Final Project Report
Children's Health – Indoor Air and Radon Project
Agreement number CH982113-01-0

St. Regis Mohawk Tribe
Environment Division
March 2003

Acknowledgements

The following persons are acknowledged for their role in this project. Without their assistance the project simply could not have happened.

Development of the Quality Assurance Work plan: Dr. David Carpenter, SUNY-Albany and Dr. Lupita Montoya-Jansen.

Review of the Quality Assurance Work plan: Rachel Chaput, USEPA, Region 2.

Sample Collection, Handling and Processing; Angela Benedict-Dunn, Joyce Barkley, and Alice Tarbell.

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Geographic Information System Support: Aimee Debo.

USEPA Region 2 Project Coordination: Rachel Chaput, Ameesha Sempatha

Budget Tracking: Denean Cook.

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Executive Summary

An asthma survey of Mohawk elders was conducted on the St. Regis Mohawk Reservation in 2000. The purpose of the survey was to examine indoor and environmental factors and their relationship to asthma in Mohawk elders. 45 elders were surveyed and information obtained and analyzed for indoor air quality factors measured and information obtained from a survey form.

Literature was researched for information on asthma and asthma in Native American elders. Literature was limited in this respect, but that which was available portrayed respiratory disease in Native American populations as a large concern.

In examining the data collected from this survey there appears to be strong influences on asthma from personal lifestyles and environmental factors, these include smoking, industry and mobile sources.

Expanding sample collection or focusing on certain critical aspects, such as mold, and by being more individualized in data interpretation, can improve upon the survey.

A previous study, focusing on industrial air pollution, forecasted imminent respiratory problems in Mohawk males, then aged in teens and twenties. Asthma, as indicated my a more recent study, has manifested itself in Mohawk Adult Males in their forties, twenty-some years later.

Introduction and Background

Saint Regis Mohawk Tribe, History

The Saint Regis Mohawk Reservation (known to the Mohawks as "Akwesasne", the land where the partridge drum) has 14,640 acres of treaty land in the northwest corner of Franklin County on the St. Lawrence River. It is situated approximately eighty miles northeast of Lake Ontario and sixty miles southwest of Montreal, and is bounded on the east by the Town of Fort Covington, on the south by the Town of Bombay, and on the west by the Town of Massena in St. Lawrence County. The reservation extends to the north across the international border.

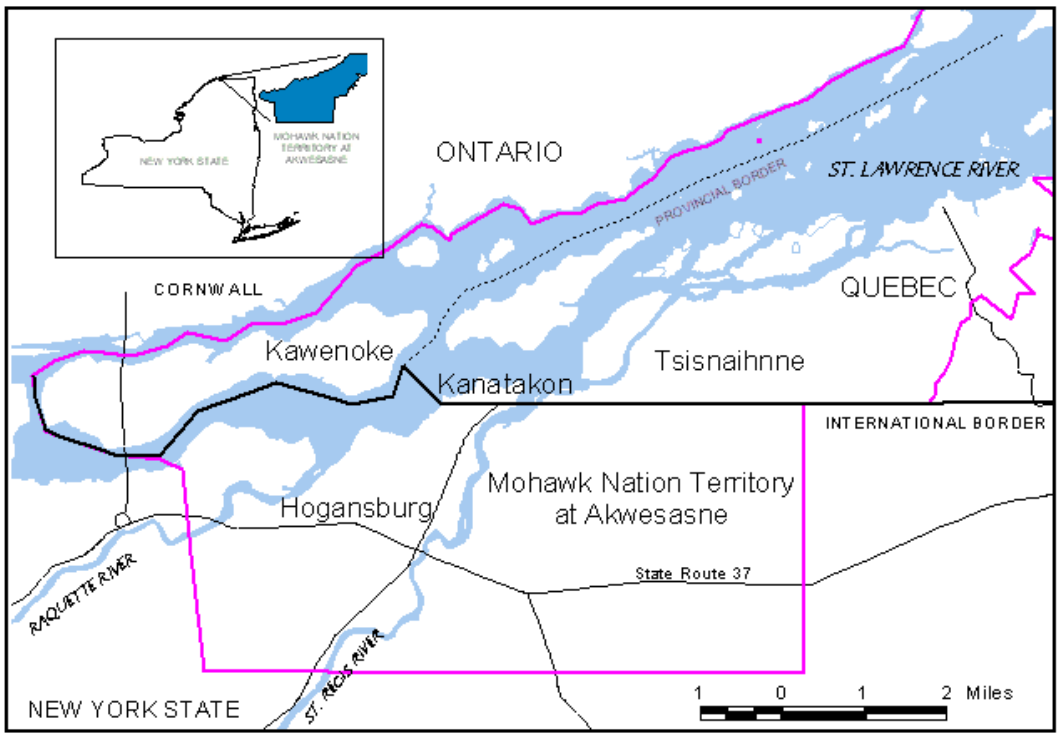

Figure 1

Christian Mohawks from the Kanawake Mission settlement near Montreal, Quebec, joined original settlers of the Saint Regis area. The Kanawake Mission was established in 1735 by French Jesuit Missionaries who had led a group of converted Mohawks to the Saint Lawrence Valley from their castle villages near Schenectady. The Saint Regis Mohawk community has lived there continuously since 1755.

Mohawks are part of the Iroquois Confederacy of Six Nations. The Confederacy, in addition to the Mohawks, is comprised of the Seneca, Cayuga, Onondaga, Oneida and Tuscorora. The Confederacy, which is thousands of years old, unified peoples of the same language stock for protection of common interests.

Geography and Climate

The Reservation is situated on the 45th parallel of latitude and has a fairly moderate climate. The mean minimum temperature for a year encountered in the region over the 30-year period from 1931-1960 was 33.1 degrees Fahrenheit.

Prevailing winds are from the southwest to west, and the mean average wind speed is 10.7 miles per hour. The Average frost-free period is 140 days per year, with the precipitation averages of 38.84 inches and 89.9 inches of rain and snow, respectively. The entire reservation lies within the Saint Lawrence Valley, and is characterized by gently rolling to hilly topography with some large areas of swamp on the eastern extremities of the mainland portion. Soils throughout the reservation are composed

predominantly of glacial till and clay deposits. Much of the reservation's soil has been shown to have moderate to severe limitation for subsurface sewage disposal because of such adverse factors as low permeability, seasonally high groundwater, or shallow bedrock.

The low-lying areas of the reservation consist mainly of willow brush, native swamp, foliage grasses, and a mixture of deciduous soft woods. The upland areas support northeastern mixed hardwood forests of maple, beech, oak, and elm along with white pine and white spruce. Grass, hay crops, pasture, and family vegetable gardens occupy the remaining cultivated lands.

Population

The 1990 census population on the reservation was 1,974. Census data for the reservation indicates that the population has grown, though this number traditionally is unreliable as tribal enrollment (6,236) and those living on the reservation as their primary home address have increased markedly, (3,631). The increase in population might well be due to recent socioeconomic improvement in the area, resulting in many people moving back to the Reservation. Results from the 2000 Census are not available at the time of this writing.

The Tribal Council believes that the population growth will continue at a steady rate, so planning and developing of a training plan for fire and environmental personnel to respond to any potential hazardous materials incident is a high priority. Along the same lines a comprehensive emergency preparedness plan that is integrated with other state, local and federal response agencies will ensure the highest degree of environmental protection and public safety for the Mohawk community.

The primary local economy, based on retail sales and services, draws thousands of people daily to the reservation. Gas stations, restaurants, bingo parlors and cigarette shops supply consumers from western Ontario, Western Quebec, and from several counties in northeast New York State. The number of people visiting is expected to rise as retail services expand and develop in the community and with the advent of casino gaming on the reservation.

Tribal Government

Its members established the original Tribal Government as part of the original treaty through the election of three chiefs is responsible for the operation and administration of the Tribal government offices, establishing laws and regulations and enforcing laws and regulations on the Saint Regis Mohawk Reservation.

Respiratory Disease

The National Institute of Allergy and Infectious Diseases defines asthma as an inflammatory lung disease that is an allergic reaction to infiltrates and inflammatories, or

allergens. The Institute suggests that even though allergic reactions are important factors in asthma, viral infections, and exposure to tobacco smoke and pollutants are just as important.

Chronic lung diseases are associated with smoking and are preventable. A study in the State of Washington found that over a 15-year period COPD increased by a rate of 19.9 per 100,000, paralleled by asthma rates for the same time period (Washington State Department of Health, 2003). COPD is considered a disease primarily of older adults, with death increasing with age (Washington State Department of Health, 2003). The Washington study also found that race and ethnicity are factors in COPD, with blacks having the highest age-adjusted death rate followed by Native Americans and Alaska Natives.

The Washington study characterized high-risk groups for COPD as

- poor or low income, lack of education and having other indicators or low socioeconomic status
- elderly
- occupational exposure to significant amounts of organic and inorganic airborne particulates

Risk factors cited were

- Tobacco usage, where even former smokers were at greater risk of developing COPD
- Air pollution, citing increased evidence that air pollution contributes to decreased lung function and increased mortality
- Occupational exposures, from organic particles, grain processing, inorganics, mining, etc.
- Tobacco usage and occupational exposures have an additive effect on the risk for COPD

Asthma and Respiratory Health Concerns of Native Populations

The people of the St. Regis Mohawk reservation (Akwesasne) are thought to be particularly susceptible to respiratory health concerns due to the close proximity of industrial sources, burn barrels and areas of high traffic flow. Various studies conducted by organizations such as the American Lung Association show that prevalence of asthma in Native American populations (men and women) is higher compared to that of white populations (men and women) (American Lung Association, 2003). Research done specific to the Akwesasne reservation performed by Ernst, Thomas, and Becklake (Ernst et al, 1986) explored the relationship of respiratory symptoms and lung function to exposure of air pollution made up of particulate and gaseous fluorides. Their results focused on young males and concluded that exposure to fluoride air pollution in the community may be associated with abnormalities in small airways. Although young males were the focus of the study, it is probable that the same effects are being felt

through other members of the community; male and female, young and old alike. Latest efforts to understand the process of health concerns among Native individuals emphasize the study of both male and female individuals, as past research has focused primarily on men. One must note that the subjects of the Ernst study are now in their forty's and as is illustrated by a more recent survey (Hodge) there may be some cause for concern.

The American Lung Association reported that age-adjusted prevalence for asthma was 4.5 percent in Native American men and 6.02 percent in Native American women compared to 4.26 percent in white men and 4.30 in white women. Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death from chronic disease for Native American men and the sixth leading cause of death for women (American Lung Association, 2003).

Among the most pressing of health concerns of Native American populations, cancer is one of the prominent. Although cancer rates in Native American peoples are generally lower compared to white populations, lung cancer is the most common among Native American males and fourth most common among Native American females. Causes of the lung cancer are due to genetic factors as well as exposure to both indoor and outdoor toxins (I.H.S. Primary Care Provider, 1996).

Asthma and Respiratory Health Concerns of the Elderly (Native American)

The National Resource Center on Native American Aging at the University of North Dakota studied chronic diseases in Native Americans by examining ambulance usage. The study stated, "Native American Elders comprise a major risk group for poor health, chronic disease, high health care costs and institutionalization" (University of North Dakota, 1999).

Of the top illness complaints breathing difficulty was found to the highest. The study defined breathing difficulty as a sensation of difficult or uncomfortable breathing and causes by COPD, obesity, smoking, tuberculosis, dust-laden environment, medications, allergies, asthma, lung disease and congestive heart failure. The rates of Native American Elders were higher for age groups of 55-64, 65-74 and 75+, at a rate of 296%, 334% and 103% respectively (University of North Dakota, 1999).

The study stated that the high prevalence of chronic diseases, including respiratory disease indicated the need for prevention programs on reservations as well as increased efforts for disease management.

The United States Department of Indian Health Services (I.H.S.) has acknowledged the importance of health care among elders in Native populations. A conference held in Duluth, Minnesota in 2000 emphasized the need to address innovations in the attention of the elderly with the establishment of the Elder Care Initiative. The department of the I.H.S. states:

> "The goal of the Elder Care Initiative is to promote the development of high-quality care for American Indian elders by acting as a

consultation and liaison resource for IHS, tribal, and urban Indian health programs."

In addition to those individuals that are very young, have chronic health infections, or weak immune systems, elderly individuals are particularly at risk for chronic health infections (Lawrence and Martin, 2001). The *I.H.S. Primary Care Provider* states that in order to address issues related to health and wellness among the elderly, "health care providers must work with the elderly as clients or partners rather than patients."

A prevalence study of self-reported disease in the Mohawk community revealed that there was a high incidence of asthma among male and female adults compared to national data. For self-reported disease conditions, comparing adult Mohawk and the US Adult Population, Mohawk males aged <45 years had a rate or 0.059% compared to 0.061% for the US Population; Mohawk males aged 45-64 years had a rate of 0.067% compared to a rate of 0.031% for the US Population; and a Mohawk males aged >64 years of age had a rate of 0.278% compared to 0.036% for the US Population.

Mohawk females aged <45 years had a rate of 0.20% compared to 0.061% in the US Population; Mohawk females aged 45-64 had a rate of 0.242% compared to 0.061% in the US Population; and Mohawk females aged >64 years had a rate of 0.10% compared to 0.042% US Population. The rate is per 1000. (Hodge)

Rates were particularly higher in Mohawk adult males older than 64 years and females in all three age categories.

Project Background

The St. Regis Mohawk Tribe, Environment Division, Air Quality Program developed plans to investigate the prevalence of asthma and indoor air quality impacts in its elder population. Most investigations focus on young and adolescent children, there are few studies made of the elder populations. Asthma and respiratory ailments in general are of concern to the Tribe because of the largely uncharacterized impacts to Mohawk residents from neighboring industries. There are also air quality concerns from burn barrels usage, diesel smoke, traffic dust and fumes and poorly ventilated homes.

As part of this project an indoor air quality and asthma workshop was hosted at Akwesasne to promote respiratory health and education. The workshop presented information about the nature of asthma, triggers and provided attendees with measures they could use in reducing exposures to allergens. The workshop was attended by community members and by Mohawk health care workers.

This project recruited elderly members from the Mohawk Territory of Akwesasne to answer a questionnaire and to allow dust samples to be taken from their homes for allergen analysis. The study was patterned after a similar study developed by the State University of New York (SUNY) – Albany to assess asthma in Mohawk children.

A technician hired from within the community by SUNY collected 45 samples including measurement of various indoor air quality parameters and completed 45 survey questionnaires. Samples were to have been analyzed by SUNY, but a loss of critical staff at SUNY resulted in samples being analyzed by the DACI Lab at John's Hopkins University, Baltimore, MD.

Delays in Quality Assurance Project Plan (QAPP) development and review, along with loss of critical staff at SUNY-Albany, placed the project including the delivery of this report behind schedule.

Data were analyzed and interpreted by the Environment Division.

Sampling Project Design

The project was targeted to survey 50 elderly households on the Mohawk reservation, , targeting the age group 65 and older, through personal interview, dust sample collection and measurement of indoor air quality indicators (carbon monoxide, carbon dioxide, relative humidity, temperature and dew point). The questionnaire specifically determined the following information:

- Indoor Exposure Assessment
- Tobacco usage information
- Indoor combustion devices – stove, fireplace, etc.
- Presence of biological contaminants – molds, mildew, pets
- Use of chemicals in home, such as paints and varnishes
- Usage of pesticides – bug sprays, plant sprays, pet sprays
- Number of hours spent indoors
- Distance and direction from heavy industry, highways and burn barrels

These elements are important to the understanding of respiratory diseases in general and may be an important contributing factor to asthma on the St. Regis Mohawk Reservation. Many residents have complained of the choking effects and, triggering of asthma attacks associated with their exposures to industrial air emissions, use of burn barrels and dust and fumes generated from the highways.

Indoor dust sample collection

Indoor dust sampling consists of collecting dust samples from carpeting and flooring using a portable vacuum cleaner with a dedicated collection bag. The dust samples collected will be analyzed for dust mites.

Dust samples collected will be examined as part of the overall sample collection process under by SUNY-Albany. Dust samples will be collected using procedures commonly practiced by the Industrial Hygiene community. Indoor air quality measurements will be accomplished using a Solomat® indoor air quality surveyor instrument. The instrument is a four-sensor probe with data logging capability.

The premise for collecting dust samples is based on knowledge that it contains materials that can trigger allergic reactions, including asthma. "Allergy symptoms are found to gradually intensify as indoor allergens accumulate and/or as ones allergic sensitivity increases (Hamilton, 1992). Dermatophagoides pteronyssinus (DerP), American dust mite and Dermatophagoides farinae (DerF), European dust mite, are responsible for contributing to over 90% of allergens in house dust (Hamilton, 1992). Dust mites thrive in warm moist environments and are best known for inhabiting bedding (beds, couches) as well as carpeting. Allergen measurements in house dust samples are most useful when interpreted within the context of an individual's history. Samples should also be representative of living areas.

This survey is limited by the fact that allergen analysis is for dust mite allergen only, as pet allergen (bird, cat, dog), mold spore and insect allergens play a role in allergen reaction and asthma as do dust mites.

The interpretation of allergen levels is tempered with the understanding of current studies that indicate, "exposure-response relationships between asthma and allergens have not been readily established, nor have thresholds that must be exceeded to cause or exacerbate asthma been identified for most allergens" (American Thoracic Society, 1990). However, mite exposure is considered to be a major risk factor in the development of respiratory allergy and asthma (Hamilton, 1992).

Indoor air quality measurement

Indoor air quality measurements were made using the Solomat Indoor Air Quality Surveyor (IAQS) for acquiring information on CO2 levels, CO levels, temperature, humidity and dew point airflow in homes where the Indoor Air Quality Assessment questionnaire were applied. The IAQS is a hand-held monitoring device, which consists of a four-function probe, anemometer probe and a data-logging unit. The IAQS was set up in the breathing zone of the occupants, 3-4 feet from the floor, in a room that is most occupied. Windows and doors were closed for the duration of the sampling, unless windows and doors were normally opened while the room is occupied.

Indoor air quality measurements:

- Carbon monoxide – toxic combustion byproduct, its presence is an indicator of faulty heating systems.
- Carbon dioxide levels – combustion byproduct and respiration byproduct, indicator of ventilation in a building.
- Humidity level – a comfort indicator, at extremely high levels promotes growth of molds and fungi.
- Temperature – a comfort indicator, high temperature in association with high humidity promotes growth of molds and fungi.
- Dew point – the temperature at which water vapor will condense, in homes it is indicator of conditions that cause walls to sweat creating and environment that promotes molds and fungi.

These parameters are general indicators of air quality in an environment (home) (Table 1). They relate to the overall quality of the air breathed by occupants. Together they provide an indication of the conditions in a home that may relate to respiratory problems. High CO2 levels indicate poor air exchange as occupants expire CO2 and it accumulates. CO is an indicator of poor ventilation for combustion devices (gas stoves, wood stoves, space heaters, and furnaces) and also may be an indicator of faulty equipment. Humidity levels affect comfort as well as health, where low humidity aggravates air passages by drying them and excess humidity contributes to molds and mold spores. Temperature in general is a measure of comfort, but in conjunction with humidity can be used to determine the dew point. The dew point, or temperature at which water vapor condenses, relates to the formation of molds and spores.

Table 1

Measurement	**Criteria**
CO2 as pollutant	Compared to outdoor levels, 340-400 ppm
CO2 – occupant generated	Recommended maximum is 1000 ppm
CO	OSHA TWA 25 ppm
CO	ASHRAE 8-hour < 2.5 ppm
Temperature °C &°F	Ratio of room temperature to flooring temperature is thermal comfort.
Relative Humidity	30%-60% is optimum for comfort and limits microbe growth
Dew Point	Dew point, or condensation point calculation. High dew points promote microbe growth.

Dust Samples - Carpeting and Air (As per SUNY-Albany Methods)

Dust samples were collected from carpeting and furniture using:

Small portable vacuum cleaner (The Boss Mighty Mite, Model 3670A, The Eureka Company, Bloomington, IL 61701) and a plastic, clear adapter/dust trap.

Two squares of cotton material, 6X6 inches as the sample media for the carpeting and furniture sample.

One filter-cassette and personal sampler (pump) assembly placed close to breathing area of the person collecting the dust sample for the air sample.

Three zip-lock bags. Labels should be inserted inside each zip-lock bag with the full name of the patient, the date of collection, and the area sampled. Each house's materials were bound together and stored at 4°C upon return to the office. Data collection sheets and chain of custody sheets were used to track the disposition of samples.

The filter cassette assembly was placed on the chest with small clip while collecting dust samples. The sampler (assembly) was calibrated to run at 4.0 liters per minute and started as soon as the vacuuming started and turned off when the vacuuming was completed. Total sampling times were recorded. Calibration were made after sampling was completed and before next use.

Two dust samples were collected: one from the living room and one from the bedroom. The sample was considered sufficient when the 6X6 cotton sheet was not visible as seen through the layer of dust. The sample was then be folded at the midline repeatedly a couple of times and placed inside a zip-lock bag. The filter cassette was placed in a separate zip-lock bag than the dust sample. After sampling was completed, the 3 samples were bound with a rubber band. In between each house visit, the adapter was wiped out with a disposable "wet nap" towel to eliminate cross contamination.

If the house had multiple living rooms or dens, sample were taken from either the room that is used the most often or the room that is located in the basement. The room was vacuumed along the baseboards and in corners where dust often accumulates. All rugs in the living room should were vacuumed if necessary (cleaning 1 square meter for 2 minutes providing an adequate sample). Dust around any fireplace, especially ash was avoided. If there is a sofa in the living room, both sides of all sofa cushions were vacuumed in addition to the sofa's armrest, back cushions, along the top, and any pillows that were on the sofa. Any carpets in the bedroom were vacuumed thoroughly including the areas around the baseboards and behind the door. Every layer of the bedding was vacuumed including the mattress unless covered by a plastic pad. The pillow was vacuumed above and below the pillowcase.

Results

The survey resulted in the ability to interview 45 elderly Mohawks from the community, giving the sample population of n=45. From this sample population, 21 were diagnosed as being asthmatic by their health practitioner, 24 were not diagnosed as asthmatic. Only one respondent, an asthmatic, reported there being another household member also being asthmatic. The average number of years they had spent in the building they were currently occupying was 8.11 years (Table 2).

Table 2

Sample size n=45	Yes	21
	No	24
	Percent Yes	46.67%
	Percent No	53.33%
Avg years in bldg		18.11

The average age of the sample population was 74.3 years, with the ranging from 63-86 years of age. The asthmatic group had an average age of 74.6 years with a similar age range. Non-asthmatics were slightly younger on average, 74.3 years and had a wider range, 85-64 (Table 3, Figure 2).

Table 3

Age Information				
	Average	Oldest	Youngest	Median
Group	74.31111	86	63	74
Asthmatic	74.62069	86	63	74
Non-Asthmatic	74.33333	85	64	73.5

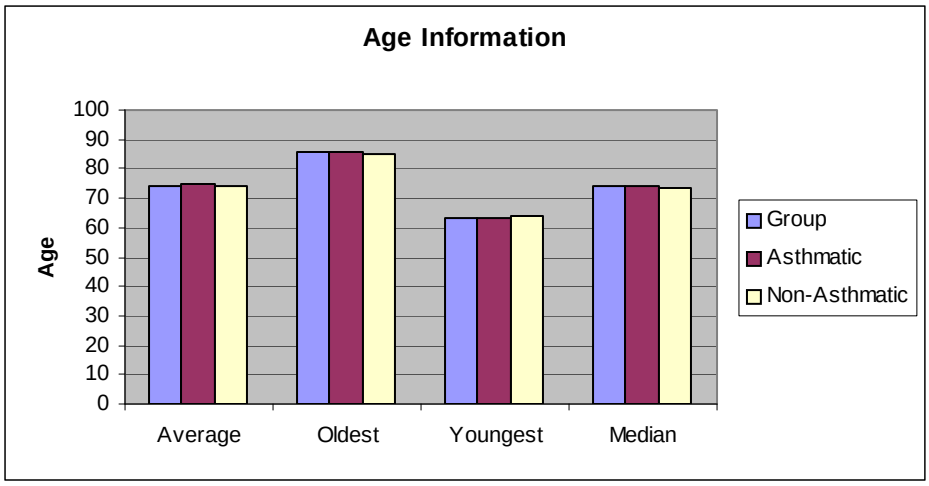

Figure 2

Elderly asthmatics had their first attack as short as the year in which the survey was conducted, 0 years and as long as 66 years ago, the average was 16 years ago. The average number of times that asthmatics experienced an attack in the past twelve months was 2.45 times, the maximum number of times was 4 and the minimum was 1 time (Table 4, Figure 3).

Table 4

For those who have asthma and had an attack, how long ago (average)?			16.41 years
Longest	66 years	Shortest	0 years
Average number of times experienced asthma attack in last 12 months.			2.45 years
Max	4	Min	1

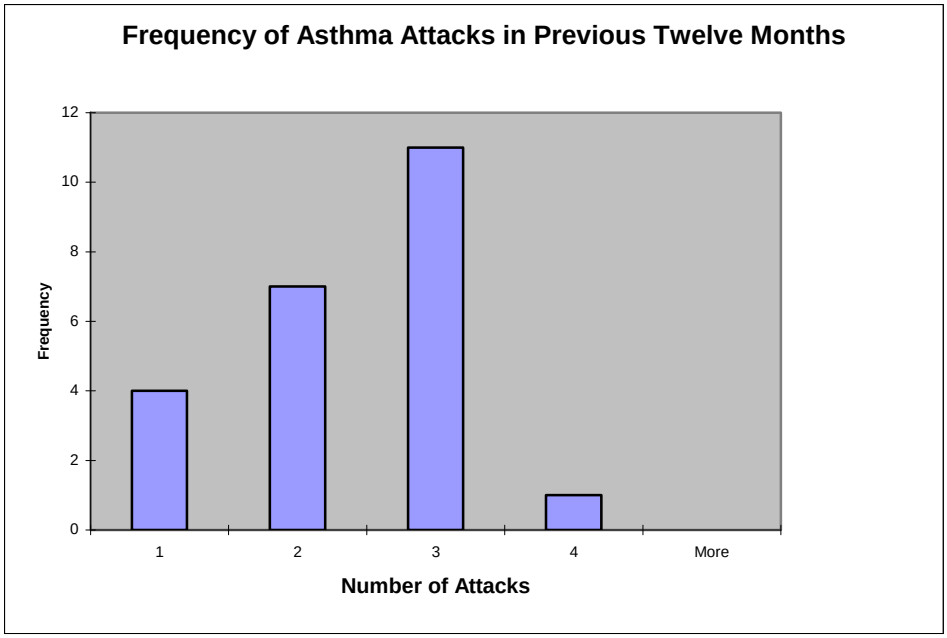

Figure 3

In examining the relationship between age and asthma it was determined that there is a negative correlation between age and being asthmatic, correlation coefficient = -0.00365.

The average household size of the asthmatics was 1.12 compared to the average household size of 0.97 for non-asthmatics, as a group the household size was 1.06. As a whole the sample population lived in their homes for an average of 18.11 years, asthmatics an average of 18.75 and non-asthmatics an average of 16.57 years (Table 5).

Table 5

What is the average Household Size? Asthmatic and non asthmatic and as a group.	
Asthmatic hhs	1.12 persons average
Non-asthmatic hhs	0.97 persons average
Group hhs	1.06 persons average
What is the number of years that persons have been occupying the home?	
Avg time in home asthmatic	18.75 years
Avg time in home non asthmatic	16.578947 years

A relationship was found between the number of years a home was occupied and the amount of allergen that was measured. The strength of this relationship was greatest for the allergen DerF. To speculate this can be expected as the longer one is in a house dust accumulates (Figures 4 & 5).

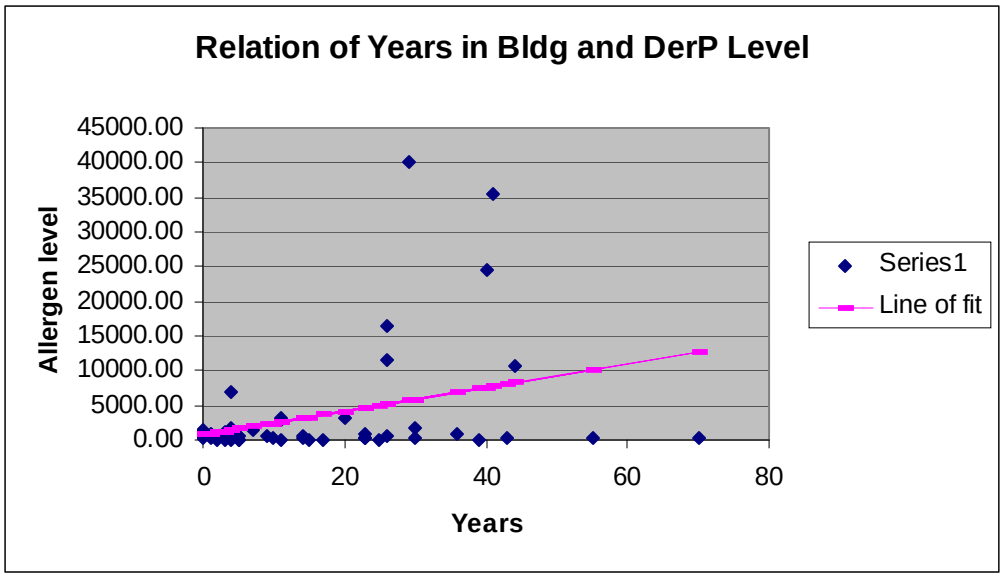

Figure 4

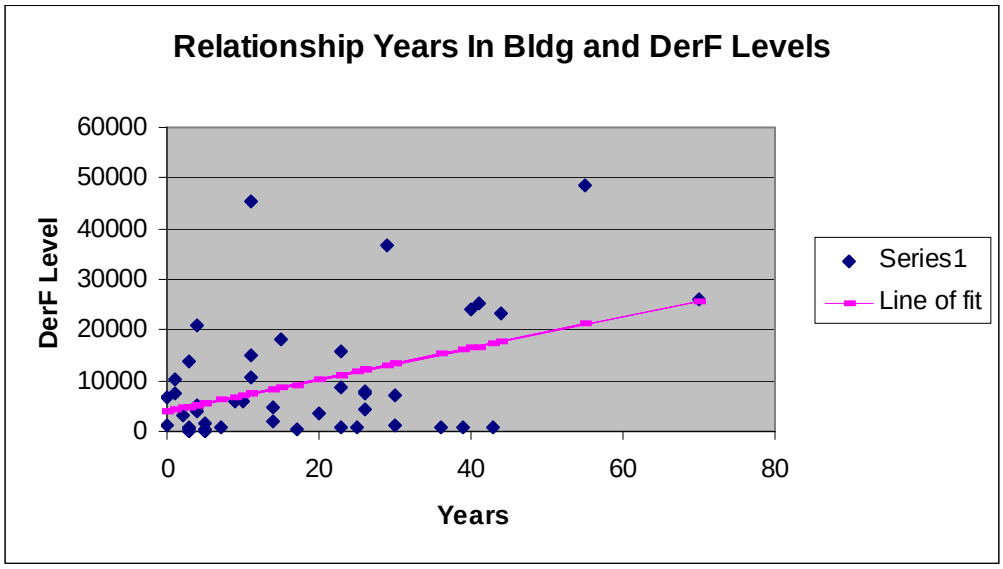

Figure 5

As a group only 6 reported having slept in a different place, other than their current house, for more than 30 days in the last 12 months. This included 4 who were asthmatic. The relevancy of this factor is the exposures to the environment in their own home (Table 6).

Table 6

Did the respondent sleep in another place other than the current house for more than 30-days in the last 12 months?		
Sleep dif place all	6 yes	13%
Sleep dif place all	39 no	87%
If asthmatic	4 yes	19%
If non-asthmatic	41 yes	91%

For the respondents as a whole, 68.8% live in separate single-family housing, 17.8% live in apartment housing, 8.9% live in trailer homes, 4.4% live in attached single-family house/duplex's (Table 7).

Asthmatics tended to live in separate single-family houses more that non-asthmatics, comparing 71.435 to 66.67% respectively. Non-asthmatics tended to live in apartment houses, 25% compared to asthmatics at a rate of 17.78% (Table 7).

Table 7

	Count – frequency			Percent		
House type	Group	Asth	Non Asth	Group	Asth	Non Asth
Separate single family house	31	15	16	68.88	71.43	66.67
Attached single family house/duplex	2	1	1	4.44	4.76	4.17
Apartment house	8	2	6	17.78	9.52	25.00
Trailer or mobile home	4	3	1	8.89	14.29	4.17
Modular home	0	0	0	0	0	0
Other, specify	0	0	0	0	0	0

In comparing the average number of rooms in their living quarters, asthmatics and non-asthmatics were very similar, 6.95 and 6.52 average rooms, respectively. As a whole the group had 6.78 rooms in their dwelling (Table 8).

Table 8

Average number of rooms in living quarters	
Survey group	6.78
Asthmatic group	6.95
Non Asthmatic group	6.53

In examining the presence of carpeting in their home, 53.3% had carpeting in the bedroom, living room and dining room, 28.9 percent had carpeting in the bedroom and living only, 6.6% had carpeting in the bedroom and dining room, 4.4% had carpeting in the living room, 4.4% having no carpeting and 2.2% had had no response. No one had carpeting in the bedroom only (Table 9).

Table 9

Profile Carpeting in home		
Survey Group	#	%
Carpeting in bedroom only 1	0	0
Carpeting in living only 2	2	4.44
Carpeting in Dining room only 3	0	0
No carpets	2	4.44
Carpeting in bedroom and living room	13	28.89
Carpeting in bed, living and dining room	24	53.33
Carpeting in bedroom and dining room	3	6.66
Non response	1	2.22

Asthmatics were proportionately similar, with 47.6% having carpeting in the bedroom, living room and dining rooms, 23.8% with carpeting in the bedroom and living room, and a spread of 9.5% with carpeting in the living room only, no carpeting and carpeting in the bedroom and dining room (Table 10).

Table 10

Asthmatic Group	**#**	**%**
Carpeting in bedroom only 1	0	0
Carpeting in living only 2	2	9.52
Carpeting in Dining room only 3	0	0
No carpets	2	9.52
Carpeting in bedroom and living room	5	23.81
Carpeting in bed, living and dining room	10	47.62
Carpeting in bedroom and dining room	2	9.52
No response	0	0

Non-asthmatics were slightly different and proportionately higher for carpeting for the bedroom and living room and bedroom, living room and dining room categories. 58.3% had carpeting in the bedroom, living room and dining room, 33.3% had carpeting in the bedroom and dining room and 4.16% had carpeting in the bedroom and dining room. 4.16% (one person) did not respond to the question. Statistically, there was little difference between the groups (Table 11).

Table 11

Non Asthmatic Group	#	%
Carpeting in bedroom only 1	0	0
Carpeting in living only 2	0	0
Carpeting in Dining room only 3	0	0
No carpets	0	0
Carpeting in bedroom and living room	8	33.33
Carpeting in bed, living and dining room	14	58.33
Carpeting in bedroom and dining room	1	4.16
No response	1	4.16

When respondents were questioned about factors that triggered asthma they provided their interpretation of what these factors were. These are listed in Table X in relation to the factor and the number of times it was cited. A total of 57 factors were cited by the 21 asthmatics (Table 12, Figures 6&7).

Table 12

Factors			
Ranking of factors as cited by respondents			
Change in temperature	7	Humidity	1
Change of seasons	6	Mow lawn	1
Chemical cleaners	5	Nerves	1
Chemical products	5	Odors	1
Cigarette smoke	4	Perfume	1
Cold	3	Pollen	1
Damp weather	2	Spray scents	1
Dust	2	Stress	1
Environmental tobacco smoke	2	Temperature	1
Excited	1	Tired	1
Exercise	6	Weather	1
Fragrances	1	Wind	1
Heat	1		
Total Number of factors listed	**57**		
Average overall number of factors cited	**2.76**		
Average number of factors cited for those that responded	**3.22**		

In reviewing the factors it appeared that many of the factors could be combined into general categories such as placing temperature, seasons and damp weather into a Weather related category. This was done and then a ranking made of the factors to determine which occurred the most frequently. Weather related was the highest, being cited 25 times, followed by chemicals at 10, environmental tobacco smoke and exercise tying at 6, dust/pollen/mow lawn and well being tying at 4 each and fragrance and perfume being cited last at 2 (Table 13).

Asthmatics cited more factors and a greater variety of factors that triggered asthma. For asthmatics, 2.76 factors were cited, for those who actually responded they cited 3.22 factors (3 people did not respond). Non-asthmatics cited 0.2 factors collectively and 1.66 factors for those who responded (Table 14 & 15).

Table 13

Ranking of combined factors	
Weather related	25
Chemicals general	10
Environmental tobacco smoke	6
Exercise	6
Dust/pollen/mow lawn	4
Well being	4
Fragrance or perfume	2

Table 14

Profile of factors triggering attacks in asthmatics and non-asthmatics (Raw data)	
Asthmatics	**Times factors cited**
Stress, Cigarette Smoke, Perfume, Chemical Products	4
Blank	0
Change of Seasons, Spray Scents, Dust	3
Blank	0
Blank	0
Heat, Dust, Cold	3
Exercise, Pollen	2
Humidity, Heat, Exercise	3
Dust, Exercise, Heat, Change in Temp	4
Fragrances, Weather, Wind, Humidity, Stress, Change of Seasons	6
Humidity	1
Tired, Exercise, Change of Seasons, Mow lawn	4
Damp weather, Change in seasons, exercise	3
Nerves, Excited, Humidity	3
Temperature, Humidity, Cold, Exercise	4
Cold, ETS	2
Humidity, Exercise	2
Heat, Humidity, Change in seasons, ETS	4
Change seasons, humidity, Dust, ETS, Fragrance, Chemical Cleaners	6
Dust	1
Exercise, Odors, Cold	3
Average overall	2.76
Average for those that responded	3.22

Table 15

Profile of factors triggering attacks in asthmatics and non-asthmatics (Raw data)	
Non Asthmatics	**# factors cited**
Blank	0
Rain, Mold	2
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Blank	0
Smoking, Humidity	2
Blank	0
Relaxing	1
Average overall	0.208333
Average for those that responded	1.666667

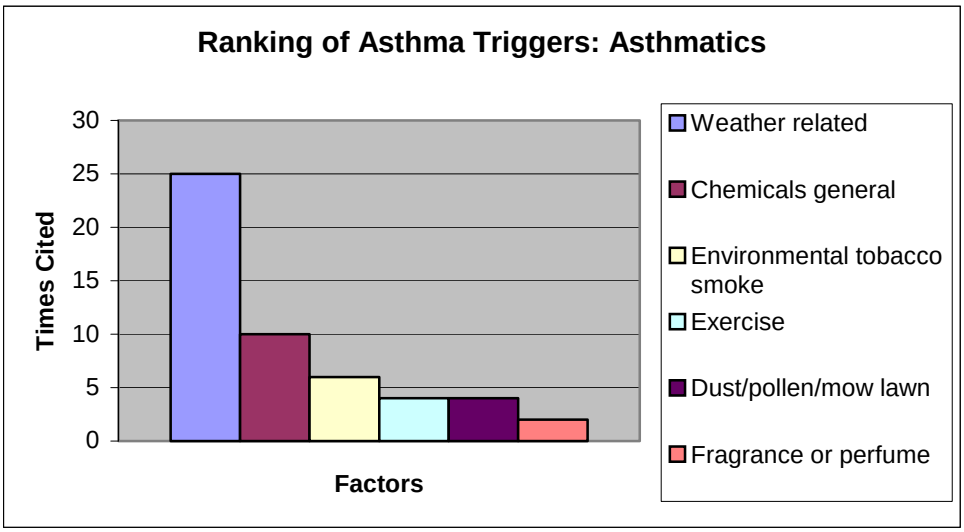

Figure 6

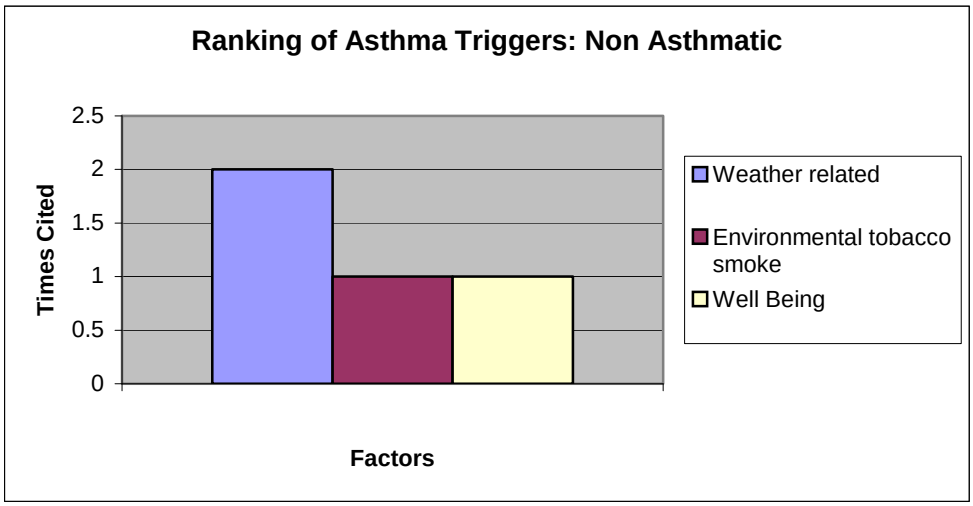

Figure 7

Those who were asthmatic on average had their first attack 16.4 years ago, with the longest condition being 66 years ago, meaning that asthma occurred during late childhood or early adolescence. The most recent occurrence was the year of the survey. This indicates that asthma for this population has spanned the lifetime of their existence, but on average occurred during the most recent years (2001-16 = 1985) (Table 16).

The average number of times an attack occurred was 2.45 times, the greatest number of times an attack was experienced in the past 12 months was 4 and the least 1. 2 people did not answer the question.

19 (90.48%) respondents who said they were asthmatic said they had experienced an asthma attack characterized by shortness of breath, smothering feeling, or an inability to get enough air, or difficulty to take a deep enough breath. The other 2 (9.52%) reported they did not have such and attack.

Table 16

For those who have asthma and had an attack, how long ago (average)?	16.40909091 years
Average number of times experienced asthma attack in last 12 months.	2.454545455 years
Longest	66
Shortest	0
Greatest number of times.	4
Average	2.45
Least number of times.	1
For those who have asthma but did not have an attack, how long ago?	2 Did not answer
Number of those that had asthma and attack	19
Number of those that had asthma and no attack	2

When those who reported these attacks were asked about having musical lung sounds or wheezes, 18 responded that they had experienced these sounds. 14 reported noticing trigger factors associated with these lung sounds. 12 reported being awakened by the condition (Table 17).

Table 17

Reporting of lung symptoms.	
Those with asthma reporting symptoms	18
Those with asthma reporting no symptoms	1
Those who noticed factors associated with symptoms	14
Those who did not notice factors associated with symptoms	2
Non responses to the question	2
Those with asthma reporting symptoms and have been awakened	12
Those with asthma reporting symptoms and have not been awakened	8

It was reported that the average number of times this occurred in the past 12 months was seven and as often as more than 100 times and as little as 0 times. It was also reported that 2 non-asthmatics experienced this condition as well (Table 18).

Table 18

Average number of times this occurred for asthmatic past 12 months	7
Max	>100
Min	0
Non Responses	3
Didn't know	1
Non asthma reporting symptoms and have been awakened	2
Non asthma reporting symptoms and have not been awakened	2

In reporting symptoms, as a group wheezing, stuffy nose and other symptoms were reported to coincide predominantly with spring and winter. This is the true for the survey group and for asthmatics and non-asthmatics proportionately. Non-asthmatics reported fewer symptoms. Spring is when there is a lot of pollen in the air and winter is when people spend most of their time indoors and exposed to indoor air pollutants (Figures 8, 9, 10, 11, 12, &13).

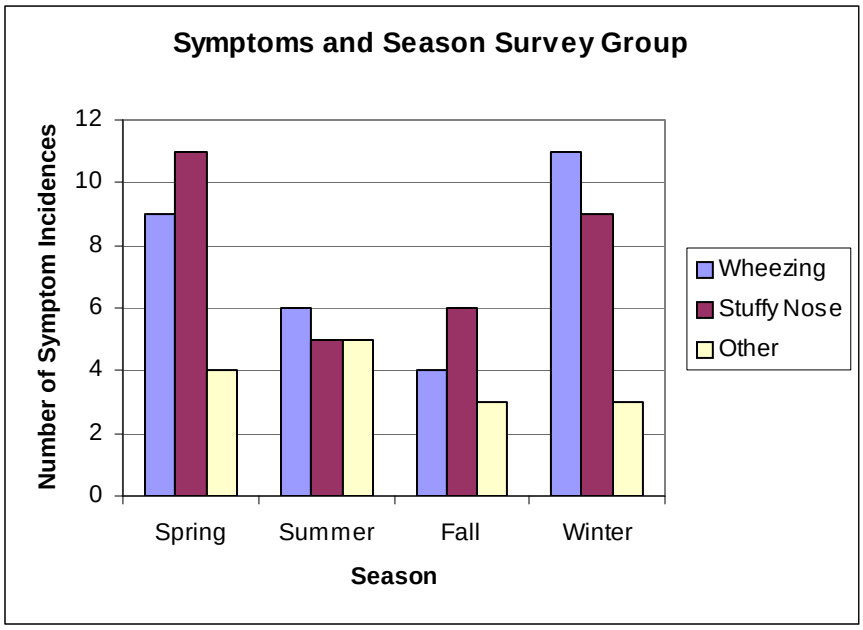

Figure 8

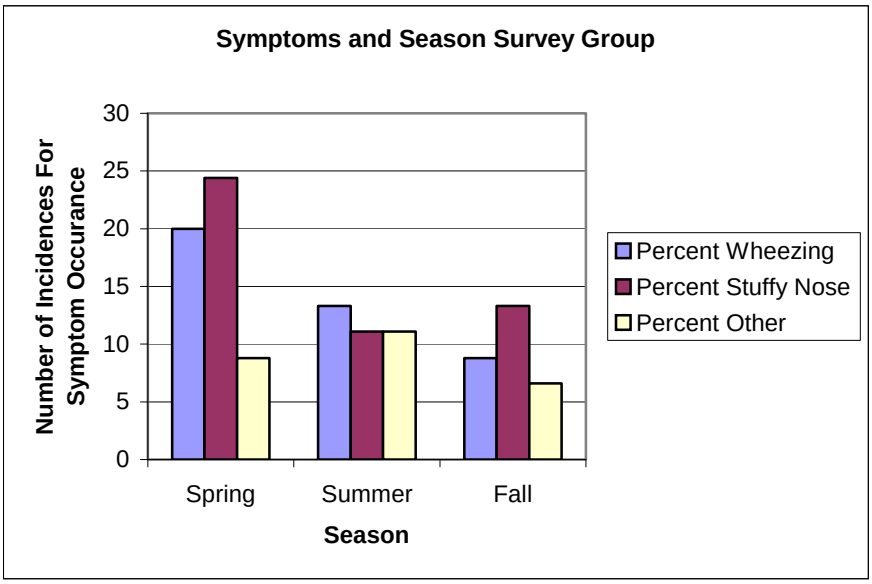

Figure 9

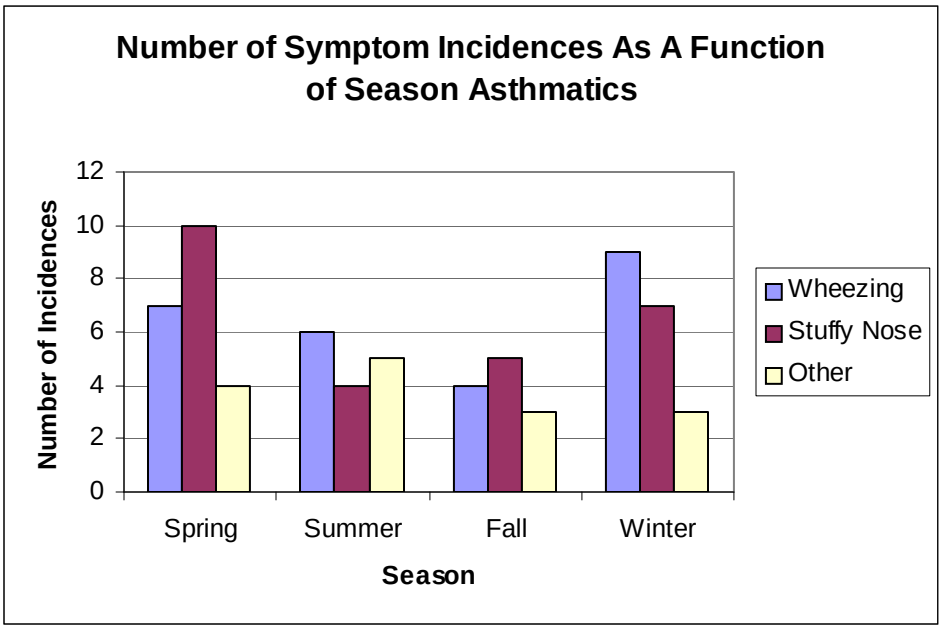

Figure 10

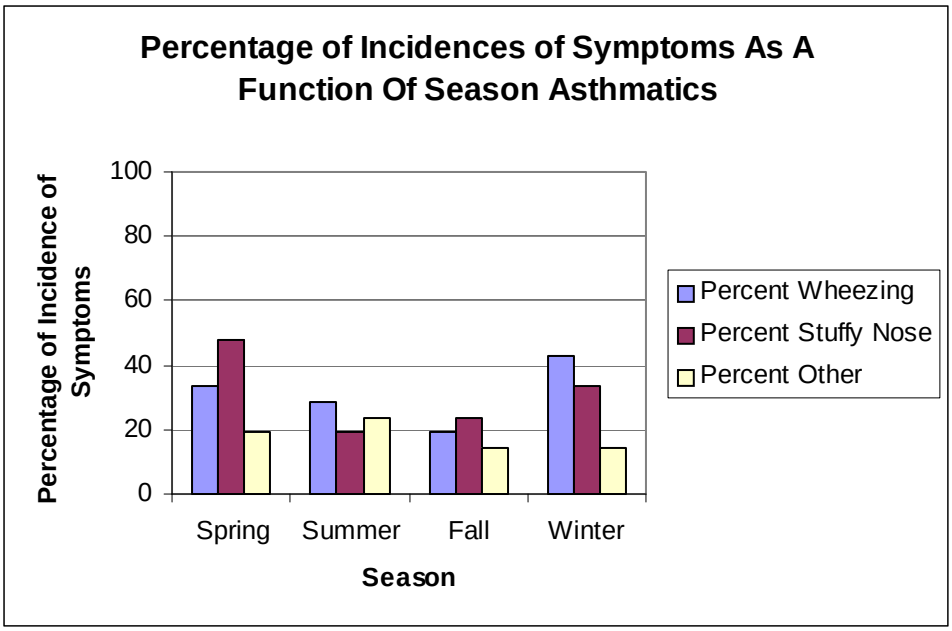

Figure 11

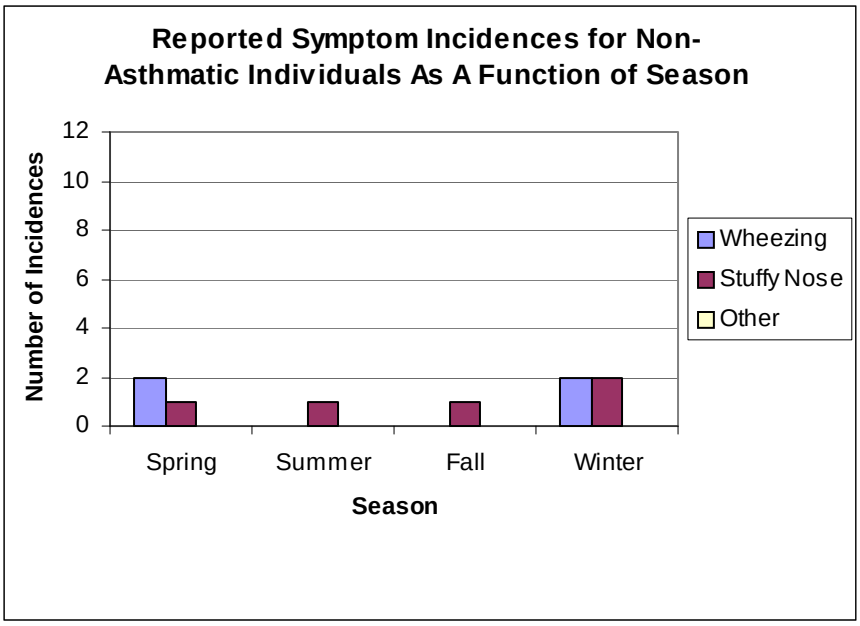

Figure 12

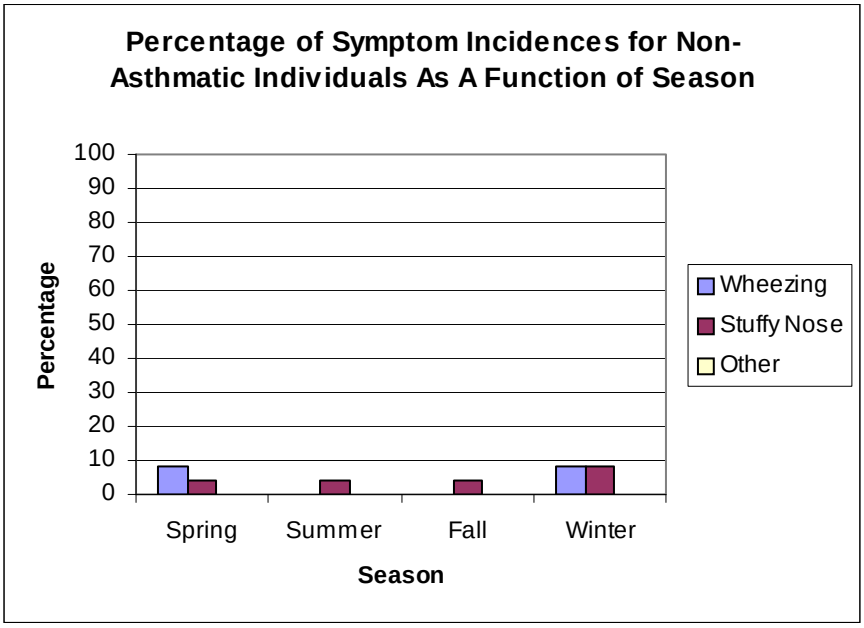

Figure 13

When asked questions about smoking it was observed that for the group there were an average of 10.6 cigarettes smoked in the home during the last week compared to a 6.7 in asthmatics homes and 9.9 cigarettes in non-asthmatic homes. There was 1/3 less cigarettes smoked in the asthmatics home in the past week of the survey (Table 19).

There was a definite relationship between the number of cigarettes smoked and CO levels in the homes for both groups (Figures 14 & 15). Cigarette smoking is a known factor in respiratory ailments, including asthma.

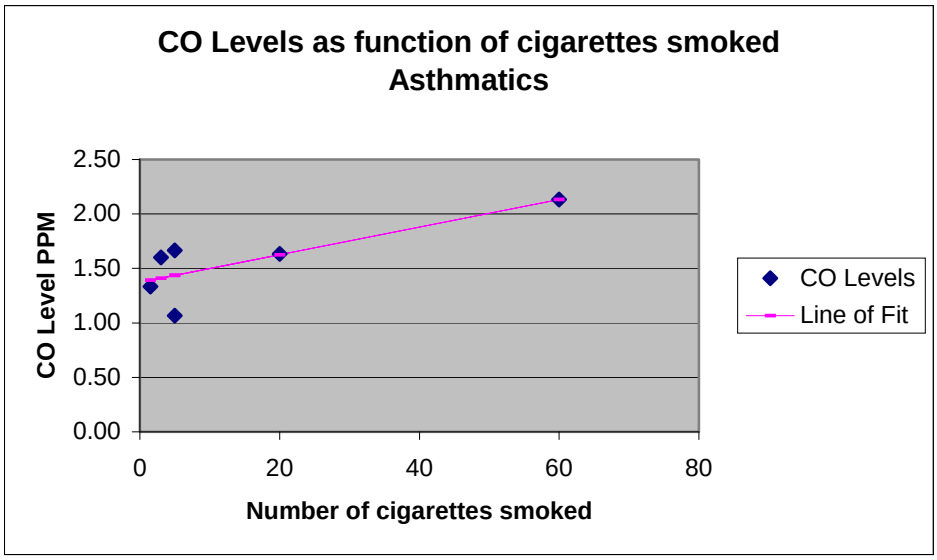

Figure 14

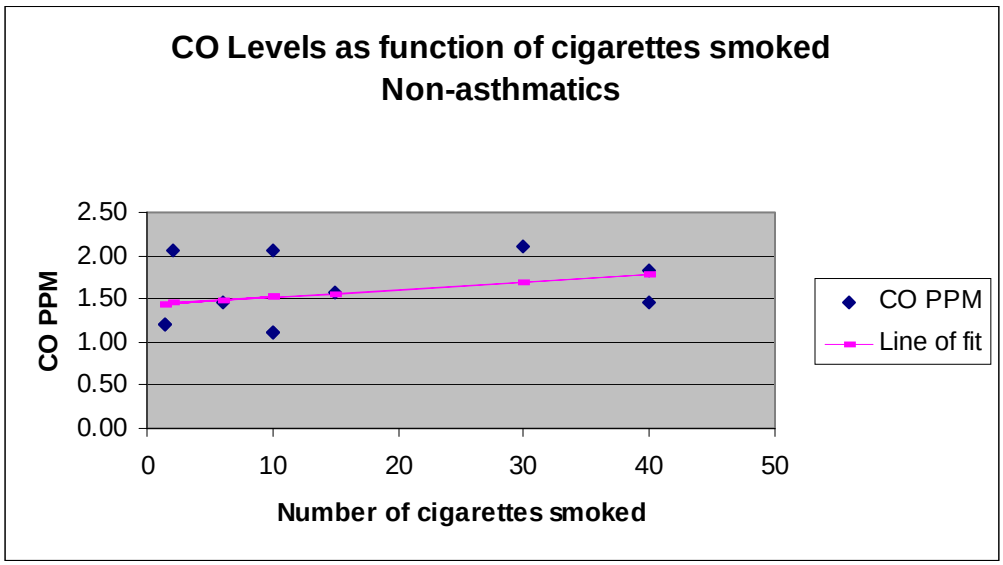

Figure 15

Table 19

Survey group, avg cigs smoked per day in last week	10.64
Asthma group avg cigs smoked per day in last week	6.72
Non asthma group avg cigs smoked per day in last week	9.97

Of the survey group 7 reported that someone living in the house smoked regularly in the house in the past 12 months. For the asthmatic group 2 said that this occurred and for the non-asthmatics 5 said this occurred (Table 20).

Table 20

Survey group, anyone smoking in house	7
Asthma group anyone smoking in house	2
Non asthma group anyone smoking in house	5

When asked if during their lifetime, if anyone who lived in the house smoked inside the house, the survey group reported in majority that there had been. 17 asthmatics and 22 non-asthmatics reported this. About 80% of asthmatics said someone said smoked regularly compared to 91.6% of the non-asthmatics (Table 21).

For the asthmatics, only one said there was other smoking (pipe, cigar, joint) taking place in the home. The non-asthmatics did not report any smoking other than cigarettes.

Table 21

Survey group, lifetime smoker	39
Asthma group lifetime smoker	17
Non asthma group lifetime smoker	22
For asthmatic	only 1 said other smoke
	4 non response
For non-asthmatic	all responded
	but no other type of smoke

17 out of 21(81%) asthmatics, and 22 out of 24 (92%) non-asthmatics said they were life-time smokers (Table 21).

Of those who had responded by giving a number of cigarettes smoked per day in the past 12 months, as a group there were 17.3 cigarettes/day smoked, with an average of 19.63 for asthmatics and 14.7 for non-asthmatics. There were slightly more cigarettes smoked per day in the asthmatic home than the non-asthmatic. While there were on average more cigarettes smoked per day in asthmatics homes, they had reported fewer cigarettes having been smoked during the past week to the survey. However, the question regarding cigarettes in the past week was for a short time period and this question is more long-term in perspective (Table 22).

One asthmatic reported that there were “lots” of cigarettes smoked each day in their house. One respondent, asthmatic, said that a pipe was smoked in addition to the 4 cigarettes a day that were smoked.

Table 22

Of those that responded with a number		
	avg #	Gave no response
As group the avg num cigs smoked a day in house	17.3	7
Asthmatic the avg num cigs smoked a day in house	19.6	6
Non-asthmatic the avg num cigs smoked a day in house	14.7	5
One non asthmatic said "lots" of cigarettes were smoked a day in the house		
On respondent indicated that a pipe was also smoked in addition to 4 cigarettes/day		

Participants were asked about the usage of various energy sources in their homes, in consideration of potential indoor air quality impacts such as CO emissions. It was found that as a group and separately as asthmatics and non-asthmatics electrical devices were largely used, followed by use of oil burning devices and gas appliances. Few used wood to fuel heaters and boilers or to cook with.

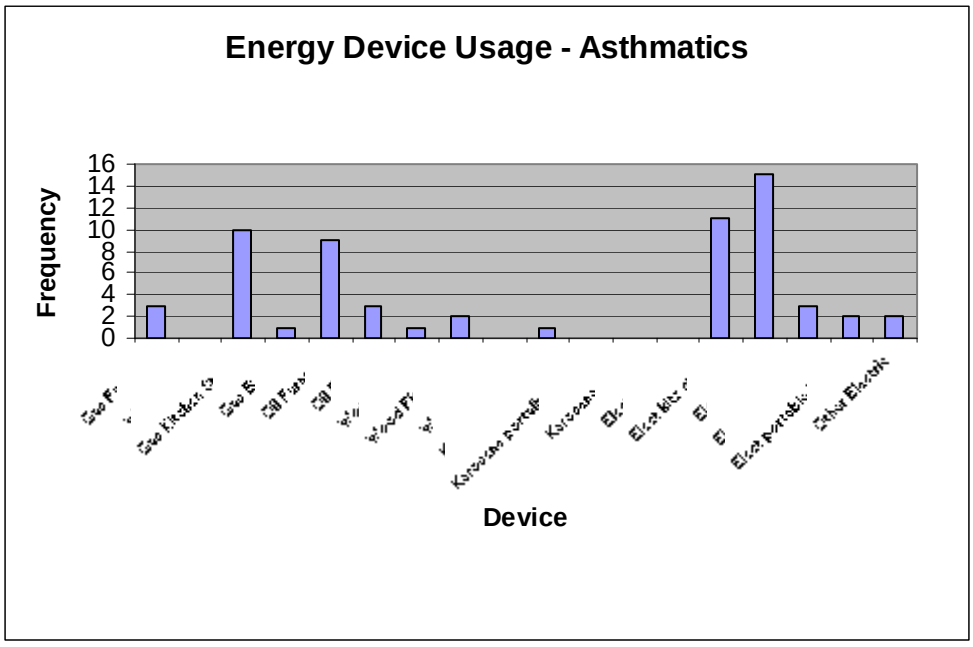

Figure 16

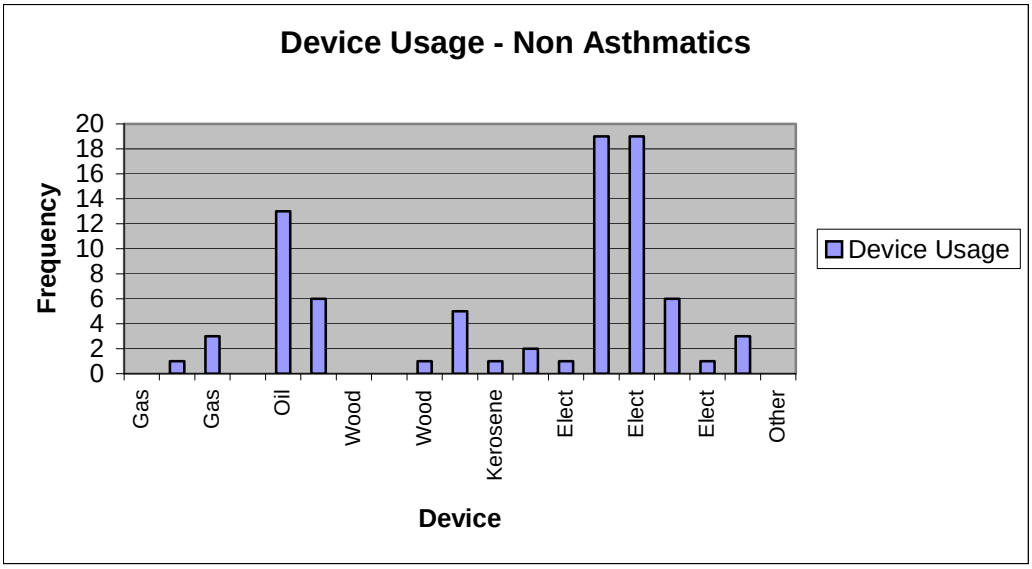

Figure 17

When asked if they had a garage attached to their homes, 22% of the survey group said yes and 77% said no. Similarly, asthmatics and non-asthmatics both reported that 89% did not have an attached garage and 11% said yes they did (Table 23).

Table 23

Does house have attached garage?	#	percent yes	percent no
Survey group	10	22.22%	77.78%
Asthmatic group	5	11.11%	89.00%
Non-asthmatic group	5	11.11%	89.00%

Of those who reported an attached garage, the majority of the group overall, the asthmatics and the non-asthmatics said they parked their car in the garage for 5 or more days per week. Few said they parked cars in the garage two or less days (Table 24).

Table 24

If there is attached garage, how often are cars parked in garage			
	said five or more days	said more than 2 days but less than 5	said two or less days
Survey group	7	2	1
Asthmatic group	4	1	1
Non asthmatic group	3	2	0

In response to the road type questions, 73% of the respondents live on main paved roads, while 71% and 75% of asthmatics and non-asthmatics live on main paved roads respectively (Table 25, Figure 18). For the group as a whole, 62% said that trucks passed

constantly, 22% said frequently. 62% of asthmatics said trucks passed constantly and 22% said they passed frequently. 62% of non-asthmatics said constantly and 20% said seldom (Table 26, Figure 19). This is the primary marked difference between asthmatics and non-asthmatics.

Main paved roads are a source of particulate air contaminants (PM 2.5 and PM 10) generated from mobile sources in addition to mobile source emissions (CO, CO2, NOx, SOx and PM 2.5 and PM 10). The wearing of tires and highways contributes to dust particles in the form of carbon and silicates. Spreading of salt during winter months is an additional concern as dust clouds develop during cold dry weather. Airborne salt is an irritant. Although, side unpaved roads may contribute to PM 2.5 and PM 10, the particle fraction would be greatest in heavier particles.

From the data obtained in the survey, highways represent an important factor in potential sources that affect asthma.

Table 25

Road Type By Group, Asthmatic and Non-asthmatic										
	Main Paved		Side Paved		Main unpaved		Side unpaved		Other	
Group	33	73.4%	6	13.3%	0	0%	1	2.2%	5	11.1%
Asthmatic	15	71.4%	4	19.1%	0	0%	1	4.8%	2	9.5%
Non-asthmatic	18	75 %	1	4.2%	0	0%	1	4.2%	3	12.5%
One person lived where there were two types, side pave and side unpaved road										

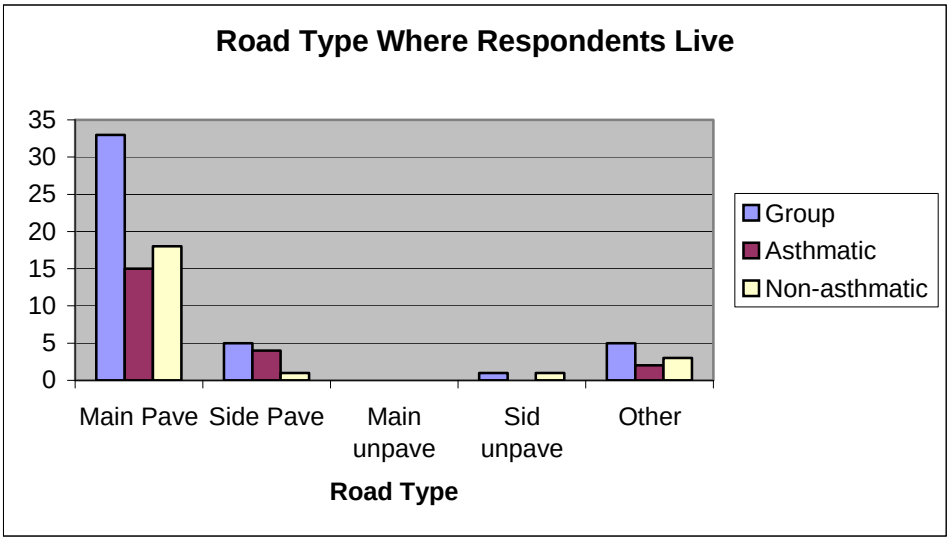

Figure 18

Table 26

How often do trucks pass by your house?								
	Never		Seldom		Frequently		Constantly	
Survey group	1	2.2%	6	13.3%	10	22.2%	28	62.2%
Asthmatic group	1	4.8%	1	4.8%	6	28.5%	13	61.9%
Non-asthmatic	0	0%	5	20.8%	4	1.7%	15	62.5%

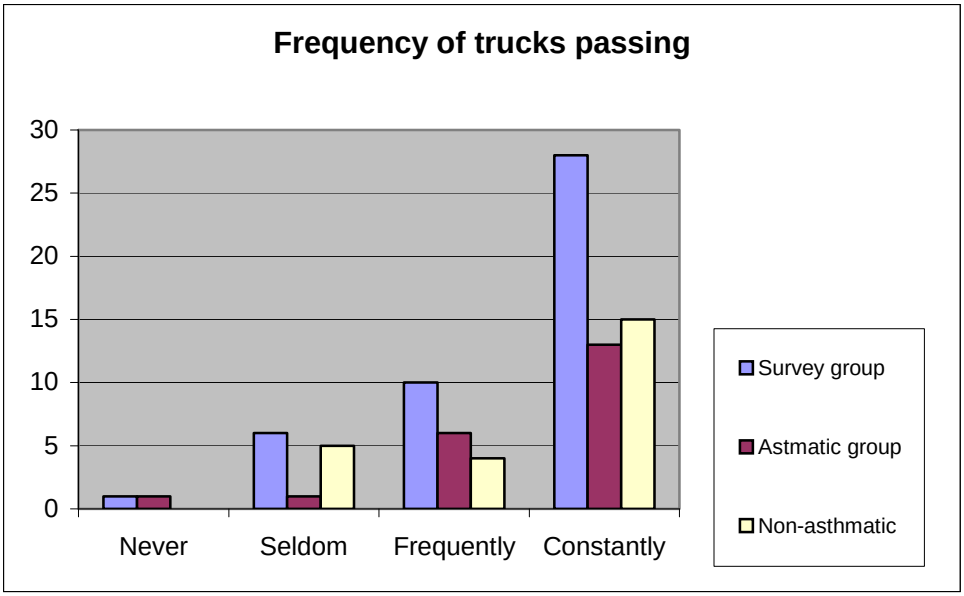

Figure 19

When asked about burn barrels as a group 53% said that no burn barrels were known within 5 minutes of their home and 47% said yes there were. 57% of asthmatics responded that there were and 43% said there were not. 62% of non-asthmatics said that there were no burn barrels and 37% said there were (Table 27, Figures 20 & 21). There is little difference between asthmatics and non-asthmatics.

Table 27

Is there a burn barrel w/in 5-minutes of your home?						
	No		Yes		Don't Know	
Survey group	24	53.3%	21	46.7%	0	0%
Asthmatic	9	42.6%	12	57.1	0	0%
Non-asthmatic	15	62.5%	9	37.5%	0	0%

For those who reported a burn barrel being used, when asked how often they noted that the burn barrel was used, a large percentage, 53% did not respond and 36% said one day or less. 57% of asthmatics said that the noted burn barrels were used one day or less and 43% said more than one and less than 5 days. If this may be used as an indicator or burn barrel usage, most burn barrels that potentially could affect asthmatics are used at least once a week.

Table 28

How often is the burn barrel used?								
Frequency	**One day or less**		**>1<5**		**>5**		**blank**	
Group	16	35.6%	3	6.7%	2	4.4%	24	53.3%
Asth	12	57.1%	9	42.9%	0	0%	0	0%
Non-asth	4	16.7%	3	12.5%	2	8.3%	15	62.5%

63% of non-asthmatics did not respond while 17% said burn barrels were used one day or less and 12% said they were used greater than one but less than 5 days (Table 28). Overall, burn barrels use was found more frequently than for non-asthmatics. Use of burn barrels is a factor in respiratory health including asthma as they produce particulate compounds as well as inorganic and organic compounds.

It is reported that burn barrel emission exceed allowable emissions from controlled incinerators on a per-pound-of-refuse basis, with particulates often 40 times higher (Patrick Engineering, 1994). Burn barrels emit at low altitudes and are in close proximity to residents.

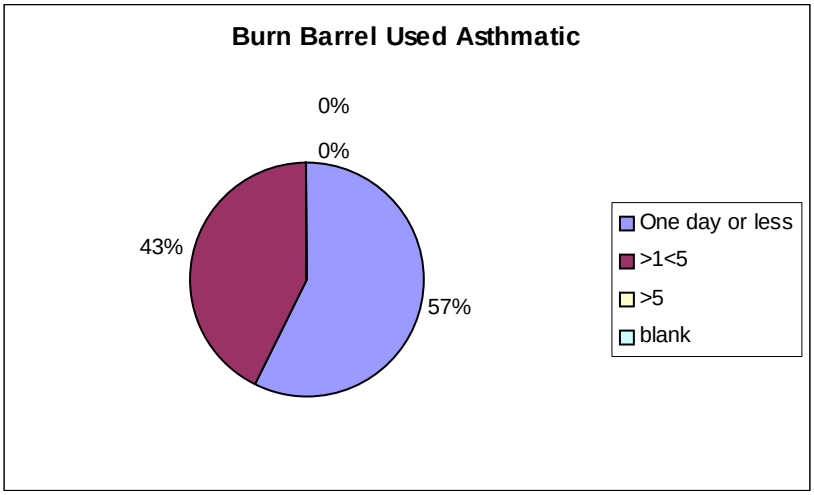

Figure 20

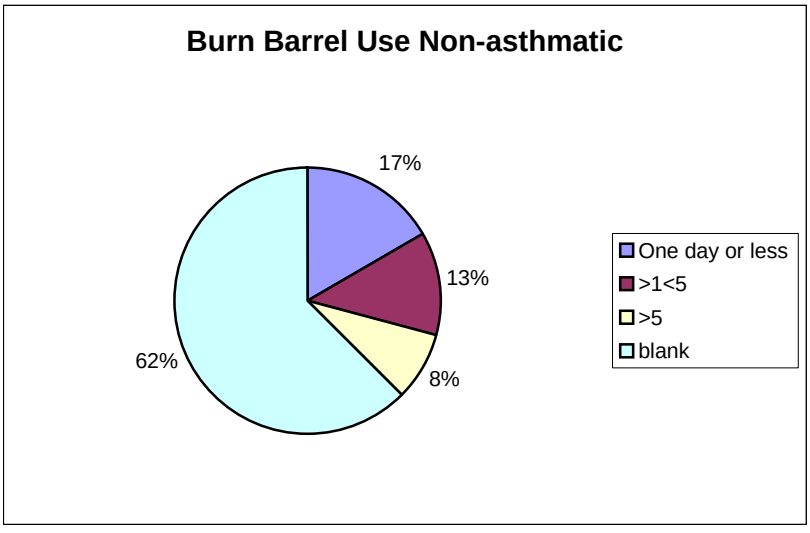

Figure 21

As a group, 47% said they had pets and 53 percent said they did not. 43% of asthmatics have pets and 53% do not, while non-asthmatics were split 50% yes and no (Table 29). As a group, and for asthmatics and non-asthmatics aquariums were found in 89%, 86% and 92% of homes, respectively (Table 31). Not everyone responded to the question of the aquariums location, but of those that did as a group and for asthmatics and non-asthmatics, most aquariums were either in the dining room or living room.

Table 29

Have any pets been present in house?				
	#		Percent	
	Yes	No	Yes	No
Group	21	24	46.67%	53.33%
Asthmatic	9	12	42.86%	57.14%
Non Asthmatic	12	12	50.00%	50.00%

The average number of pets owned by asthmatics was 1.5, the same as for non-asthmatics, asthmatics had twice as many dogs as non-asthmatics and fewer birds than non-asthmatics. Asthmatics also had other pets, lizards, while non-asthmatics did not (Table 30, Figures 22 & 23).

Table 30

Numbers of pets owned by respondents		
Asthmatics		
	Range 1-3	Avg #
Cats	1-3	1.5
Dogs	1-4	2
Birds	1	1
Oth Lizard	3	3
Non asthmatics		
Cats	1-3	1.5
Dogs	1	1
Birds	1-2	1.5
Oth	0	0

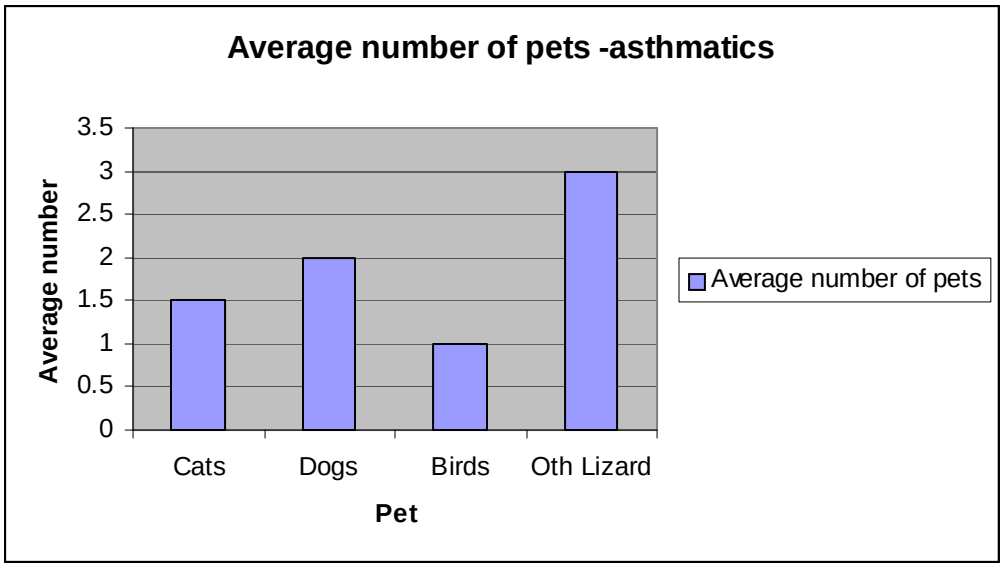

Figure 22

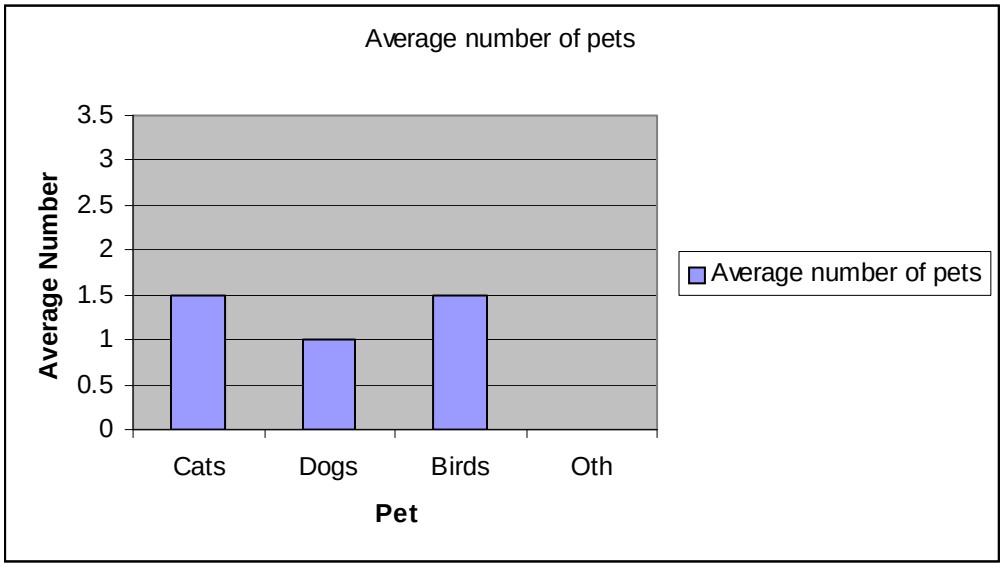

Figure 23

When asked about how long pets were inside asthmatics and non-asthmatics were about the same in reporting that cats, dogs and birds were inside half day and all day. They also both reported that dogs were rarely inside. The significance of this is that the more frequently pets are inside the more they will contribute to allergens. Pet allergens were not measured in this survey.

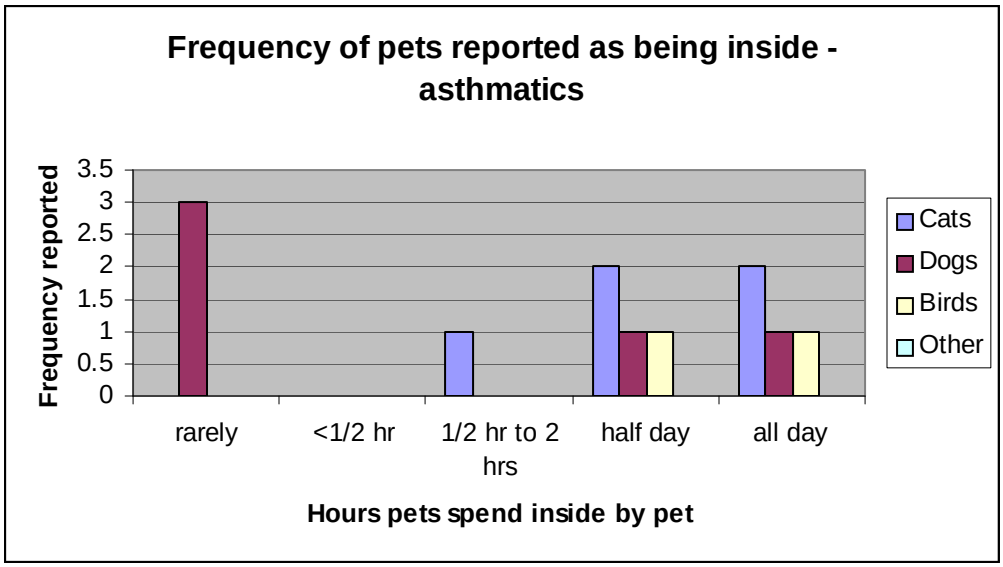

Figure 24

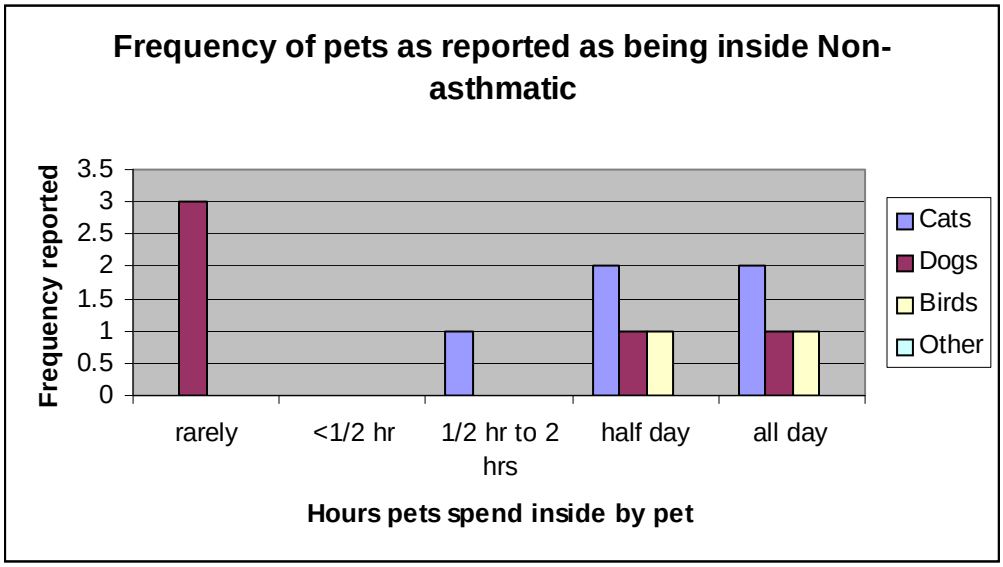

Figure 25

Table 31

Do you have an aquarium?				
	#		Percent	
	Yes	No	Yes	No
Group	5	40	11.11%	88.89%
Asthmatic	3	18	14.29%	85.71%
Non Asthmatic	2	22	8.33%	91.67%

Table 32

Where is aquarium located?						
	Freq					
	Living room	Dining	Your bdrm	Other bdrm	Kitch	Other
Group	2	2	0	0	1	0
Asthmatic	1	2	0	0	0	0
Non Asthmatic	1	0	0	0	0	1
	Percent					
Group	4.44%	4.44%	0.00%	0.00%	2.22%	0.00%
Asthmatic	4.76%	9.52%	0.00%	0.00%	0.00%	0.00%
Non Asthmatic	4.17%	0.00%	0.00%	0.00%	0.00%	4.17%

When asked about the condition of walls in their homes, having noticed wet or moist walls, the majority responded that they did not notice this condition in their homes, 82%, 81% and 83% for the group, asthmatics and non-asthmatics respectively. If they did note this condition it was most prevalent in the living room, followed by their bedroom and kitchen (Table 33 & 34).

Table 33

Have you noticed wet/moist walls, etc?				
	#		Percent	
	Yes	No	Yes	No
Group	8	37	17.78%	82.22%
Asthmatic	4	17	19.05%	80.95%
Non-asthmatic	4	20	16.67%	83.33%

Table 34

If you noticed wet/moist walls, etc, where?						
	Frequency cited					
	Liv rm	Din rm	Your bdrm	Other bdrm	Kitch	Other
Group	4	1	3	0	3	1 (laundry)
Asthmatic	2	1	1	0	1	1
Non-asthmatic	2	0	2	0	2	0

When asked if there had been any floods or leaks in the house most said no and most said no that there was no evidence of mold growth in the house. As a group they were split closely in having insect problems, but a majority of non-asthmatics said they did while the majority of asthmatics said they did not. The majority of respondents did not have problems with rodents (Table 35, 36, 37 & 38). There is no significant difference between the two groups.

Table 35

Has there been floods or leaks in the house?				
	Yes	No	Don't know	Blank
Group	13	31	0	1
Asthmatic	6	14	0	1
Non-asthmatic	7	17	0	0

Table 36

Is there evidence of mold growth in house?			
	Yes	No	Don't Know
Group	10	35	0
Asthmatic	4	17	0
Non-asthmatic	6	18	0

Table 37

Do You Have Problems with insects?				
	Yes	No	Don't Know	Blank
Group	24	21	0	0
Asthmatic	9	12	0	0
Non-asthmatic	15	9	0	0

Table 38

Do You Have Problems with Rodents?			
	Yes	No	Don't Know
Group	6	39	0
Asthmatic	4	17	0
Non-asthmatic	2	22	0

When asked if they had gotten rid of pets because of their asthma condition, 100% of the group said no, 100% of asthmatics said no and 100% of non-asthmatics said no (Table 39). It seems that people are likely to keep their pets despite having asthma. They were not questioned about why this was the case.

Table 39

Have you gotten rid of pets because of asthma?			
	Yes	No	Don't Know
Group	0	45	0
Asthmatic	0	21	0
Non-asthmatic	0	24	0

When asked about chemical cleaner usage in the home most, group (asthmatics and non-asthmatics) said they were used 1-4 times a month, followed by 2-4 times a month. Few said they used them daily. When asked how many times carpets were washed the

average was about ½ times for the group, 1 time for the asthmatics and about ½ times for the non-asthmatics (Table 40).

Table 40

How often are chemical cleaners used inside house?				
	Never	1-4 tms/mo	2-4tm/mo	Daily
Group	5	32	6	2
Asthmatic	3	15	2	1
Non-asthmatic	2	17	4	1

When asked about how many times the carpets had been washed, it was found that carpets in general for both groups have not been cleaned very often. But, asthmatics cleaned their carpets twice as much as non-asthmatics (Table 41).

Table 41

How many times have the carpets been washed?	
	Avg
Group	0.48
Asthmatic	1.07
Non-asthmatic	0.48

When asked about cleaning types, the most frequent form of cleaning for asthmatics and non-asthmatics was sweeping, followed by dusting, vacuuming and then other. When asked about windows being opened while performing a cleaning activity asthmatics and non-asthmatics reported that they opened windows most frequently for sweeping, dusting, vacuuming and other, all at about the same rates (Figures, 26, 27, 28 & 29).

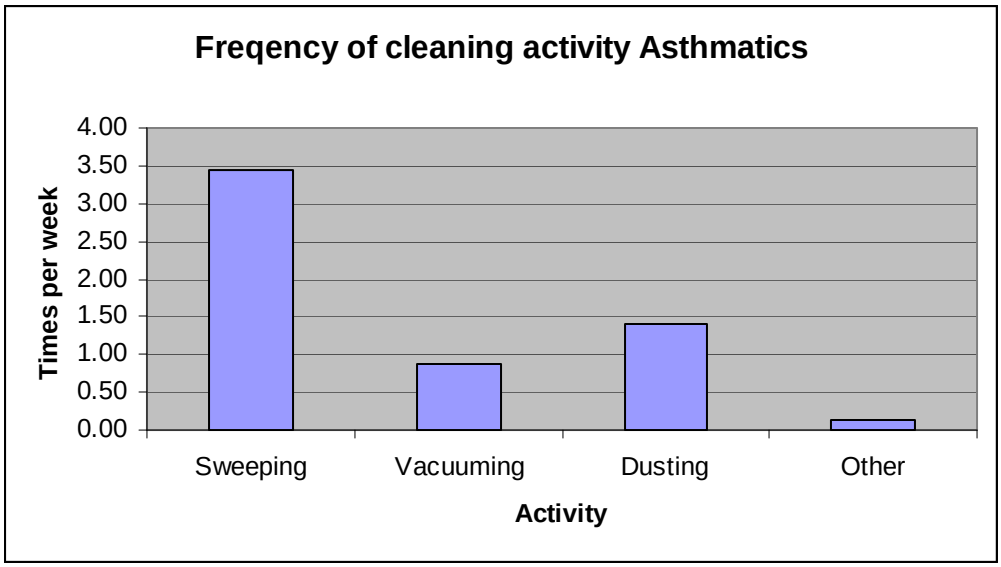

Figure 26

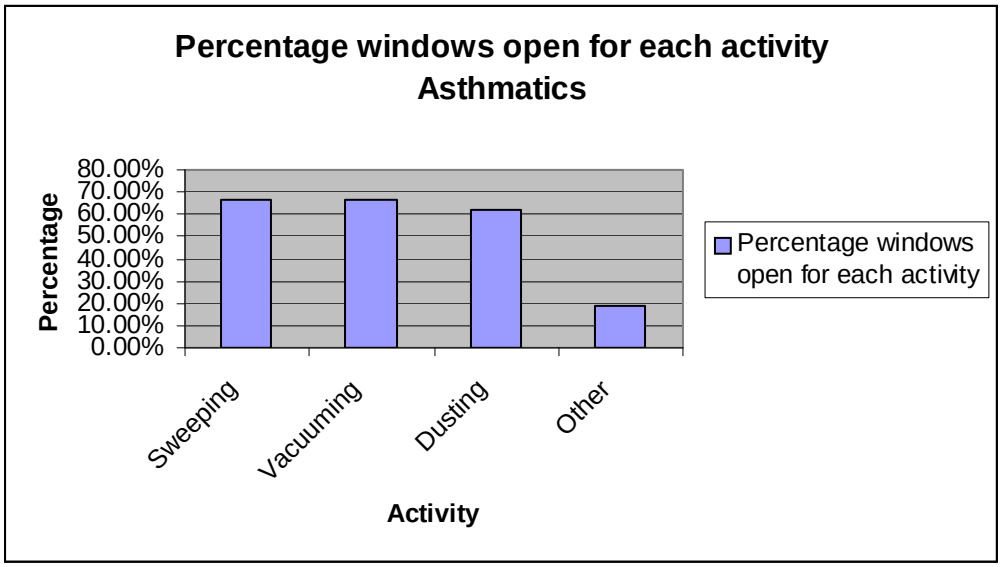

Figure 27

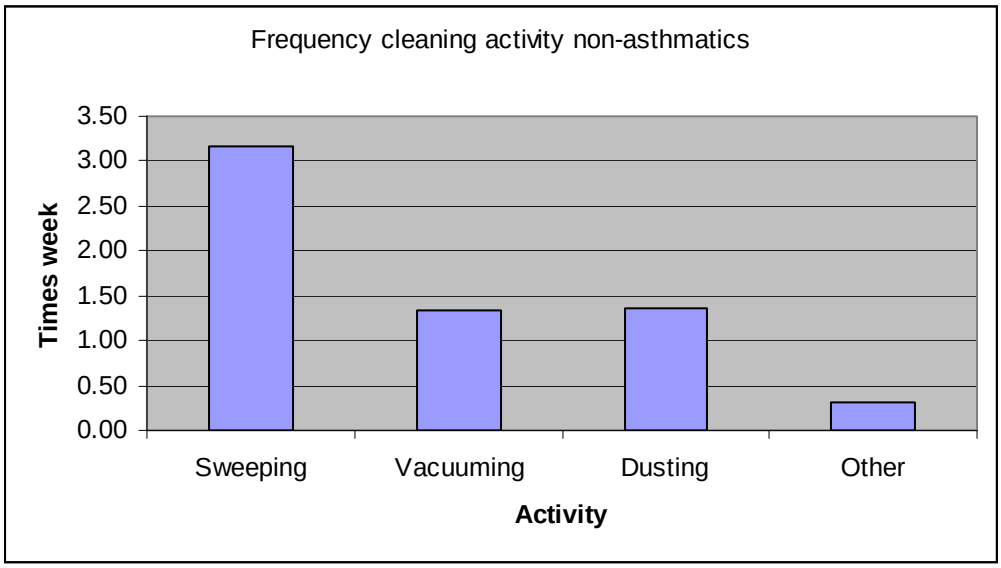

Figure 28

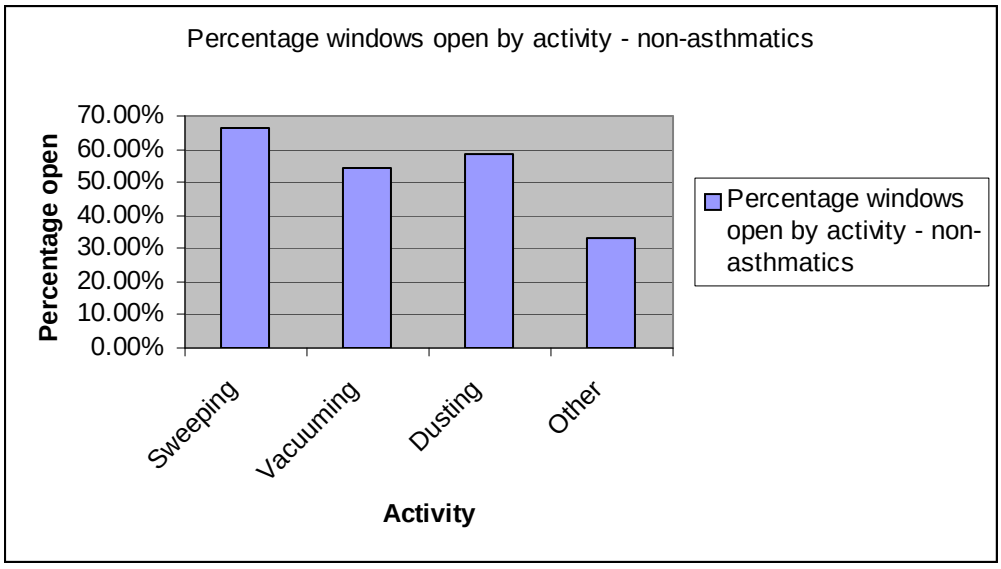

Figure 29

When asked if anybody worked with craft materials, the majority from each group said that they did not. Of those that said there was somebody in the house who worked with crafts, as a group the majority was split between their use of once per month and once per week. The majority of asthmatics said that they were used once per week and non-asthmatics said once per month (Table 42 & 43).

Table 42

Does anybody work with craft materials?		
	Yes	No
Group	7	38
Asthmatic	4	17
Non-asthmatic	3	21

Table 43

For those that answered yes, how often do they use them (avg)?			
	Once/mo	once wk-2	Everyday
Group	3	3	1
Asthmatic	1	3	0
Non-asthmatic	2	0	1

Participants in the survey reported the most frequent craft/hobby was crafts in general and that glue, paint and paint thinner was the most frequently used material in the craft. Asthmatics only reported crafts, while non-asthmatics reported crafts, painting and beads as activities in the home (Table 44). From this information it does not appear that craft/hobby is a significant factor in asthma. However, the survey did not determine

whether glues and paints were water based or solvent based. Product base is important to consider as solvent based materials are more noxious.

Table 44

Frequently cited craft/hobby and pollutant			
Asthmatic			
Activity	Times cited	Pollutant type	Times cited
crafts	3	Glue	2
		Paint	2
		paint thinner	0
		Other	2
non-asthmatic			
crafts	1	Glue	3
painting	1	Paint	1
beads	1	paint thinner	1
		Other	0

As a group the majority ventilated their homes by opening windows in the bedrooms, followed by living/dining rooms, kitchen/baths and other. The same was found for asthmatics and non-asthmatics (Table 45).

Table 45

What rooms are ventilated by open windows?			
	Frequency		
	Group	Asthmatic	Non-asthmatic
Bedrooms	39	19	20
Liv/din rms	35	19	16
Kit/bath rms	34	19	15
Others	5	2	3

The effect of the number of hours windows were opened was examined with the CO2 levels measured in the building (Figures 30 & 31). CO2 levels increased in asthmatic homes with the number of hours windows were open for venting and there was a decrease in CO2 levels in non-asthmatic homes as the number of hours increased. The latter is what one would expect as ventilation modulates CO2 that has been respired.

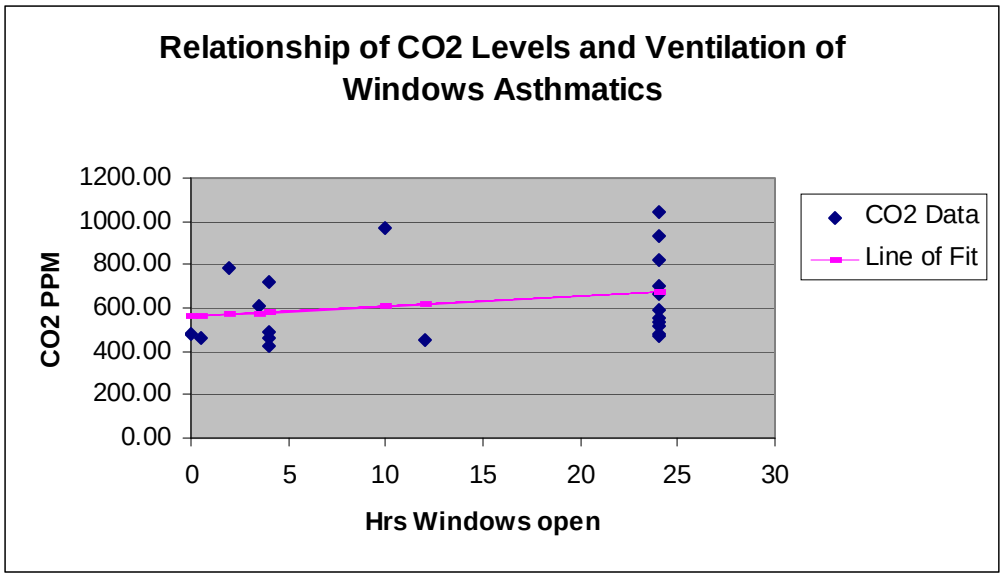

Figure 30

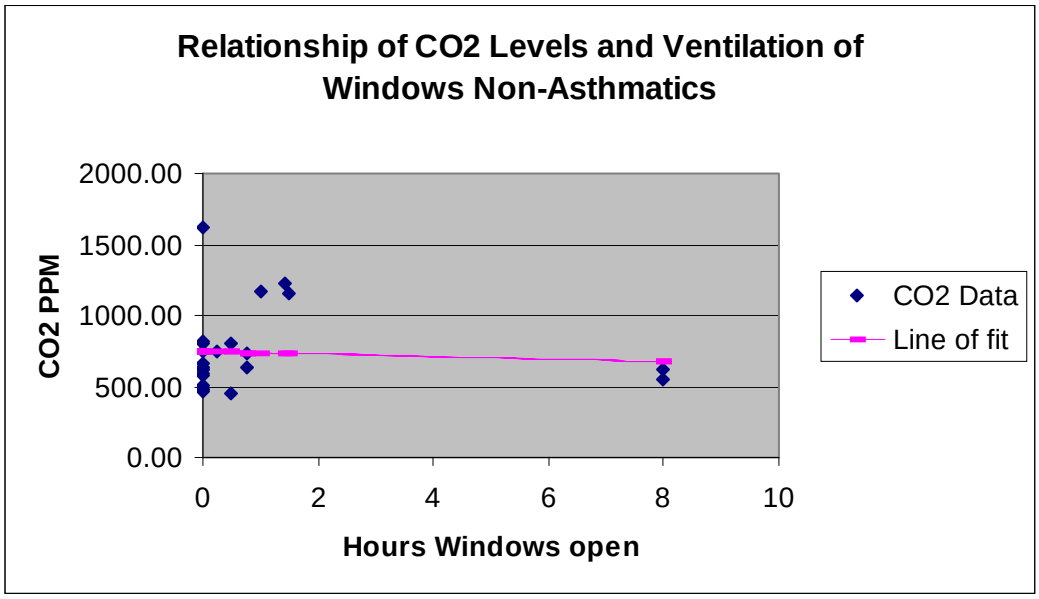

Figure 31

This relationship was further examined for CO levels as similar pattern was found, but the relationship was not as strong (Figures 32 & 33). One thought was that living near a highway, with mobile sources, CO would be expected to be influenced, but the relationship between smoking and CO levels was much stronger.

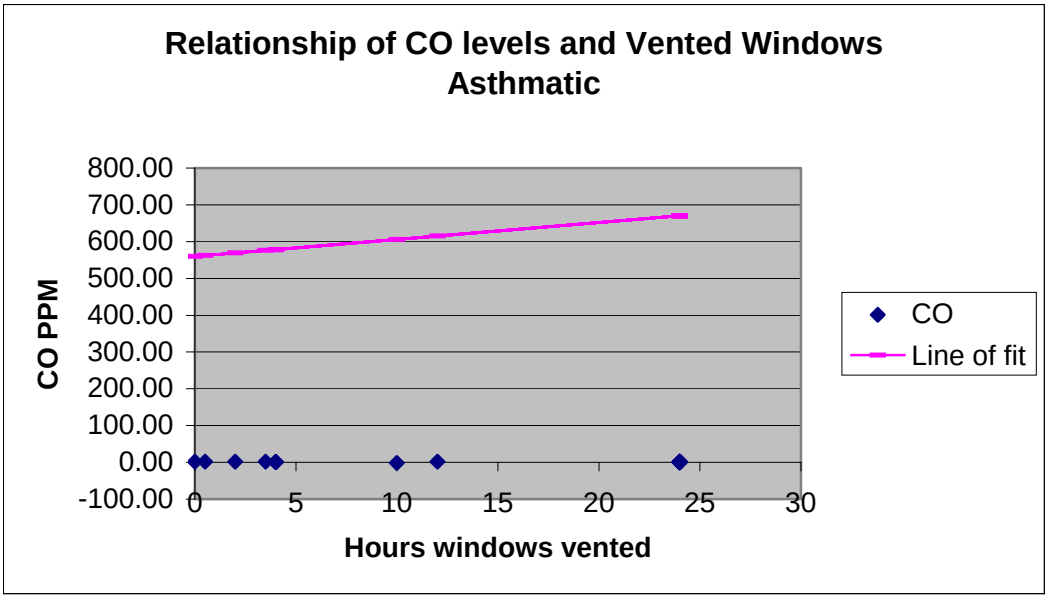

Figure 32

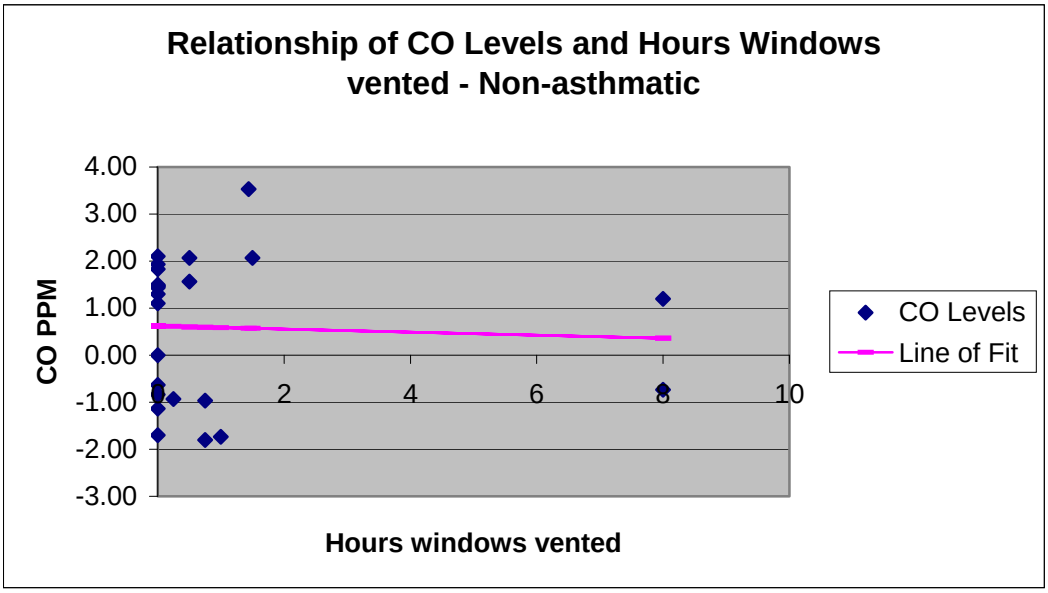

Figure 33

When asked about their habits for keeping bedrooms windows open, the 13% of the group kept their windows open in the summer, while 15% of asthmatics did and only .9% of non-asthmatics did. During the winter months, only 1.75% of the group opened windows, 2.7% of asthmatics and .9% of non-asthmatics (Table 46).

Table 46

On average how many hours/day did you keep bedroom windows open? Summer? Winter?				
	Summer			
	Average	Max	Min	Non response
Group	13.31	24	0	2
Asthmatic	15.2	24	0	1
Non-asthmatic	0.92	1.5	0	1
	Winter			
	Average	Max	Min	Non response
Group	1.75	24	0	2
Asthmatic	2.7	24	0	1
Non-asthmatic	0.92	1.5	0	1

Measurements of indoor air quality conditions revealed that on average the group had CO well below any action levels or concern (0.84 ppm), but levels in asthmatic homes was slightly higher (1.13) than in non-asthmatic homes (0.59 ppm). C02 levels for the group average 685.92, approximately 68% of the recommended maximum of 1000 ppm, with an extreme level at 1617.67 ppm. Asthmatics had lower levels on average (652.76), with extreme levels above the action level at 1046.33 ppm. Non-asthmatics had higher CO2 levels with an average of 737.05 ppm and maximum of 1617.67 ppm.

The average relative humidity for the group was 50.7%, 51% for asthmatics and 50% for non-asthmatics, levels within optimal range and not excessive so as to promote mold or so low as to affect respiratory tracts. The average temperature for the group was 23.94 C, 24.17 for asthmatics and 24.15 for non-asthmatics. Dew points were well below points where moisture would be formed (Table 47, Figures 34 & 35).

Optimal levels are:

- CO2 340-400 ppm, Max 1000 ppm
- CO OSHA TWA is 25 ppm, ASHRAE 8-hr limit is 2.5 ppm
- RH 30%-60%

Table 47

Ambient Indoor AQ Conditions					
	Averages				
	CO PPM	CO2 PPM	RH%	Temp C	Dew Pt C
Group	0.84	685.92	50.71	23.94	12.99
	Max	Max	Max	Max	Max
	3.53	1617.67	65.93	27.70	20.10
	Min	Min	Min	Min	Min
	-1.80	428.00	33.33	18.33	6.97
Asthmatic	1.13	652.76	51.41	24.17	13.39
	Max	Max	Max	Max	Max
	2.27	1046.33	65.93	27.70	17.60
	Min	Min	Min	Min	Min
	-1.30	428.00	33.33	18.33	6.97
Non-asthma	0.59	737.05	50.88	24.15	13.31
	Max	Max	Max	Max	Max
	3.53	1617.67	63.00	27.70	20.10
	Min	Min	Min	Min	Min
	-1.80	36.90	36.90	20.30	7.50

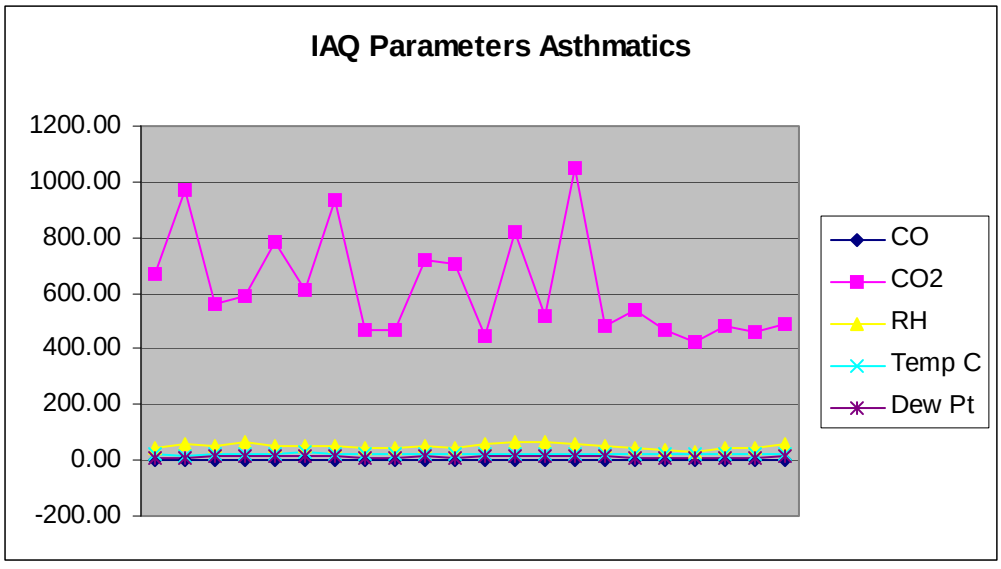

Figure 34

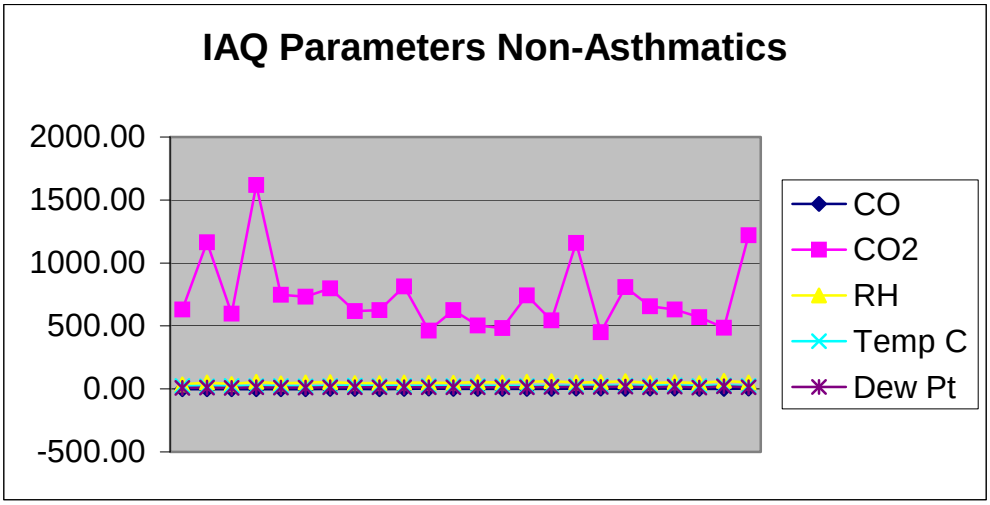

Figure 35

When asked about central ventilation systems, as a whole, for asthmatics and non-asthmatics said no central ventilation was installed in their homes (Table 48). Most said that air cleaner or purifiers were used (Table 49). The majority of the group, asthmatics and non-asthmatics said that they did not have urethane foam insulation installed in their homes, but a large portion were uncertain (Table 50).

Table 48

Does your house have central ventilation?			
	Yes	**No**	**Don't Know**
Group	0	45	0
Asthmatic	0	21	0
Non-asthmatic	0	24	0
When was the last time you cleaned air ducts?			
No one responded			
When was the last time the air filter was changed?			
There were no responses by asthmatics.			
A non-asthmatic responded, 1989. A period of 12 years.			

Table 49

Have you used any air cleaner or purifier?		
	Yes	**No**
Group	9	36
Asthmatic	6	15
Non-asthmatic	3	21

Table 50

Is the house insulated with UFFI?			
	Yes	No	Don't know
Group	1	29	15
Asthmatic	1	14	6
Non-Asthmatic	0	15	9
Have you used any dehumidifiers or other water spray systems?			
	Yes	No	Don't Know	No response
Group	8	36	0	1
Asthmatic	4	16	0	1
Non-asthmatic	4	20	0	0

In examining how far respondents lived from industrial sources and what direction they lived from them, as a group the average distance from the nearest source, General Motors and Alcoa east, combined average to 3.7 miles, with an average of 2.8 miles for non-asthmatics and 4.4 miles for non-asthmatics. Non-asthmatics lived twice as far away from this source than did asthmatics (Table 51).

The average distance from industry, grouped, is 4.78 miles as a group, 5.64 miles for asthmatics and 4.02 miles for non-asthmatics. The average distance from Alcoa West is 11.95 miles as a group, 12.77 miles for asthmatics and 11.30 miles for non-asthmatics (Table 52).

The sources are most frequently west and northwest of the respondent's homes. The predominant wind direction for the area is southwest and west (Table 53, Figures 36, 37, 38 & 39).

Table 51

Average distance from Industry Centroid (GM, Reynolds (Alcoa East) and Domtar)			
	Average	Max	Min
Group	4.78	9.40	1.02
Asthmatic	5.64	9.40	1.38
Non-Asthmatic	4.02	8.24	1.02

Table 52

Average distance from Alcoa (west)			
	Average	Max	Min
Group	11.95	17.14	7.75
Asthmatic	12.77	17.14	7.75
Non-asthmatic	11.30	15.50	8.59

Table 53

Wind Direction and Frequency								
	N	NE	E	SE	S	SW	W	NW
GM/RMC/DOM	2	0	0	0	0	11	1	31
ALCOA W	0	0	0	0	0	0	45	0

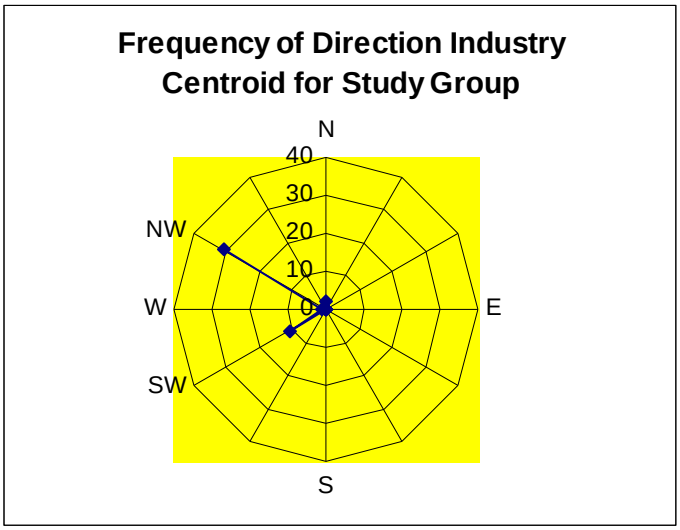

Figure 36

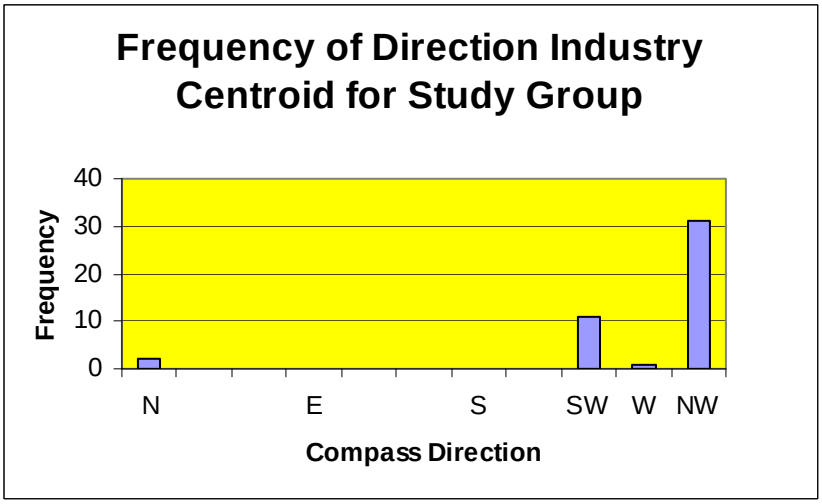

Figure 37

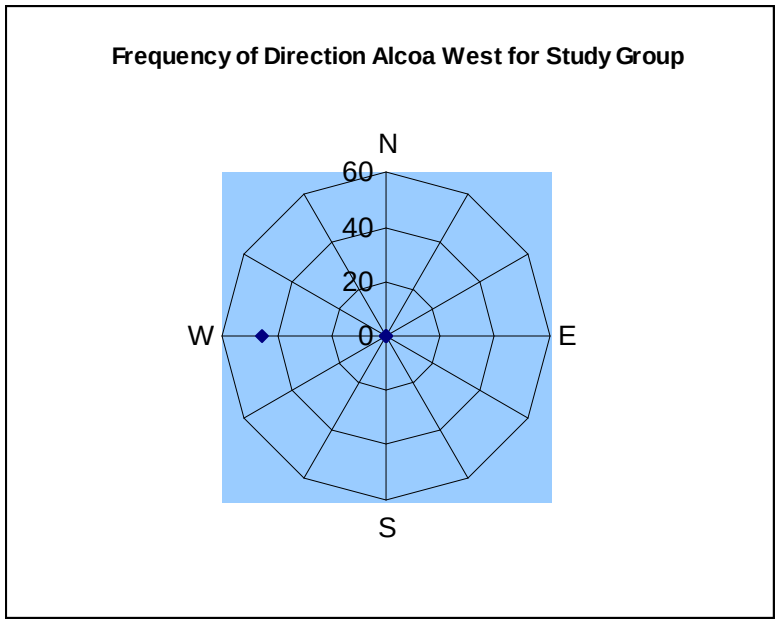

Figure 38

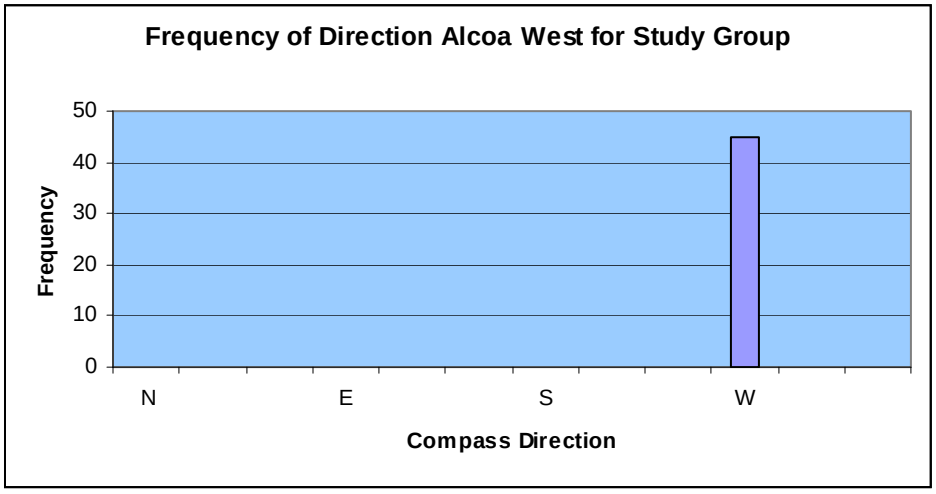

Figure 39

With regard to dust and relationship to distance from the survey groups, indications were as one would expect, a negative correlation between distance from industry and the amount of dust, sieved weight (grams) measured in each house (Figures 40 & 41). This indicates some, although weak, relationship between dust measured and distance to industry. As one would expect, the closer to a source the higher dust level would be measured.

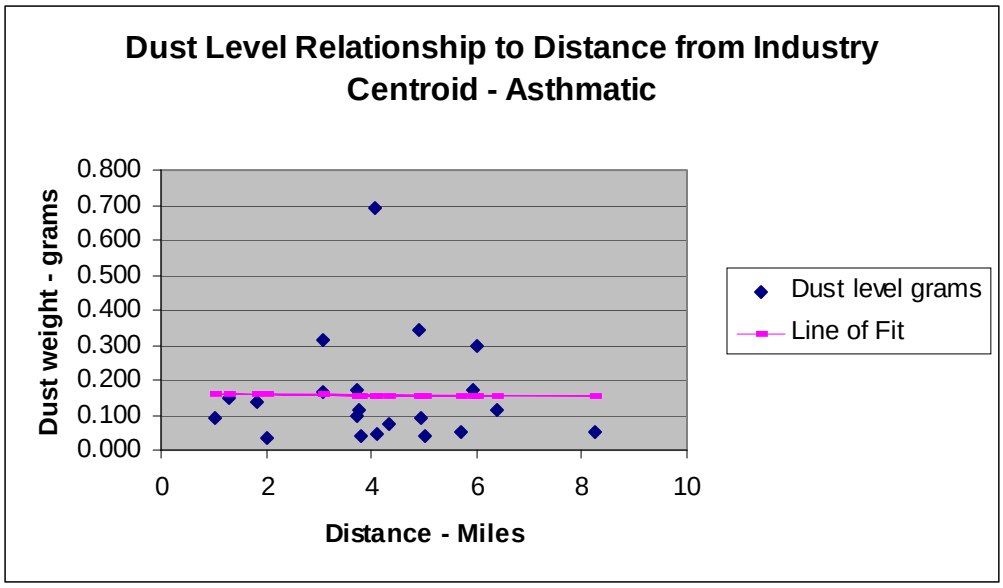

Figure 40

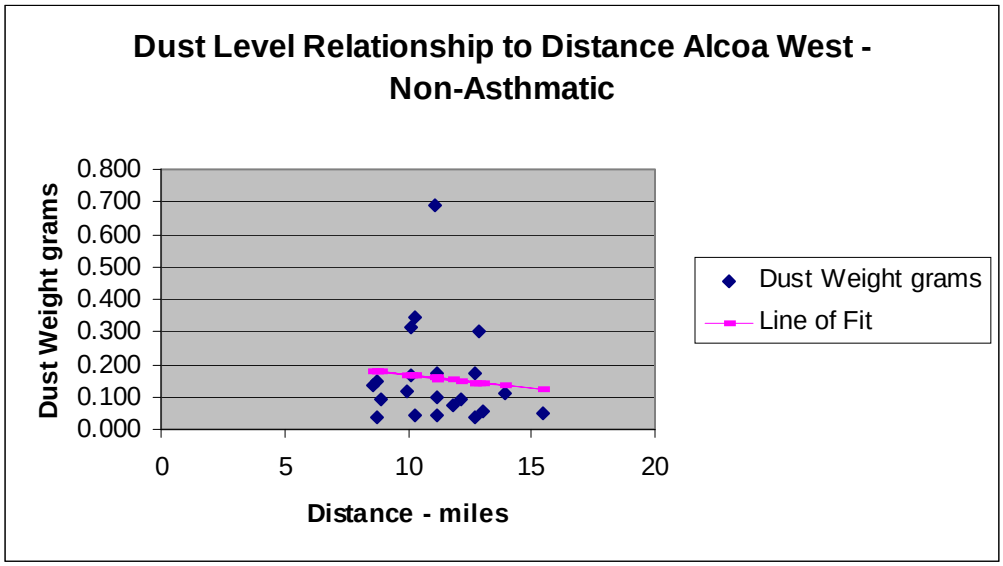

Figure 41

The allergen levels were examined in relation to the number of times the carpet is cleaned (Figures 42 & 43).

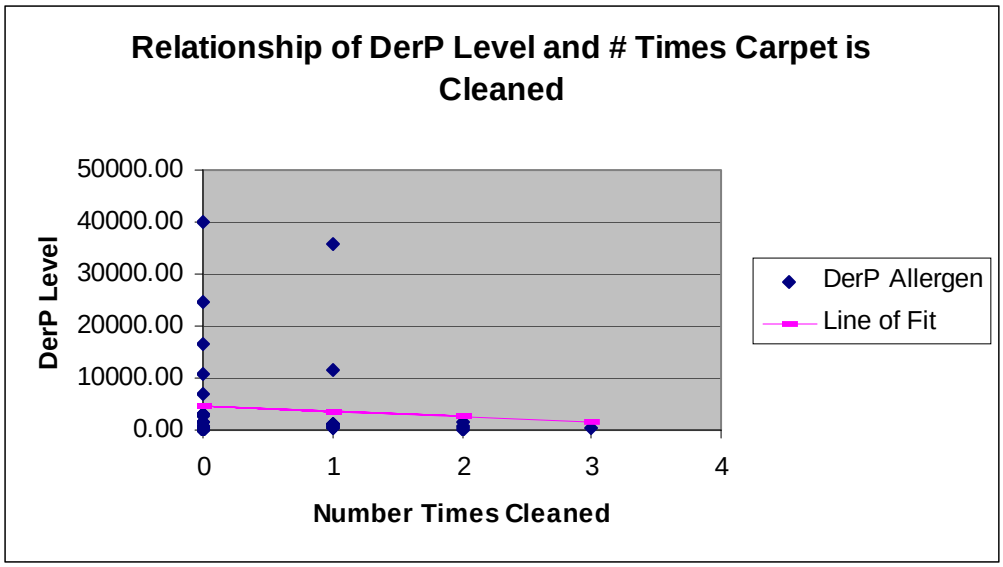

Figure 42

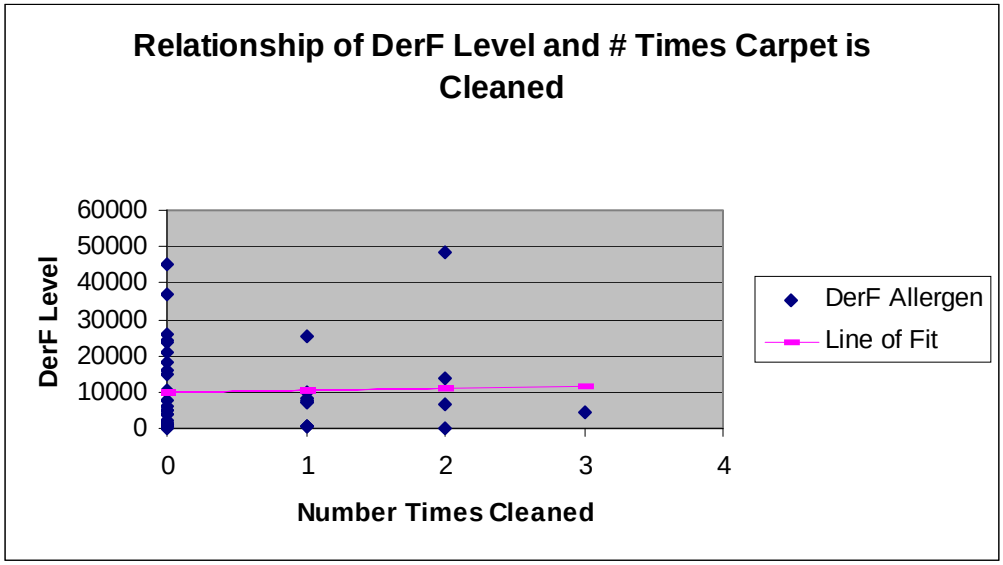

Figure 43

Paradoxically, the relationship between dust levels DerP and DerF to the number of times a carpet is cleaned is opposite. One might expect, the more you clean the less allergen would be found. This is true for DerP only. The levels of DerF are found to increase with carpet cleaning. To speculate, there may be a relationship between DerF and the method of cleaning. For example cleaning may only be removing food source for DerP mites and not DerF. Considering the cleaning systems currently available, HEPA vacuums, it may be worth investigating their efficiency especially for asthmatics.

In examining the presence of dust mite allergens from dust samples collected from the homes it was found that the majority of respondents had DerP allergen present at low risk factor to moderate risk factor levels, while the majority had levels at moderate risk to high risk for sensitization risk factor levels. The presence of the allergens does not mean people have allergies, it means that the allergens are present at high enough levels to suggest concern. Overall, asthmatics have a high risk for symptoms and sensitization due to DerF allergen than do non-asthmatics. They are on a par with non-asthmatics for DerP risks.

Examined was the distribution of allergen levels as a group and for asthmatics and non-asthmatics. In determining whether or not there was any correlation between DerP and DerF values for asthmatics and non-asthmatics, correlation coefficients of 0.452 were obtained for each. There is weak to moderate correlation between having a particular between DerP and DerF allergen levels.

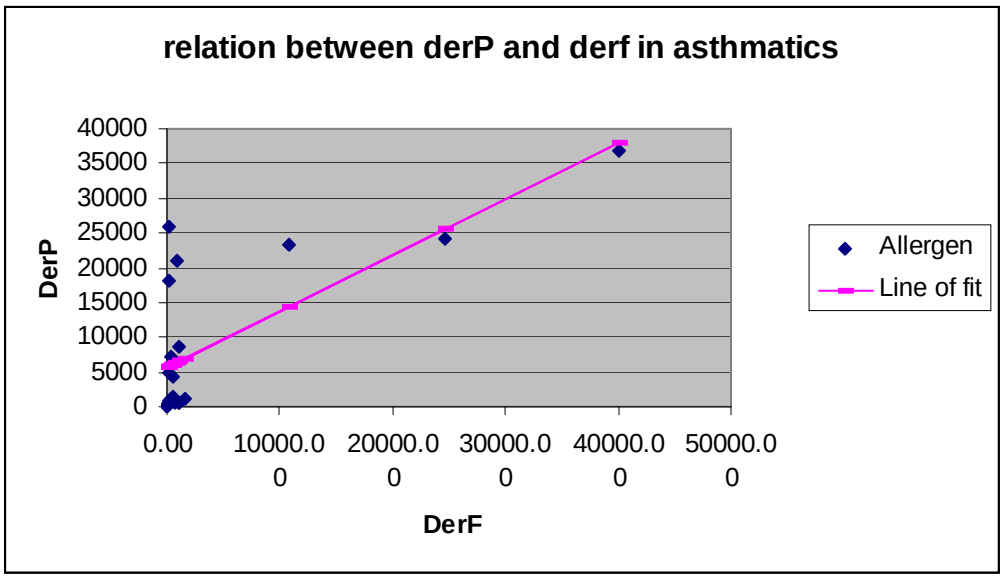

Figure 44

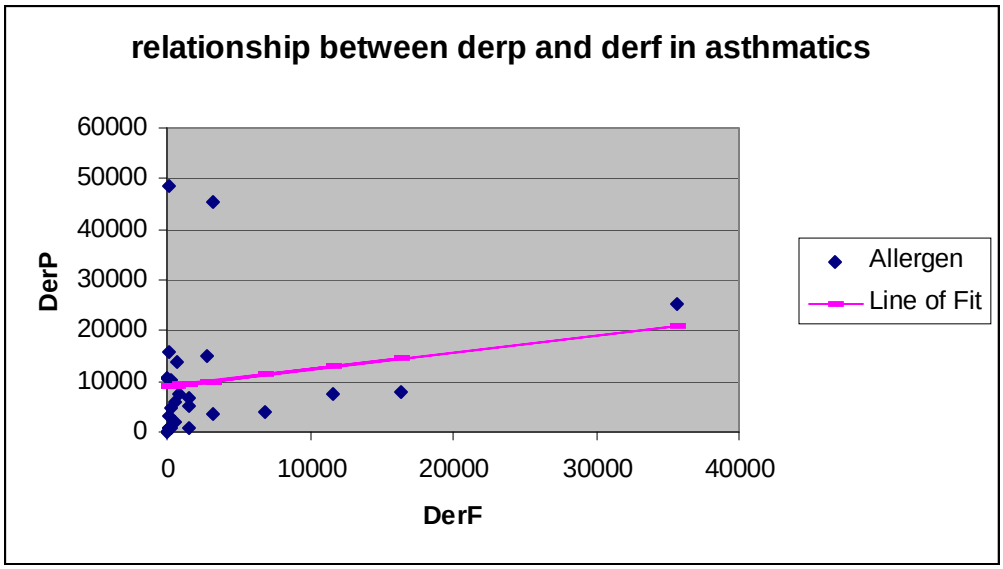

Figure 45

In examining whether or not there was a difference between asthmatics and non-asthmatics with respect to allergen levels, t-test for DerP and DerF are, P=0.264 and P=0.337 respectively. There is no significance in difference between the two groups for these values.

No allergen was measured in the air samples collected.

In determining if there was any relationship between allergen levels and asthma frequency histograms were developed and compared. Several important items developed from examining the histograms, as well as reviewing the overall distribution of allergen measurements.

Allergen levels measured in this survey averaged 3850 ng/g for DerP and 9600 ng/g for DerF (Table 56). These average levels were higher than in a national survey that were measured at 700 ng/g and 1000 ng/g for DerP and DerF respectively (Hamilton, 1992). Tables 56 and Figures 48 & 49 illustrate the frequency distribution of the allergens and risk factors for the group as a whole and asthmatics and non-asthmatics.

Overall the risk is low to moderate for both groups and as a whole for exposure to DerP allergen, but non-asthmatics have a slightly higher risk factor than asthmatics. There is a higher risk factor, moderate to high risk, for both groups and as a whole for exposure to DerF allergen.

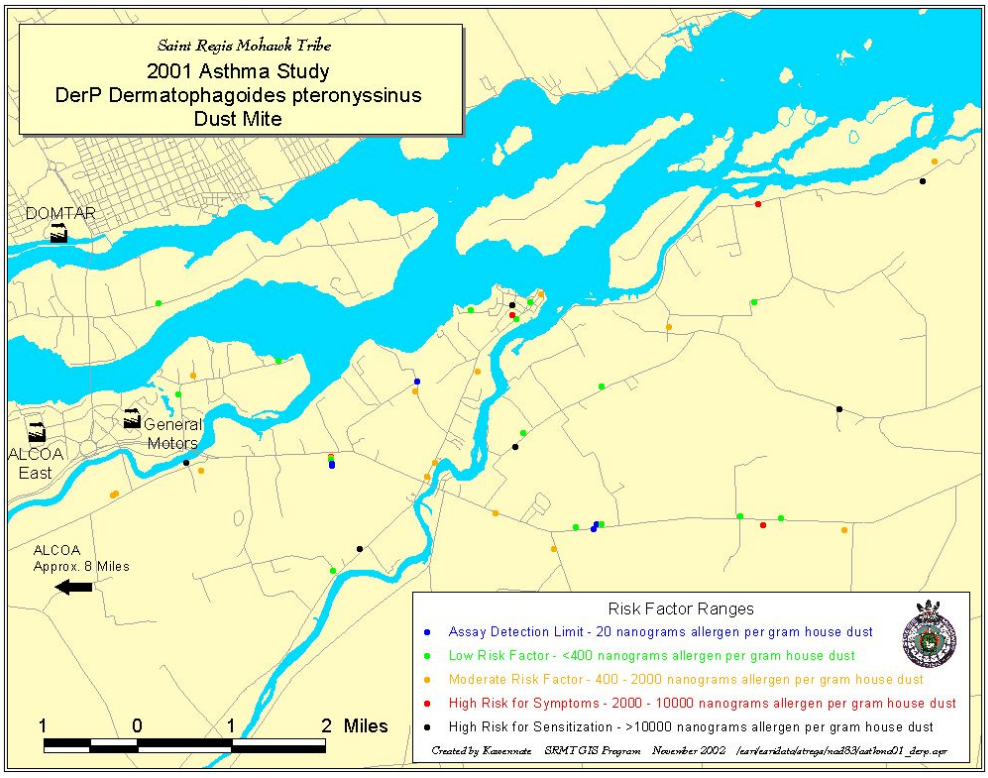

Figure 46

Figures 46 and 47 illustrate geographic distribution of elders who participated in the survey and corresponding risk levels for each allergen, DerP and DerF.

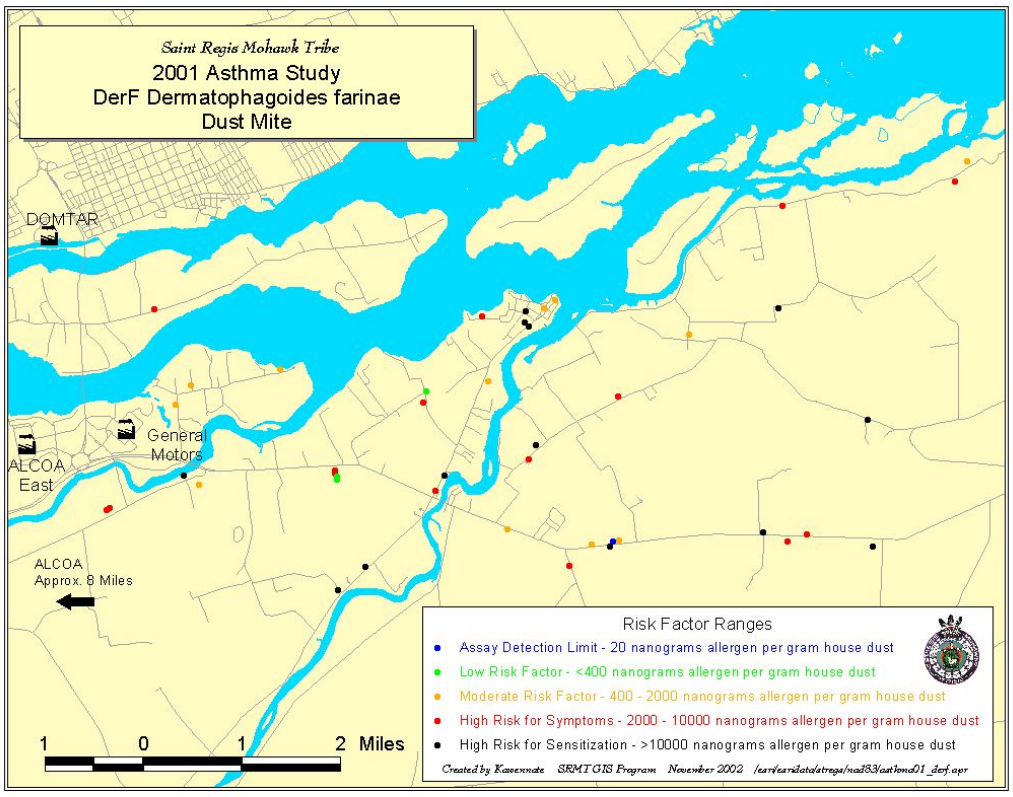

Figure 47

Table 54

Assay Detection Limit……20 nanograms allergen per gram house dust						
Low Risk Factor……<400 nanograms allergen per gram house dust						
Moderate Risk Factor……400-2000 nanograms allergen per gram house dust						
High Risk for Symptoms……2000-10000 nanograms allergen per gram house dust						
High Risk for Sensitization……>10000 nanograms allergen per gram house dust						
Frequency						
	DerP			DerF		
	Asthma	Non Asthma	All	Asthma	Non Asthma	All
DL	0	0	0	0	0	0
LRF	10	10	20	3	1	4
MRF	8	7	15	7	5	12
HRSymp	0	4	4	5	10	15
HRSens	3	3	6	6	8	14

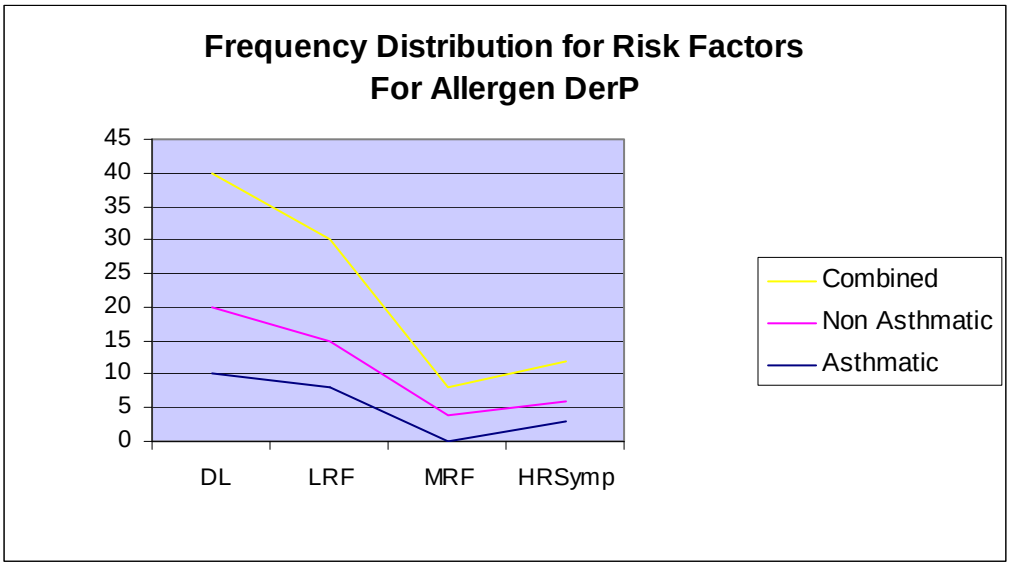

Figure 48

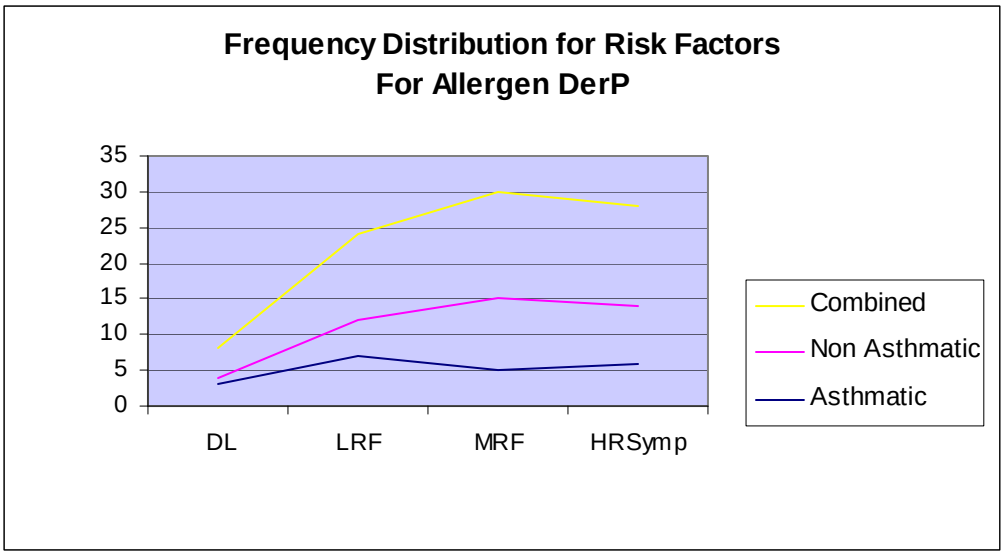

Figure 49

Tables 57 and 58 illustrate the frequency distribution of DerP and DerF allergen respectively, and the percentage of the sample that falls under each class level. Figures 50, 51, 52 and 53 display the distributions by frequency and cumulative frequency. They show that as a whole allergen levels were observed in the low to moderate risk factor ranges. This is illustrated for asthmatics and non-asthmatics in Tables 59, 60 and 61 and in Figures 54, 55, 56 and 57. While the majority were found to have low DerP allergen levels (asthmatic and non-asthmatic) a greater proportion of asthmatic had higher DerF allergen levels than non-asthmatics. From the data the reasons for this and the effect are not known.

Table 55

Frequency Distribution DerP n=45					
Class					
DerP (ng/gm)		**Frequency**	**Cum Freq**	**Percent**	**Class X100**
0-4999.99	**4999.9**	38	38	84.44%	0-49.99
5000-9999.99	**9999.9**	1	39	2.22%	50-99.99
10000-14999.99	**14999.9**	2	41	4.44%	100-149.99
15000-19999.99	**19999.9**	1	42	2.22%	150-199.99
20000-24999.99	**24999.9**	1	43	2.22%	200-249.99
25000-29999.99	**29999.9**	0	43	0.00%	250-299.99
30000-34999.99	**34999.9**	0	43	0.00%	300-349.99
35000-39999.99	**39999.9**	1	44	2.22%	350-399.99
40000-44999.99		1	45	2.22%	400-449.99
	Median	550.00			

Table 56

Frequency Distribution DerF n=45					
DerF (ng/gm)		**Frequency**	**Cum Freq**	**Percent**	**Class X100**
0-4999.99	**4999.9**	22	22	48.89%	0-49.99
5000-9999.99	**9999.9**	9	31	20.00%	50-99.99
10000-14999.99	**14999.9**	3	34	6.67%	100-149.99
15000-19999.99	**19999.9**	3	37	6.67%	150-199.99
20000-24999.99	**24999.9**	3	40	6.67%	200-249.99
25000-29999.99	**29999.9**	2	42	4.44%	250-299.99
30000-34999.99	**34999.9**	0	42	0.00%	300-349.99
35000-39999.99	**39999.9**	1	43	2.22%	350-399.99
40000-44999.99	**45999.9**	1	44	2.22%	400-449.99
45000-49999.99	**49999.9**	1	45	2.22%	450-459.99
	Median	5000.00			

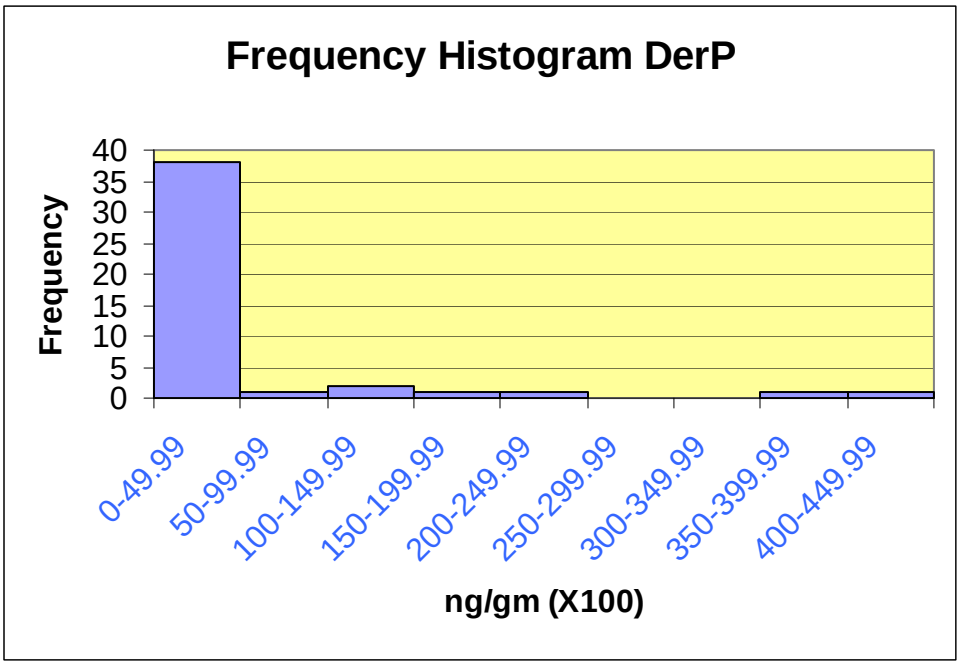

Figure 50

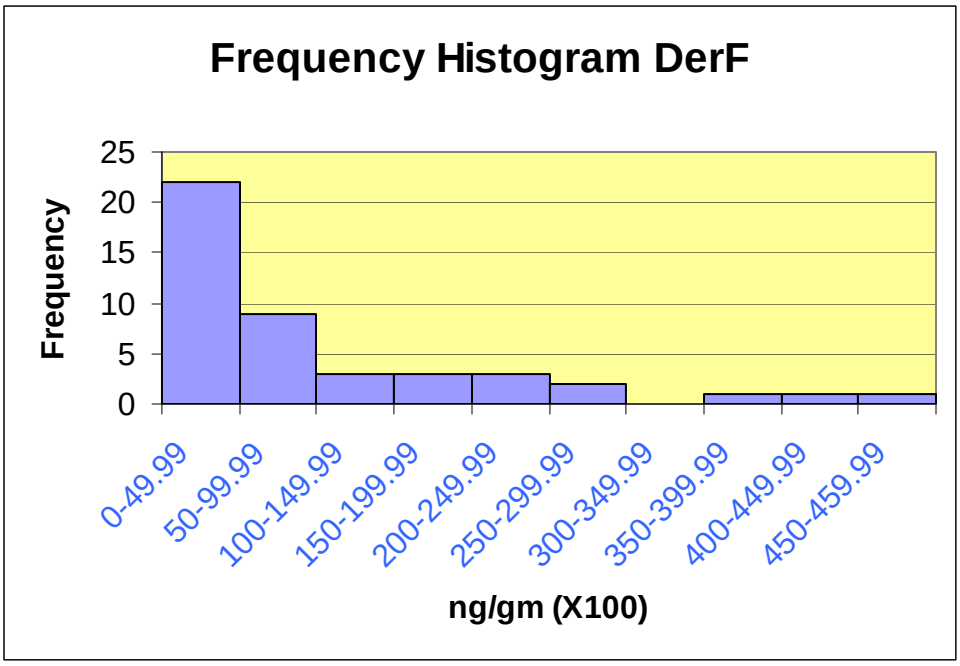

Figure 51

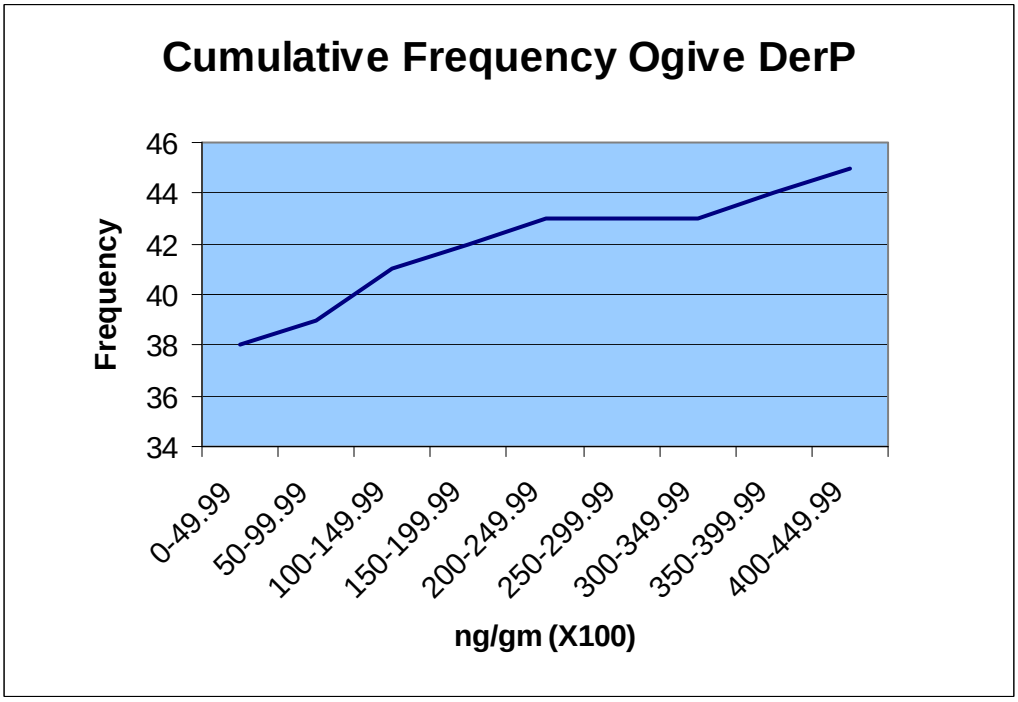

Figure 52

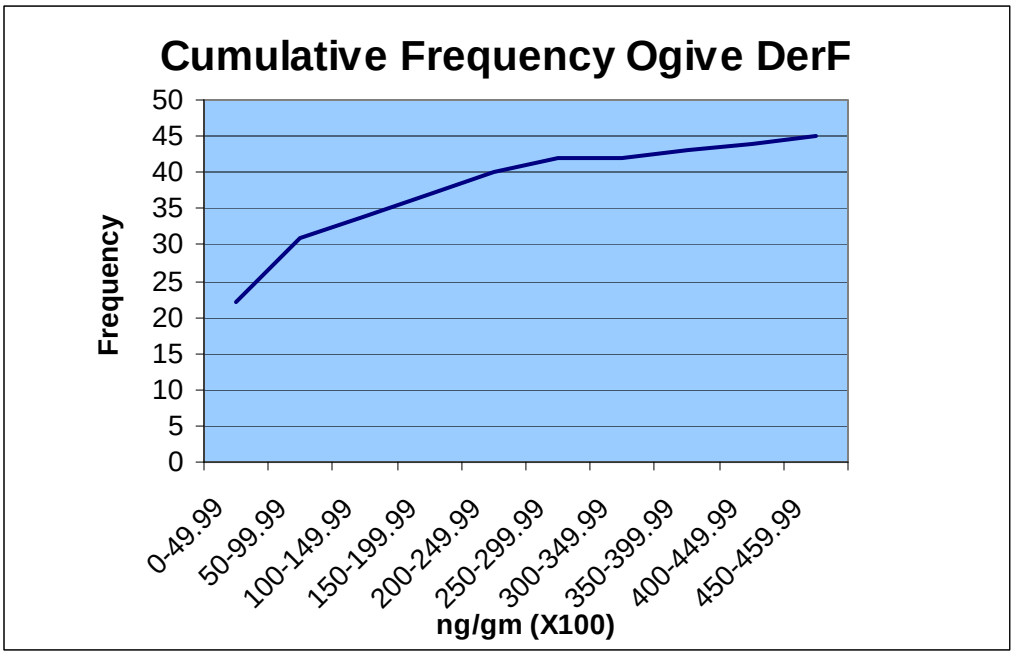

Figure 53

Table 57

DerP				
	#	Percent		
Less than 20	5	11.11%	Average	4327.50
Low Risk	15	33.33%	Max	40100.00
Moderate Risk	15	33.33%	Min	<20
High Risk for Symptoms	4	8.89%		
High Risk for Sensitization	6	13.33%		

Table 58

DerF				
	#	Percent		
Less than 20	1	2.22%	Average	9841
Low Risk	3	6.67%	Max	48500
Moderate Risk	12	26.67%	Min	<20
High Risk for Symptoms	15	33.33%		
High Risk for Sensitization	14	31.11%		

Table 59

Risk Factor Ranges		
Assay Detection Limit……20 nanograms allergen per gram house dust		
Low Risk Factor……<400 nanograms allergen per gram house dust		
Moderate Risk Factor……400-2000 nanograms allergen per gram house dust		
High Risk for Symptoms……2000-10000 nanograms allergen per gram house dust		
High Risk for Sensitization……>10000 nanograms allergen per gram house dust		
n=45		
	DerP Counts	
Less than 20	**5**	
Low Risk	**15**	
Moderate Risk	**15**	
High Risk for Symptoms	**4**	
High Risk for Sensitization	**6**	
	DerF Counts	
Less than 20	**1**	
Low Risk	**3**	
Moderate Risk	**12**	
High Risk for Symptoms	**15**	
High Risk for Sensitization	**14**	
	DerP	**DerF**
Average	**4327.50**	**9841**
Max	**40100.00**	**48500**
Min	**<20**	**<20**

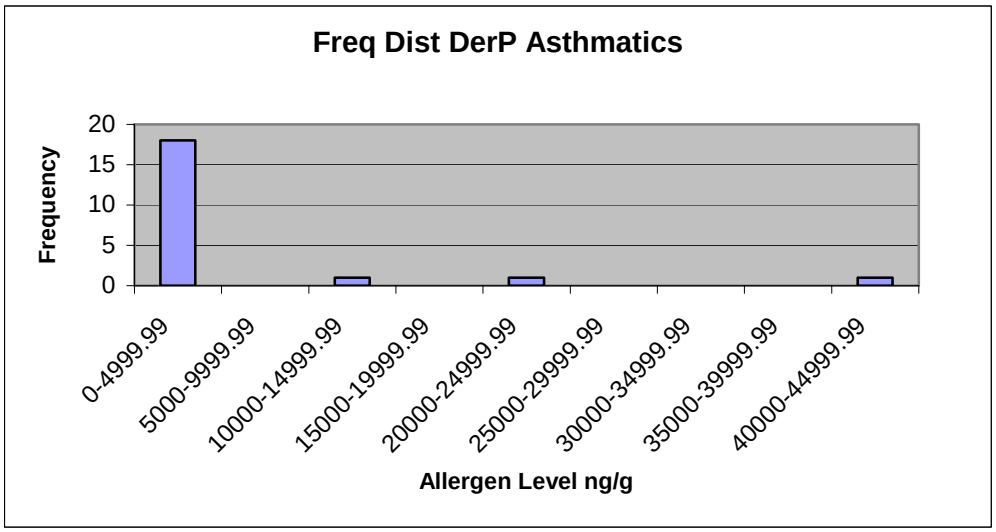

Figure 54

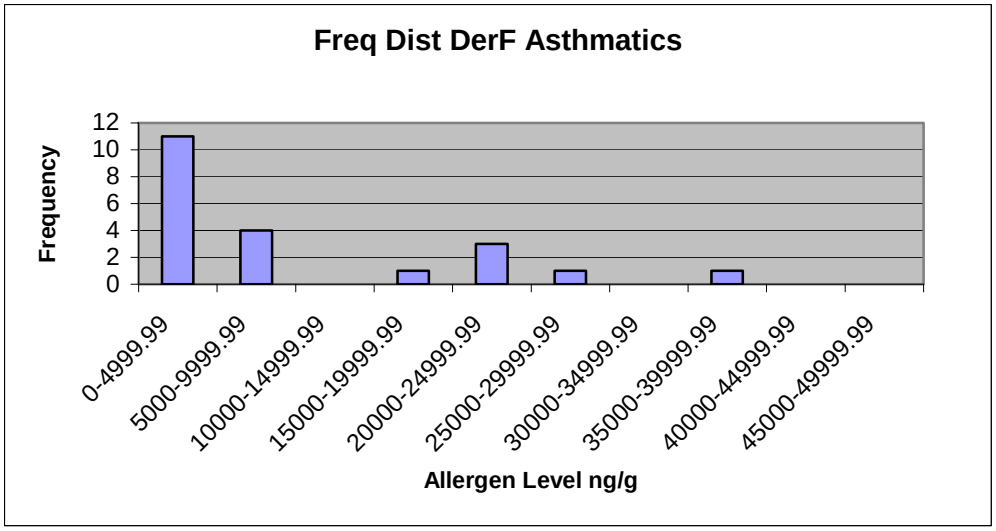

Figure 55

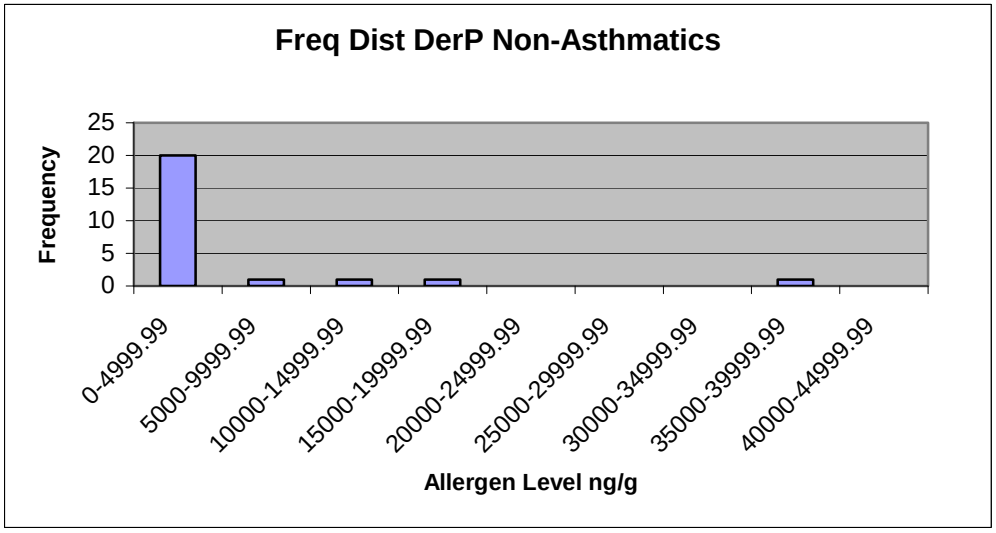

Figure 56

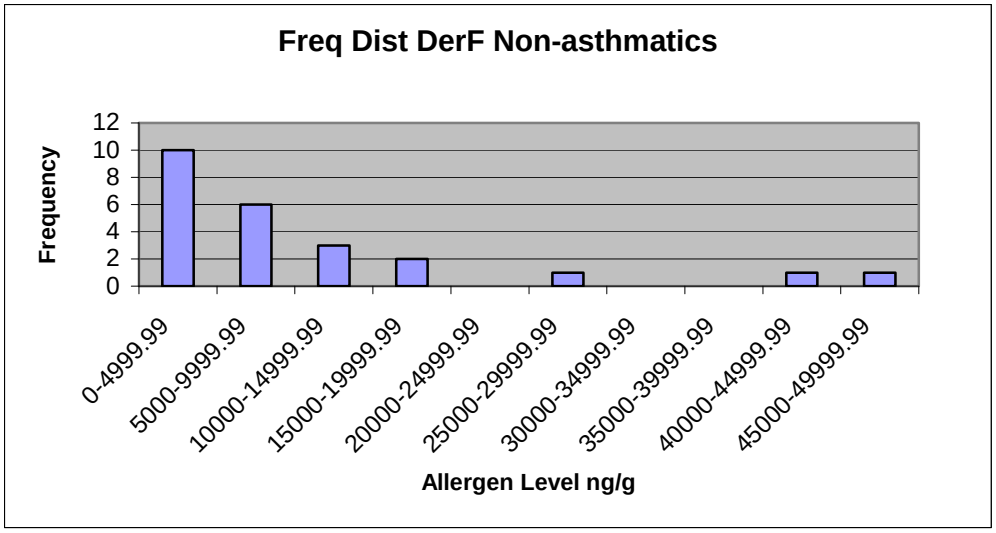

Figure 57

Frequency of respondents is examined with respect to Risk Factor class, Less Than 20 ng/g, Low Risk, Moderate Risk, High Risk for Symptoms and High Risk For Sensitization, in Figures 54, 55, 56, 57, 58 and 59, for each allergen. The Figures illustrate the frequency as a group, for asthmatics and for non-asthmatics. These graphical illustrations provide additional insight to the previous figures.

As a group, for DerP, the predominant risk factors are Low and Moderate; for DerF, they are High Risk for Symptoms and High Risk for Sensitization (Figures 54 & 55). For asthmatics, Figures 56 & 57, the predominant risk factors are Low and Moderate for DerP and Moderate and High Risk for Sensitization for DerF.

For non-asthmatics, Figures 58 & 59, the predominant risk factors are Moderate, with Low and High Risk for Symptoms equal, for DerP. The predominant risk factors are High Risk For Symptoms and High Risk for Sensitization for DerF.

Although the data is weak in connecting allergen levels to being asthmatic, if allergen levels were considered an important factor in asthma, then these illustrations would seem to suggest a connection between DerF and asthma. However, it does not explain the levels in the non-asthmatic group that are found to have Moderate risk factor to DerP and a High Risk for Symptoms and Sensitization to DerF. Based on this information and the premise that allergen level is connected to being asthmatic the non-asthmatics would then be asthmatic. Questions remain: Do the non-asthmatics have asthma that has gone unreported or undiagnosed? Will the non-asthmatics develop or be diagnosed with asthma at some later time? Is there a latency period for exposure to allergens and developing asthma? Are there factors that allow someone to be exposed to allergens and then have a “trigger” that pushes them over the edge and developing asthma? Without a larger data set and more powerful statistical analysis these questions remain unanswered.

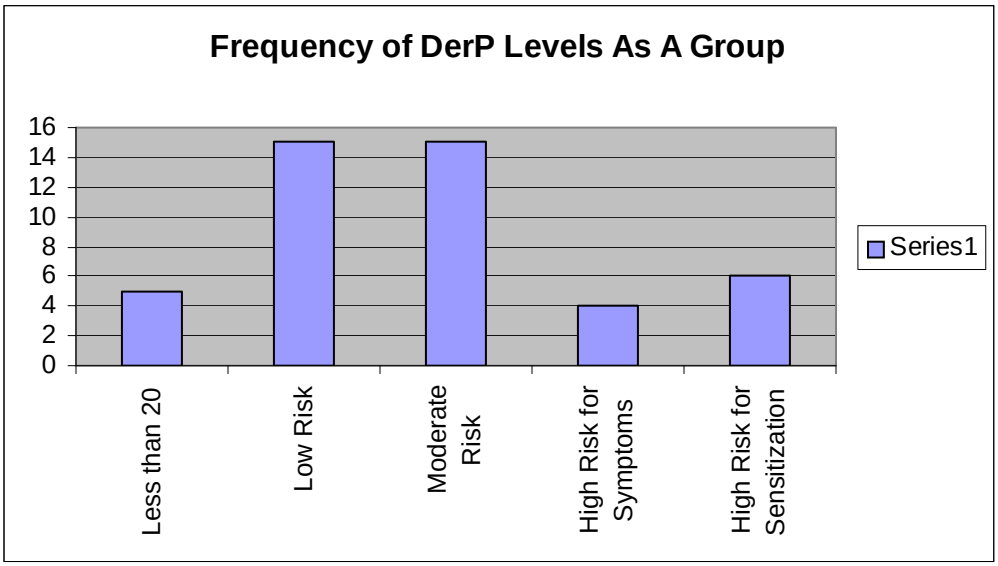

Figure 54

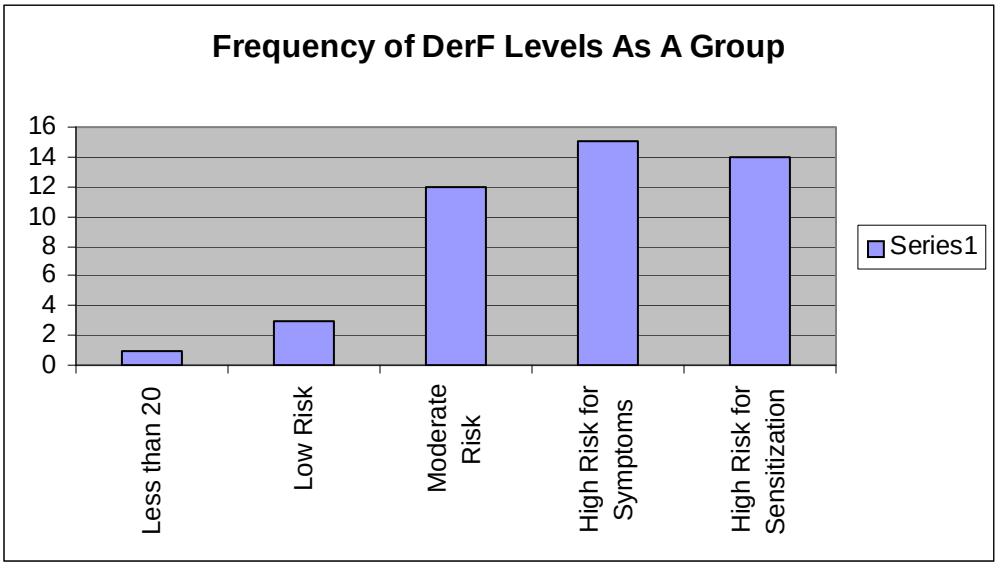

Figure 55

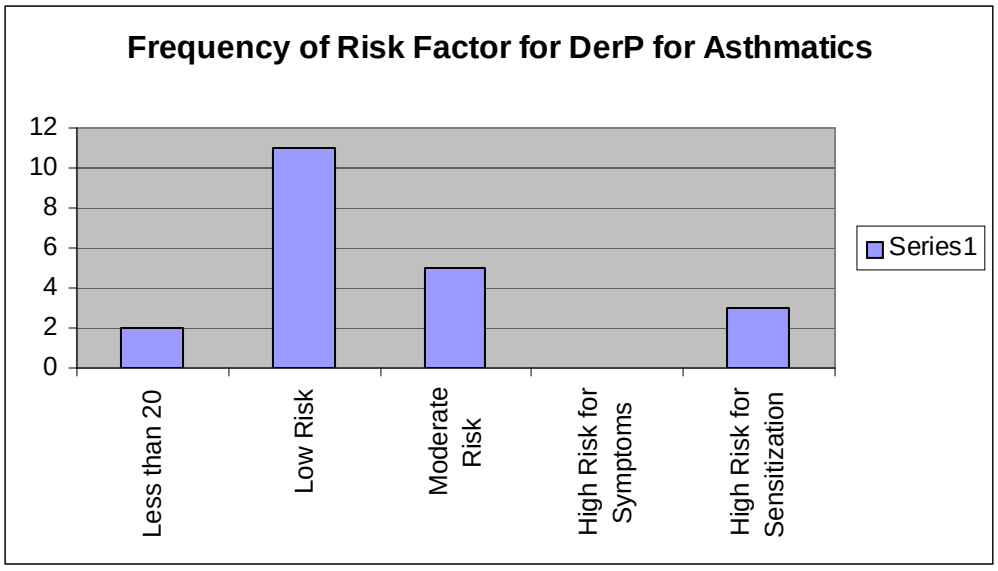

Figure 56

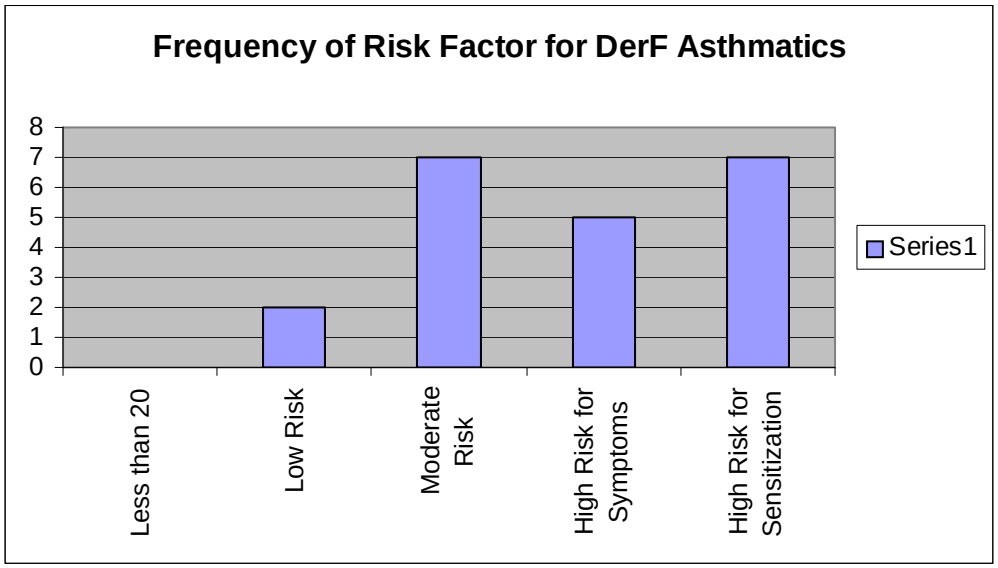

Figure 57

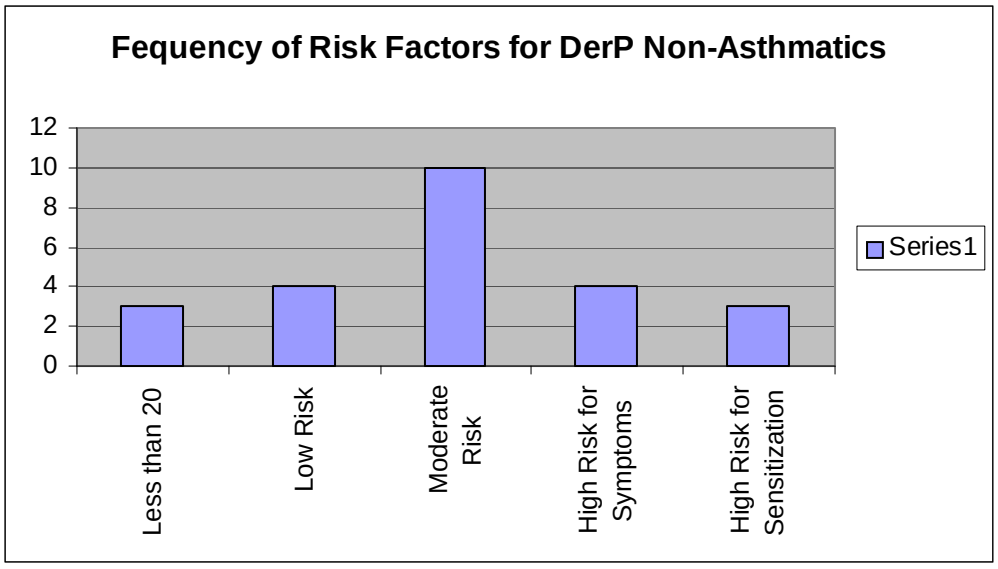

Figure 58

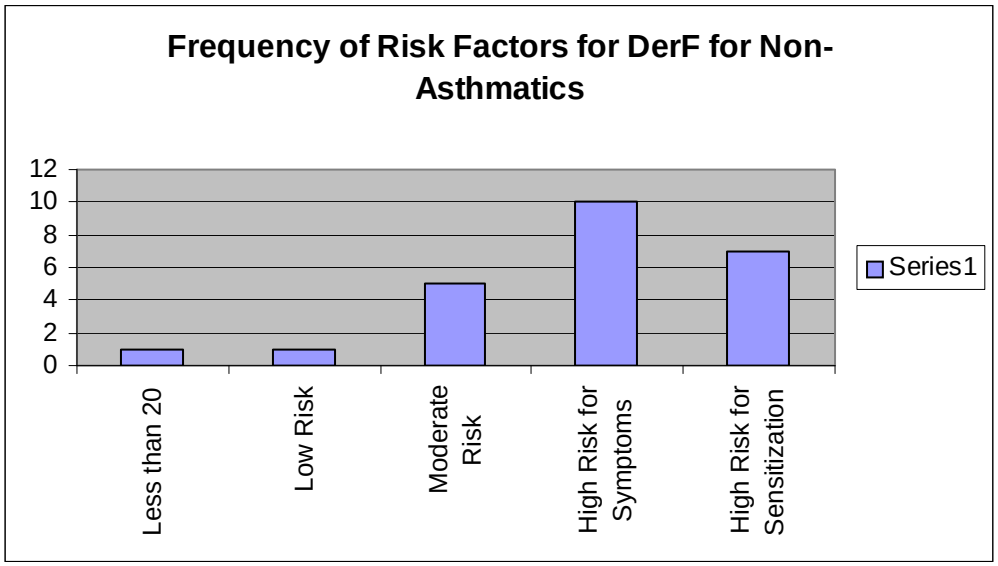

Figure 59

Conclusions

Elderly Native American populations have a higher incidence of respiratory disease, including COPD, than white populations. The higher incidence is associated with socioeconomic indicators such as low income, poor education, and limited access to health care. Lifestyles and occupation also play a large role in respiratory disease. There is a need for respiratory disease prevention programs and for disease management programs on reservations to communicate risk factors and life choices.

One study reported higher self-reported asthmatic rates in Mohawk adult males aged 64 and older and in Mohawk adult females in 3 age categories surveyed, less than age 45, age 45-64 and older than 64.

For most factors, asthmatics and non-asthmatics were little different in their home and environmental settings. The largest differences appear to be the influence of cigarette smoking, found higher in asthmatics than non-asthmatics.

Patterns, although weak, were found that indicate industry is a factor, in terms of distance for dust measured in homes of the survey group. Homes closer to the industries had more dust collected.

Mobile sources, along highways, were found to be an important factor potentially affecting asthmatics in the survey group. CO2 levels were higher in asthmatics homes than in non-asthmatics homes despite windows being opened.

Carpet cleaning habits indicated the reduction of DerP with increased carpet cleaning but not for DerF. Methods of cleaning may play an important part in removal efficiency and redistributing of allergens.

Based on literature references and inferences from data, measured allergen levels are not precise indicators of asthmatic condition. Allergen levels are more appropriately interpreted on an individual basis. Analysis of data collected in this survey suggests a weak to moderate correlation (R=0.0417) between the DerP allergen levels and being asthmatic and a weak negative correlation (R=-0.138) between DerF allergen levels and being asthmatic, which is congruent with the lower levels found in asthmatic homes than non-asthmatic homes.

Asthmatics in the survey were found to have a lower risk factor for DerP exposure while non-asthmatics were found to have a higher risk factor for DerF exposure than asthmatics. Questions remain regarding allergen exposure, diagnosis and latency and other factors. Larger data sets and more refined statistical analysis can answer these questions. However, is there a need to have these questions answered and utilizing limited resources or would time and resources be better-spent promoting education and awareness?

Allergens were not detected in indoor air samples collected.

The survey could be expanded to include additional measurements or refined to focus on specific items such as mold and pet allergens to develop a better understanding of the asthma situation on the St. Regis Mohawk Reservation.

The data was not correlated with clinical health data since an epidemiologist was unavailable to review and interpret this type of information.

The Centers for Disease Control (CDC) reviewed the data and offered some suggestions in an e-mail communication (see Addendum). Most significant is, “Based on the protocol more data should have been collected, thus my impression is that more analyses could be done. It would especially be informative to correlate the environmental data with objective health data” (E-mail from Mr. Clive Brown, CDC, March 13, 20033). Mr. Brown further suggested that the information and data be presented in person for further discussion.

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Addendum

FYI

Here are comments that I received from the CDC regarding the Asthma Study. There main recommendation is to keep working with NYS. I know that this may not seem right, but these folks do not understand working with tribes.

See Below.

Dean S.

Dean S. Seneca, MPH, MCURP
Assistant Director, Office of Tribal Affairs
Agency for Toxic Substances and Disease Registry
1600 Clifton Road, N.E., MS E-32
Atlanta, GA 30333

-----Original Message-----
From: Brown, Clive
Sent: Thursday, March 13, 2003 8:54 AM
To: Seneca, Dean; McGeehin, Mike
Cc: Mott, Joshua; Redd, Stephen
Subject: REVIEW: Mohawk Tribal request- asthma study

Dean,
I received your CD this morning, there is no description of the files included. The documents included are a protocol for the project and a summary of Indoor Air Quality results.

I will first say that I'm somewhat reluctant to comment on the document, especially via a third party, because I note that the document was peer reviewed and states that different agencies have oversight for the document, including data review by the NYSDOH. I don't know if the summary document includes the review by the NYSDOH.

If the Branch and Division think this it necessary, I think it would be more useful to have the relevant parties present the project and findings to us and we give them suggestions for further work, or collaboration if deemed necessary. However, I will give some general comments.

The premise of the study is that there is a relationship between the incidence of asthma in the elderly Mohawks and indoor air quality problems and exposure to ambient sources that may contribute to asthma.

The project uses a questionnaire to determine indoor air risk based on asking about tobacco use, presence of mold & pets, use of indoor combustion devices and demographic information. The protocol mentions that it will get permission to review medical records to determine if the participants have health conditions related to air pollution. There is no mention as to whether the survey collected information about whether the participants have asthma, asthma symptoms or other conditions, although that is the premise of the study.

The protocol includes procedures for assessing dust sampling for dust mites, and air quality assessment for CO & CO2, humidity, airflow and temperature. There was also evaluation of the outdoor environment including proximity to industrial plants and paved roads.

The protocol outlines the procedures for indoor air sampling and air quality assessment, but does not say how the homes or participants were selected, what lab procedures were planned and what type of data analyses are planned.

The only results presented are that of the Dust mite distributions from the dust sampling and an estimation of the risk for sensitization and symptoms based on benchmarks presented by the lab. There is no health outcome data and no correlation of these findings with any other data.

Based on the protocol more data should have been collected, thus my impression is that more analyses could be done. It would especially be informative to correlate the environmental data with objective health data.