is the contribution of socio-demographic factors in the environment to asthma.

Epidemiology of Asthma

Pertinent to understanding the relationship between asthma and socio-demographic and environmental factors, is knowledge of its epidemiology, a discipline concerned with the distribution and determinants of health and diseases, morbidity, injuries, disability, and mortality in populations (Friis & Sellers, 2004). Conboy-Ellis (2006) description of the epidemiology of asthma shows that asthma does not just usually begin in childhood but can present at any age. It is known to be associated with atopy, the

genetically determined predisposition to produce large amounts of specific immunoglobulin E (IgE) antibodies against environmental substances such as pollens, molds, dander from animals, their emanations, and dust mite. In other words, atopy is instrumental to the epidemiology of asthma and other related diseases. According to the author, the atopic constitution occurs in up to one-half of the population in developed countries, and both atopy and asthma are becoming more prevalent in the developed world.

Epidemiological studies have regularly shown a strong association between atopy and asthma in both children and adults. Therefore, the odds ratio (OR) for asthmatic individuals being atopic varies between 2 and 7 (Ronchetti, Rennerova, Barreto, & Villa, 2007). The finding and argument of these authors is based on the generally accepted pathogenetic theory, which associates atopic sensitization (overproduction of specific IgE) to allergenic exposure in predisposed subjects, with the result that repeated exposure leads to the clinical symptoms of asthma. This confirms the contribution of atopy in the epidemiology of asthma even in subjects with negative allergen skin prick test (ASPT) responses. As such, a variable (high) proportion of asthma cases are considered ‘atopic diseases’ (caused by atopy). Supporting this view is Liao, Huang, Chiang, Wang, and Chen (2005), who also identified atopy as the major etiological factor in the epidemiology of asthma.

It is also important to note that the epidemiology of asthma has been extensively investigated in different populations, including children, adults and elderly subjects, during the last 20 years, with results showing a variable estimated prevalence (Ciprandi,

Vizzaccaro, Cirillo, Tosca, Passalacqua, & Canonica, 2001). Nevertheless, all the studies agreed on the increasing prevalence of the disease. The report of epidemiological surveys performed in occidental (western) countries suggest that the prevalence of asthma is between 6– 12% in children and 6–8% in adults, with the prevalence and severity of this disease continually increasing since 1960 (Ciprandi, Vizzaccaro, Cirillo, Tosca, Passalacqua, & Canonica, 2001).

Epidemiological studies have also shown that asthma is more prevalent in certain areas than others. For instance, Gregg (1986) reported a survey in 1946, which estimated that 46% of the study population had asthma. The high prevalence was attributed to inbreeding and the inclusion of several asthmatics among the original settlers. Gregg (1986) further reported results of surveys of other remote populations, such as Maldive Islands, where asthma was identified in 20% of children and adolescents, and Western Carolines, where the prevalence in children, aged less than 5 years, was estimated as 75%, exceeding the prevalence reported in western countries. Another example is a study of rural school children in Tanzania, where a current prevalence rate of 7-9% was reported, this being in marked contrast to the low prevalence previously reported in Gambia and Nigeria (Gregg, 1986).

The differences between populations of the developing countries in their prevalence rates of asthma are said to be much too large to be explained on methodological grounds. With these conflicting results, it is no longer possible to sustain the widely held belief that a high prevalence of asthma is incompatible with the environments or lifestyles of populations in the developing countries (Gregg, 1986). Of

importance also is the observations made in migrants from developing countries, where there is an undoubted tendency for their prevalence of asthma to rise after coming to live in Western countries. This was attributed to the existence of some 'Westernization' factor not only because it might be the key to a clearer understanding of the pathogenesis of asthma but also because it may have been responsible for a rise in its incidence in Western countries themselves. Hence, the anecdotal report that the prevalence and severity of asthma have increased in some Western countries since the Second World War (Gregg, 1986).

Prevalence studies, as reported by Springett in a 1971 annual general meeting also proved that asthma is more common in boys than girls, and hospital admission rates also are higher for boys than girls. In adult life up to age 65 years, admission rates are higher for women than men. In a study to determine whether the incidence of asthma has increased in Rochester, MN, Kamada (1994) found that the annual age and sex-adjusted incidence of definite and probable asthma rose from 183 per 100 000 in 1964 to 284 per 100 000 in 1983. With this finding, they concluded that a higher incidence and earlier onset of asthma occurs in males and the increase in overall incidence from 1964 to 1983 occurred only in children and adolescents. Springett, in the same1971 annual general meeting of the “British allergy society,” compared and contrasted the available indices of the occurrence of asthma in England and Wales in the past 10 years. According to him, the main feature has been a rise in mortality rates, especially of younger males, up to 1965-66, with subsequently a fall to the original levels. Hospital admission rates show a similar rise, which continued at least until 1967.

To provide a brief overview of the current and emerging national and international trends in the epidemiology of asthma, Castro, Malka-Rais, and Bellanti. (2005) presented the results of surveys and studies on the prevalence of asthma. According to a 2001 report by the National Health Interview Survey (NHIS), lifetime prevalence of asthma in the United States showed that a total of 31.3 million people (114/1000) had been diagnosed with asthma. Among these, were 22.2 million adults (109/1000) with a lifetime diagnosis of asthma compared with 9.2 million (126/1000) in children (subjects <17 years of age). Non-Hispanic African Americans were 4% more likely than non-Hispanic whites to have ever been diagnosed with asthma and 30% more likely than Hispanics. Women were 10% more likely than men to ever have been diagnosed with asthma. These authors also found that Prevalence rates for children and adults in countries around the world differ substantially. A six fold variation in the prevalence of current asthma was found among the countries surveyed (range, 2–1.9%), with a high (>7%) prevalence found in Australia, New Zealand, the United States, Ireland, and the United Kingdom in contrast to asthma prevalence rates of < 4% found in Iceland, parts of Spain, Germany, Italy, Algeria, and India. Based on the results of their study, which confirmed the diagnosis of asthma in 6,186 subjects, out of 12,544 conscripts referred to the Navy Hospital, Ciprandi, Vizzaccaro, Cirillo, Tosca, Passalacqua, & Canonica (2001) concluded that their findings confirm the results of previous surveys about the prevalence of asthma.

The definitions of asthma, which have been used as the criteria for recognizing and diagnosing asthma is considered as central to the epidemiology of asthma (Sears,

1997). This emanates from recent consensus statements, from national and international expert panels, which showed an addition to the past definitions of asthma. With this new consensus, asthma is now defined to include specific cellular functions, and describes a disorder characterized by variable airflow obstruction; symptoms of wheeze, cough, dyspnea, and chest tightness; reversibility to bronchodilators and corticosteroids; increased airway responsiveness to a variety of stimuli; and evidence of inflammation in which eosinophils, mast cells, and lymphocytes together with a multitude of cytokines have important roles (Sears, 1997). Supporting this statement is Tattersfield, Knox, Britton, and Hall (2002), who in explaining the epidemiology of asthma, described asthma as a disease diagnosed clinically on the basis of symptoms of wheeze, dyspnea, and cough, and by objective evidence of variable airflow obstruction. Their reason for this description is that many studies have shown lots of inconsistencies in the definition and diagnosis of asthma. Hence, the statement that asthma has no standard definition, and that attempts to define asthma have generally resulted in descriptive statements invoking notions of variable airflow obstruction over short periods of time, sometimes in association with markers of airway hyper-responsiveness and cellular pathology of the airway. These authors further explained that in developed countries, asthma is strongly but not exclusively associated with allergic sensitization to many environmental allergens.

In as much as incidences are highest in childhood, allergic asthma can present for the first time at any age making it more difficult to define. Asthma in childhood are said to remit during adolescence but can recur in adult life, while asthma presenting in adult

age persists throughout life and is a source of lung malfunction. In spite of the fact that there are still high incidences of asthma, death from asthma is now uncommon (Tattersfield, Knox, Britton, & Hall, 2002). With these definitions, it is important to note that in trying to grasp the epidemiology of asthma, one has to consider the many factors leading to its manifestation as a disease. Therefore, it is believed that based on the heterogeneity of the clinical forms of asthma, a single definition seems remote, because the definitions vary between children and adults, although genetic studies may help (Sears, 1997).

Etiology and Risk Factors for Asthma

Asthma, like many other chronic and prevalent diseases has been associated with many causes. Swineford Jr. (1962) traced the etiology to the biblical book of Exodus and the medical classics since the days of Homer, Herodotus, Hippocrates, Galen, Aretaeus, and Celsus, depicting the inherent nature of asthma in our society and the world at large. Eggleston et al. (2005) reported major issues related to the identification of asthma, asthma-related symptoms and end points, relevant exposures, biologic markers, and follow up requirements. According to these authors, the result of studies of asthmatic children and their homes that were conducted at seven children's centers showed that the definition of asthma and assessment of the disease severity proved to be complex and required a combination of questionnaires, pulmonary function tests and biologic samples for markers of immune response and disease activity. Their findings point to the fact that asthma has many triggers thereby substantiating the complexity of the disease. Some of these triggers include: exposure to substances that individuals are allergic to. For

instance, a cat allergic patient develops an asthma attack when entering a home that contains cats (Wray & McCann, 2003).

The incidence and prevalence of asthma are known to be greatest where there are poverty and resulting environmental risk factors such as smoking, air pollution, overcrowding, poorly vented heating, house dust, dust mites, presence of pets, psychosocial risk factors, and inadequate access to health care. All these can affect the development and exacerbation of asthma symptoms (McEwen, Johnson, Neatherlin, Millard, & Lawrence, 1998). Next are gastro esophageal reflux, obesity, and exposure to fumes or irritants such as tobacco smoke. Lung infections with germs called mycoplasma and Chlamydia have also been linked to asthma as well as to chronic infection of the sinuses that surround and empty into the nose, which is associated with asthma attacks in some people (Wray & McCann, 2003). A summary of recommendations from the Canadian asthma consensus guidelines, 2003 pointed out that inflammation and its resultant effects on airway structure are considered the main mechanisms leading to the development and persistence of asthma (Becker et al. 2005). An addition to the many risk factors for asthma is the findings that fewer material resources and low educational level were risk factors for asthma symptoms (Corvalán, Amigo, Bustos, & Rona, 2005).

Another factor that has been identified as contributing to the development of asthma is low – birth weight. A number of studies have found strong association between low birth weight and subsequent poor lung function, although not all have focused specifically on children or asthma and the mechanism underlying the association are not clearly understood (Nepomnyaschy & Reichman, 2006; Chan, Noble-Jameison, Elliman,

Bryan, Silverman,1989; Stern, Morgan, Wright, Guerra, & Martinez, 2007; McLeod et al., 1996; Hack, Klein, & Taylor, 1995; Stein, Kumaran, Fall, Shaheen, Osmond & Barker, 1997). According to Nepomnyaschy and Reichman (2006), low-birth weight infants who survive particularly those who are very low birth weight are said to be at high risk for respiratory disorders. Their research to assess whether the association between low birth weight and early childhood asthma can be explained by an extensive set of individual and neighborhood –level measures resulted in a strong association between low birth weight and asthma among 3- year old children who were born in large U.S cities.

Postma and Boezen (2004) conducted a study to explain the rationale for the Dutch hypothesis formulated in 1960, which states that various forms of airway obstruction such as asthma, chronic bronchitis, and emphysema should not be considered as separate diseases but rather as different expressions of one disease entity, a chronic nonspecific lung disease. Their proposition was that in this disease entity, both endogenous (host) and exogenous (environmental) factors play a role in its pathogenesis. The authors opined that the Dutch hypothesis is suggesting a classification of asthma, chronic bronchitis, and emphysema as one disease type because they share a number of defining characteristics. The endogenous factors identified in their hypothesis were age and sex while allergens, viral infections, and pollutants, such as smoking were considered as important exogenous factors.

Among the many factors identified as the reasons for the underlying high prevalence of asthma are genetic predisposition, a westernized lifestyle and high allergen

exposure especially to house dust mites and fungi (Jenkins 2003). Other risk factors include gender (boys have higher prevalence); family history of asthma; history of respiratory infections; small size at birth (<2500 g); food allergy; and sensitivity to other allergens (McEwen, Johnson, Neatherlin, Millard, & Lawrence, 1998). Additionally, Van Bever, Desager, and Hagendorens (2002) identified risk factors for the development of childhood asthma to include gender, atopic status, genetic and familial factors, respiratory infections, and outdoor and indoor pollution.

In summary, this aspect of the review points to the fact that asthma is a product of both inherited and environmental factors. The question that now remains to be answered is whether asthma is more of genetics or environment. The researcher believes that a review of both genetic and environmental risk factors will provide an insight to the following question:

Is Asthma Genetically or Environmentally Inclined?

In an attempt to explain the constant change in the diagnosis of asthma, the problem of asthma was classified under two headings: genetics and environment. Researchers have described it as a product of both genetic background and the environment (Pesola, Dogra, & Coelho-D'Costa, 2002) and a complex disease in which the interaction between both genetic and environmental factors play a fundamental role both in the pathogenesis and in the development of the disease (Holloway, Beghé, Holgate, & Holloway, 1999). These statements are the basis for the review of these risk factors under genetic and environmental factors.

Genetic risk factors. A thorough review of the literature on genetic risk factors for asthma shows that genetics has a role to play in the etiology and exacerbation of asthma. But the question here is, to what extent does genetics contribute to this problem? Asthma was characterized as a partially genetic illness because current molecular genetic data still cannot pinpoint an abnormal gene which is associated with asthma, but certain gene products are said to be clearly associated with the pathophysiology of asthma and so could be used as targets for a genetic therapy for this disease (Demoly, Mathieu, Curiel, Godard, Bousquet & Michel, 1997). Wray and McCann (2003) stated that no one asthma gene has been discovered despite the fact that the commonality of asthma in some families has led to the suspicion that asthma has genetic origins. Their explanation is that asthma tends to occur more often in families in which someone has allergic rhinitis (hay fever) or atopic dermatitis (eczema). But, these authors also argued that if a parent or brother or sister have asthma, a person is more likely to have early on-set of asthma, which means it develops in early childhood. This is just a few studies creating skepticism on the genetic impact of asthma.

On the other hand, Tattersfield, Knox, Britton, & Hall (2002) stated that even though there are findings providing clear evidence that environmental factors play a major part in the cause of asthma and allergy, family studies show that a strong component of asthma risk is genetically determined. These researchers opined that the reason for the apparent inconsistencies in the risk factors could be that at least in the developed world, exposure to the major environmental determinants of asthma is now relatively widespread and possibly ubiquitous, leaving genetic factors as the major

detectable determinants of individual disease risk. Although McEwen, Johnson, Neatherlin, Millard, and Lawrence (1998) wrote that the exact cause of asthma is unknown, they believe that an inherited tendency exists toward the development of asthma, typically including a family history of allergy. According to Orie and Sluiter's advancement of the Dutch hypothesis of the 1960s, a hereditary predisposition to develop allergy and airway hyper-responsiveness (AHR) was considered to be an important factor in disease susceptibility (Postma, & Boezen, 2004). These researchers considered the presence of AHR as an important determinant of the course of asthma. Their argument is that persistent AHR in early childhood is related to a progressive reduction in airway caliber and ongoing symptoms of asthma, suggesting abnormal growth of airways that results in reduced levels of forced expiratory volume (FEV1).Postma and Boezen (2004) reported a study that found that more severe AHR at 1 month after birth was associated with a lower level of lung function at the age of 6 years. The result of some longitudinal studies also showed that persistent AHR in early childhood may constitute a risk factor for the development of asthma. In an Australian cohort study, researchers found that the coexistence of AHR and wheeze during early childhood identifies individuals who are at increased risk of persistent wheezing and who might reasonably be described as having persistent asthma (Postma & Boezen, 2004). Through observations of different age groups (children, young adult, & middle-aged men), Postma and Boezen (2004) confirmed that AHR usually precedes the development of asthma. Jansen and colleagues in Postma and Boezen (2004) showed that adults, who have both AHR and markers of

allergy such as blood eosinophilia, are at an increased risk of developing asthma attacks and asthma-related symptoms such as wheeze.

In their statement, Nepomnyaschy and Reichman (2006) suggested that the uterine environment may play a role through nutritional intake and the development of the immune and respiratory systems. Their explanation is that neonatal respiratory support interventions may contribute to disturbances in subsequent pulmonary function.

Postma, Meijer and Koppelman (1998) addressed the issues in phenotyping of asthma with respect to the different clinical possibilities available in relation to designing an algorithm and also discussed the choice in phenotypes which they recommend should be based on current knowledge of risk factors for the development, progression, and severity of asthma as well as on current insights in the underlying inflammatory process of asthma. They opined that despite the complexity in defining asthma, there are a number of closely related phenotypic characteristics that can be used in investigating the genetics of asthma.

In response to the question of whether asthma is a heritable disease, Holloway et al.(1999) explained it is widely accepted that asthma is a heritable disease and a number of studies have shown an increased prevalence of asthma, and phenotypes associated with asthma, among the relatives of asthmatic subjects compared with non-asthmatic subjects. These authors validated their assertion with numerous twin studies, which have shown a significant increase in concordance among monozygotic twins compared with dizygotic twins, providing evidence for a genetic component. The findings of population-based twin studies were also reported to estimate the effects of genetic factors to be about 35–

70%, depending on the population and the design of the study. Holloway et al. (1999) also used a series of findings from researches to substantiate the genetic component of asthma. First is a study using a twin-family model, where Laitinen and coworkers reported:

> In families with asthma in successive generations, genetic factors alone explained as much as 87% of the development of asthma in offspring, and the incidence of the disease in twins with affected parents is fourfold compared with the incidence in twins without affected parents, suggesting that it is more likely that asthma is reoccurring in families due to shared genes rather than shared environmental risk factors.

Conboy-Ellis (2006) summarized genetic role in the etiology of asthma when he described asthma as a chronic inflammatory disease of the pulmonary airways in which a variety of cells and their products play a pathogenetic role. According to his description, the inflammation leads to an increase in airway reactivity (responsiveness) which, after diverse stimuli, results in recurrent episodes of wheezing, coughing, and shortness of breath, especially during the hours of sleep (nocturnal asthma), early morning, or with exercise. Additionally, there is a variable degree of widespread airflow obstruction, which usually resolves either spontaneously or with treatment.

Environmental risk factors. Despite the fact that there is a strong reason to believe that asthma is genetically related, a remarkable evidence show that most diseases that plague human life have its roots in our environment, making it harder to agree with the genetic proponents that nature has more role to play in the development of asthma than the environment This is evident in the statement that optimal management of

asthma requires adequate evaluation of the patient and his or her environment and confirms that the environment has a major role to play in the etiology and exacerbation of asthma (Becker et al.2005). In as much as family history of asthma and atopy is highly predictive of asthma in children, most researchers agree that environmental factors must play an important role because genetic variation alone cannot explain such a steep increase (from 3.7% of children in 1980 to 6.9% in 1995) in childhood asthma rates (Nepomnyaschy & Reichman, 2006). This is to say that, in order to explain the relationship between asthma, sociodemographic, and environmental factors, it is important to have a holistic examination of the environment in which an individual lives. According to Warren and Hernandez (2007), biomedical and public health research has typically sought to explain socioeconomic disparities in morbidity and mortality rates by looking closely at the downstream or proximate factors that link socioeconomic position to these outcomes, including biomedical, psychosocial, behavioral, and physiological mechanisms. These efforts have clearly led to a better understanding of the ways in which the effects of social, economic, behavioral, and psychological factors are mediated by biological processes and behaviors to create health inequalities.

Low socioeconomic status is said to be related to poor physical function and the development of physical disabilities in older adults, leading to the suggestion that several factors, including biomedical, behavioral, and psychosocial, may be important in explaining these SES differences in physical function. An example is a recent study, which shows that biomedical factors, including a wide range of diseases and biological risk factors, explained part of the SES differences in mobility limitation incidence in

older adults. Low SES was also found to relate to many adverse behavioral factors, such as smoking, excessive alcohol consumption, and decreasing physical activity, that in turn are related to poor functional outcomes (Koster et al. 2006). These findings led to the suggestion that psychosocial factors need to be considered as important in explaining SES differences in poor functional outcomes because people with low SES generally have fewer psychosocial resources than people with high SES. In other words, psychosocial factors, such as control beliefs and social support, are seen as links to ill health and poor functional outcomes.

Specifically, many cases of asthma have been proved to be as a result of human activities and changes in our environment. Tattersfield, Knox, Britton, and Hall (2002) are of the opinion that the emergence of asthma in the developing world probably reflects the strong effect of environmental exposures associated with economic development. One of their reasons for this assertion is that exposure to D pteronyssinus from living in warm and insulated housing and sleeping on soft pillows and mattresses is associated with more severe asthma symptoms in sensitized individuals.

School programs and activities such as animals in the classroom, arts and crafts, science laboratories, school maintenance, renovations, and field trips have been found to have the potential to expose students to irritants and allergens (McGhan, Reutter, Hessel, Melvin, &Wilson, 2002). A report of a survey of elementary schools in Texas by (75%), pets (10%), high humidity (49%), and mold odors (45%) (McGhan, Reutter, Hessel, Melvin, &Wilson, 2002). Many of these environmental exposures are modifiable and can

be controlled or eliminated in a school setting in order to keep the environment safe for the students thereby eliminating asthma (Pillai et al. 2006).

Another risk factor for asthma is exposure to ambient air pollutants. Lin, Liu, Le, and Hwang (2008) investigated the impact of chronic exposure to high ozone levels on childhood asthma admissions in New York State and found that asthma admissions were significantly associated with increased levels for all chronic exposure indicators, with a positive dose – response relationship (OR range 1.16 – 1.68). Their findings also showed a stronger association among younger children, low socio-demographic groups, and New York City residents as effect modifiers leading to the conclusion that chronic exposure to ambient ozone may increase the risk of asthma admissions among children. Secondly, younger children and those in low socioeconomic groups have a greater risk of asthma than do other children at the same ozone level. Nevertheless, Lin, Liu, Le, and Hwang (2008) explained that the acute health effects of ambient ozone have been examined in many geographic regions, and the findings showed inconsistency. But the potential adverse effects reported include decrements in lung function, airway inflammation, symptoms of asthma, increases in hospitalization for respiratory diseases, and excess mortality. Asthma symptoms are also said to exacerbate to varying degrees by exposure to particulates, sulphur dioxide, and nitrogen oxides (Tattersfield, Knox, Britton, & Hall, 2002).

Other factors that have been implicated in the case of asthma and allergy include maternal diet, smoking, and duration of breastfeeding, (Tattersfield, Knox, Britton, &Hall, 2002). Results from observational studies have shown that diets low in foods

providing vitamin E, vitamin C, magnesium, and ω-3 polyunsaturated fats, or high in sodium and ω-6 polyunsaturates, are associated with increased risk of asthma (Tattersfield, Knox, Britton, & Hall (2002).

Many of these environmental factors are either directly or indirectly related to socio-demographic factors and have been implicated in the development of asthma. Some of these environmental factors that will be reviewed in this study are smoking, ambient air pollution, substandard housing, and poverty.

Smoking. Smoking was defined as an environmental stimulus that interacts with host factors while cigarette smoke was seen as the most prominent factor determining the increased prevalence and mortality of chronic obstructive pulmonary disease (COPD) patients worldwide. This definition and assertion was based on the fact that the majority of COPD patients are cigarette smokers (Postma, & Boezen, 2004). According to Martinez, Cline, and Burrows (1992), the adverse effect of cigarette smoke on children's health is not new among researchers. Based on increasing evidence, parental smoking (especially maternal) may be associated with an increased respiratory symptoms in infants and toddlers. Research findings have also shown that there is reduced level of lung function in older children of smoking parents, and increased prevalence of airway hyper-responsiveness among other problems (Martinez, Cline, & Burrows, 1992). In a longitudinal study to determine the relationship of parental smoking at enrolment (before age 5) to both subsequent incidence of asthma and subsequent lung function in a random sample of children, Martinez, Cline, & Burrows (1992) found that the risk of developing asthma before age 12 was two and a half times higher in children whose mothers smoked

10 or more cigarettes per day. Data from this research suggest that children of lower socioeconomic status are at increased risk of developing asthma if their parents smoke 10 or more cigarettes per day.

In-utero exposure to cigarette smoke has also been associated with a negative effect on lung function, which persists for a long time. Of importance also are large, persistent deficits in lung function, which the authors said were documented in children who developed asthma (Postman, & Boezen, 2004). Substantiating this assertion is a series of research findings that established a positive association between asthma and cigarette smoking. First, among these reports are the findings of Boezen and colleagues who showed that FEV1 values at age 6 years were lower in children who had been exposed in utero to cigarette smoke. Secondly, based on figures from the United States studies, Postman, & Boezen (2004) predicted that of the 17 million children exposed currently to environmental tobacco smoke, 380,000 (2%) will experience asthma and/or wheeze as a result. The third is a review of the effects of parental smoking on the respiratory health of children, which indicated that there is much evidence of a positive association between maternal smoking and asthma development. Next, is a report of parental smoking, especially cigarette smoke exposure in utero and in the first few months of life, which appeared to be a risk factor for the development of asthma among other diseases.

As reported in Postma & Boezen (2004), Meijer and colleagues showed that in children who have already developed asthma, parental smoking is a risk factor for instability of the disease, which is reflected in a large circadian variation in peak

expiratory flow. Finally, parental smoking was reported as having had clinically significant effects on the FEV1/FVC ratio among adolescents with wheeze and asthma in a longitudinal study (Postma & Boezen, 2004). In summary, it is believed that maternal smoking increases the likelihood of developing asthma at a young age (Wray & McCann, 2003).

In order to explain the relationship between asthma and environmental tobacco smoke, Eisner (2002) reported the findings of Larsson and colleagues, 2001, who conducted a research to examine the relationship between childhood environmental smoke exposure and the prevalence of self-reported asthma in adulthood. According to the authors, more than forty epidemiologic studies, and extensive data support a causal association between environmental tobacco smoke (ETS) exposure and induction of asthma in children. It is on the basis of the epidemiologic literature and some strong biologic plausibility that Eisner (2002) concluded that ETS exposure may be instrumental to adult on-set of asthma.

Ambient air pollution. An individual is a product of his/her own surrounding. Therefore, any negative effect on the surrounding will have a detrimental effect on his/her health. Ambient air pollution has been linked with a broad range of health effects, including mortality and morbidity from heart and lung disease, impaired lung function, and lung cancer (Brunekreef & Holgate 2002). Studies show that air pollution is more likely to cause respiratory and cardiovascular diseases, as well as premature deaths, among people in lower socioeconomic groups (Morello-Frosch, 2009). According to this author, it is estimated that 1.5 billion people currently live in polluted urban areas, and

65% of the world's population is projected to live in cities by 2025. Moreover, more than 40% of the world's children are estimated to live in polluted cities of the developing world, with majority of this 1.5 billion people coming from poor socioeconomic status, which has been identified as an important determinant of health (Morello-Frosch, 2009). The findings by O'Neill, Jerrett, and Kawachi, (2003) showed that air pollution exposure is known to vary according to socioeconomic circumstances with the result that people in lower socioeconomic position (SEP) may receive higher exposure to air pollution. Secondly, since people from lower SEP already experience compromised health status due to material deprivation and psychosocial stress, they may be more susceptible to the health effects of air pollution. Additionally, with the combination of greater exposure and susceptibility, these groups are likely to suffer greater health effects from air pollution exposure (O'Neill, Jerrett, & Kawachi, 2003). Due to the importance of SEP as a determinant of health, and since air pollution exposure can vary according to socioeconomic circumstances, Bobak & Leon, 1999 ; and Dockery et al. 1993 included SEP as a potential confounder and an effect modifier.

Researchers have established that ambient nitrogen dioxide (NO2), particulate matter (PM10), ozone (O3), and sulfur dioxide (SO2) adversely affect asthma (Qian et al, 2009; Patel et al. 2009). Of particular importance are the ambient levels of particulate matter which epidemiologic studies have greatly associated with the exacerbations of asthma disease, lung function decrements, and greater use of medical services for asthma patients (Patel et al. 2009). Among these particulate matters are diesel exhaust particles, which are a dominant source of atmospheric elemental carbon (EC).

Traffic is also considered an important source of ambient metals from tailpipe emissions, brake and tire abrasion, and resuspended roadway dust. Specifically, in New York City (NYC), researchers have found that residual oil combustion for heating contributes to ambient nickel (Ni) and vanadium (V) concentrations that exceed levels in most other cities in the United States (Patel, et al. 2009). In consequence, studies have demonstrated that communities with higher EC concentrations have higher prevalence of asthma and chronic respiratory symptoms. In a study to characterize the differential relationships between exposure to ambient particulate matter and its specific components, including metals, EC, and respiratory symptoms in a cohort of very young children living in high-density NYC neighborhoods, Patel et al. (2009) found that Nickel and Vanadium were associated significantly with wheeze in this cohort during the first 24 months of life after adjusting for sex, ethnicity, ETS, seasonal trends, and co-pollutants. EC was associated significantly with cough only during the cold/flu season. Zhengmin et al. (2009) demonstrated that air pollution is associated with morning peak expiratory flow (PEF) in patients with moderate asthma on well-defined asthma medication regimens. In another study to identify the reason for the prevalence of asthma in India, it was found that about half to one-third of the cases of asthma have been associated with ambient air pollution. This ambient air pollution has resulted in exposure to polycyclic aromatic hydrocarbons (PAH), which are also associated with asthma (Suresh, Shally, Mahdi, Patel, Singh, & Rita, 2009). PAH are described as a group of small organic compounds of three to five benzene rings that are formed during the incomplete combustion of coal, oil,

gas wood garbage, or other substances, such as tobacco and have been linked to asthma due to these components.

Substandard housing. Housing is regarded as an important determinant of health. Findings across the country show that more than 5 million families and 4million children are living in substandard housing that they can barely afford despite its wretched state (Bashir, 2002**)**. The recognition of the relationship between housing condition and health by public health practitioners in the early 1800s, in the United States and Europe led to the rise of the sanitary reform movement (Corvalán, Amigo, Bustos, & Rona, 2005). These authors also reported Engels' study of the working class in England, which presented ample proof that the dwellings of the workers who live in the slums, combined with other adverse factors, give rise to many illnesses. In Engels' interpretation, a house that lacks cleanliness, convenience, and consequently no comfort is only suitable for inhuman, degraded beings that are reduced morally and physically to bestiality. Bashir (2002) described low-income and inner-city homes as one where asthma triggers like mold, cockroaches and cockroach dust, mice and rats and their droppings, dust mites, carbon monoxide, and environmental tobacco smoke are all more prevalent. Once again, the most vulnerable find themselves at greatest risk of harm.

According to the department of work and pension (DWP) policy, acceptable housing conditions is defined as "homes that are warm and weatherproof with reasonably modern facilities"(The environmental impact on children of poor housing, 2007).When a house is infested with cockroaches, mice and mold, the housing condition is said to be poor. According to Krieger and Higgins (2002), poor housing conditions are associated

with a wide range of health conditions, including respiratory infections, *asthma*, lead poisoning, injuries, and mental health. Their report indicated that housing quality is an important determinant of morbidity from infectious diseases, chronic illnesses, injuries, poor nutrition, and mental disorders. Pathologist Rudolf Virchow, in the 19TH century advised city leaders that poorly maintained crowded *housing* was associated with higher rates of infectious disease transmission (Corvalán, Amigo, Bustos, & Rona, 2005).

Substandard housing features such as lack of safe drinking water, absence of hot water for washing, ineffective waste disposal, intrusion by disease vectors (e.g., insects and rats) and inadequate food storage, have long been identified as contributing to the spread of infectious diseases. In other words, a person's physical environment affects their health and well-being, which is especially the case for young children, who can spend 90% of their time in the home. Other groups of children are also vulnerable to environmental conditions within the home, especially children with asthma or related conditions, and small, immature or pre-term infants (The environmental impact on children of poor housing, 2007).

According to Krieger and Higgins (2002), reports have shown that each year in the United States, 13.5 million nonfatal injuries occur in and around the home, 2900 people die in house fires, and 2 million people make emergency room visits for *asthma.* One million young children in the United States are also reported to have blood lead levels high enough to adversely affect their intelligence, behavior, and development. Two million Americans occupy homes with severe physical problems, and an additional 4.8 million live in homes with moderate problems.

Nepomnyaschy and Reichman (2006) reported that a growing body of research has shown a strong association between housing characteristics and child health. This is evident in their finding that housing characteristics was a strong and significant independent predictor of asthma leading to the suggestion that high rates of renter-occupied housing units may reflect residential instability or poorly maintained housing, both of which are associated with poor health outcomes, including asthma. According to the report, the associations between both of the housing measures (Rates of renter-occupied housing and vacancies at the census tract-level) and asthma were large, although the association between the housing vacancy rate and asthma was of borderline statistical significance. A 10 percentage point increase in the proportion of vacant houses in the census tract increased by 20% the likelihood of being diagnosed with asthma (OR=1.02; P= .096).

A United States study that used an objective measure of housing quality, which included heating, wall and ceiling surfaces, and the condition of structures such as stairs, found that there was an association between adverse housing conditions and the poor psychological health of children aged 8-11 years. These children demonstrated less ability to persist with tasks, showing that these children's feelings of helplessness is a response to chronic exposure to aversive housing conditions that is beyond their control (The environmental impact on children of poor housing, 2007). Of particular importance in this review are those housing conditions that contribute to the exacerbation and/or development of asthma namely: overcrowding, poor ventilation, damp, cold and moldy

housing conditions, pest infestations, exposure to toxic substances/endotoxins, and old, dirty carpeting.

Overcrowding is one of the poor housing conditions that have been linked to respiratory problems in spite of the fact that there have been mixed results on studies of overcrowding and how it contributes to asthma. Some studies have found a lesser association between overcrowding and asthma symptoms, atopy, and BHR (Corvalán, Amigo, Bustos, & Rona, 2005; Singh, Sobti, Arora, &.Soni, 2002; Da Costa, Victora, Menezes, & Barros, 2003). For instance, Corvalán, Amigo, Bustos, & Rona (2005) found that greater overcrowding appeared to protect against wheezing with atopy (P = .02), atopy (P = .002), and BHR (P = .03). These authors also reported a Brazilian study of children, which also showed an association of asthma symptoms with low overcrowding and high SES. According to these authors, when objective definitions of asthma were used, overcrowding emerged as consistently associated with less asthma symptoms with atopy, less atopy, and less BHR. The result of a study by Singh, Sobti, Arora, and Soni, (2002) also showed no significant association of asthma with overcrowding. This observation according to the author is in accordance with previous studies (Gergen et al. Clifford et al. Schenker et al. Chabra et al.) on asthma. On the other hand, other researchers have found crowding to be associated with transmission of tuberculosis and respiratory infections (Krieger & Higgins, 2002). Their example is the lack of housing and the overcrowding found in temporary housing for the homeless, which has been found to contribute to morbidity from respiratory infections and activation of tuberculosis. Another example is in a study to find the association between tuberculosis

and overcrowding, Horna-Campos, Sánchez-Pérez, Sánchez, Bedoya, & Martín, (2007) analyzed the relationship between the use of minibuses and pulmonary TB in Lima Peru. The result showed that commuting in minibuses (which is usually overcrowded) was a risk factor for pulmonary TB. Similarly, in a clinic-based case-control study, Hill, Jackson-Sillah, Donkor, Otu, Adegbola, Lienhardt (2006) identified overcrowding and a history of household exposure to a known TB case as key risk factors for tuberculosis in The Gambia. Overcrowding has also been found by other studies to have an impact on the psychological health of very young children. Many researchers have found that overcrowding is associated with infection in the lower respiratory tract in pre-term infants. (Pandey, Smith, Boleij, &Wafula, 1989; Weisman, 2003; Cunney, Bialachowski, Thornley, Smaill, & Pennie, 2000).

Poor ventilation is another housing condition that cannot be overlooked. Residential ventilation influences a wide array of indoor environmental exposures, which suggests that poor ventilation can lead to occupant discomfort, accumulation of indoor air pollutants and infectious disease agents which can impact various health outcomes including communicable respiratory illnesses, sick building syndrome symptoms, and task performance and productivity (Adamkiewicz, Levy, & Spengler, 2005). Poor ventilation may increase exposure to smoke (Krieger & Higgins (2002). These authors also linked indoor exposure to nitrogen dioxide (from inadequately vented or poorly functioning combustion appliances) with *asthma* symptoms. According to the reports in 1999, *Overcrowding* and inadequate ventilation were also reported to increase interior moisture.

Damp, cold, and/or moldy housing are another example of poor housing conditions that have been associated with increased risk of chronic illnesses. To be specific, they are known to be associated with *asthma* and other chronic respiratory symptoms, even after potentially confounding factors such as income, social class, smoking, crowding, and unemployment are controlled for. Dampness usually means the presence of water damage, damp stains, visible mold and condensation (Science research briefing, 2005). According to this article, some studies and reviews from the UK and elsewhere have reported an association between dampness, moisture and mould and the prevalence of respiratory symptoms among children of all ages (Bush, Portnoy, Saxon, Terr, & Wood, 1989; Cuijpers, Swaen, Wessling, Sturmans, 1995; Nicolai, Illi, von Mutius, 1998). In these reports, water intrusion was identified as a major contributor to problems with dampness. For example, Peat, Dickerson, and Li (1998) found that children in homes with damp and/or mold are two and a half times more likely to have coughs or wheezing than children in dry homes. Another U.K study found that visible mold was significantly associated with an increased risk of wheezing illness among children aged 9-11 years (Venn, Cooper, Antoniak, Laughlin, Britton, & Lewis, 2003). This significant association between visible mold and damp spots inside the house has also been reported by other researchers. For instance, a large Swedish study of households with children aged 1-6 years, a Finnish study of preschool and school-aged children, and a wider European study of older children in which the prevalence of asthma and chronic cough was higher in "damp" compared to "dry" homes (Bornehag, Sundell, Hagerhed-Engman, Sigsggard, Janson, Aberg, et al. 2005; Koskinen, Husman, Meklin,

1999; Andriessen, Brunekreef, Roemer, 1998). According to reports, in 1999, eleven million occupied homes in America had interior leaks and 14 million had exterior leaks. Damp houses are also said to provide a nurturing environment for mites, roaches, respiratory viruses, and molds, all of which play a role in respiratory disease pathogenesis (Bradley, 2009).

Most epidemiological case control and cross sectional studies have established associations between damp and moldy housing, respiratory problems and other related disease such as recurrent headaches, fever, nausea and vomiting, and sore throats (Bush, Portnoy, Saxon, Terr, & Wood, 1989;Verhoeff, van Strien,van Wijnen, &Brunekreef,1995; Koskinen, Husman, Meklin, & Nevalainen, 1999; Krieger & Higgins, 2002; Fung, & Hughson, 2003; Fisk, Lei-Gomez, Mendell, 2007). Evidence from a review of five case control studies, 17 cross-sectional surveys, and 7 case reports suggests that excessive moisture promotes mold growth and is associated with an increased prevalence of symptoms due to irritation, allergy, and infection (Fung, & Hughson, 2003). An example of the far reaching effect of mold is a report of an incident by the coalition members from “Make the road New York,” in May 2009. According to this report, Louisa Mejia, a Bushwick resident, who was recently hospitalized for several days in Woodhull hospital for an asthma attack, and whose son, daughter and granddaughter all have severe asthma reported that their bathroom is full of mold, and the landlord refused to fix the leak that cause it (Bradley, 2009).

Pest infestations have also been associated with asthma, and as such provide another linkage between substandard housing and chronic illness. During Louisa’s report,

she mentioned that their house is also infested with roach and mice, suggesting that these pests also contributed to the asthmatic condition of her family (Bradley, 2009). The report from Krieger and Higgins (2002) suggested that cockroaches can cause allergic sensitization and have emerged as an important asthma trigger in inner-city neighborhoods. Therefore, children with asthma who are sensitized and exposed to cockroaches are at elevated risk for hospitalization.

In a study to investigate the levels of mite allergen in dust from bedrooms, living rooms, kitchens, and bathrooms from 130 homes of asthmatic children in three climatic zones of Sweden, Munir et al. (2007) confirmed that high absolute indoor humidity (AIH), relative humidity (RH), and poor ventilation increase the risk of mite infestation in homes, which consequently resulted to asthma in mite-sensitized children. In this study, mite allergen was detected in 62% of the homes and mite allergen levels were higher in homes with dampness problems, in homes with a smoker, and in homes without a basement. Homes with high absolute humidity (≥7 g/kg) or relative humidity (≥45%) and poor ventilation (≤0.5 ach) also contained higher levels of mite allergens than homes with lower humidity and better ventilation.

Mouse allergen has also been identified to act as a clinically important cause of allergy and *asthma* morbidity. According to Phipatanakul et al.(2004) studies have demonstrated an extremely high prevalence of mouse allergen in inner-city homes of children with asthma (Stelmach,Jerzynska, Stelmach, Majak, Chew, &Kuna, 2002; Phipatanakul, Eggleston, Wright, &Wood, 2000). Structural defects permit entry of cockroaches and rodents; leaking pipes and other sources of water provide them with

water to drink. Inadequate food storage and disposal facilities provide them with opportunities for obtaining food. Dead spaces in walls harbor pests and permit circulation among apartments in multiunit dwellings (Krieger & Higgins, 2002). In addition, research from the United States has found that indoor allergens, especially dust mites, can exacerbate or cause asthma (Institute of Medicine, 2000).

Exposure to toxic substances found in homes can result in chronic health problems. Inside many of the deteriorating houses and apartments, inhabited by low income families, are hosts of harmful biological and chemical contaminants that contribute to the growing asthma epidemic (Bashir, 2002**).** For instance, passive exposure to indoor tobacco smoke has been associated with respiratory disease; exposure to volatile organic compounds (emitted by particle board and floor coverings) may be associated with *asthma* and sick building syndrome; moderately elevated levels of carbon monoxide (from poorly functioning heating systems) are known to cause headache, whereas higher levels result in acute intoxication; Polyvinyl chloride flooring and textile wall materials have been associated with bronchial obstruction during the first 2 years of life (Krieger & Higgins, 2002). According to the report by the coalition members from "Make the road New York" Teanna Price, a Bronx resident, and a 25 year old mother of a four month old son, reported that her son was diagnosed with bronchiolitis and his doctor thinks her apartment conditions, like peeling paint, might be contributing to the problem (Bradley, 2009).

Old, dirty carpeting, such as often found in substandard housing, is an important reservoir for dust, allergens, and toxic chemicals. Exposure to these agents can result in

allergic, respiratory, neurological, and hematologic illnesses. Old carpeting can also contain pesticide residues and other compounds such as polycyclic aromatic hydrocarbons (Krieger & Higgins, 2002).

Thorne, Cohn, Mav, Arbes Jr., Zeldin (2009) wrote about endotoxin exposures in households. Endotoxin is described as an ampiphilic outer-cell wall component of gram-negative bacteria that is a potent inflammatory agent and asthma trigger. As a microorganism-associated molecular pattern (MAMP), endotoxin is recognized by the innate immune system through an evolutionarily conserved pathway. Because of the importance of limiting endotoxin exposures, particularly among asthmatic individuals, several studies have evaluated the predictors of endotoxin concentration in house dust or endotoxin loading of surfaces in homes (Bischof et al. 2002; Gehring ET al.2004; Park et al. 2001; Wickens et al. 2003).

As a result of the devastating effects of poor housing conditions on asthmatics, some coalition groups have called for the passage of the Asthma-Free Housing Act, Intro 750, which would strengthen the City's code enforcement system to reduce indoor allergens, like cockroaches, mold and mice, in asthmatic tenants' residences. In a press advisory in New York on Wednesday, May 20, 2009, the Coalition for Asthma-Free Homes, a multi-borough coalition of health, housing and environmental advocates, was joined by Public Advocate Betsy Gotbaum and Councilmember Rosie Mendez to release a report documenting how asthma triggers in New Yorkers' homes - combined with a lack of enforceable guidelines to curb them - are contributing greatly to the city's high asthma rates. Supporting their release are several studies linking asthma with poor

housing conditions. In their individual statements, councilmember Rosie Mendez referred asthma as a dangerous threat to children especially those in poor communities while public advocate Betsy Gotbaum stated that poor housing condition is a public health issue, which means that no one with asthma, a group that includes a large number of New York City children - should have to live in an apartment with health hazards like pests and mold (Bradley, 2009).

Since results from researches have indicated that poor housing condition is instrumental to the exacerbation of many asthma cases, addressing housing issues offers public health practitioners an opportunity to address an important social determinant of health that has been a long standing issue among public health practitioners.

Poverty. Poverty is an incapacitating agent and therefore, has been linked to many health conditions. Poverty is instrumental to most environmental factors, which means that without poverty, other factors may not exist. Researchers have found that individuals in poor rural areas, as well as in low-income urban communities suffer disproportionately from childhood *asthma*, in part because of inadequate housing, deficient medical care and proximity to multiple sources of air pollution (Morello-Frosch (2009).

People living in economically and racially segregated communities face excessive stressors, including poverty, substandard housing, malnutrition and lack of health care. These social stressors can impair an individual's ability to fend off illnesses that pollution creates or aggravates because environmental burdens, such as pollution from power plants, freeway corridors and chemical manufacturing plants, are also known to be

concentrated in the same neighborhoods where there are stressors, thereby causing a double jeopardy as Morello-Frosch (2009) termed it. Statistics from the WHO (2005) revealed that 80% of deaths due to chronic diseases occurred in low and middle income countries and in the next decade, these will increase by 17%, suggesting that the burden of illnesses will erode the health expenditure of poor individuals, families, communities and the developing nations in which they reside (Bourne, 2009).

The problem of asthma and disadvantaged communities cannot be overemphasized. Among the many studies that have associated asthma in children to poverty is Clark, Shah, Dodge, Thomas, Andridge, Little, (2010). According to these authors, urban minority children are faced with the problem of both diagnosed and undiagnosed asthma. In 2002, 12% of children under the age of 18 years had a diagnosis of asthma. Although annual rates of asthma mortality have declined since 1999 in the United States, asthma deaths continue to occur at unacceptably high rates, particularly among African-Americans residing in urban areas. Risk factors for potentially fatal childhood asthma (PFCA) are less well established, but poverty, race/ethnicity, urban area of residence, among other factors have been linked with an increased risk of fatal asthma in children (Vogel, Katz, Lopez, & Lang 2008). Nepomnyaschy & Reichman (2006) Stated that the observed association between low birth weight and childhood asthma are also thought to reflect at least in part, poverty – related factors such as inner-city residence and poor housing quality which has been associated with both conditions.

Socioeconomic Status and the Development of Asthma

Socioeconomic status is an aggregate concept that takes into account material and social resources and the individual's ranking in the social hierarchy (Corvalán, Amigo, Bustos, & Rona, 2005) or a group's living circumstances (Mckenzie, Pinger, & Kotecki, 2005, p.294).The findings of numerous epidemiologic studies show that there is an association between socioeconomic position (SEP) and health, with gradients observed for outcomes including mortality, infectious and chronic diseases, and psychiatric disorders (Haan et al. 1987; Krieger et al. 1997; Marmot, 2001). Nevertheless, the relationship between SEP and poor health is not confined to poor people alone. Although it is clear that the highest risks of premature mortality and morbidity are concentrated among the poor, studies have also repeatedly demonstrated the existence of a graded relationship between low SEP (whether measured by income or educational attainment) and worse health outcomes (Lynch et al. 1996; Davey Smith et al. 1996; Sorlie et al. 1995; Link & Phelan, 1995; Marmot et al. 1987.) According to Kawachi & Berkman (2003), at each step of the socioeconomic hierarchy, individuals tend to have better health compared with those immediately below them, a gradient that extends well into the range of incomes that can be termed "middle class." Secondly, SEP can be conceptualized and measured at both the individual level and the area level (e.g., neighborhoods). Evidence suggests that each level exerts an independent influence on an individual's chances of health. In other words, an individual with the same level of income or educational attainment could experience different chances of health depending upon the SEP of his or her neighbors. Moreover, area-level SEP may pattern an individual's access to

opportunities for good health. Examples of such patterning include differential access to the service environment (e.g., health clinics, supermarkets, sanitation or waste disposal), the physical environment (e.g., traffic burden, crowding, clean water for drinking or bathing), and the social environment (crime rate, social cohesion, and vandalized public areas) (Kawachi and Berkman, 2003).

Another important factor in the conceptualization and measurement of the effects of SEP on health is the dimension of time. According to Davey Smith et al. (2001), SEP rarely remains static across the life course, and the measurement of income, for example, at a single point in time is unlikely to capture the dynamic as well as the cumulative effects of SEP on health. In consequence, childhood socioeconomic circumstances are now believed to exert an effect on adult health, independently of SEP attained in adulthood. McDonough et al. (1997) found that income dynamics (e.g., downward social mobility, or accumulated spells of poverty) have been shown to predict mortality and other health outcomes.

Many public health researchers have considered socioeconomic status as the most influential single contributor to premature morbidity and mortality. The result of these studies have shown that better health is associated with more years of education and having more income, a more prestigious job and living in superior neighborhoods. Similarly, elevated levels of morbidity, disability, and mortality are associated with less education and lower income, poverty, unemployment and poor housing (Mckenzie, Pinger, & Kotecki, 2005). The historic association between socioeconomic status and diseases is explained in Warren and Hernandez (2007) statement which emphasized that

despite the fact that there have been dramatic long-term improvements in public health, changes in the types of diseases that are most prevalent, and changes in health risk factors, the magnitude of socioeconomic disparities in morbidity and mortality rates has persisted for decades or longer. This statement was the basis of Link and Phelan (1996) theory which was oriented to account for enduring associations between socio-demographic factors and disease.

In as much as studies have shown inconsistent results in the association between socioeconomic status and asthma, recent national surveys in the United States and Europe has reported that low SES is a major risk factor for asthma prevalence (Corvalán, Amigo, Bustos, & Rona, 2005). A good number of researchers have also indicated the far reaching effect of poor socioeconomic status (SES) (Hosseinpoor et al. 2005; Koster, et al. 2006). Evidence worldwide suggests that children in households with a lower socioeconomic status have higher mortality rates. This led to the suggestion that socioeconomic status can directly or indirectly influence health conditions including asthma in children (Hosseinpoor et al. 2005).

SES is seen as a multidimensional concept and as such, no single measure can fully account for a person's SES. The advice is that we use a multiple SES indicators in order to understand its possible effects on health (Corvalán, Amigo, Bustos, & Rona, 2005). But, in recent years, some researchers has moved toward contextualizing the downstream or proximate mechanisms within the framework of upstream or macro-social factors, such as education, occupation, income, and other environmental factors. The result is a growing interest in conceptualizing SES as a "basic cause" (Lieberson 1985) of

morbidity and mortality and a reassessment of the long-term efficacy of exclusively focusing on the proximate mechanisms that link SES to morbidity and mortality (Warren & Hernandez, 2007).

Some of the single socioeconomic status that has been used in the study of asthma is education, occupation, income, or neighborhood characteristics (Corvalán, Amigo, Bustos, & Rona, 2005). In their study, Corvalán, Amigo, Bustos, and Rona (2005) found that indicators of low SES such as fewer belongings, less education, and not having a car were related to asthma symptoms. In the study of the association between socioeconomic status (SES) and asthma symptoms, severity of asthma, atopy, and bronchial hyper-responsiveness (BHR) to methacholine, Corvalán, Amigo, Bustos, & Rona (2005) used 1232 men and women born between 1974 and 1978 in a semi-rural area of Chile and a standardized questionnaire to assess asthma symptoms. Their findings show that asthma symptoms were more common among poor people. Having an education and owning a car were found to be deterring factors for asthma. According to the report, the level of correlation between SES variables ranged, with few exceptions, from 0.1 to 0.4. The correlation between parents' full-time education was 0.4, whereas the correlation of the participant's education with each of the parents was about 0.28. Those possessing fewer household belongings were more likely to have asthma symptoms (wheezing, $P<.0.5$, or wheezing and another asthma symptom, $P<.001$). Those who did not own a car and were less educated were more likely to report wheezing and another asthma symptom ($P<.05$). But these authors suggested that the choice of SES indicators could partially account for reported risk factor inconsistencies.

A prospective study was conducted to examine the association between the frequency of use of antibiotics in the first year of life and the occurrence of asthma, allergic rhinitis, and eczema at 5 years, using 498 infants who had a history of allergy or asthma in at least one parent. Though no significant association was found between the use of oral antibiotics in the first year of life and asthma, allergic rhinitis, or eczema at age 5 years, transient wheezing was significantly associated with low household income (Celedon, Litonjua, Ryan, Weiss, Gold, & Leickly, 2003).

In order to explain the relationship between SES and diseases, Warren & Hernandez (2007) stated, “The reason SES has been so consistently associated with disease is that it embodies resources like knowledge, money, power, and prestige that can be used in different ways in different situations to avoid risks for disease and death.” People who are relatively better off use their advantage to avoid risks and to adopt protective strategies that enhance health and well-being no matter what the risk and protective factors happen to be at a given point in time.

There is a growing body of evidence implicating socioeconomic status as a risk factor for asthma in adults and that socioeconomic factors may increase the risk of the disease in many ways. The argument here is that exposure to harmful agents may be related to occupational, residential and lifestyle factors, which may depend on social class (Li, Sundquist, & Sundquist, 2008). In their study, Li, Sundquist, and Sundquist (2008) investigated the association between socioeconomic status (education), occupation and hospitalization for asthma among men and women >30 years of age and found that socioeconomic status (education) and occupation carried significantly increased or

decreased risks of hospitalization for asthma. According to them, men and women with a high educational level had a slightly lower risk of hospitalization for asthma (CI= 0.57 for men and 0.59 for women), whereas those with lower educational levels (waiters, chimney sweeps, bricklayers, welders, farmers, packers, loaders, etc.), all with the same occupational titles in two consecutive censuses, had substantially higher risks of hospitalization for asthma than the reference group (95% CI = 1.01 for men and 1.03 for women).

Indicators of socioeconomic status. In a general description of socioeconomic status, Duncan, Daly, McDonough, Williams (2002) explained that indicators of SES are meant to provide information about an individual's access to social and economic resources. As such, they are markers of social relationships and command over resources and skills that vary over time. Link, Phelan, Miech, and Westin (2008) considered SES as instrumental to healthy lifestyle as well as the development of diseases. According to them, SES affects the distribution of stress, influences the development of healthy lifestyles or provides resources that allow people to avoid risks and adopt protective strategies. Duncan, Daly, McDonough, Williams (2002) identified education, occupation, household income, and wealth as some of the indicators of SES, with education and occupation as the most frequently used indicators. According to them, numerous indicators of SES, including occupation, education, and household income have been shown to affect health outcome.

As noted in Phelan & Link (2005), there is a strong, well-established, and very robust association linking both morbidity and mortality to educational attainment,

occupational standing, and income. According to Fat & Drugan (2007), data from European countries have shown that chances of premature death were found to be higher among people with a lower educational level, a lower income or a lower social position. In confirmation is Allin, Masseria, & Mossialos (2009) statement that income and education are indeed considered determinants of ill health and hence of use in health care services. The fact that various SES indicators may capture different aspects of overall health risk suggests that a systematic examination of the explanatory power of a variety of SES indicators is required before an optimal set of indicators can be recommended. For the present study, the following indicators of socioeconomic status have been chosen for review.

Education. Level of education is considered an important indicator of health status because it appears to lead to better health by increasing knowledge about health and promoting behaviors to maintain health and participate in prevention activities (Mckenzie, Pinger, & Kotecki, 2005, p.295). Corvalán, Amigo, Bustos, and Rona (2005) described education as a proxy measurement of people's potential in the marketplace, which they measured as years of full-time education. The result of their study showed that those who did not own a car and were less educated were more likely to report wheezing and another asthma symptom ($p < .05$). Higher education and not being registered with social services ($p = .01$ and $p = .03$, respectively) were risk factors for atopy. Lack of a private car and less education were also risk factors for BHR ($p = .02$ and $p = .003$, respectively)

In a study by Duncan, Daly, McDonough, Williams (2002), education was described as an important determinant of individuals' work and economic circumstances, which are themselves linked to health through specific work conditions and levels of consumption. Education may also be associated with health through its connection to health behaviors. In their explanation, these authors stated that the higher one's level of education, the more likely one is to engage in a range of health-enhancing self-maintenance activities. Years of completed schooling are reported with reasonable ease and reliability and are a meaningful indicator of SES for virtually all adults. These authors regarded education as a marker of early life circumstances, with no reverse-causation problems resulting from linking education with health outcomes at older ages.

Laurent, Pedrono, Segala, Filleul, et al. (2008) investigated and tested the short term relations between air pollution estimated at the level of small sub-city geographic areas, asthma attacks and the influence of socioeconomic deprivation, also measured at this level, on these relations, using 450,000 inhabitants of Strasburg located in the Bas-Rhin district of France. Among the data used for their analysis are two studies focused on socioeconomic indicators measured by small areas. In these studies, the researcher observed that carbon monoxide and ozone had a greater effect on asthma hospitalizations of Californian children aged 3–18 years in zip codes characterized by lower educational attainment. As reported inPhelan & Link (2005), evidence from researches show that for both men and women, adjusted mortality rates are much higher for those with less than 12 years of education compared with those with 13 or more years (Males =. 745.8;

females = 407.1 as opposed to 275.3 for males and 171.5 for females with more than 13 years of education).

According to Sobel et al. (2009), recent studies have found limited 'health literacy' (one's capacity to obtain, process, and understand health information in order to make appropriate decisions) to be associated with poorer patient understanding of and inadequate self-care for chronic diseases, including asthma (Gazmararian, Williams, Baker & Peel, 2003; Williams, Baker, Honig, Lee & Nowlan, 1998; Wolf, Davis, Arozullah, Penn, Arnold, Sugar et al., 2005; Davis, Williams, Marin, Parker & Glass, 2002). Recent evidence suggests that certain noted racial disparities in health outcomes are mediated by patients' literacy abilities. Sobel, et al. (2009), reported that in the above mentioned studies and other health literacy studies, African American race has been linked to less education and inadequate literacy skills. Sobel, et al. (2009) conducted a study to develop and pilot test a novel education tool called Asthma 1-2-3 that incorporates best practices derived from adult literacy and cognitive factors research but culturally tailored to the African American community. The goal of the tool is to simplify and standardize asthma education with the aim of assuring that patients have a functional understanding of the disease and how to prevent and manage symptoms. The result showed that while participants across all literacy levels demonstrated significant improvement in their overall knowledge of asthma after watching Asthma 1-2-3, participants with adequate literacy skills learned the most while those with low literacy skills gained the least. In other words, knowledge scores significantly improved from

pretest to posttest following presentation of the developed tool for subjects across all literacy levels (Pretest: Mean = 4.2 [SD = 1.6]; Posttest: M = 6.8 [SD = 2.0], p\0.001).

Occupation. The importance of occupation as an indicator of socioeconomic status has been greatly documented. Occupation is instrumental to poor or good economic status and as such, is responsible for standard or substandard living environment. Occupation represents exposure to the psychosocial and physical dimensions of work arrangements, as well as a range of expected earnings and social capital in the form of relative standing or prestige (Duncan, Daly, McDonough, Williams (2002). According to these authors, indicators of occupational class are widely used in other industrialized countries and have been found to be robust in predicting variations in health status. As such, occupation is regarded as a core SES variable in measuring social inequalities in health. For instance, in a study investigating the relationship between two indicators of socioeconomic status (education and occupation), Hrubá et al. (2009) found that blue collar jobs and /or low education with smoking habits are possible high risk for lung cancer development. In a study to show the relationship between causes of death and social class, Fat and Drugan (2007) found that there were statistically significant differences between the frequencies of diseases in connection with occupation and place of living ($p < 0.05$).

In addition to being an indicator of socioeconomic status, most occupations are instrumental to the development of diseases. Simon (2008) noted that over 200 industrial materials cause occupational asthma. The 2003 publication of the American Thoracic Society also attributed about 15% of all asthma as well as COPD cases to occupational

origins (Baur & Latza, 2005). In the United Kingdom (UK), occupational disease is one of the recognized important causes, with the result that up to 15% of all adults with new onset or recurrence of asthma have occupational asthma (Simon, 2008). Report from Sweden showed that the risk of delivering an infant in poor condition, varied between socioeconomic groups, despite universal health care provision in Sweden. Manual working mothers were more likely than non-manual or self-employed mothers to have an infant with persistently low Apgar scores (the most commonly used measure of newborn infant well-being), an association that remained after adjusting for maternal education and other risk factors (Odd, Doyle, Gunnell, Lewis,Whitelaw, Rasmussen, 2008).

Income and wealth. Income is regarded as a useful measure of socioeconomic position because it is directly related to the material condition that may influence health…Under the framework of the sanitary approach of the 19th century, improved material conditions involved adequate housing, avoidance of hunger, safe water supply, and the reduction of environmental hazards through waste removal and treatment. (Berkman & Kawachi, 2003). Several studies in both the United States and the United Kingdom have associated the indicators of wealth to health. Among them is Duncan, Daly, McDonough, Williams (2002) who found that economic indicators (household income and wealth) are considerably more sensitive than traditional (education and occupation) ones and suggested that the former should be a standard feature of the US measurement system for monitoring links between SES and health. Daly et al. (2002) showed that wealth (or some other measure of permanent income) is much more strongly related to health than is a single measure of income.

In an analysis of the empirical relationship between a set of SES indicators and mortality for a nationally representative sample of individuals, Duncan, Daly, McDonough, Williams (2002) used a unique data set, the Panel Study of Income Dynamics (PSID), and evaluated the predictive power of a variety of SES indicators. Although the data includes the traditional SES indicators of education and occupation, their analysis focused on the relatively neglected economic indicators of SES.

In order to explain the magnitude of economic problem, Kahn & Pearlin (2006) reported that among the array of chronic stressors that people may confront in their daily lives, there is probably none more pivotal than economic hardship (Fei, Hilgeman, Durkin, Allen, & Burgio, 2009). In support of this statement are Hanratty, Holland, Jacoby, & Whitehead (2007), who found that numerous studies have linked financial strain with negative physical and mental health outcomes throughout the life course. Lincoln (2007) also confirmed the problem of income in his statement that although rates of poverty are higher earlier in the lifespan, financial strain has been identified as an important stressor experienced most frequently in later life. This author specifically mentioned members of the minority group as one that may experience greater financial strain throughout the life course because of disproportionate levels of poverty, compared with Whites (Fei, Hilgeman, Durkin, Allen, & Burgio, 2009).

In a study to determine if wealth is a more sensitive indicator of socioeconomic status than income in a population in which many people are retired, Allin, Masseria, & Mossialos (2009) found that greater wealth predicted dentist use more strongly than did higher income. The analysis of their result showed that in almost all countries, the odds

of visiting a dentist were higher for richer individuals, both in terms of income and wealth. Furthermore, wealth had a stronger, more significant effect on dentist visits than income in Belgium, Denmark, Germany, the Netherlands, and the United States (Allin, Masseria, & Mossialos, 2009). In addition, Corvalán, Amigo, Bustos, and Rona (2005) found that those possessing fewer household belongings were more likely to have asthma symptoms (wheezing, $p < .05$, or wheezing and another asthma symptom, $p < .001$). Lieu et al. (2002) constructed a multivariate model to test whether the black-white disparities in the AAP asthma subscales persisted after adjusting for other sociodemographic variables. In the final model, worse asthma physical health status was associated with household income of <$20 000/y (8.5 points lower; p = .0002), household income of $20 001 to $40 000/y (5.6 points lower; p = .02), increasing family size (1.2 points for each additional member; p=.002), and living in a single-adult household (3 points lower; p=.02).

Neighborhood characteristics. Neighborhood characteristics have been strongly linked to the development of diseases. Cagney, Browning, and Wallace (2007) examined the extent of the health advantage between foreign-born Latinos and U S-born persons of the same socioeconomic status for the prevalence of asthma and other respiratory conditions, using a combination of data from the project on human development in Chicago neighborhoods community survey and two other data sources. The result of their study, show that asthma and other breathing disorders differ in etiology, so they also may differ in the extent to which they are affected by neighborhood characteristics.

Wang, McGeady and Yousef (2007) conducted a study to identify patient, home residence, and neighborhood characteristics of children with asthma-related emergency department visits. Medical records of children with one (group A) or more than one (group B) asthma-related pediatric emergency department visit were reviewed. Their findings showed that a significantly higher percentage of group B had Medicaid insurance ($p=0.04$), history of asthma-related hospitalizations ($p=0.04$), and passive tobacco smoke exposure. The use of Medicaid insurance suggests poor income neighborhood which in consequence has majority of smokers. It was indicated that neighborhood characteristics in the two groups were similar. Their finding led them to conclude that "Smoking cessation counseling and close monitoring of patients with a history of asthma-related hospitalizations and patients with Medicaid insurance may be helpful in decreasing emergency department visits." Krieger and Higgins (2002) suggested that the home may be a determinant of health. Several features of neighborhoods with low socioeconomic status may contribute to poor health. Air quality may be poor because of their proximity to sources of vehicle exhaust emissions such as major roads, bus depots, airports, and trucking routes. These sources are also said to create substantial noise exposure, which may be associated with a range of adverse health effects. There may be sites of improper waste disposal which can harbor pests that can subsequently infest homes. Evidence show that neighborhoods of low socioeconomic status, independent of individual-level risk factors are characterized by elevated rates of intentional injury, poor birth outcomes, cardiovascular disease, HIV, gonorrhea, tuberculosis, depression, physical inactivity, and all-cause mortality. In a study to

determine the general risk factors in the development of asthma, Juhn et al. was reported to have found that the relative risk of developing asthma among children residing in census tracts that face intersections with highways or railroads was increased when compared with those that did not face highways or railroads (Wang, McGeady, &Yousef, 2007).

Social dimensions of neighborhoods are another factor that has been found to either promote or affect health adversely. Sampson and colleagues examined the relation between collective efficacy (a combination of trust, social cohesion, and informal social control) and violence in Chicago neighborhoods and concluded that rates of neighborhood violence were lower in areas with high collective efficacy. In addition, physical insecurity and violence can cause people to stay in their homes, thus limiting physical activity.

On the other hand, Nepomnyaschy and Reichman (2006) conducted a study to assess whether the association between low birth weight and early childhood asthma can be explained by an extensive set of individual and neighborhood –level measures. The finding that there is a strong association between low birth weight and asthma among 3-year old children who were born in large US cities remained virtually unchanged after extensive set of maternal demographic, socioeconomic, medical, and behavioral risk factors that are associated with both low birth weight and asthma were controlled, as well as measures of neighborhood housing quality and poverty at the census tract level. Their finding showed that the odds of asthma was more than two-fold elevated for low birth weight children (Adjusted OR= 2.36; P<.001) From all indications, the finding here does

not necessarily mean that neighborhood characteristics have no relationship to asthma, but the only possible explanation to this finding might be that low birth weight has other individual risk factors not mentioned or controlled in the study.

Minority Children and Asthma

One major focus and controlled factor in this review is minority children. This study employs a cross sectional method to examine minority children in a community, presumably with a very poor socioeconomic status. Social epidemiologists have shown the importance of distinguishing the concept of SEP from race, more especially in the United States, where official statistics often conflict with racial disparities in health with socioeconomic disparities. Their findings have shown that the two are not the same, despite the fact that racial minorities in the United States are overrepresented among lower-SEP groups. In other words, race and SEP have been shown to have independent effects on health, and interpretation of studies using these variables should acknowledge that one variable may be a poor proxy of the other.

Reports have shown that a larger percentage of minority families are enrolled into Medicaid, which is a government sponsored health insurance for the under – privileged – one indication of their socioeconomic status but this does not explain the reason for the high rate of asthma in a community.

Lieu et al.(2002) conducted a study on minority children in the Medicaid program and found that black children have more severe asthma than their white and Latino peers, a finding consistent across several different measures. For instance, for daily anti inflammatory use, blacks has an OR of 0.64, C.I=0.45-

0.90, *P*=.01; For Latinos, *OR*=0.52, *C.I*= 0.33-0.82, *P*=.005. Based on outpatient visit for preventive asthma care in the past 6months, Blacks has an *OR* of 1.25, *CI*=0.96-1.62, p=.09; For Latinos, *OR*=1.32, *CI*= 0.96-1.82, *P*=.089. Even after adjusting for other variables, black children had AAP asthma physical health scores an average of 6 points lower (on a 1-100 scale) than white children (p = .0001). Latino children were also found to have more asthma symptoms than their white counterparts, implying that asthma disease varies according to race Black and Latino children in the managed Medicaid populations had worse asthma status and were less likely to be using preventive *asthma* medications than white children. The disparities in asthma status persisted after adjusting for socioeconomic status and family structure.

Moseley and Hudson (2009) wrote about the disproportionate effect of asthma on minority children, especially non-Hispanic black and Hispanic. These groups are known to have a higher prevalence of asthma, more asthma-related office visits, ER visits, and more asthma-related deaths than non-Hispanic white children. Despite interventional strategies, which have attempted to reduce asthma morbidity and mortality in the urban inner city, the morbidity and mortality statistics remain unchanged for children of African Americans and Hispanic children of African descent (Robinson Jr, Calmes, & Bazargan, 2008). In addition, Liao, Morphew, Amaro and Galant (2006) wrote that the challenge of controlling asthma among ethnic minority children of the inner city is particularly difficult because these underserved children have higher rates of asthma hospitalization and death. Substantiating this assertion are studies from major metropolitan cities, which

suggest a two to tenfold higher rate of hospitalization and death in impoverished non-white neighborhoods when compared to adjacent non disadvantaged neighborhoods or national norms. According to studies, the prevalence of asthma is also inversely correlated with family income, where families with an annual income of less than $15,000 are almost twice more likely to have asthma than those earning greater than $75,000 (Liao, Morphew, Amaro & Galant, 2006).

Discussion and Summary

This literature review sought to establish that the persistence of asthma in minority children is as a result of several factors that exist in the child's immediate environment. Hence, the present study explored socioeconomic and environmental factors that are contributing to the development and persistence of asthma among minority children in the South Bronx, New York City.

Since the environment is a very broad topic, it is not very clear which of the many environmental factors is contributing to asthma in minority children. Though, some studies have established some association between socioeconomic status and diseases little has been done to prove the association of the three major variables of interest (asthma, socioeconomic status, and the environment) in relation to the population of interest in this review.

Consequently, this study employs the theoretical concepts of environmental and social ecology models to address the issue of Correlates of Asthma among the Minority Population in South Bronx, New York City. The choice of these two models rests on the fact that they recognize the individual as a product of his / her environment and therefore

address the issues in the environment that might be detrimental to the individual's health. Therefore, this study is intended to add to the existing knowledge on asthma, socioeconomic status, environment, and minority children with the hope of creating awareness and in consequence bringing about a social change. Chapter 3 will give a detailed explanation of the methods that was employed to answer the research questions and hypothesis stated in earlier chapter.

Chapter 3: Research Method

Introduction

This is explanatory cross sectional research aimed at identifying the socioeconomic and environmental correlates of asthma in minority children from the South Bronx in New York City. The social ecological theory and theory of environmental health, which formed the theoretical basis of this research, have shown that an individual does not exist in isolation but as a product of his/her environment. Therefore, any inadequacy or abnormality emanating from an individual's environment calls for an explanation, and as such justifies the reason for the choice of this explanatory method of research. This section of the study described the study design used, study sample, sampling method, rationale, and data analysis method.

Study Design

A cross sectional study design with a survey model of inquiry and a quantitative method of analysis was used to determine the relationship between parents' socioeconomic status, exposure to environmental factors, and asthma in minority children. The decision to employ a survey model of inquiry is based on the fact that this research involves a cross section of a population. Using a quantitative method and a survey design provides a quantitative or numeric description of trends, attitudes, or opinions of a population and enables the researcher generalize or make claims about the population from sample results (Creswell, 2003).

To this effect, I embarked on primary data collection and analysis using a parent administered questionnaire in order to measure the variables of interest and examine the

relationships among them. The questionnaires were both mailed and hand delivered through personal contacts to parents residing in Districts 9 and 10. In order to identify addresses in Districts 9 and 10, I used the phone directory to obtain the zip codes there. Then, I used personal contacts to obtain addresses under identified zip codes that had potential participants with children within the study age range. My intention was to mail the questionnaires to participants' addresses or hand deliver them. Therefore, I identified addresses of potential participants through personal contacts in Districts 9 and 10.

The decision to use mailed questionnaires in addition to hand delivery stems from the fact that mailed questionnaires usually yield the most reliable information, especially when closed questions are used, when the order in which questions are answered are unimportant, and when the questions and format are simple and straightforward (Singleton & Straits, 2005). Inasmuch as mailed questionnaires often have low response rates and do not allow for detailed written responses, they are inexpensive to administer in that they require little or no facilities and staffs and give respondents time and privacy (Trochim, & Donnelly, 2007).

Study Sample

In describing the study sample, it is important to give an overview of the South Bronx and its population. The South Bronx, a part of the New York City borough of the Bronx, strictly refers to the southwestern portion of the borough. The true South Bronx, which is a very small area, extends from the southern tip of the borough north to 149th street. This includes neighborhoods of Tremont, University Heights, Highbridge, Morrisania, Soundview, and Hunts Point. Castle Hill is sometimes also considered part of

the South Bronx (New York Daily News, 2010). Keith (2009) described the South Bronx as an area with an average household size of 2.298 and a median household income of $40,297. In addition, 20.9% of the homes in the South Bronx have children. Nevertheless, its total population in 2000 stood at 522,412, which represents about 40% of the population of the Bronx, showing a growth rate of 11.8% between 1990 and 2000, which is slightly higher than that of Bronx county (10.7%) and New York City (9.4%), and double that of New York State (5.5%; Zimmerman, 2002). Population sectors within the South Bronx have changed in size over the past decade in different ways between 1990 and 2000 with the Black population declining (by 3.5%) while the Hispanic population has increased dramatically (by 18.8%). According to this report, 39% of this population is Black and 60% is Hispanic, which represents a higher percentage of Blacks and Hispanics than those residing in Bronx County, New York City, and New York State. This means that the percentages of the population who are Black and Hispanic are above federal guidelines that define minority populations for the purposes of identifying environmental justice issues associated with federal actions (Zimmerman, 2002).

According to the latest census, more than 40% of South Bronx residents currently live at or below the poverty level. As a neighborhood, the South Bronx has struggled for nearly 3 decades under the negative connotations of its name as a flash point for violent crime, drugs, and unchecked urban decay. For many of those who live there, life is bounded on all sides by pollution and poverty (Keith, 2009).

Zimmerman (2002) described the South Bronx area as comprising of five community districts in the southwestern portion of the borough (also the county) of the

Bronx in New York City. Two of these five districts (Districts 9 and 10) were sampled. According to the 2005 statistics, there were approximately a total of 106 elementary and middle schools assigned to Districts 9 and 10 in the South Bronx. This results in a total population of 61, 212 students in the two districts, which gives an idea of the total number of children residing in these two districts in the South Bronx. Addresses of participants from these two districts were obtained through personal contacts. A consent form and questionnaire were sent to each address selected. Therefore, each participating parent received a consent form and questionnaire to complete on behalf of his/her child, and participants were expected to be parents of children in elementary and middle schools.

The study population was 400, but 800 questionnaires were distributed with the expectation of getting a response rate of at least 25%. The distribution of the large number was to make sure that enough surveys would be returned for the proposed analysis because most people are reluctant to complete questionnaires. Therefore, it was safer to send out as many as possible. This number is derived from sample size calculation using “The Survey System” calculator from creative research systems (The Survey System, 2007). There are tables and figures explaining the data collected and the results. For instance, there is information on the sociodemographic characteristics of the study population, distribution of age among children of study participants, distribution of race among study participants, distribution of gender among children of study participants, distribution of grade among children of study participants, and distribution of occupation and income among study participants.

Protection of Study Participants

As primary research that involves primary data collection, ethical steps were taken to protect the study participants in terms of confidentiality and harm (both physical and emotional) because ethics is the key concern in research (Babbie, 2007). To do this, I submitted an application to the institutional review board of Walden University for permission to conduct this study. Second, each participating parent was required to sign an informed consent that discusses the nature of the study, procedure, confidential and voluntary nature of the study, and risks and benefits of participating. It was assumed that majority of the study population had a basic knowledge of the English language. For proper understanding, the wordings of the questionnaire were very simple. Parents who did not have a basic knowledge of the English language and had no one to translate for them were excluded from the study. Since social research often represents an intrusion into people's lives (Babbie, 2007), my contact information was included in the questionnaire for contact purposes.

The South Bronx of New York City is predominantly made up of minorities from different racial backgrounds, languages, and religions. The research questionnaire was such that it recognized and respected the participants' beliefs and culture. Since the questionnaires were completed at home, there was no form of coercion in responding to the questions. The questions were answered at the discretion of the study participants. The completion of the questionnaire was strictly voluntary, and respondents were not enticed with any material gift. To protect the confidentiality of the study participants, the

names of the children and their parents were not used during reporting and all information presented by the participants was kept secret.

Ethical steps taken in this study were based on the ethics of social research in Babbie (2007) and the Belmont Report, *Ethical Principles and Guidelines for the Protection of Human Subjects of Research* (National Institute of Health, 1979). According to Babbie (2007), two basic ethical issues are "voluntary participation" and "no harm to subjects" which means that study participants were not coerced in any way to participate in a study either by threats, intimidation, or deceit and should not be subject to physical, psychological or emotional harm. A copy of the informed consent and questionnaire were included in the research report.

Sampling Method and Rationale

This study utilized survey method of data collection. As stated earlier, the study group was selected from two school districts in the South Bronx of New York City using referral and convenience sampling. These are nonprobability sampling method which according to Singleton and Straits (2005) refers to processes of case selection other than random sampling. In as much as nonprobability sampling "do not control for investigator bias in the selection of units" and their pattern of variability cannot be predicted from probability sampling theory, thereby making it impossible to calculate sampling error," it is less expensive and appropriate when dealing with a large population with few cases (Singleton & Straits, 2005, p.132).

Referral and convenience sampling are appropriate for this study because referral sampling targets populations that comprise of small subgroups of the larger population,

and convenience sampling simply selects a requisite number from cases that are conveniently available, thereby avoiding the cost of extensive screening and waste of time (Singleton & Straits, 2005). Addresses were identified through personal contacts from Districts 9 and 10, and questionnaires were either distributed in person or mailed to homes.

The decision to limit the study population to children in elementary and middle schools was based on the large number of asthmatic children the researcher noticed in one school district alone. For instance, out of 7, 468 students enrolled in 10 elementary schools in district 9,471 were identified as asthmatics (Asthma initiative program, Quarterly report, 2009). Secondly, Grades k-8 falls within the age range of 5 to 14, the age group that has been found to be mostly affected by asthma. Data from the National Health Interview Survey (2003) showed that asthma is a significant problem with 13.9% of 5- to 14-year-old children nationwide diagnosed with asthma during their lifetimes and 9.5% reporting asthma symptoms in the previous 12 months. A survey of 19,138 children in grades K-5 in Texas also showed that 8.5% of the children had a current diagnosis of asthma (Petronella, Bricker, Perrotta, Brown, Brooks, 2006).

Although there are cases of asthma among older children, the 4 to 16 year group is the group often in emergency rooms and prone to asthma attacks, consequently resulting in numerous absences in school. Information from a school nurse, Ms. Crawford, at P. S 230 in District 9, Bronx County, implied that the reason for this high rate of asthmatics within this age group (4-16 years) is that most of these children lack the knowledge to manage their asthma on their own. According to research, self-

management of asthma has been shown to reduce costs related to hospital admissions and visits to emergency departments (Becker, Filuk, Gillespie, McColm, Piwniuk, Thomas, Watson, 2009). Hence, the inability of 4 to 16 year olds to manage their asthma has resulted in incessant attacks of asthma leading to emergency room visits and subsequent absences from school.

Consequently, most parents of elementary and middle school children choose to report their children's asthma to the school nurse, unlike parents of high school children, who assume that their children are old enough to handle their asthma medications and as such do not require the assistance of the school nurses. Hence, their children's asthmatic conditions are never reported to the schools' nurses. Moreover, older children are more aware of the signs and symptoms of asthma and when to use their medications.

Children were automatically included in the study population if their parents returned the questionnaire. Children were deemed ineligible for the study if they were not in elementary or middle school, did not live in the South Bronx, or had relocated in the last 6 months. The rationale for selecting only the children that reside in the South Bronx and eliminating children who have relocated was to ensure that the economic situation of their parents was still the same with others in the community. Data have shown that the majority of the areas in the South Bronx are characterized with low income earners. According to Robert Leibson Hawkins, an assistant professor of social work at New York University, "One of the things you have in the South Bronx is a high concentration of poverty" (as cited in Trapasso, 2008). This statement is supported by Zimmerman's (2002) report of the Institute for Civil Infrastructure Systems (ICIS) at NYU's Wagner

Graduate School of Public Service. According to this report, in 1989, 39% of the population lived below the poverty level. This is over 10% higher than the portion of the population that have incomes below the 1989 poverty level in Bronx County, almost 20% higher than those in New York City and about three times than those in New York State and the United States.

The sociodemographic characteristics of the study population are not expected to be far from what previous researchers (Brugge, Rivera-Carrasco, Zotter, & Leung, 2010; Mutlu & Balci, 2010) have reported in their investigation of asthma. The study participants were mostly between the ages of 4 and 16years and comprised of both male and female of different races.

Sample Size. The estimated sample size for this study is 400. This number was based on an estimated population of 37, 938 (which represents the total number of students in two school districts), a confidence level of 95% and confidence interval of .05%. This calculation was enabled by "The Survey System" calculator from Creative Research Systems (2007). Their formula for sample size calculation which was used in deriving the sample size for this study is as follows:

$$ss = \frac{Z^2 * (p) * (1-p)}{c^2}$$

Where:

Z = Z value (e.g. 1.96 for 95% confidence level)

p = percentage completing questionnaire, expressed as decimal

(.38 used for sample size needed)

c = confidence interval, expressed as decimal

(e.g., .04 = ±4)

$$\frac{1.96^{2} * .38 * (1-.38)}{.05 * .05} = 362 \text{ (app. 400)}$$

It was estimated that a total of 400 parents from Districts 9 and 10 would be surveyed. Parents were selected from the above two districts through referrals and personal contacts. My intention was to distribute between 700 and 1,000 questionnaires with a response of 400 questionnaires.

Criteria for Eligibility. To be eligible for this study, study participants must be residents in the south Bronx or have relocated from the south Bronx in less than six months. Children of study participants should be in grades kindergarten to eight and should not be more than 16years of age at the time of data collection. Children are automatically included in the study if their parents completed and returned the questionnaire.

Demographic Data. The demographic data that were collected from the study participants include information on both parents and children. Questionnaires were structured to elicit information on race/ethnicity of both parents and children, educational level of parents, parents' occupation and income, children's age and grade, birthplace, location of residence, length of residency, and type of residence.

Description of Study Variables

The selection of study variables was based on the environmental and socioeconomic factors contributing to the development of asthma in minority children. Among them are dependent variables such as self/parent reported asthma, presence of night time asthma, symptoms of wheezing, breathlessness, chest tightness or cough. Independent variables include: both socioeconomic and environmental factors such as parental education, parental occupation, parental income, neighborhood characteristics which includes air pollution from traffic and smoking, living conditions described as presence of mold in the home, overcrowding, lack of proper ventilation, presence of dust and other allergens. There are also confounding variables such as age and gender of child.

Table 1 below is a list of the study variables, type of variable, their relationship to the research questions and specific items on the survey instrument.

Table 1 *Description of Study Variables*

Name of variable	Type of variable	Research questions	Item on survey
Medical history	Independent ordinal variable	Research Question 4	Measured by items 1, 2, 3, 65, 68,69, 70, 71 ,72
Self/parent/ physician reported asthma	Dependent nominal/ordinal variable	Research Question 3	Measured by items 66, 67, 73
Symptoms of wheezing	Dependant nominal/ ordinal variable	Research Question 4	Measured by items 54, 55 ,56
Breathlessness	Dependant nominal/ordinal variable	Research Question 4	Measured by items 62, 63, 64

Continued

Name of variable	Type of variable	Research questions	Item on survey
Chest tightness or cough	Dependant interval variable	Research Question 4	Measured by item 57
Sneezing, runny/blocked nose	Dependant nominal Variable	Research Question 4	Measured by items 58, 59, 60, 61
Parental education	Independent ordinal variable	Research Question 1	Measured by items 45, 53
Parental occupation	Independent ordinal variable	Research Question 1	Measured by items 46, 47, 48, 49, 50
Parental income	Independent ordinal variable	Research Question 1	Measured by items 51 and 52
Air pollution from heating, traffic, industries, and cigarette smoke	Independent ordinal variable	Research Question 3	Measured by items 21, 22, 23, 36, 37, 38, 39, 40,
Overcrowding	Independent Ordinal/ nominal variable	Research Question 3	Measured by items 19 and 20
Presence of mold and other allergens in the home	Independent nominal variable	Research Question 3 and 4	Measured by items 29, 30, 31, 32, 33, 34, 35, 43, 44
Lack of proper ventilation in the home	Independent ordinal variable	Research Question 3	Measured by items 24, 25, 26, 27, 28
Age	Confounder-ratio variable		Measured by items 6
Gender	Confounder nominal variable		Measured by items 4
Race	Confounder ordinal variable		Measured by items 5 and 7
Grade	Confounder ordinal variable		Measured by items 8
Place of residence	Dependent ordinal	Research Question 1	Measured by items

Continued

Name of variable	Type of variable	Research questions	Item on survey
	variable		9, 10, 11, 12, 13, 14, 15, 16, 17, 18,
Breastfeeding	Confounder ordinal variable		Measured by items 41 and 42

Data Gathering and Instrumentation

The data for this research was obtained through questionnaires distributed to parents of children in the participating districts. Questionnaires were sent to parents of children in districts 9 and 10.

The main instrument that was used in this data collection is a survey questionnaire modeled after three existing questionnaires but modified by the researcher to suit the present study. Survey instrumentation is described as the science of asking questions and is responsible for a good sample survey (Singleton & Straits, 2005, p. 263). In order to obtain reliable and valid responses, the researcher has taken all possible precautions in selecting the survey instrument for this research. As a self administered mail questionnaire that requires comprehension and formulation of appropriate responses by the respondents, the questions that were included in the questionnaire are simple and self explanatory.

This questionnaire is modeled after the “Childhood Health Survey” prepared by the Department of health services research and management, Texas Tech University Health Sciences Center, and “The Childhood Asthma Survey Instrument” used in the ZAP project, which assessed the impact of cockroach antigens, dust mites, and

environmental tobacco smoke on the severity of the disease, and, on cost of care, school days missed, and parent work days missed" (ZAP Asthma Home). Additional information was obtained from the Child Health Questionnaire (CHQ-PF50), a paper-and-pencil measure completed by parents of children ages 5 through 12 years.

The ZAP Asthma project is a "16 member public, private partnership created to reduce preventable morbidity and mortality from asthma for children living in Atlanta's Empowerment Zone." The purpose of this project is to specifically combine the strengths of scientific research and community action in order to address the problem of asthma. The project utilized the "action research/participatory research model," and the skills of trained community health workers, who assist families in sustaining the environmental interventions. This method enabled the identification and ameliorating of known asthma triggers in the home environment of study participants. Overall, the study is designed to "monitor the impact of reductions in exposure to cockroach antigens, dust mites, and environmental tobacco smoke on the severity of the disease, and, on cost of care, school days missed, and parent work days missed." The questionnaire (The Childhood Asthma Survey Instrument) is made up 57 questions that assessed information regarding disease management, periodicity of episodes, and severity of asthma, symptoms, hospital visits, medical history, family and social history, parents' occupation, Education, income and insurance information.

The CHQ-PF50 includes a broad spectrum of child- and family-focused health areas divided into 12 concepts (Physical Functioning, Role/Social Limitations– Physical, General Health Perceptions, Bodily Pain/Discomfort, Family Activities, Role/Social

Limitations–Emotional/Behavioral (counts as two concepts), Parent Impact Time; Parent Impact Emotion; Self-Esteem; Mental Health; Behavior; Family Cohesion; Change in Health).

Lastly, "The Childhood Health Survey" contains 100 questions divided into 5 sections. Section A focuses on the child's general health; Section B is on the child's health care and insurance; Section C assessed child's respiratory health; Section D assessed the child's home; and finally, Section E focused on pediatric asthma health related quality of life supplement. All three instruments "Childhood Health Survey" CHQ-PF50 and "The Childhood Asthma Survey Instrument" are open documents and can be obtained from the internet.

Since the present study seeks to identify factors in the environment that are instrumental to the development of asthma in minority children, most of the questions in the questionnaire focused on environmental problems instead of biological or otherwise. The questions were categorically designed to elicit responses that show the demographic characteristics of study participants, economic situation, educational background, living conditions, physical functioning /general health of the child and impact of asthma on the child. To avoid ambiguity in the responses and to enable faster coding of responses, all questions are closed ended or fixed choices.

Validity and Reliability of Survey Instrument

The main aim of this research questionnaire is to elicit responses that will identify the correlates of asthma among minority children in the South Bronx of New York City and as such requires a reliable and valid instrument. An

instrument is reliable and valid when it consistently measures what it is expected to measure. According to Golafshani (2003):

> Reliability and validity in quantitative research reveal two strands: First, with regard to reliability, whether the result is replicable. Secondly, with regard to validity, whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure.

These two terms are very important in research because it helps in establishing objectivity and authenticity of research conclusions (Kirk & Miller, 1986). Therefore, to ensure the reliability and validity of the questionnaire for this study, questions selected from preexisting questionnaires and those newly constructed will focus on obtaining relevant information pertaining to the study.

Validity of the survey instrument. Trochim & Donnelly (2007) defined validity as the best available approximation to the truth of a given proposition, inference or conclusion. According to these authors, validity does not refer to measures, samples, and designs but to proposition, inference, or conclusion. In another explanation, Kirk & Miller (1986) stated that to focus on the validity of an observation or an instrument is to care about whether the measurements have currency (what do the observations buy?), and about whether phenomena are properly labeled (what are the right names for variables?). Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others (Joppe, 2000, p. 1). Therefore, in order to obtain the validity of a survey instrument, our focus should be on the study variables,

how they are operationalized or translated in the survey instrument and how reliable the measures are.

To ensure that the questionnaire to be used in this study measures what the researcher intends to measure, questions have been constructed to focus on the three variables of interest – asthma, socioeconomic status, and environmental factors. For the purpose of this study, the questions have been designed to assess four types of validity namely: conclusion, internal, construct, and external validity (Trochim & Donnelly, 2007, p.20- 21).

To test for these four validity types, questions were constructed:

1.To address factors contributing to the development of asthma in order to confirm that there are socioeconomic and environmental factors contributing to the development and persistence of asthma among minority children in South Bronx or to disprove that environmental and socioeconomic factors have no relationship to the development of asthma in minority children.

2. To identify causes of asthma such as time of onset, asthma in the family, and so on. Negative responses to these questions helped in confirming internal validity.

3. To draw out responses that were used in drawing conclusions on other minority groups of poor socioeconomic status within and outside the state/country. This means that the outcome of this study has a social implication to other minority groups with poor socioeconomic background and will therefore necessitate intervention processes or government action.

4. To achieve construct validity. By construct validity, the researcher means the approximate truth of the conclusion that the operationalization accurately reflects its construct (Trochim & Donnelly, 2007, p.59). In order to obtain the appropriate responses that will establish the relationship between parents' socioeconomic status, environmental factors and asthma in minority children, content validity (a type of construct validity described as a construct itself) was used. Content validity was assessed by constructing questions that reflect the major areas of concern in this study such as parental income and education, living conditions, time of onset of asthma, and other demographic data. These variables were operationalized to elicit required responses which enabled the researcher to make the right conclusion...

Reliability of the survey. Reliability is the extent to which a measurement procedure yields the same answer however and whenever it is carried out or the degree to which a research's finding is independent of accidental circumstances of the research (Kirk & Miller, 1986). In another definition, Joppe (2000) defines reliability as:

> The extent to which results are consistent over time and an accurate representation of the total population under study; and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable. (p. 1)

Simply put, it means repeatability or consistency in measurement and shows the quality of the measurement (Trochim & Donnelly, 2007, p. 80-84). Reliability is considered the "essential basis of all good research" because "without it, the only reason the reader of the research might have for accepting the conclusions of the

investigator would be an authoritarian respect for the person of the author" (Kirk & Miller, 1986).

Kirk and Miller (1986) identified three types of reliability referred to in quantitative research, which relate to: (a) the degree to which a measurement, given repeatedly, remains the same (b) the stability of a measurement over time; and (c) the similarity of measurements within a given time period (pp. 41-42).

The questions that will be included in the survey instrument are taken from previously validated survey instruments (ISAAC, ZAP, and CHQPF50 questionnaires). Therefore, the questions are assumed to be valid and reliable.

The Questionnaire

The questionnaire comprises of 73 questions grouped under 5 headings namely: General perception of child's health; Demographical background of both parents and child; Child's living environment; Parents' education, occupation, and income information; and Child's respiratory health and family history. The questionnaire elicited information that pertains to the demographics of study participants, parents' income, education, living condition, time of onset of asthma, symptoms of asthma, age of onset, presence of pollutants in the environment, and possible causes of asthma.

Data Management/Quality Control Procedure

I was solely responsible for administering and collecting the questionnaire. Each questionnaire was enclosed in an official envelope addressed to identified parents. Current and correct addresses of these parents were obtained from personal contacts. Each returned questionnaire was carefully checked for errors, omissions, and incomplete

responses. The data were analyzed using standardized statistical analysis software. To maintain the confidentiality of the study data, all data were kept under lock and key in a safe place and with limited access.

Data Analysis Procedure

The descriptive statistics were used to describe and summarize the sample data in manageable forms while the inferential statistic was used to draw conclusions from data collected (Babbie, 2007). Descriptive statistics were used in summarizing the dependent variables, independent variables, and covariate variables. The inferential statistic was used to estimate the characteristics of the population from sample data and to test the hypotheses raised in this study thereby ruling out any rival explanation that observed data patterns, relationships or differences are due to chance processes arising from sampling error or other sources (Singleton & Straits, 2005). In other words, the inferential statistics were used to estimate parameters and test statistical hypothesis.

In survey research, the first step in data analysis is the editing and summary of the responses known as coding, data entry and error checking (Singleton & Straits, 2005, p.446). Therefore, at the completion of data collection, I developed a codebook which helped in managing the various responses gathered from the respondents. First and foremost, I developed appropriate code categories, which finally enabled the construction of a codebook, the document that describes the location of the different variables and list the assignment of codes to the attributes composing those variables (Babbie, 2007). The construction of a codebook is necessary for the conversion of data items into numerals or numerical codes.

Next, I inspected the data for necessary modifications and choice of appropriate statistical analyses. For easy analysis, the data were modified by combining variables that describe the same item, which enabled the reduction of data size and unnecessary duplication of items that might create redundancy. Then the variables were tested for possible relationships between the independent and dependent variables using bivariate and multivariate methods of analysis. The Stata statistical software was used for the coding process, data entry and analysis.

Univariate analysis. The first consideration in this analysis was a description of how each variable measured in this study was distributed, dispersed and the frequency of each. This was done through the use of univariate analysis which is the analysis of a single variable for purposes of description. In other words, univariate analysis describes the units of analysis of a study or a case in terms of a single variable - specifically, the distribution of attributes that it comprises and allows the researcher to make descriptive inferences (Babbie, 2007,). In this study, univariate analysis examined each variable listed for insufficient variation in responses, missing information and any other weaknesses that may be detected. This was done through the frequency distribution table, which shows the frequency of variables, averages, and measures of dispersion.

Bivariate analysis. The second part of this data analysis was sub group comparison using bivariate and correlation analysis. Bivariate analysis was used to analyze two variables simultaneously in order to determine the relationship between them. There was a computation of the correlation coefficient explaining the relationship between the major variables of interest in this study (Babbie, 2007). The empirical testing

of the relationship between asthma and its socio-demographic and environmental correlates was tested using chi square test. Chi square (x^2) is based on the null hypothesis: the assumption that that there is no relationship between two variables (Babbie, 2007).

Multivariate analysis. In order to account for extraneous variables, multivariate method, the analysis of simultaneous relationships among several variables (Babbie, 2007) was used. For instance, the racial background of the children was analyzed in relation to their socioeconomic status, environmental factors and their development of asthma. Specifically, the elaboration model of multivariate analysis, otherwise known as the interpretation or Lazarsfeld method of data analysis was used to explain the extent of the relationship between the major variables of interest (asthma, socioeconomic status, and environmental factors) in this study. The elaboration model which aims at elaborating on an empirical relationship among variables for the purpose of interpreting the relationship among them is one method for doing multivariate analysis (Babbie, 2007). This method of analysis helped the researcher to understand the relationship between parents' socioeconomic status, environmental factors, and asthma in minority children because it offers the clearest available picture of the logic of causal analysis.

In recognition of the theoretical assumption of this study and antecedent variables that might produce spurious statistical associations, the researcher used relationship modeling in conjunction with the elaboration model. This helped in specifying hypothesized relationships among the explanatory variables thereby accounting for random or chance variables (Singleton & Straits, 2005, p.487). This entails the use of multiple logistic regression analysis, which provides information on the impact of an

independent variable on the dependent variable while simultaneously controlling for the effects of other independent variables (Singleton & Straits, 2005). Below is a summary of the analysis procedure that was used in this study.

A Summary of the Data Analysis Procedure

As stated above, this study utilized the descriptive and inferential method of data analysis in analyzing the data collected. The first step was to identify and group the questions according to their question/response format. Next, was to identify questions addressing the four hypothesis types, expected outcomes, demographic information, and the statistical method of analysis. Each question was analyzed based on information on tables 3 and 4 below.

Table 2 below is a grouping of questionnaire items according to type of question / response format.

Table 2

Items on Questionnaire and Type of Question/Response Format

Item on questionnaire	Type of question / Response format
Questions 1, 2, 3, 4, 5, 7, 8, 14, 15, 16, 21, 24, 25, 26, 27, 29, 35, 36, 37, 38, 40, 52 53, 61, 68, 69, 70, 71, 72, 73	Nominal
Questions 4, 10, 13, 18, 20, 33, 34, 40, 41, 59, 60, 62, 63, 64, 67, 72	Dichotomous
Questions 17, 22, 23, 31, 32, 39, 43, 44, 56, 65, 73	Cumulative
Questions 23, 28, 40, 42, 46, 47, 48, 49, 54, 55, 56, 57, 58, 66	Filter/Contingency
Questions 6, 9, 11, 12, 13, 19, 44, 47, 49, 50, 55, 57, 67	Fill – in – the – blank

The questionnaire which is modeled after three existing questionnaires contains 73 questions grouped under 5 headings. All the questions are structured with five question/response formats. The response formats used in this questionnaire are as follows:

1. Dichotomous response format-This is required when a question has two possible responses ex. Yes/No, agree/disagree, True/False
2. Nominal response format – a response format that has a number (which is used as a place holder) beside each choice. Numbering responses just help in speeding data entry.
3. Cumulative scale response format – a response format that requires respondents to check each item with which they agree.
4. Filter or Contingency response format – When a question is asked to determine whether respondents are qualified or experienced enough to answer a subsequent one.
5. Fill-in-the-blank response format- used to collect data for a number of different response types. For example, asking for a respondent's gender (Trochim & Donnelly, 2007, p.101-102

The table below shows the four hypotheses for this study, items on the questionnaire explaining each hypothesis, method of quantification, and method of statistical analysis.

Table 3

Detailed Explanation of the Hypotheses in Relation to Questionnaire Items, Quantification and Statistical Methods of analysis

Hypothesis	Item on Questionnaire	Method of Quantification	Statistical Method
Alternative /Null Hypothesis (Ha/Ho) 1: There is an /no association between parents' socioeconomic status as measured by education, income and wealth, neighborhood characteristics, occupation, and the development of asthma in minority children.	Questions 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 45, 46, 47, 48, 49, 50, 51, 52, 53,	Developing categories that accounts for parents' socioeconomic status	Univariate analysis, Chi square statistics and logistic regression analysis
Alternative/Null Hypothesis (Ha/Ho) 2: There is an/no association	Questions 36, 37, 38, 39, 40	Developing categories of factors in the	Univariate analysis, Bivariate

Continued

between exposure to factors in the ambient environment such as smoking, traffic exhaust, and presence of industries close to neighborhoods and development of asthma in minority children.		ambient environment – Air pollution from smoke (1), Air pollution from industries and traffic(2)	analysis, chi square statistics, and logistic regression analysis
Alternative/Null Hypothesis (HA/Ho) 3: Conditions in the home such as overcrowding, poor ventilation, presence of mold and other allergens greatly contribute/do not contribute to asthma in minority children.	Questions 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 43, 44, 56, 72	Developing categories of conditions in the home that affect health – overcrowding(1), allergens (2), poor ventilation (3)	Univariate analysis, Bivariate analysis, regression analysis and chi square statistics
Demographical information and symptoms / History of asthma	Questions 4, 5, 6, 7, 8, 13,54, 55, 57, 58, 59, 60, 61, 62, 63, 64,	Developing categories that account for demographic	Univariate analysis and multiple regression

Continued

	65, 66, 67, 68, 69, 70, 71, 72, 73	information and symptoms of asthma - age (1), gender (2), place and length of residency(3), symptoms of asthma (3) history of asthma	analysis

Summary

This chapter dealt with the research design and methodology used in investigating the correlates of asthma among the minority population in South Bronx, New York. It includes a description of the study population, sample size, sampling method and rationale, thorough explanation of data gathering procedure, instrumentation and analysis procedure. There was also an explanation of the validity and reliability issues and other important procedures used.

Chapter 4: Results

Introduction

The purpose of this current study was to quantitatively examine the socioeconomic and environmental factors contributing to the development and persistence of asthma among the minority population in South Bronx of New York City. The assumption in this study is that residents of the South Bronx have many cases of asthma associated with environmental factors and their socioeconomic status. This assumption is supported by the theoretical background of this study, the theories of social ecology and environmental health. In other words, this research study is intended to statistically investigate and determine the association between status of asthma among children in the South Bronx of New York City and parents' socioeconomic status, environmental factors, and conditions in the home. To effectively determine the effects of these variables of interest-environmental factors and socioeconomic status on asthma, the following three research questions guided this study, namely

1. Does parental socioeconomic status as indicated by parental income, education, occupation, wealth, and neighborhood characteristics contribute to the development of asthma in minority children?
2. Do factors in the ambient environment (like smoking, traffic exhaust, and presence of industries close to neighborhoods) predispose minority children to asthma?

3. To what extent do conditions in the home such as overcrowding, poor ventilation, and presence of mold and other allergens contribute to the development of asthma in minority children?

Based on these research questions, three hypotheses were formulated, tested, and analyzed using a variety of statistical methods and analysis. My three hypotheses are (a) There is an association between parents' socioeconomic status as measured by education, income and wealth, neighborhood characteristics, occupation, and the development of asthma in minority children; (b) there is an association between exposure to factors in the ambient environment such as smoking, traffic exhaust, and presence of industries close to neighborhoods and development of asthma in minority children; (c) conditions in the home such as overcrowding, poor ventilation, and the presence of mold and other allergens greatly contributes to the development of asthma in minority children. It is in consideration of these hypotheses and demographic information that the following data are analyzed and presented. In other words, the data are analyzed on the basis of the above research hypotheses using the SPSS analytical tools. Through these tools, the univariate and multivariate analysis are carried out, and the selection of the variables was based on their relationship to the hypotheses for which the research was carried out and whereby inferences are to be made. Therefore, this chapter provides a description of the recruitment of study participants, demographic and descriptive characteristics of the study sample, and results of the analyses.

Recruitment of Study Participants

Initially, the plan was to recruit study participants from 10 schools in Districts 9 and 10 (five schools from each school district) in the South Bronx of New York City using the simple random sampling approach. However, the New York City Department of Education refused to grant permission to collect data from the New York City public schools on the pretext that the research is not related to education and cannot contribute much towards their educational goals. After consulting with the study dissertation chair at the time, I, with the approval of the Walden IRB, decided to change the sampling method to referral and convenience sampling, which involves identifying zip codes in Districts 9 and 10, identifying contacts that will furnish me with addresses of potential study participants. In addition, I used the public phone directory to identify addresses which was also approved by the Walden IRB.

The first step was to identify personal contacts. I identified four contacts, which subsequently identified five additional contacts, making a total of nine contacts. Through these contacts, fliers were distributed in the neighborhood of the chosen districts informing and inviting residents to participate in the study. The response from the fliers and employed contacts helped to obtain 236 addresses. Given that these addresses would not provide the number of participants needed for this study, I used the public phone directory to obtain 300 more addresses. Most of the addresses identified have multiple floors and apartments and so were more than enough for the distribution of the questionnaires.

Between the spring and summer of 2012, 800 informed consents, questionnaires, and stamped envelopes were sent to addresses in Districts 9 and 10 in the South Bronx of New York City. Some of them were hand delivered to the mail boxes of potential study participants while some were mailed. Out of the 800 questionnaires distributed, 580 (72.4%) were completed and returned. Of these 580, there were 400 study participants who met the inclusion criteria. Participants had children between the ages of 4 and 16 years, have lived in their present address for not less than 6 months, were enrolled in a school (K through 8th grade).

Descriptive and Demographic Characteristics of the Study Sample

The study population comprised of 400 participants recruited from Districts 9 and 10 in the South Bronx of New York City. This sample represents the South Bronx community, which is predominantly made up of the minority population as evidenced in the total number of Hispanics and African Americans included in the study population. Environmental and socioeconomic variables chosen and analyzed in this study have the potential of contributing to the development and persistence of asthma among the study population. The tables below summarize the descriptive data of study participants.

Demographic characteristics. In order to obtain the demographic characteristics of the study sample, the questionnaire included questions on age range of children, grades in school, their gender, racial background and relationship to study participants. The results are summarized in Table 4.

Table 4

Demographic Characteristics of the Study Sample (N=400)

Characteristics (Age range of children)	Number of children	Percentage of children (%)
4-6years	132	33.0
7-10years	151	37.8
11-16years	114	28.5
Missing	3	0.8
Grade		
Kindergarten	50	12.5
1st - 5th grade	211	52.8
6th – 8th grade	139	34.8
Racial Background of Participants		
Caucasian/Asian/Other	63	15.8
African American	192	48.0
Hispanic	144	36.0
Missing	1	0.3
Gender of children		
Male	140	35.0
Female	260	65.0
Relationship of study participants to children		
Parents/Grandparents	336	84.0
Uncles/Aunts	11	2.8
Guardian/Other	33	8.3
Missing	20	5.0

The age range of the study population were 4 to 6years (33%), 7 to 10years (37.8%), and 11to 16years (28.5%), while the grades of the study population ranged from K – 8th grade. The table above (Table 4) shows that out of 400 participants in the study, 12.5% of the children (50) are in kindergarten, 52.75% (211 children)are in the elementary school (1^{st} – 5^{th} grade), and 34.75% (139 children) are in middle school (6^{th} – 8th grade). Furthermore, 35% (140) are male and 65% (240) are female. The majority of the study participants were African American (48%), while Hispanic and Caucasian /Asian/Pacific Islander participants in the study sample made up 36 and 15.8%of the study population, respectively. 13.75% (55 respondents) did not indicate their racial background and were grouped with Caucasians and Asians as Other, making up the 15.8% shown on the table. This combination is on the assumption that both Caucasian and Pacific Islanders are classified as whites, and the missing population might be other groups that classify themselves as whites but are neither Caucasian nor Pacific Islanders. Among these diverse racial groups are parents/grandparents (84%), uncles/aunts (2.8), guardians/other (8.3), and 5% percent who did not indicate their relationship the children.

Dependent Variable

The dependent variable in this study is asthma as determined or defined by self or parent reported diagnosis, diagnosis by a doctor, asthma medication prescription, and/ or asthma medication usage. Therefore, questions were asked to elicit information on the status of asthma, age of onset, and its possible symptoms. Table 5 below summarizes the results of the data collected.

Table 5

Descriptive Data for Dependent Variable

Variables	Number of participants	Percentage
Child ever had asthma		
No	260	65.0
Yes	140	35.0
Was it confirmed by a doctor		
No	266	66.5
Yes	134	33.5
Child currently taking any medication for asthma?		
No	263	65.8
Yes	137	34.3
Type of medication		
Inhaler	99	24.8
Pills	30	7.5
Other	11	2.8
Missing	260	65.0
Age when child's asthma was discovered		
0 - 11 months	30	7.5
1 - 6 years	90	22.5
10 years and over	19	4.8
Missing	261	65.3
Child had breathing problem right after birth		
No/ Don't know	334	83.5
Yes	65	16.3
Missing	1	.3
Child placed in an incubator after birth		
No	345	86.3
Yes	55	13.8
Child intubated at birth		
No	335	83.8
Yes	65	16.3

Continued

Child ever been awakened at night by wheeze, cough, shortness of breath in the last 12 months?		
Wheezing	186	46.5
Cough	108	27.0
Shortness of breath/ Chest tightness	106	26.5

Table 5 shows that more than half of the participants (65%) indicated that their children do not have asthma. Among the number who indicated that their children have asthma, 33.5% were confirmed by a doctor and 34.3% indicated that their children are currently on medication for asthma. For most of these study participants, the age of onset of asthma varies. Thirty children (7.5%) were discovered between the age of 0 and 11 months, 90 children (22.5%) between 1 and 6 years, while 19 children (2.8%) were discovered at 10 years and over. The majority of the population was not able to confirm the age of onset of their child's asthma.

Most of the participants (83.5%) stated that their children had no breathing problem right after birth, but 13.8% of the children were placed in an incubator while 16.3% were intubated right after birth. The data also show that 46.5% of the children have periodic attacks of wheezing, 27% periodic attack of cough, and 26.5% have periodic attack of shortness of breath/chest tightness. The following bar chart (Figure 3) indicates the percentages of children with /without asthma, with the taller bar showing the number of children without asthma and the shorter bar showing the number with asthma.

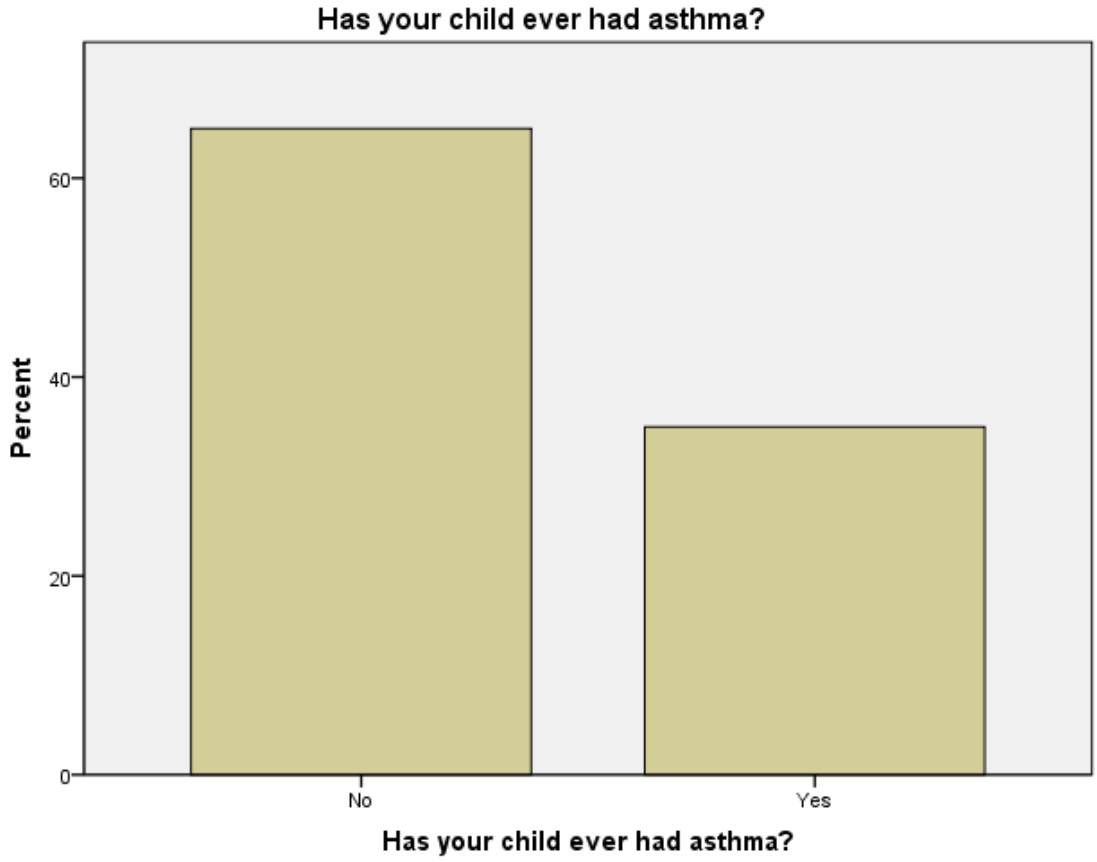

Figure 3. Number of children with/without asthma.

Socioeconomic Characteristics of the Study Population

One of the major contributors of asthma as hypothesized in this study is the socioeconomic status of parents, which was measured by income, level of education, employment status, years of employment, wealth, and neighborhood characteristics. Therefore, questions were formulated to elicit information on socioeconomic status of parents. Table 6 below summarizes the result.

Table 6

Socioeconomic Characteristics of the Study Population

Variables	Number of participants	Percentage
Parental Socio Income (household), in US $, annual		
70,000K and above	19	5.0
>10,000K and <70,000K	244	61.0
< or =10,000K	65	16.3
Missing	72	18.0
Current educational level of study participants		
Some high school/high school diploma	89	22.3
Vocational or some college/college degree	175	44.0
Professional/graduate degree	136	34.0
Educational level (at child's birth)		
Professional/ Graduate	24	6.0
Vocational	153	38.3
HS or less	223	55.8
Employment Status (at child's birth)		
Unemployed	104	26.00
Employed	296	74.0
Current employment status		
Employed	169	42.3
Looking for work/laid off/ disabled/homemaker/student	118	29.50
Retired/other	72	18.00
Refused/missing	41	10.3
Years of Employment		
15years or more	68	17.0
10years or more	264	66.0
Less than 6months	68	17.0
Wealth **(**measured by sources of income/other benefits		

Continued

Wages	123	30.8
interests from bank accounts/social security payments /retirement pensions	62	15.3
unemployment /disability/alimony or child support/public assistance/aid for families/SSI/WIC/Food stamps/other	215	53.8

Table 6 shows that more than half of the participants (61%) have an income between 10,000k and 70,000k a year, but 18% refused to disclose their income. The range used here is wide, but the idea is to identify those earning an income that is somehow sustaining as opposed to those earning little or nothing. Initially, there were five categories in the questionnaire but were collapsed into three to enable easy analysis. Educational level at child's birth shows that more than half of the participants only had high school or less (55.8%), but current educational level show that those with vocational/some college degrees (43.8%) are greater in number. For both employment status at child's birth and current employment status, 296 (74%) and 169 (42.3%) were employed at both stages, 104 (26%) and 118 (29.5%) were unemployed, 72 (18%) were retired/other, while 41 (10.3%) refused to disclose their employment status. Among those that were employed, 264 (66%) have been employed for 10 years or more. For most of the participants, sources of income ranges from wages (30.8%), interests from bank accounts/social security payments /retirement pensions (15.5%), to unemployment /disability/alimony or child support/public assistance/aid for families/SSI/WIC/Food stamps/other 215 participants (53.8%).

Environmental Characteristics of the Study Population

Another variable of interest in this study is the environmental factor, which is also hypothesized as contributing to the development of asthma in children. Among these environmental factors are conditions inside and outside the homes of study participants. The results of the analysis of the variables relating to this factor are summarized in Table 7 below.

Table 7

Environmental Characteristics of the Study Population

Variables	N	%
Economic Description of Neighborhood		
Economically developed	70	17.5
Somewhat economically developed/poor	233	58.3
Very poor	97	24.3
Length of Time in Present Neighborhood		
1 - 5 yrs	176	44.0
6 - 10 yrs	116	29.0
11 - 16 yrs	108	27.0
Satisfaction on maintenance in neighborhood		
Very well satisfied	50	12.5
Somewhat satisfied/A little bit satisfied	193	48.3
Not satisfied/ Don't know	157	39.3
Safety in Neighborhood		
No	230	57.5
Yes	170	42.5
Amenities within the neighborhood		
Restaurants/Entertainment centers/cultural facilities/churches	299	74.8
Ethnic diversity	61	15.3
Industries	40	10.0
Home structure		
Mobile home/Trailer	0	0

Continued

Apartment/ Single family house	380	95.0
Detached townhouse/Other	20	5.0
Length of Time in present Apartment/House		
4yrs/5yrs/6yrs	66	16.5
7yrs/8yrs/9yrs/10yrs	120	30.0
14yrs/15yrs/16yrs	214	53.3
Number of People in Household		
Less than 5	158	39.5
5 - 10	238	59.5
More than 10	4	1.0
Child have own room		
No	253	63.3
Yes	147	36.8
Amenities in child's home		
Central heating	84	21.3
Ducted air heating (forced air heating)	81	21.0
Air conditioning	231	57.8
Fuel used for heating home		
Gas/Electricity	160	40.0
Oil	69	17.3
Coal /Wood/Other	171	42.8
Window open when cooking		
Most of the time	206	51.5
Some of time	75	18.8
Rarely/I do not have a door or window that opens to the outside in my kitchen	119	29.8
Have extractor fan over cooker		
No	242	60.5
Yes	158	39.5
Use fan when cooking		
All of the time	35	8.8
Some of the time	163	40.8
None of the time	202	50.5

Continued

Fan take fume outside		
No	257	64.3
Yes	143	35.8
Child's home have air conditioning		
No	46	11.5
Yes	354	88.5
Age of carpet or rug in child's bedroom		
Less than one year	134	33.5
1-5 years old	76	19.0
more than 5 years old	190	47.5
Age of child's mattress		
Less than one year	154	38.5
1 - 5 years old	171	42.8
More than 5 years old	75	18.8
Type of pillow used by child		
Foam	173	43.3
Synthetic fiber/Feather	200	50.0
Does not use pillow	27	6.8
Type of bedding used by child		
Synthetic/ Feather quilt	135	33.8
Blankets/ Wool	225	56.3
Other materials	40	10.0
Damp spots in child's home		
No	302	75.5
Yes	98	24.5
Visible Molds or Fungus in child's home		
No	307	76.8
Yes	93	23.3
	Table Continue	
Water damage in child's building		
Yes	270	67.5
No	130	32.5

Continued

Outdoor air pollution from traffic, industries, etc in child's home		
a lot	173	43.3
a little	79	19.8
not all	148	37.0
Passing cars near child's home		
Constantly/Frequently	321	80.3
Seldom	55	13.8
Never	24	6.0
Heavy vehicles passing near child's home		
Constantly/Frequently	335	83.8
Seldom	40	10.0
Never	25	6.3
Child's mother smoke cigarettes		
No	188	47.0
Yes	212	53.0
Anybody at present smoke cigarette in child's home		
No	73	18.3
Yes	327	81.8
Pets kept in child's home		
Cat/Dog/Other furry pets	310	77.5
Bird	61	15.3
Other animals	27	6.8
Missing	2	.5
Pests in child's home		
Cockroaches	177	44.3
Rats/Mice	137	34.3
Other	86	21.5

The above data show that more than half of the participants (233/400, or 58.3%) consider their neighborhood as somewhat economically developed /poor and 299 (74.8%)

participants expressed that their neighborhoods have restaurants/entertainment centers/cultural facilities/churches, while 61 (15.3%) participants see their neighborhood as ethnically diverse, and only 40 (10%) participants acknowledged the presence of restaurants. On the question of how satisfied they are with regard to maintenance in their neighborhood, almost half of the participants 193 (48.3%) expressed that they were somewhat/a little bit satisfied and 157 (39.3%) expressed dissatisfaction. Overall, 230 (57.5%) respondents expressed that they do not feel safe in their neighborhood.

Responses on outdoor pollution show that 173 (43.3%) participants were very much annoyed by outdoor pollution and 321 (80.3%) participants expressed that cars constantly pass their house. More than half of the participants 335 (83.8%) also indicated that heavy vehicles constantly pass their house.

Responses on home structure revealed that 380 (95%) participants live in apartment/single family house and 214 (53.5%) participants have lived in their present homes for 12-16years. In response to number of people in household, data shows that more than half of the participants 238 (59.5%) indicated that 5-10 people live in their household. Additionally, 253 (63.3%) do not have their own rooms.

With regard to amenities in the houses, 84 (21%) homes use central heating, 85 (21.3%) use ducted air heating, 231(57.8%) has air condition, 160 (40%) use gas/electricity, 69 (17.3%) use oil, 171(42.8%) use coal/wood/other, 173 (43.3%) children use pillow made of foam, 200 (50%) use pillow made of synthetic fiber/feather, 135 (33.8%) use beddings made of synthetic/feather quilt, 225 (56.3%) use blankets/wool, while 40 (10%) use other materials.

Additional questions directed towards conditions in the homes show that about 205 (51.5%) of the participants expressed that they had kept a door or window to the outside air open most of the times during the last four weeks when they were cooking but119 (29.8%) rarely/ do not have a door or window that opens to the outside in their kitchen. Most of the participants (242/400, or 60.5%) do not have extractor fans over the cooker. Therefore, 242 (60.5%) do not use extractor fan when cooking. Subsequently, 257(64.3%) of participants expressed that they do not have a fan that takes fumes outside the house. Almost half of the participants 190 (47.5%)expressed that the carpet or rug in their child' bedroom is more than 5 years old and 171 (42.8%) expressed that the mattress in their child's bedroom is 1-5years.Data also show that majority 302 (75.5%) of the homes do not have damp spots and 307 (76.8%) of the homes have no visible molds but 270 (67.5%) homes had water damage to the building or its contents, for example, from broken pipes, leaks or floods. More than half of the participants 310 (77.5%) indicated that they kept cat/dog/other furry pets in the homes, 61 (15.3%) kept birds, 27 (6.8%) kept other animals. Additionally 177 (44.3%) participants have seen evidence of Cockroaches in their homes, 137 (34.3%) have seen evidence of rats/mice, and 86 (21.5%) participants have seen evidence of other pests in their homes. In addition to the pets and pests in the homes, 212 (53%) mothers smoke cigarettes at child's birth 327 (81.8%) participants indicated that someone in the child's home still smoke cigarettes at present.

Allergen Variables

These are another group of variables that depict characteristics inherent in the child's environment that are instrumental to the onset of asthma. The result of the analysis of these variables is summarized in Table 8 below.

Table 8

Descriptive Characteristics of Allergen Variables

Variables	*N*	Percentage
Child had wheezing or whistling in the last 12months		
No	282	70.5
Yes	118	29.5
Number of attacks of wheezing in the last 12months		
0	282	70.5
1 – 5	75	18.8
6 – 10	43	10.8
What made child's wheezing worst in the last 12 months		
Weather/pollen/fumes/dust/pets/wool clothing/colds or flu/cigarette smoke/soaps, sprays, or detergents	96	24.0
Emotion/ other things	1	.3
Foods or drinks	18	4.5
Missing	285	71.3
Child ever had dry cough at night not associated with cold in the last 12months		
No	299	74.8
Yes	101	25.3
Child ever had a problem with sneezing, a runny nose, or blocked nose not associated with cold or the flu		
No	255	63.8
Yes	145	36.3
In the past 12 months, child ever had a problem with sneezing, or a runny or blocked nose not associated with cold or the flu?		
No	129	32.3
Yes	270	67.5

Continued

Missing	1	.3
In the past 12 months, was this nose problem accompanied by itchy-watery eyes?		
No	207	51.8
Yes	193	48.3
How much does runny nose problem interfere with child's daily activities in the last 12 months?		
Not at all	97	24.3
A little/ A moderate amount	214	53.5
A lot	88	22.0
Missing	1	.3
Child ever been breathless		
No	236	59.0
Yes	164	41.0
Child ever had an attack of shortness of breath during the day when at rest at any time in the last 12 months		
No	221	55.3
Yes	179	44.8
Child ever had an attack of shortness of breath following strenuous activity at anytime in the last 12 months		
No	202	50.5
Yes	198	49.5
Ever been told that child has any health conditions?		
Anxiety problems/ depression/ Sleep disturbance	212	53.0
Chronic allergies or sinus trouble/ chronic respiratory, lung or breathing trouble	27	6.8
Other medical conditions	86	21.5
Missing	75	18.8
Child ever hospitalized for a severe chest illness or cold before the age of 2 years?		
No	334	83.5
Yes	66	16.5
Child's relatives with asthma, allergies or allergic reactions		

Continued

Grandparents	200	50.0
Brothers/ Sisters	115	28.8
Uncles/aunts/cousins	85	21.3

Table 8 shows that the majority (70.5%) of the children had no wheezing/whistling or attacks of wheezing during the last 12 months. For the 29.5% that had wheezing and the 10.8% that had the most attacks in the last 12 months, the wheezing was made worst in by Weather/ Pollens/ Fumes/ Dust/ Pets/ Wool/ Clothing/ Colds or flu/ Cigarette smoke/ Soaps, Sprays, or detergents (24.0%) in the last 12 months. It is also obvious from the data that 74.8% of the children do not have a dry cough at night apart from a cough associated with a cold or chest infection. It is also evident from the data that about 63.8% of the children had no problem with sneezing, a runny nose, or blocked nose when he/she did not have a cold or the flu but in the past 12 months, about 67.5% of the children had a problem with sneezing or a runny or blocked nose when he/she did not have a cold or the flu. About 51.8% of the children expressed that this runny nose problem was not accompanied by itchy-watery eyes in the past 12 months. About half of the children (53.5%) indicated that their runny nose problem had a little/moderate amount of interference with their daily activities in the past 12 months.

From the data, we can also observe that about 59.0% of the children were never breathless and 55.3% of the children had no attack of shortness of breath that came on during the day when he/she was at rest at any time in the last 12 months.50.5% of the participants also indicated that their children had no attack of shortness of breath that came on following strenuous activity at anytime in the last 12 months, but about half of the participants (53%) have been told by a teacher, school official, doctor, nurse or other

health professional that their child has anxiety problems. Data from questionnaire also show that about half of the children (50.0%) had no history of asthma, or other allergic reactions such as eczema, hives, sinusitis, and rhinitis.

Chi Square Statistics and Fisher's Exact test

Chi-square tests were run on each independent categorical variables that suitably explains the three hypotheses in this study, in order to investigate which independent variable (X=all other variables) is potentially associated with the dependent variable (Y= status of Asthma). The use of the chi-square test in this analysis is very appropriate, given that chi-square is designed to analyze categorical data and given that the study variables in this study have been categorized as Dependent=Y and Independent=X. Each effect is presented as null (H_0) and alternative hypotheses (H_a) as follows:

H_0: There is no relationship between Q66 (Has your child ever had Asthma?) and independent variable X.

H_a: There is a relationship between Q66 (Has your child ever had Asthma?) and independent variable X. In other words, the alternative hypothesis is that knowing the level of Variable X can help to predict the level of asthma based on p-value < 0.05.

This process compared the independent variables to the occurrence of asthma in children (see Tables 6-8 for detailed chi-square data). Specifically, the chi-square test was used to determine whether there is a significant association between environmental factors, especially conditions in the child's home, socioeconomic factors, and asthma as proposed in the three hypotheses for this study. The results of chi-square analysis comparing independent variables measured in this study to asthma outcome indicates that

majority of the variables appear to have no potentially statistically significant association with asthma in children. However, four variables were statistically significant and nine others have the potential for a positive association (based on a p value of< 0.25).

Hypothesis 1

The first hypothesis predicted that there is an association between development of asthma in minority children and parents' socioeconomic status as measured by education, income and wealth, neighborhood characteristics, and occupation. To determine whether there is a significant association between the parents' socioeconomic status as measured by the education, income and wealth, neighborhood characteristics, occupation and the development in minority children, a chi square test was applied by using SPSS. Table 9 shows the result of this analysis.

Table 9

Chi-Square Analysis of the Association between Independent Variables for Hypothesis 1and Asthma

Variables	Number/% of hadasthma-no	Number/% of hadasthma-yes	Total	Pearson chi square test	*p*-value
Highest grade				1.507[a]	0.471
some high/high school diploma	53 (20.4%)	36 (25.7%)	89 (22.3%)		
vocational or some college/college degree	116 (44.6%)	69 (42.1%)	175 (43.8%)		
professional or graduate degree	91 (35.0%)	45 (32.1%)	136 (34.0%)		
Cemploymentstatus				0.498[a]	0.919
Employed	107 (41.2%)	62 (44.3%)	169 (42.3%)		
looking for work/laid off/disabled/home maker/student	77 (29.6%)	41 (29.3%)	118 (29.5%)		
Retired/other	48 (18.5%)	24 (17.1%)	72 (18.0%)		
Refused/Missing	28 (10.8%)	13 (9.3%)	41 (10.3%)		
Work type				1.876[a]	0.599
health care workers	60 (23.1%)	39 (27.9%)	99 (24.8%)		
Office workers	52 (20.0%)	27 (19.3%)	79 (19.8%)		
Others	132 (50.8%)	63 (45.0%)	195 (48.8%)		
Missing	16 (6.2%)	11 (7.9%)	27 (6.8%)		
employedtime					
1=15yrs or more	41 (15.8%)	27 (19.3%)	68 (17.0%)		
2=6mths or more /1yr or more /3yrs or more /5yrs or more/10yrs or more	173 (66.5%)	91 (65.0%)	264 (66.0%)		

Continued

3=less than 6mths	46 (17.7%)	22 (15.7%)	68 (17.0%)		
Annualhhincome				1.152[a]	0.765
70k and above	11 (4.2%)	8 (5.7%)	19 (4.8%)		
>10kand<70k	163 (62.7%)	81 (57.9%)	244 (61.0%)		
< or = 10k	40 (15.4%)	25 (17.9%)	65 (16.3%)		
Missing	46 (17.7%	26 (18.6%)	72 (18.0%)		
Timeinhood				0.984[a]	0.611
1-5yrs	117 (45.0%)	59 (42.1%)	176 (44.0%)		
6-10yrs	77 (29.6%)	39 (27.9%)	116 (29.0%)		
11-16yrs	66 (25.4%)	42 (30.0%)	108 (27.0%)		
Hooddescription				4.961[a]	0.084
economically developed	38 (14.6%)	32 (22.9%)	70 (17.5%)		
somewhat developed/poor	160 (61.5%)	73 (52.1%)	233 (58.3%)		
very poor	62 (23.8%)	35 (25.0%)	97 (24.3%)		
Hoodmakeup				0.740[a]	0.39
people from two/ three racial background or less	122 (46.9%)	72 (51.4%)	194 (48.5%)		
People from diverse or many racial background	138 (53.1%)	68 (48.6%)	206 (51.5%)		
Amenities				4.691[a]	0.096
very well satisfied	26 (10.0%)	24 (17.1%)	50 (12.5%)		
somewhat/a little bit satisfied	132 (50.8%)	61(43.6%)	193 (48.3%)		
Not satisfied / Don't know	102 (39.2%)	55 (39.3%)	157 (39.3%)		
Nhdxteristics				0.974[a]	0.615
Restaurants/Entertainment centers/cultural facilities/churches	191 (73.5%)	108 (77.1%)	299 (74.8%)		
Ethnic diversity	43 (16.5%)	18 (12.9%)	61 (15.3%)		
Industries	26 (10.0%)	14 (10.0%)	40 (10.0%)		
Safety				0.011[a]	0.916
No	150 (57.7%)	80 (57.1%)	230(57.5%)		

Continued

Yes	110 (42.3%)	60 (42.9%)	170 (42.5%)

Table 9 shows that none of the variables analyzed had a p value of less than 0.05. Since their p values are more than 0.05, we can conclude that the variables tested under this hypothesis are not statistically significant at this point. Only the variables, neighborhood description (p-value 0.084) and Amenities (p-value 0.096) showed the potential for a positive association and are therefore included in the logistic regression model.

Hypothesis 2

To determine whether there is a significant association between development of asthma in minority children and exposure to factors in the ambient environment such as smoking, traffic exhaust, and presence of industries close to neighborhood, a chi square test was applied by using SPSS. Results are summarized in Table 10 below.

Table 10

Chi-Square Analysis of the Association between Independent Variables for Hypothesis 2 and Asthma

Variables	Number /% of hadasthma-no	Number/% of hadasthma-yes	Total	Pearson chi-square test	p-value
Outdoorpollution				0.683[a]	0.711
a lot	110 (42.3%)	63 (45.0%)	173(43.3%)		
a little	50 (19.2%)	29 (20.7%)	79 (19.8%)		
not at all	100 (38.5%)	48 (34.3%)	148(37.0%)		
Passingcars				1.558	0.459
constantly/frequently	211 (81.2%)	110 (78.6%)	321(80.3%)		
Seldom	32 (12.3%)	23 (16.4%)	55 (13.8%)		
Never	17 (6.5%)	7 (5.0%)	24 (6.0%)		
Heavyvehicles				2.006[a]	0.367
constantly/frequently	222 (85.4%)	113 (80.7%)	335 (83.8%)		
Seldom	22 (8.5%)	18 (12.9%)	40 (10.0%)		
Never	16 (6.2%)	9 (6.4%)	25 (6.3%)		
Smokecigarettes				0.637[a]	0.425
No	126 (48.5%)	62 (44.3%)	188 (47.0%)		
Yes	134 (51.5%)	78 (55.7%)	212 (53.0%)		
Smokeatpresent				1.525[a]	0.217
No	52 (20.0%)	21 (15.0%)	73 (18.3%)		
Yes	208 (80.0%)	119 (85.0%)	327 (81.8%)		

Table 10 shows that all the variables analyzed have p-values more than 0.05 with only one variable, smokeatpresent (p-value 0.217) that has a potential for a positive

association with asthma. Smokeatpresent is thus included in the next model for further analysis based on the range of 0.25 which is statistically accepted as a variable with potential positive association.

Hypothesis 3

Lastly, another chi-square test was run using SPSS to determine whether there is a significant association between the development of asthma in minority children and the conditions in the home such as overcrowding, poor ventilation, presence of mold, and other allergens (See Table 11 for results).

Table 11

Chi-*Square Analysis of the Association between Independent Variables for Hypothesis 3 and Asthma*

Variables	Number/% of hadasthma-no	Number /% of hadasthma-yes	Total	Pearson chi square test	p-value
Haveaircon				.390[a]	0.532
No	28 (10.8%)	18 (12.9%)	46 (11.5%)		
Yes	232 (89.2%)	122 (87.1%)	354 (88.5%)		
Airsystems				2.081[a]	0.353
central heating	49 (18.8%)	35 (25.0%)	84 (21.0%)		
ducted air heating	57 (21.9%)	28 (20.0%)	85 (21.3%)		
air conditioning	154 (59.2%)	77 (55.0%)	231(57.8%)		
Heatingmthd				1.384[a]	0.500
Gas/Electricity	108 (41.5%)	52 (37.1%)	160(40.0%)		
Oil	41 (15.8%)	28 (20.0%)	69 (17.3%)		
coal / wood / other	111 (42.7%)	60 (42.9%)	171(42.8%)		
Cookingmthd				3.198[a]	0.202
Gas/Electricity	161 (61.9%)	84 (60.0%)	245(61.3%)		
Coal/wood	11 (4.2%)	12 (8.6%)	23 (5.8%)		
Other	88 (33.8%)	44 (31.4%)	132(33.0%)		
Doortoutsideair				1.232[a]	0.54
Most of the time	129 (49.6%)	77 (55.0%)	206(51.5%)		
some of the time	52 (20.0%)	23 (16.4%)	75 (18.8%)		
Rarely/ I do not have a door or window unit that opens to the outside	79 (30.4%)	40 (28.6%)	119(29.8%)		
Havefan				0.133 [a]	0.715

Continued

No/Don't know	159 (61.2%)	83 (59.3%)	242(60.5%)		
Yes	101 (38.8%)	57 (40.7%)	158(39.5%)		
Usefan				5.853[a]	0.054
All the time	26 (10.0%)	9 (6.4%)	35 (8.8%)		
Some of the time	114 (43.8%)	49 (35.0%)	163(40.8%)		
None of the time	120 (46.2%)	82 (58.6%)	202(50.5%)		
Takefumesoutside				0.000	1.0
No/Don't know	167 (64.2%)	90 (64.3%)	257(64.3%)		
Yes	93 (35.8%)	50 (35.7%)	143(35.8%)		
Chldcarpet	96	38	134	4.013[a]	0.134
less than five years	96 (36.9%)	38 (27.1%)	134 (33.5%		
more than 5 years	48 (18.5%)	28 (20.0%)	76 (19.0%)		
No rug or carpet in child'sroom	116 (44.6%)	74 (52.9%)	190 (47.5%)		
Chldmatress				.423[a]	0.809
less than one year	98 (37.7%)	56 (40.0%)	154 (38.5%)		
1-5 years old	111 (42.7%)	60 (42.9%)	171 (42.8%)		
more than 5 years old	51 (19.6%)	24 (17.1%)	75 (18.8%)		
Pillowtype				1.212[a]	0.546
Foam	116 (44.6%)	57 (40.7%)	173 (43.3%)		
synthetic fiber/Feather	125 (48.1%)	75 (53.6%)	200 (50.0%)		
Does not usepillow	19 (7.3%)	8 (5.7%)	27 (6.8%)		
Beddingtype				4.396[a]	0.111
synthetic/Feather quilt	90 (34.6%)	45 (32.1%)	135 (33.8%)		
Blankets/wool	150 (57.7%)	75 (53.6%)	225 (56.3%)		
Othermaterials	20 (7.7%)	20 (14.3%)	40 (10.0%)		

Continued

Dampspots				1.312[a]	0.252
No	201 (77.3%	101 (72.1%)	302 (75.5%)		
Yes	59 (22.7%)	39 (27.9%)	98 (24.5%)		
Molds				1.219[a]	0.269
No	204 (78.5%)	103 (73.6%)	307 (76.8%)		
Yes	56 (21.5%)	37 (26.4%)	93 (23.3%)		
Waterdamage				3.619[a]	0.057
No	184 (70.8%)	86 (61.4%)	270 (67.5%)		
Yes	76 (29.2%)	54 (38.6%)	130 (32.5%)		
Hmstructure				5.784[a]	0.016
mobile home/trailer					
apartment/Single family house	252 (96.9%)	128 (91.4%)	380 (95.0%)		
detached townhouse/Other	8 (3.1%)	12 (8.6%)	20 (5.0%)		
Ownroom				2.695[a]	0.101
No	172 (66.2%)	81 (57.9%)	253 (63.3%)		
Yes	88 (33.8%)	59 (42.1%)	147 (36.8%)		
Housepets				2.371[a]	0.306
cat/dog/other furry pets	206 (79.5%)	104 (74.8%)	310 (77.9%)		
Bird	39 (15.1%)	22 (15.8%)	61 (15.3%)		
Other animals	14 (5.4%)	13 (9.4%)	27 (6.8%)		
Housepests				6.397[a]	0.041
Cockroaches	105 (40.4%)	72 (51.4%)	177 (44.3%)		
rats/mice	100 (38.5%)	37 (26.4%)	177 (34.3%)		
Other	55 (21.2%	31 (22.1%)	86 (21.5%)		
Household				2.809[a]	0.245
less than 5	95 (36.5%)	63 (45.0%)	158 (39.5%)		
5-10	162 (62.3%)	76 (54.3%)	238 (59.5 %%)		

Continued

more than 10	3 (1.2%)	1 (.7%)	4 (1.0%)

According to table 11, only three variables, usefan (p-value 0.054), homestructue (p-value 0.016), and housepests (p-value 0.041) showed a positive association to asthma. Nevertheless, seven variables, waterdamage (p-value 0.057), cookingmthd (p-value =0.202), childcarpet (p- value=0.134), beddingtype (p-value=0.111), dampspots (p-value=0.252), ownroom (p-value=0.101), and household (p-value=0.245), showed potentials for a positive association by having a p-value not more than 0.25.

Logistic Regression Analysis

A preliminary logistic regression analysis was run on each of the individual variables not included in the three hypothesis tables in order to account for possible confounders and extraneous variables to determine which variables are likely to be or have the potential as significant contributors to asthma outcome in these 4-16 year old children. For this further analysis, all independent variables were regressed as categorical variables (Dependent=Y; Independent=X). The result showed that the following variables: bodypain (*P*=0.194), gender (*P*=0.188), breastfedchild (*P*=0.188), numberofattacks (*P*=0.003), worsenwheezing (*P*=0.183), snzwoutcoldin12 (*P*=0.075), snzprblminterfer (*P*=0.178), everbreathless (*P*=0.173), shortofbrthwacti (*P*=0.187), hadnightcough (*P*=0.127), takingmedication (*P*=0.000), medicationtype (*P*=0.000), asthmaage (*P*=0.000),gparentswrhinitis (*P*=0.057), gparentswsinusitis (*P*=0.051), parentswhives (*P*=0.218), siblingsweczema (*P*=0.205),Siblingswrhinitis (*P*=0.205), uncleauntwasthma (*P*=0.205), uncleauntwhives (*P*=0.205) uncleauntsinusit (*P*=0.228), cousinswhives (*P*=0.232), cousinwsinusitis (*P*=0.205), had *p* value of less than 0.25.

Hence these variables were considered for multivariate logistic regression analysis. However, thirty four variables, health (*P*=0.466), hlthnow (*P*=0.640), birthdate (*P*=0.497), rbkground (*P*=0.874), zipcode (*P*=0.914), breastfedtime (*P*=0.270), hadwheezing (*P*=0.765), ,snzwoutcoldever (*P*=0.957), snzwitchyeyes (*P*=0.908), shortofbrthatres (*P*=0.327), hlthconditions (*P*=0.959), trblbreathatbirth (*P*=0.426), usedincubator (*P*=0.494), everhospitalized (*P*=0.382),), intubated (P=0.619),rltiveswhlthconditions (*P*=0.448), gparentswasthma (P=0.529), gparentsweczema (*P*=0.309), gparentswhives (*P*=0.948), parentswasthma (*P*=0.290), parentsweczema (*P*=0.753), parentswrhinitis (*P*=0.698), parentswsinusitis (*P*=0.290), siblingswasthma (*P*=0.644), siblingswhives (*P*=0.753), siblingswsinusitis (*P*=0.753), uncleauntweczema (*P*=0.801), unleauntwrhinitis (*P*=0.698), cousinwasthma (*P*=0.258), cousinweczema (*P*=0.644), cousinwrhinitis (*P*=0.644), everhadwheez (*P*=0.377), everhadcoughatt (*P*=0.264), shorthofbrth (*P*=0.276), chestightness (*P*=0.822) were unlikely to have any significant association to asthma. Therefore, only the twenty three variables that showed the potential for positive association with asthma were included in the multivariate model for further analysis (see Table 12 for detailed logistic analysis of the individual confounding variables)

Table 12

Logistic Regression of Individual Independent Confounding Variables with Potential for Positive Association to Asthma

Variables	O.R.	P	95% CI	
			Lower	Upper
Bodypain	1.240	0.194	0.897	1.715
Gender	1.342	0.188	0 .866	2.081
Breastfedchild	0.757	0.188	0.500	1.146
Numberofattacks	1.579	0.003	0.173	2.126
Worsenwheezing	0.898	0.183	0.766	1.052
Hadnightdrycough	0.682	0.127	0.418	1.994
snzwoutcoldin12	1.510	0.075	0.959	2.377
Snzprblminterfer	1.230	0.178	0.910	1.662
Everbreathless	0.745	0.173	0.489	1.138
Shortofbrthwacti	0.758	0.187	0.502	1.944
Takingmedication	8806.000	0.000	947.647	79562.82
Medicationtype	0.013	0.000	0.004	0.045
Asthmaage	0.007	0.000	0.002	0.024
Gparentswrhinitis	0.667	0.057	0.440	1.013
Gparentswsinusitis	1.159	0.051	0.998	2.314
Parentswhives	1.296	0.218	0.858	1.957
Siblingsweczema	1.305	0.205	0 .865	1.970
Siblingswrhinitis	1.305	0.205	0.865	1.970
Uncleauntwasthma	1.305	0.205	0.865	1.970
Uncleauntwhives	1.305	0.205	0.865	1.970
Uncleauntsinusitis	1.288	0.228	0.853	1.944
Cousinswsinusitis	1.305	0.205	0.865	1.970
Cousinwhives	1.285	0.232	0.851	1.940

Model building strategy

Subsequent to the above individual variable analysis, two separate regression models (Regression model 1 and Regression model 2) were employed in identifying variables that are statistically significant to asthma.

Regression model 1. The first regression model is a combined analysis of the twenty-three variables with apparent association to asthma and ten variables from the result of the chi-square test with apparent statistical association to asthma. Before the proposed combined analysis, a preliminary individual logistic regression analysis was run on the twenty-three confounding variables. Results show that confounding variables bodypain (*OR*=1.359), gender (*OR*=1.852), number of attacks (*OR*=1.683), snzwoutcoldin12 (*OR*=11.278), shortofbirthwacti (*OR*=14.021), gparentswrhinitis (*OR*=1.193), gparentswsinusitis (*OR*=13.766) had odds (Exp *B*) more than 1.0 but none of them were found to be significant. So, these variables were excluded from the proposed multivariate model. In subsequent iterations during model building, strongly insignificant variables were removed and various combinations of remaining variables were regressed against asthma outcome. These include variables like cousinswhives and snzwoutcoldin12, which seemed to be repetitive. At each iteration, the *p* values were monitored to determine fitness of the model, and insignificant variables were removed. After the exclusions of insignificant variables, the resulting model, in addition to the ten variables with the potential for positive association during the chi square stage were included in the model for further analysis. In other words, a multivariate regression analysis of all the potential significant confounding variables, in addition to the ten potential variables from the chi-square analysis were carried out but again, there was problem in the calculation of exp B using multivariate logistic table due to duplication of variables. Nevertheless, based on their *p*-values medicationtype (*P*=0.000) and asthmaage (*P*=0.001) were statistically significant. Therefore, medicationtype (*P*=0.000) and

asthmaage (*P*=0.001) were included for further analysis (see table 10 for detailed analyses of result).

Table 13

Multivariate Logistic Regression Analysis of Independent Variables against Asthma Outcome

Variables	OR	P	95% CI	
			Lower	Upper
Bodypain	7.516	0.318	0.143	393.888
Gender	108.887	0.179	0.116	102579.108
Breastfedchild	0.378	0.528	0.018	7.766
Numberofattacks	23.695	0.096	0.569	986.254
Worsenwheezing	0.366	0.272	0.061	2.197
Hadnightdrycoug	0.226	0.491	0.003	15.594
snzwoutcoldin12	14.899	0.224	0.191	1160.828
Snzprblminterfer	20.934	0.071	0.775	565.552
Everbreathless	4.129	0.463	0.094	182.012
Medicationtype	0.002	0.040	0.000	0.736
Asthmaage	0.000	0.034	0.001	0.524
Gparentswrhinitis	25.655	0.114	0.460	1431.332
Parentswhives	1.359	0.854	0.051	35.935
Uncleauntsinusit	0.283	0.527	0.006	14.146
Nhddescriptn	4.671	0.257	0.326	66.974
Amenities	4.491	0.382	0.155	129.915
Smokeatpresent	1.064	0.980	0.008	137.855
Usefan	4.701	0.355	0.177	125.104
Hstructure	540.359	0.103	0.278	1049049.602
Housepests	15.223	0.163	0.331	699.371
Cookingmthd	0.005	0.080	0.000	1.854
Chldcarpet	0.087	0.125	0.004	1.963
Beddingtype	0.285	0.385	0.017	4.860
Household	0.182	0.375	0.004	7.842

Note: This table is for both confounders and potential significant variables at the chi-square stage.

The next model is a combined analysis of the potential significant variables at the chi square stage and the two significant confounding variables. To reduce redundancy

encountered in the previous model, the dependent and confounding variables that were not initially significant were excluded from the model. Therefore, variables included in this model are: usefan (*p*-value 0.054), waterdamage (*p*-value 0.057), homestructue (*p*-value 0.016),and housepests (*p*-value 0.041), cookingmthd (*p*-value =0.202), childcarpet (*p*- value=0.134), beddingtype (*p*-value=0.111), dampspots (*p*-value=0.252),ownroom (*p*-value=0.101), and household (*p*-value=0.245),medicationtype (*P*=0.000) and asthmaage (*P*=0.001). The result of this analysis found only medication type and asthma age to be significant since the p value is more than 0.05, but the odds ratio was more than one for usefan, waterdamage, hstructure, beddingtype, depicting an association between usefan (*OR*=1.091), waterdamage (*OR*=5.976), hstructure (*OR*=8.903), beddingtype (*OR*=1.110) and asthma (see table 14 for detailed result.

Table 14
Multivariate Logistic Regression Analysis of Independent Variables against Asthma Outcome

Variables	Odds ratio	P value.	95% C.I.for Odds ratio	
			Lower	Upper
Usefan	1.091	0.920	0.198	6.016
Waterdamage	5.976	0.257	0.271	131.864
Hstructure	8.903	0.195	0.326	242.806
Housepests	2.050	0.354	0.449	9.368
Cookingmthd	0.236	0.115	0.039	1.422
Chldcarpet	0.152	0.070	0.020	1.169
Beddingtype	1.110	0.900	0.216	5.708
Dampspots	0.192	0.895	0.000	9.775E9
Ownroom	2.640	0.418	0.252	27.706
Household	0.278	0.245	0.032	2.405
Medicationtype	0.054	0.003	0.008	0.370

Note: This second multivariate analysis is for significant confounders and potential significant variables at the chi-square stage.

Regression model 2. In another model (Regression model 2), multivariate logistic regression analysis was run using only the significant variables at the chi square stage, homestructure and housepests and the possible significant confounding variables. One significant variable (usefan) and some confounding variables were eliminated from this model due to insignificance. The result showed that the odds of getting asthma increased with body pain, home structure, gender, and date of birth, grandparents with asthma, grandparents with eczema, and grandparents with hives, parents with asthma, parents with eczema, parents with hives, sibling with asthma. However, only home structure and grandparents with rhinitis were significant.

Table 15

Multivariate Logistic Regression Analysis of Independent Variables against Asthma Outcome

Variables	Odds Ratio	P value	wald χ^2	Df
Bodypain	1.168	0.375	0.787	1
Housepests	.816	0.159	1.987	1
Hstructure	2.649	0.047	3.944	1
Gender	1.280	0.294	1.103	1
Birthdate	1.102	0.479	0.500	1
Rbkground	0.943	0.717	0.132	1
Trblebreathatbirt	0.882	0.687	0.163	1
Usedincubator	0.794	0.486	0.486	1
Intubated	0.756	0.368	0.811	1
Gparentswasthma	1.193	0.430	0.622	1
Gparentsweczema	1.381	0.151	2.058	1
Gparentswhives	1.267	0.316	1.005	1
Gparentswrhinitis	0.585	0.020	5.417	1
Parentswasthma	1.536	0.068	3.336	1
Parentsweczema	1.262	0.784	0.075	1
Parentswhives	2.427	1.000	0.000	1
Parentswrhinitis	0.721	1.000	0.000	1
Siblingswasthma	1.597	1.000	0.000	1
Siblingswhives	0.000	1.000	0.000	1
Uncleaunteczem	0.000	1.000	0.000	1
Cousinswasthma	0.000	1.000	0.000	1
Cousinsweczema	1.351	1.000	0.000	1
				1

Note: This third multivariate analysis is for confounders and significant variables: homestructure and housepests with Wald χ^2

Based on the above result, it was decided to exclude the independent variables which had high p values of more than 0.6 and run the analysis again. This second model shows that the Odds Ratio (OR) was more than 1.0 for body pain, house structure, gender, birth date, grandparents with asthma, grandparents with eczema, and grandparents with hives.

Table 16

Multivariate Logistic Regression Analysis of Independent Variables against Asthma Outcome

Variables	Odds Ratio	*P* value	Wald	Df
Bodypain	1.176	.345	.893	1
Housepests	0.807	.129	2.309	1
Hstructure	2.530	.054	3.705	1
Gender	1.336	.210	1.575	1
Birthdate	1.118	.406	.690	1
Usedincubator	0.849	.609	.262	1
Intubated	0.794	.442	.592	1
Gparentswasthma	1.133	.565	.331	1
Gparentsweczema	1.298	.228	1.455	1
Gparentswhives	1.145	.555	.349	1
Gparentswrhinitis	0.664	.066	3.389	1

Note: Table 16 is for confounders and significant variables with *p* values lower than 0.6 with Wald χ^2

Next, variables with p values of more than 0.2 were discarded from the model. So, the result of the final model shows that home structure was the only significant variable with odds ratio of more than 2.

Table 17

Multivariate Logistic Regression Analysis of Independent Variables against Asthma Outcome

Variables	Odds ratio	P value	Wald	Df
Housepests	0.817	0.145	2.121	1
Hstructure	2.727	0.035	4.438	1
Gparentswrhinitis	0.692	0.090	2.878	1

Note: Table 17 is a logistic regression analysis for confounders and significant variables with p values lower than 0.2 with Wald χ^2)

To determine whether the logistic model used in the analysis was a good fitting model or not, the Hosmer and Lemeshow test was applied. The Hosmer and Lemeshow's test indicates the extent of the model to provide a better fit than null model with no predictors. The chi square statistic of the model was 6.233 and its corresponding p value was 0.621>0.05. Since the p value is more than 0.05, the conclusion is that the there is no difference between observed and model predicted values. This implies that the model's estimates fit the data at an acceptable level. The dependent variable, the children having asthma was dichotomous variable. Based on the model it is correct at this point in predicting that the independent variables are instrumental in the occurrence of asthma in 64.8% of the cases.

Table 1*8*

Hosmer and Lemeshow test showing Model Fit

Chi-square	DF	P
6.233	6	0.621

Comparison of Regression Model 1 and 2

In comparing the result of the two models employed in this analysis, home structure was shown to be statistically significant in both models with odds ratios of 8.903 (regression model 1) and 2.727 (regression model 2). Throughout the analysis, homestructure maintained a low p value in the two regression models. Medicationtype (*P*=0.000) and asthmaage (*P*=0.001), on the other hand are statistically significant only in regression model 1. The same applies to the variables: usefan (*OR*=1.091), waterdamage (*OR*=5.976), (*OR*=8.903), beddingtype (*OR*=1.110) which have odds ratios of more than 1 in regression model 1(see table 11 and 14 for detailed result). To further confirm the statistical significance of these five variables, a logistic regression analysis is carried out for the Wald chi –square test for main effect. The result indicates that the effect of hmstructure (*p* =0.019) was statistically significant while usefan (*p*=0.065) though not statistically significant at 0.05 has maintained an impressionable potential throughout the analysis (see Table 15)

Table 19:
Results of the Wald χ^2 Test for the Main Effects: DF=degrees of freedom

Effect	Wald χ^2	Df	P-value
Hmstructure	5.524	1	0.019
Usefan	3.398	1	0.065
Beddingtype	0.032	1	0.857
Waterdamage	0.070	1	0.791
Medicationtype	1.705	3	0.636
Asthmaage	0.844	3	0.839

Goodness of Fit of the Regression Model

The fitness of the logistic regression models was monitored throughout the model building data analysis with the Hosmer and Lemeshow test. Progressively, the logistic models were refined until the final chi-square score of 1.659and a p value of 0.990 is obtained. Again, since the p value is more than 0.05, it can be concluded that there is no difference between observed and model predicted values which implies that the model's estimates fit the data at an acceptable level. Based on the model, the prediction that the independent variables, especially conditions in the homes are instrumental to the occurrence of asthma is correct in most of the cases.

Summary

In summary, it is evident from the result of this analysis that the statistical analysis used in analyzing the data for this study was partially supported. Although the three hypothesis indicated an apparent relationship at the early stages of the analysis, it was conditions in the home (Hypothesis 3) that was proved to have a positive association to asthma.

Chapter 5 will summarize and present conclusions for the findings. Highlights of the chapter will include: Summary and Interpretation of Findings; Discussion of the final model; effect of different Conditions in the home; the influence of race, age, and neighborhood; the goodness of fit of the final model; implications for Social Change, limitations and recommendations for action.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The focus of this quantitative cross sectional study was to identify the socioeconomic and environmental factors contributing to the development and persistence of asthma among the minority population in the South Bronx of New York City. Specifically, this study sought to demonstrate and help explain that asthma is not just a product of one factor, but a combined action of many factors within and outside of many homes in our environment by targeting a cross section of a community. Therefore, in order to assess the extent of the effects of these factors, two school districts were surveyed using a parent administered questionnaire. The questionnaire included questions that evaluated the socioeconomic status, living conditions, and the health of the child in order to prove or disprove that asthma is as a result of socioeconomic and environmental factors.

Asthma is a devastating disease that is known to plague young and old, male and female, rich and poor. In as much as there is evidence to show that asthma is an inherited disease, researchers have proved that asthma is mostly a result of environmental factors (see Chapter 2) and the findings of the present study is not far from what other researchers have found. Therefore, identifying factors instrumental to the development and persistence of asthma will help in ameliorating the debilitating effects of asthma in our society.

Summary and Interpretation of Findings

As stated in Woodin, Tin, Moy, Palella, and Brugge (2011), asthma impacts both society and the individual, causing millions of lost school and work-days, which create losses in academic achievement and economic productivity. In as much as there have been studies on asthma and some of its causes, the incidence of asthma has continued to increase. For instance, a study by Brugge, Moy, Palella, Tin, &Woodin (2011) showed that asthma is still one of the most common chronic childhood illnesses in the United States where prevalence nearly tripled from 3.6% in 1980 to 9.1% in 2007, thereby causing this society billions of dollars of health care costs for treatment and hospitalizations. Despite these increases in the cases of asthma, no study exists on this population, the South Bronx, in relation to asthma. Secondly, no researcher has considered examining the combined actions of socioeconomic status and environmental factors on the growing child with regard to this population. To this effect, there have been many speculations on the actual causes of asthma among the minority population in the South Bronx of New York City. Some researchers have tried to generalize based on what was found in other neighborhoods similar to the South Bronx or its surrounding communities. According to McConnell et al. (2010), previous analyses have found associations of asthma with residential distance to major roads and modeled and measured pollutant markers for intra community variation in exposure to traffic (Gauderman et al., 2005; Jerrett et al., 2008; McConnell et al., 2006; Salam et al., 2007b) and with regional pollutants in susceptible children (Islam et al., 2008; McConnell et al.,

2002). However, those were mere speculations because the environments differ and an individual is mostly influenced by his /her immediate environment. As stated in Arvidsson, Frisk, Ivarsson, Kamwendo, Kiviloog, & Stridh (2006) an important issue in occupational therapy is the relationship between the person and the environment, which is related to the person's ability to lead an independent life and subjective well-being and health. In other words, these three components of person, environment, and activity are transactionally related in a process that supports or constrains performance of daily activities.

To identify the constraints to independent and healthy life among the minority population in the south Bronx of New York City, which in effect predispose children to asthma, socioeconomic, and environmental factors, were identified and statistically analyzed for their association to the development and persistence of asthma in this population. The expectation in this study is that there would be a positive correlation between environmental factors, socioeconomic status, and asthma. However, data collected and analyzed indicated that none of the socioeconomic factors were statistically significantly associated with asthma, thereby rejecting alternative Hypothesis #1, which assumed that parental socioeconomic status as indicated by parental income, education, occupation, wealth, and neighborhood characteristics contribute to the development of asthma in minority children in favor of the null. Secondly, none of the surrounding environmental factors were statistically significant, thereby rejecting Hypothesis #2, which stated that factors in the ambient environment (like smoking, traffic exhaust, and presence of industries close to neighborhoods) predispose minority children to asthma as

well, in favor of the null. Only some of the factors indicating conditions inside the homes were statistically significant or showed a likelihood for a positive association in this study, thereby supporting alternative Hypothesis #3, which stated that conditions in the home such as overcrowding, poor ventilation, and presence of mold and other allergens contribute to the development of asthma in minority children and rejecting the null. In other words, the findings of this study suggest that asthma is not a combined action of both socioeconomic and environmental factors but specifically a result of poor conditions in the homes.

This result, therefore, supports the theoretical background of this study, the theories of social ecology and environmental health, which recognizes the child as a product of his/her immediate environment. In other words, any abnormality or inadequacy in the child's immediate environment results in adverse health conditions for the growing child and therefore militates against his/her normal functioning. This abnormality is always a result of poor socioeconomic background because according to literature reviewed in this study, socioeconomic status is one of the militating factors against healthy living.

Discussion of the Final Model

The final model of this analysis suggested that, when considering the development of asthma in minority children, conditions in the home and age of the child play a very significant role. This is evident in the persistent correlation of variables like home structure (*OR*=2.727), usefan (*OR*=1.091), waterdamage (*OR*=5.976), (*OR*=8.903), beddingtype (*OR*=1.110), Medicationtype (*p*=0.000) and asthmaage (*p*=0.001) with

asthma throughout the analysis. It is pertinent to note that medicationtype and asthmaage, though confounding variables, were consistently statistically significant, thereby indicating the presence of asthma among the study population. The variables in the final model, with the exception of medicationtype and asthmaage, are conditions found in the homes that can directly affect the health of the child. In addition, the age of onset being statistically significant in most stages of this analysis is an indication of the prevalence of asthma among the age group studied. A further confirmation of the persistence of asthma in this age group studied is the statistical significance of medication type which is an indication of the of the number of children suffering from asthma.

Conditions in the Home and Childhood Asthma

Housing has been found to affect health directly and indirectly, and the burden of housing-related diseases and injuries is substantial because of the physical, chemical and biological exposures in the home that produce adverse health outcomes (Aceti, Breysse, Dixon, Jacobs, Kawecki, Lopez, & March 2011). In as much as the risk of encountering certain environmental factors known to exacerbate asthma (e.g., dust mite) is only relevant in the indoor environment in some cases, in other cases, the indoor environment accounts for the bulk of most individuals' exposure time, despite the fact that the inciting factor (e.g., particulate matter) could be found outdoors (Diette, McCormack, Hansel, Breysse,& Matsui, 2008).According to Largo, Borgialli, Wisinski, Wahl, and Priem (2011), environmental conditions within the home can exacerbate asthmatic children's symptoms. As an inflammatory respiratory disease that ranges in severity, asthma has acute episodic symptoms that can be induced by exposure to environmental pollutants

and allergens among other factors (Borgialli, Largo, Priem, Wahl, &Wisinski, 2011). This statement is supported by Breysse, Diette, Hansel, Matsui, & McCormack (2008) study, which acknowledged the existence of a growing evidence of environmental causes of asthma and substantial evidence that points to the role of the environment, especially inhaled agents such as allergens, pollutants, and viruses, in provoking asthma attacks.

In recognition of this powerful influence of the environment on the health of an individual, especially young children, this study sought to explore the impact of environmental conditions and situations in the development and persistence of childhood asthma. Hypothesis 2 and 3 examined environmental conditions both inside and outside the homes of study participants and found that two factors inside the homes are significantly associated with asthma. The structure of the homes was statistically significant while absence of extractor fan when cooking, though not statistically significant showed a strong association. The results suggest that home structure (p = 0.019) and absence of extractor fan when cooking (p = 0.065) have a positive relationship with asthma. Consequently, since Americans spend nearly 90% of their time indoors, such as the home, workplace, and school (Breysse, Diette, Hansel, Matsui, & McCormack, 2008) just as other people in most Western societies Arvidsson, Frisk, Ivarsson, Kamwendo, Kiviloog, & Stridh, 2006), any intervention with asthma has to begin in the homes.

Age and Asthma

The age of onset of asthma is one of the variables of interest in this study. This is evident in the age range (4-16 years) included in this study. Descriptive data collected showed

that the age range of the study population were 4 to 6years (33%), 7 to 10years (37.8%), and 11to 16years (28.5%). Age was further analyzed as one of the confounding variables and the result indicated a positive correlation with asthma with a *p*-value of 0.000. This is supported by the significance of the variable medicationtype (*p*=0.000) which is an indication of the percentage of children on asthma medication. Age was again analyzed in combination with other potential significant variables and significant confounders. The result again showed asthmaage (P=0.001) as statistically significant suggesting that the age of onset of asthma is very crucial and worthy of note because age, though not a predictor in this study, might be instrumental to children's susceptibility to asthma and other diseases. Further regression analysis of the two significant confounders (asthmaage and medicationtype) and potential significant variables at the chi square stage also found only medicationtype (*P*=0.000) and asthmaage (*P*=0.001) as the only significant variables. Despite the fact that age was not statistically significant at the final Wald test for main effects previous results suggest that age is an important factor in the development of asthma among minority children 4to 16 years. This finding goes to support the statement by Winer, Qin, Harrington, Moorman &, Zahran (2012) that "over the past 30 years, patterns in asthma epidemiology have shown that prevalence of current asthma is higher in children compared with adults…with over 7.1 million United States children suffering from asthma in 2009." Their study on asthma incidence among children and adults found that during the 3years represented in their analysis, asthma incidence rates were statistically significantly higher for children compared with adults.

The Structure of the Home, Poor Ventilation, and Childhood Asthma

One significant finding of this study is the effect of home structure and indoor pollution, which were suggested by the absence of extractor fan when cooking and poor structure of the home on asthma. These two factors were identified as major contributors to the development and persistence of asthma in children. This means that most of the homes surveyed are poorly structured and ventilated, thereby causing obstruction of air and less oxygen circulation in such homes. This condition subjects children to dyspnea or asphyxia which predisposes them to asthma. This goes to suggest that there are air pollutants in homes which are injurious to the respiratory system.

Indoor air pollution is defined as a complex mixture of pollutants migrating indoors from outdoor air and pollutants generated by indoor sources. Since studies have shown that indoor air pollution concentrations can greatly exceed outdoor air concentrations, indoor sources can be very important contributors to total indoor air pollution (Breysse, Diette, Hansel, Matsui, & McCormack, 2008) These pollutants can be generated from carbon gases from cooking stoves, chimneys, boilers, heaters, and lead paints in homes and are dangerous to children living in these poorly structured homes. For instance, nitrogen dioxide (NO2) is a gaseous product of high temperature combustion, which has many indoor sources, including gas stoves, space heaters, furnaces, and fireplaces, and has been linked to respiratory health effects (Breysse, Diette, Hansel, Matsui, & McCormack, 2008). In a study with inner city children, these authors reported a strong and significant association between higher indoor NO2 and respiratory morbidity, including wheeze, chest tightness, breathlessness, daytime and

nighttime asthma attacks. According to them, NO2 exposure has also been found to impair host resistance to respiratory viruses and bacteria, by reducing bacterial clearance and impairing innate immunity. In addition, higher personal NO2 exposure increased the severity of virus-induced asthma exacerbations, as measured by symptom severity and peak-flow reduction. These authors suggested that gas stoves may also increase other indoor air pollutants, such as nitrous acid, that may also adversely affect respiratory health.

In a study to compare the housing environment between persons with asthma and persons without asthma with regard to building construction and conditions in the homes including physical, chemical, and biological factors that may influence respiratory symptoms, environmental factors were identified in individual homes at levels that could maintain or increase respiratory symptoms in predisposed and sensitive individuals (Frisk, Arvidsson, Kiviloog, Ivarsson, Kamwendo, Stridh, 2006). This finding suggests that home structure and poor ventilation in homes are significant causes of asthma and should be seriously addressed. According to Breysse, Jacobs, March, Dixon, Kawecki, Aceti, &Lopez (2011) building performance results demonstrate that sufficient planning at the design stage and immediate post-renovation testing are essential to ensure that building ventilation works as intended.

Implication for Social Change

The development of asthma is multifactorial but some of its risk factors are known to be preventable. Among these preventable risk factors are those found in the environment such as allergen exposure, environmental tobacco smoke, nutrition, low

birth weight, history of infections, and ambient levels of air pollution (D'Amato, 2002). A statement by Jacobs, Wilson, Dixon, Smith, &Evens (2009) shows that despite the fact that there are other risk factors for diseases, the large health differences among lower-income and minority families compared with other populations suggest housing conditions may contribute to chronic disease in some populations (Rosenberg and Wilson 2001). Researchers have found that asthma rates are higher among children living in low-income communities (Mannino et al. 2002) with the result that from 2001 to 2004, asthma in children living below the federal poverty level was 10.3%, compared with 6.4–7.9% for those at or above the poverty level (Moorman et al. 2007).

The Bronx, especially the South Bronx, being one of the economically disadvantaged counties in New York City has been associated with the highest rate of asthma mostly because of conditions in the environment such as smoking and other air pollutants. Asthma has been linked to a number of pollutants among other factors, which are mostly found in poor neighborhoods. Some of the most commonly studied among these pollutants are the criteria pollutants (carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), ozone (O3), particulate matter (PM10 and PM2.5) and lead (Pb), which is regulated in the United States by the Clean Air Act (D'Amato, 2002).

D'Amato (2002) also reported that Bronx County has some of the highest rates of asthma in the United States, with rates of death from asthma about three times higher than the national average and hospitalization rates about five times higher. In some neighborhoods in the Bronx, it is estimated that 20% of the children have asthma (Ruppel, 2000). Within New York City, the disparity in asthma hospitalization rates is very pronounced.

According to Stolberg (1999), hospitalization rates for asthma in Bronx County and East Harlem are 21 times higher than those of affluent parts of the city. Subsequent reports on asthma trend show that 9.1% of US children (6.7 million) currently had asthma in 2007 (Akinbami, Moorman, Garbe, & Sondik, 2009). According to this report, "recent data showed higher prevalence among older children (11–17 years), but the highest rates of asthma-related health care use were among the youngest children (0–4 years)". In addition, Forno & Celedón (2009) article stated that the prevalence, morbidity, and severity of asthma are higher in children who belong to certain ethnic minorities. According to this article, the overall prevalence of current childhood asthma in the U.S. is 8.7%, but it varies widely by ethnicity, which ranges from 4–5% in Asian Indians and Chinese to 19% for Puerto Ricans, with non-Hispanic whites and other minorities ranking in the middle. Their report also indicated the high severity of asthma in certain ethnic groups such as Puerto Ricans and African Americans with African Americans experiencing more ER visits, hospitalizations, and higher mortality rates from asthma than whites while Mexican-Americans have low mortality rates from asthma (0.3 per 100,000). Additionally, Hispanics in New York City which has a large proportion of Puerto Ricans has mortality rate approximately 1.3 per 100,000 (Forno & Celedón (2009).

These reports are the basis of this present study, which examined the correlates of asthma among the minority population in the South Bronx of New York City. Among the factors examined in the present study is the demographical background of study participants and the result strongly supports what former researchers found on the

demographic characteristics of the South Bronx population. According to these reports, South Bronx is dominated by the minority population. This is suggestive of the result of the present study which found that out of 400 participants in this study, 84% are minorities. The high level of poverty in the South Bronx is also supported by the number of participants who have little or no means of livelihood (see table 4, demographic characteristics of study sample). Also worthy of note is that more than half of the participants in the present study have only high school diploma or less than high school diploma which suggests their possibility/impossibility of being employed and making a good living.

In addition to demographical information from this present study is the result of the data analysis, which showed that environmental factors and conditions in the homes are instrumental to the development of asthma among children in the south Bronx. The houses are poorly structured with improper ventilation.

The implication here is that the Bronx government needs to pay more attention to the South Bronx community by providing amenities that helps to improve the living conditions of the residents. The result of this study showed that more than half of the population of the South Bronx community has little or inadequate education. This explains why majority are unemployed, which contributes to their poor living conditions. This situation calls for an education of the masses, which can never be overemphasized. The residents of the South Bronx community need to be empowered to take care of themselves and their environment by educating them, not just high school education, but college or vocational education. This will help to provide them with good jobs and

consequently enough money to improve their living conditions. Therefore, the researcher advocates for education and grassroots efforts in furtherance of such. Since education is believed to be instrumental to upward mobility, with good education, there will be an improvement in socio economic status and consequently improvement in health conditions.

Recommendations for Action

It is evident from this result of this study that the problem of asthma in the South Bronx is mainly a result of housing conditions and ambient environment. Based on this information, it is important for housing inspectors to schedule routine inspection of the houses in the South Bronx in order to ensure that they are conducive for living. These inspections will help to identify the need for scheduled renovations to old buildings, as even the most well-designed renovation needs post-renovation commissioning, including building performance testing (Breysse, et al, 2011). According to Breysse et al (2011), renovations yield improved housing conditions, making homes easier to clean, more comfortable, and safer both inside the apartment and in the community. In addition, there were fewer moisture and dampness issues, little or no pest problems, and less smoke indoors. Overall, their study found significant health improvements following low-income housing renovation that complied with green standards.

Secondly, since this community has been defined as perpetually poverty stricken, possibly due to lack of adequate education and employment as seen in the result of the present study, the government should consider designing programs that will provide mass education and job readiness. This will presumably help the residents in getting good jobs

and remain employed because with good and steady jobs, there will be less risk of little or no question of poverty. There is also a need for proper supervision of what goes on in the South Bronx environments in order to make sure that there is an alignment of activities with acceptable health standards. Specifically, the State Environmental Sanitation Services should consider increased need to routinely supervise proper disposal of refuses, and to monitor industries and other businesses to ensure that they follow stipulated health guidelines. In other words, the ambient environment and conditions of living in the South Bronx calls for a serious attention of environmental engineers. Breysse, et al (2011) suggested a collaboration of housing, public health, and environmental health professionals through integrated design, which they believe hold promise for improved health, quality of life, building operation, and energy conservation.

To reduce the effect of NO2, Diette, McCormack, Hansel, Breysse,& Matsui, (2008) suggested replacing unfueled gas heaters with fueled gas or electric heaters, reducing exposure to common indoor irritants, ensuring that a NO2 -producing device (such as a stove) is properly vented to the outside, and selecting electric rather than gas appliances.

In general, management of asthma requires attention to environmental exposures that originate from both the outdoor and indoor environment, though, arguably, those originating indoors may be more relevant for certain patients with asthma (Diette, McCormack, Hansel, Breysse, & Matsui, 2008). Their suggestion is that avoidance of environmental factors that provoke asthma, where feasible, is a logical way to improve

asthma-related health and to minimize the need for long term use of asthma medications (Diette, McCormack, Hansel, Breysse, & Matsui, 2008).

The result of this study will be communicated to the residents of the South Bronx Community as a method of educating them on the risk factors for asthma in their environments that are affecting their well being. It is intended and hoped that this study will act as a catalyst for change by creating social and economic awareness in the South Bronx. In addition, it will provide knowledge useful for program developers, educators, psychologists, and other researchers who are searching for ways to improve the environment and protect the health of the masses especially children.

Recommendations for Further Study

Due to limited resources, the data for this study were generated from only two school districts, which may not give a comprehensive representation of the South Bronx. The researcher therefore recommends that future researchers should use more than two districts. Secondly, a case control study on the South and North Bronx will enable all stakeholders to see if there is really a disparity in environmental and living conditions in the South Bronx. Thirdly, the findings in this present study suggest that both environmental factors and living conditions are detrimental to the health of the child. In order to have an in depth examination of each factor, the researcher recommends further studies on each. Lastly, to ensure that research participants have thorough understanding of survey questions and the accuracy of information given by participants, the researcher suggests that future researchers use interview mode of data collection in addition to children's medical records.

Conclusion

An analysis of the problem of asthma in children reveals a multidimensional problem that requires an extensive research. The present study dealt with factors in the child's immediate environment with the result showing a positive correlation between asthma and some conditions in the home. This result is an addition to the numerous findings on asthma as an inherent disease that needs the attention of all in different works of life.

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Appendix A: Parents' Socioeconomic Status and Child's Health Survey Informed Consent Form

Your child's district has been selected to participate in a study that seeks to find out some of the factors responsible for the development of asthma in minority children. In as much as there will be no material gifts for your participation, this study, if successfully carried out will create awareness on the conditions in your environment that are contributing to the development of asthma among children. It will also attract the attention of community leaders and program developers in providing help for the neighborhoods. Specifically, you will learn about the causes of asthma in your environment and how to avoid them.

A questionnaire has been prepared and is being given to you for responses. Your help is needed in collecting required information if you have lived in your present address for at least six months and is a parent of a child/children in either elementary and middle school. This form "informed consent" explains the nature of the study so that you will be able to decide whether to participate or not. The researcher conducting this study is a doctoral student at Walden University and will be grateful if you complete and return the questionnaire.

Background of the Study.

The researcher has worked with public school children in the South Bronx of New York City for over 15 years, and in the process noticed that one of the reasons for poor attendance and failure in school among public school children in this area of the Bronx is asthma. For this reason, the researcher has decided to find out reasons for the high rate of

asthma in the South Bronx. The purpose of this study, therefore, is to find out if things in the environment and the living conditions have any relationship to the children's development of asthma.

The researcher needs your help in order to obtain information on your living environment and could help by answering questions on your living conditions, and your child's health since you started living in this area of the Bronx if you agree to participate. The questions will require YES or NO answer or CIRCLE ONE LETTER at the most and will only take about 5 - 10 minutes of your time.

Your participation in this study is voluntary and will not in any way affect you or your child. If you agree to complete the questionnaire, you can skip any question you don't understand or feel comfortable answering.

The nature of this study and the completion of this questionnaire have no risk involved, so no problem will be anticipated because of your participation. It is for the sole purpose of obtaining information and any information you provide will be kept confidential. The researcher can only use your information for the sole purpose of this study and nothing else. Anything that identifies you and your child will not be mentioned when reporting the result of this study.

Walden University has approved this study. The approval number is ……..This approval will expire on……..

Completing this questionnaire will indicate you have agreed to participate in this study. You may keep a copy of this consent form for your records.

Thank you for participating.

Appendix B: Parents' Socioeconomic Status and Child's Health Survey Questionnaire

(PSSCHQ)

The purpose of this survey is to ask for some information about your child's asthma, his/her health history, as well as living environment. Write your child's name, school and district in the space provided and then continue with section A.

Child's Name: _____
Child's School _____
District: _____

SECTION A: PERCEPTION OF CHILD'S HEALTH

The following questions ask about your child's health in general. Please read each question carefully before answering.

Instructions: Please complete form in Black, Blue, or Red ink. Circle one number for each question.

1. In general, would you say your child's health is:
    1. Excellent
    2. Very good
    3. Good
    4. Fair
    5. Poor

2. Compared to his or her first year of life, how would you rate your child's health now?
    1. Much better now than his/her first year
    2. Somewhat better now than his/her first year
    3. About the same now as his/her first year
    4. Somewhat worse now than his/her first year
    5. Much worse now than his/her first year

3. During the PAST 4 WEEKS, how much bodily pain or discomfort has your child had?
    1. None
    2. Very mild
    3. Mild
    4. Moderate
    5. Severe
    6. Very severe

SECTION B: DEMOGRAPHICAL BACKGROUND OF BOTH PARENTS AND CHILD

4. Are YOU:
   - o Male
   - o Female

5. What is your relationship to the child?

   1. Mother
   2. Father
   3. Grandparent
   4. Uncle/Aunt
   5. Guardian
   6. Other (specify)_____

6. What is your child's date of birth?

Month Day Year

7. Which of the following best describes YOUR racial background?
   1. Caucasian
   2. Afro-American
   3. Hispanic
   4. Asian/Oriental or Pacific Islander
   5. Other

8. In what grade is your child now? (Check one number only)
   1. Kindergarten
   2. 1st grade
   3. 2nd grade
   4. 3rd grade
   5. 4th grade
   6. 5^{th} grade
   7. 6^{th} grade
   8. 7^{th} grade
   9. 8^{th} grade

SECTION C: CHILD'S LIVING ENVIRONMENT

The following questions are about your child's living conditions

9. What is your residential address? _____

_____
_____

10. Which of the following best describes your home structure?
    1. Mobile home or trailer
    2. Apartment
    3. Single family house
    4. Detached townhouse
    5. Other
       (specify)_____

11. How long have you lived in your present apartment/house?
    _____Months_____Years

12. When was this house built? _____

13. How long have you lived in your present neighborhood?
    _____Months_____Years.

14. How would you describe your neighborhood? (Circle one)
    1. Economically developed
    2. Somewhat economically developed
    3. Poor
    4. Very poor

15. Is your neighborhood mostly made up of
    1. People from two racial background or less
    2. People from three racial background or less
    3. People from diverse or many racial background

16. How do you feel about the amenities and maintenance in your neighborhood?
    1. Very well satisfied
    2. Somewhat satisfied
    3. A little bit satisfied
    4. Not satisfied
    5. Don't know

17. Which of the following do you have within 1mile in your neighborhood? (Circle all that apply)
    1. Restaurants
    2. Entertainment centers
    3. Cultural facilities
    4. Churches

5. Ethnic diversity
6. Industries

18. Do you feel safe in your neighborhood?
    - o Yes
    - o No

19. How many people live in your household?
_____people

20. Does your child have his/her own room?
    - o Yes
    - o No

21. Does your home have any of the following?
    1. Central heating
    2. Ducted air heating (forced air heating)
    3. Air conditioning

22. Which fuel does or did you use for heating? (MARK ALL THAT APPLY)

	a. At Present	b. During the Child's first year of life
Gas		
Oil		
Electricity		
Coal or coke		
Wood		
Other		

23. Which fuel does or did you use for cooking? (MARK ALL THAT APPLY)

	a. At Present	b. During the Child's first year of life
Gas		
Electricity		
Coal or Wood		
Other		

24. Over the last four weeks, when you were cooking, did you have a door or window to the outside air open?
    1. Most of the time
    2. Some of time
    3. Rarely (or only occasionally)
    4. I do not have a door or window that opens to the outside in my kitchen

25. Do you have an extractor fan over the cooker?
    1. Yes
    2. No
    3. Don’t know

IF 'NO' OR 'DON'T KNOW' GO TO QUESTION 26. IF 'YES', next questions

26. When cooking, do you use the fan?
    1. All of the time?
    2. Some of the time?
    3. None of the time?

27. Does the fan take the fumes outside the house?
    1. Yes
    2. No
    3. Don’t Know

28. Does or did your child's home have air conditioning?

	a. At Present	b. During the Child's first year of life

Yes, central air conditioning		
Yes, window unit		
No		

29. How old is the oldest carpet or rug in your child's bedroom or the room which your child uses most at home during the day?
    1. less than one year
    2. 1-5 years old
    3. more than 5 years old
    4. child's bedroom does not have a rug or carpet

30. How old is your child's mattress?
    1. less than one year
    2. 1-5 years old
    3. more than 5 years old

31. What kind of pillow does or did your child use? (MARK ALL THAT APPLY)

	a. At Present	b. During the Child's first year of life
Foam		
Synthetic fiber		
Feather		
Does not use pillow		

32. What kind of bedding does or did your child use? (MARK ALL THAT APPLY)

	a. At Present	b. During the Child's first year of life
Synthetic quilt		

Feather quilt		
Blankets		
Wool		
Other materials		

33. Does or did your child's home have damp spots on the walls or ceiling?

	a. At Present	b. During the Child's first year of life
Yes		
No		

34. Does or did your child's home have visible molds or fungus on the walls or ceiling?

	a. At Present	b. During the Child's first year of life
Yes		
No		

35. Has there been any water damage to the building or its contents, for example, from broken pipes, leaks or floods?

1. Yes
2. No
3. Don’t know

36. How much were you annoyed by outdoor air pollution (from traffic, industry, etc.) in your home, if you kept the windows open?

1. a lot
2. a little

3. not all

37. How often do cars pass your house?
    1. constantly
    2. frequently
    3. seldom
    4. never

38. How often do heavy vehicles (e.g. trucks/buses) pass your house?
    1. constantly
    2. frequently
    3. seldom
    4. never

39. Does or did your child's mother smoke cigarettes? (MARK ALL THAT APPLY)

At Present	b. During the Child's first year of life	c. During pregnancy with your child

40. Does anybody at present smoke cigarettes inside your child's home?
    - o Yes
    - o No

    40.1. If YES, how many cigarettes in total are smoked per day in the child's home? (E.g. mother smokes 4 + father smokes 5 + other persons smoke 3 = 12 cigarettes)
    - o Less than 10 cigarettes
    - o 10-20 cigarettes
    - o More than 20 cigarettes

41. Was your child ever breast fed?
    - o Yes
    - o No

42. If YES, for how long?
    - o Less than 6 months
    - o 6-12 months
    - o More than one year

43. Which of the following pets do or did you keep inside your child's home? (MARK ALL THAT APPLY)

	a. At Present	b. During the Child's first year of life
Dog		
Cat		
Other furry pets		
Bird		
Other animals		

Other animals		

44. In the past month have you seen any evidence of the following pests in your home? (CIRCLE ALL THAT APPLY)
    1. Cockroaches
    2. Rats/mice
    3. Other (Specify)_____

SECTION D: PARENTS' EDUCATION, OCCUPATION, AND INCOME INFORMATION

I'd now like to ask you a few questions about your job, your education, and your family income.

45. What is the highest grade you completed in school?
    1. Some high school or less
    2. High school diploma/GED
    3. Vocational school or some college
    4. College degree
    5. Professional or graduate degree

If employed, go to question 47. If No, go to the next question

46. Which of the following best describe your current status?
    1. Employed

2. Looking for work or on layoff from a job
4. Homemaker
5. Student
6. Retired
7. Disabled, unable to work
8. Other (describe)
9. Refused

47. What type of work do you do? _____

48. How long have you been employed?
1. 15years or more
2. 10years or more
3. 5years or more
4. 3years or more
5. 1year or more
6. 6months or more
7. Less than 6months

49. How many hours per week do you usually work? (List total number of hours)
_____hours per week

50. What was your occupation at the time this child was born?
_____

51. In order to get an accurate picture of the income for your household, could you please tell me the sources of income or other benefits for you and your family members? (CIRCLE ALL THAT APPLY)
1. Wages
2. Interest or dividends from bank accounts or investments
3. Social Security payments
4. Retirement pensions or payments
5. Unemployment payments
6. Disability or workman's compensation payments
7. Alimony or child support payments
8. Public assistance (welfare) payments
9. Aid for Families with Dependent Children (AFDC or ADC) payments
10. Supplemental Security Income (SSI) payments
11. Women, Infants and Children's (WIC) program benefits
12. Food stamps
13. Other
(describe)_____

52. What is your total annual household income? Is it…
    1. Less than $10,000
    2. $10,001 to $20,000
    3. $20,001 to $30,000
    4. $30,001 to $40,000
    5. $40,001 to $50,000
    6. $50,001 to $60,000
    7. $60,001 to $70,000
    8. $70,001 or Higher
    9. Refused

53. What was your educational level at the time this child was born?
    1. Some high school or less
    2. High school diploma/GED
    3. Vocational school or some college
    4. College degree
    5. Professional or graduate degree

SECTION E: CHILD'S RESPIRATORY HEALTH AND FAMILY HISTORY

Please read each of the following questions carefully before answering.

54. Has your child had wheezing or whistling in the chest in the last 12 months?
    - o Yes IF YES, GO TO QUESTION 55
    - o No IF NO, GO TO QUESTION 57

55. How many attacks of wheezing has your child had in the last 12 months?

    ☐☐☐ Number of attacks

56. In the last 12 months, what has made your child's wheezing worse? (MARK ALL THAT APPLY)

Weather	Pets	Soaps, Sprays or detergents
Pollen	Wool clothing	Other things (please list below)
Emotion	Colds or 'flu	☐☐☐☐☐☐☐☐☐☐☐☐☐
Fumes	Cigarette Smoke	☐☐☐☐☐☐☐☐☐☐☐☐☐

Dust	Foods or drink	☐☐☐☐☐☐☐☐☐☐☐☐☐

57. In the last 12 months, has your child had a dry cough at night, apart from a cough associated with a cold or chest infection?
    - o Yes IF YES, How many episodes? _____
    - o No

58. Has your child ever had a problem with sneezing, a runny nose, or blocked nose when he/she DID NOT have a cold or the flu?
    - o Yes
    - o No …….IF NO, GO TO QUESTION 65

59. In the past 12 months, has your child had a problem with sneezing, or a runny, or blocked nose when he/she DID NOT have a cold or the flu?
    - o Yes
    - o No

60. In the past 12 months, was this nose problem (mentioned in Question 47) accompanied by itchy-watery eyes?
    - o Yes
    - o No

61. In the past 12 months, how much did this nose problem interfere with your child's daily activities?
    1. Not at all
    2. A little
    3. A moderate amount
    4. A lot

62. Has your child ever been breathless?
    - o Yes
    - o No

63. Has your child had an attack of shortness of breath that came on during the day when he/she was at rest at any time in the last 12 months?
    - o Yes
    - o No

64. Has your child had an attack of shortness of breath that came on following strenuous activity at anytime in the last 12 months?
    - o Yes
    - o No

65. Have you ever been told by a teacher, school official, doctor, nurse or other health professional that your child has any of the following conditions?

1. Anxiety problems
2. Chronic allergies or sinus trouble
4. Chronic respiratory, lung or breathing trouble (NOT ASTHMA)
5. Depression
6. Sleep disturbance
7. Does your child have any other chronic medical condition that is affecting what they do or how they feel? (please describe below)

66. Has your child ever had asthma?
- o Yes
- o No IF NO, GO TO QUESTION 68

66.1. Was it confirmed by a doctor?
- o Yes
- o No

66.2. Is your child currently taking any medication for asthma?
- o Yes
- o No

66.2.1. What type of medication? (MARK ALL THAT APPLY)
- o Inhaler
- o Pills
- o Other, specify_____

67. How old was your child when his/her asthma was first discovered? Please tell me the number of years, or the number of months if he/she was less than 1 year old when his/her asthma was discovered.

_____years old
_____months old

68. Did your child have trouble with breathing right after birth?
1. Yes
2. No
3. Don't know/Not sure

69. Was he/she placed in an incubator (a machine to help him/her keep warm) after birth?
1. Yes
2. No
3. Don't know/Not sure

70. Was he/she intubated, that is, had a tube in his/her throat, with a machine helping him/her breathe, after birth?
    1. Yes
    2. No
    3. Don't know/Not sure

71. Was your child ever hospitalized for a severe chest illness or cold before the age of 2 years?
    1. Yes
    2. No
    3. Don't know/Not sure

72. Which of your child's relatives have asthma or the following allergies or allergic reactions (check all that apply). We want this information only for people related to your child by blood.

	Grandparents		Parents		Brothers/ Sisters		Uncles /Aunts	Cousins		
	Yes	No	Yes	No	YeS	No	Yes	No	Yes	No
a. Asthma										
b. Eczema (skin rash)										
c. Hives (welts)										
d. Rhinitis (runny nose, watery eyes, and sneezing not related to a cold)										
e. Sinusitis (sinus headache)										

f. Other (specify)					

73. Has your child been awakened during the night by an ATTACK of any of the following symptoms in the last 12 months? (MARK ALL THAT APPLY)

	YES	NO	How many times?
a. Wheezing			
b. Cough			
c. Shortness of Breath			
d. Chest Tightness			

Thank you for participating in this survey

Curriculum Vitae

VERONICA C.UWANAKA
3208 Wilson Avenue
New York, N.Y 10469
347-602-5310
vuwanaka@aol.com

EDUCATION

Sep 2006 –Present, Walden University

- Candidate for Doctorate degree in Public Health –Epidemiology
- Completed Masters degree courses in Public Health
- Highlights of Researches: To what extent does Outdoor Air Pollution affect Human Health? (PUBH 6140-04);Water pollution: A Threat to Human Health (PUBH 6430-05); Factors Affecting the Development of Asthma in Children Ages 1-10 (PUBH 6105-05); Smoking and the Regulation of Tobacco (PUBH 6130-09);
- Presentation: An overview of Public Health
- Dissertation: "The correlates of Asthma Among the Minority Population in South Bronx, New York"

Sep 2001 – 2004, Columbia University in the City of New York

- M.A in Developmental Psychology
- Research: Effects of Social interaction on Individuals' Development of an understanding of Gender Roles

Sep 1989 – 1991, University of Nigeria, Nsukka in Enugu State

- B.ED in English /Education
- Research: Teaching Nigerian Culture through Literature: A Cultural Fictional Approach

Sep 1986 -1989, Alvan Ikoku College of Education, Owerri in Imo State, Nigeria

- NCE, English/Igbo
- Three Months internship at Emmanuel College, Owerri- Taught English and Igbo languages

EXPERIENCE

High/Middle School English Teacher

- Developed curriculum and lesson plans for instruction
- Provide instructions
- Keep daily attendance and records

- Tested and evaluated students' progress

Common Branch Teacher

- Managed students' behavior
- Plan and provide instruction in different subject areas
- Evaluated students' daily performances
- Keep daily attendance and records

SKILLS

- Knowledge of SPSS Statistical software
- Microsoft Office, internet
- Fluent in English and Igbo Languages
- Excellent Writing Skills

PROFESSIONAL AFFILIATIONS

- Chapter Leader, United Federation of Teachers
- Member, English Language Association Council
- Member, American Federation of Teachers

Interests

- Reading
- Movies