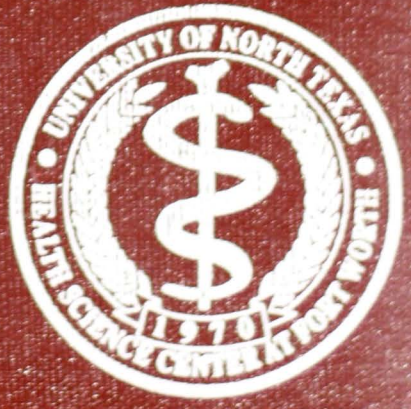

UNIVERSITY OF NORTH TEXAS
HEALTH SCIENCE CENTER AT FORT WORTH
1970

Marruffo, Marco, Predictors for the Severity of Asthma in the Hospital Setting. An Epidemiologic Study Based on Hospital Records from the Texas Health Care Information Council. Doctor of Public Health (Epidemiology), May 2005, 118 pp., 40 tables, 3 figures, bibliography, 62 titles.

The purpose of this research was to identify and assess prognostic factors for severity and risk of death among 27,383 hospitalized asthma patients in the state of Texas during 2002, by using the public available Texas Hospital Inpatient data, collected by The Texas Health Care Information Council (TCHIC) (TCHIC, 2002).

Data was analyzed by means of multinomial logistic regression using minor risk as the reference group.

Among other results, severe asthma cases were 20% more likely to be females, 20% more probability to have HIV/AIDS, 5.5 times more chance to be obese, 4.2 times more likely to have esophageal reflux, 1.7 times more likely to be hypertensive, and 11.8 times more likely to have diabetes as compared to those without severe asthma ($p < 0.001$). Obese were 2.8, diabetics 3.3, those with urinary tract infection 2.3, those with fever 3.1 and those with congestive heart failure 7.5 times more likely to have major risk of death due to asthma ($p < 0.001$). The results of this study can be used to identify high risk groups to plan and applied control measures for tertiary prevention of severity and death due to asthma.

PREDICTORS FOR THE SEVERITY AND RISK OF MORTALITY OF ASTHMA

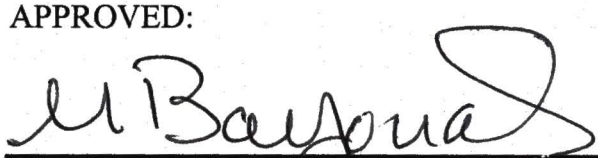
IN THE HOSPITAL SETTING

A CROSS-SECTIONAL STUDY BASED ON HOSPITAL RECORDS FROM THE

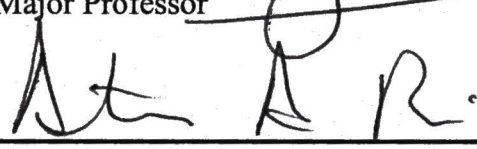
TEXAS HEALTH CARE INFORMATION COUNCIL

Marco Marruffo, M.D., S.C.P., M.P.H.

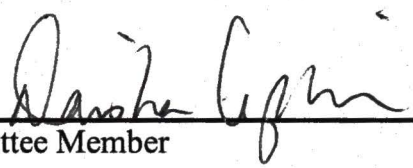
APPROVED:



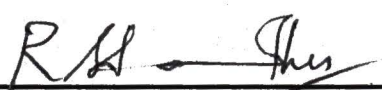
Major Professor



Committee Member



Committee Member



Committee Member

Department Chair

Dean, School of Public Health

# PREDICTORS FOR THE SEVERITY OF ASTHMA IN THE HOSPITAL SETTING. AN EPIDEMIOLOGIC STUDY BASED ON HOSPITAL RECORDS FROM THE TEXAS HEATH CARE INFORMATION COUNCIL.

DISSERTATION

Presented to the School of Public Health

University of North Texas
Health Science Center at Fort Worth

In Partial Fulfillment of the Requirements

for the Degree of

Doctor of Public Health

By

Marco Marruffo M.D., M.S.

Fort Worth, Texas

April 2005

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

# CHAPTER I

# BACKGROUND

## A. Purpose of the Dissertation

The purpose this study was to identify and assess prognostic factors for asthma severity and risk of mortality of asthma in hospitalized patients. A total of 27,000 hospitalizations due to asthma during 2002 were included in the study. Hospital Discharge Data from the Texas Health Care Information Council (THCIC, 2002) was used for this purpose.

## B. Literature Review

### 1. Introduction

Asthma is a chronic inflammatory disorder of the airways in which many factors play a role. Current research has increased considerably the knowledge of the epidemiology and physiopathological mechanisms of asthma, it is still considered to be a significant and serious public health problem (Pearce et al., 1998; Giembycz &

O'Connor, 2000). The underlying condition of asthma is chronic inflammation of the airways. This inflammation causes an associated increase in bronchial hyperresponsiveness to a wide variety of immunological and environmental factors. In susceptible individuals, chronic inflammation may cause recurrent or sporadic episodes of coughing, wheezing, dyspnea, tightness in the chest, and breathlessness (Harrison's, 2005; Pearce et al., 1998). This episodic symptomatology that is usually associated with airflow obstruction is variable in intensity due to unknown causes (Harrison's, 2005).

The airflow obstruction in asthma is often reversible, either spontaneously or after medical treatment. The episodic nature of asthma makes it part of a unique category of conditions. It is known that asthma typically produces acute exacerbations that alternate with symptom-free periods. The symptoms are characterized by a wide range of intensities. Most attacks or exacerbations are short in time and from the clinical view point, the patient many times recover quickly and completely. However, some patients suffer some degree of airway obstruction on a daily basis which can suddenly present a potentially life-threatening situation (Harrison's, 2005).

Many environmental triggers of asthma exacerbations are well documented including indoor environmental factors such as dust mites, pet's dander, cockroach allergens, endotoxins, and exposure to tobacco smoke (Pearce et al., 1998). However, once the patient has developed the exacerbation, factors that make it worst or better

(prognostic factors) other than treatment have not been clearly defined (Bayona et al., 2002).

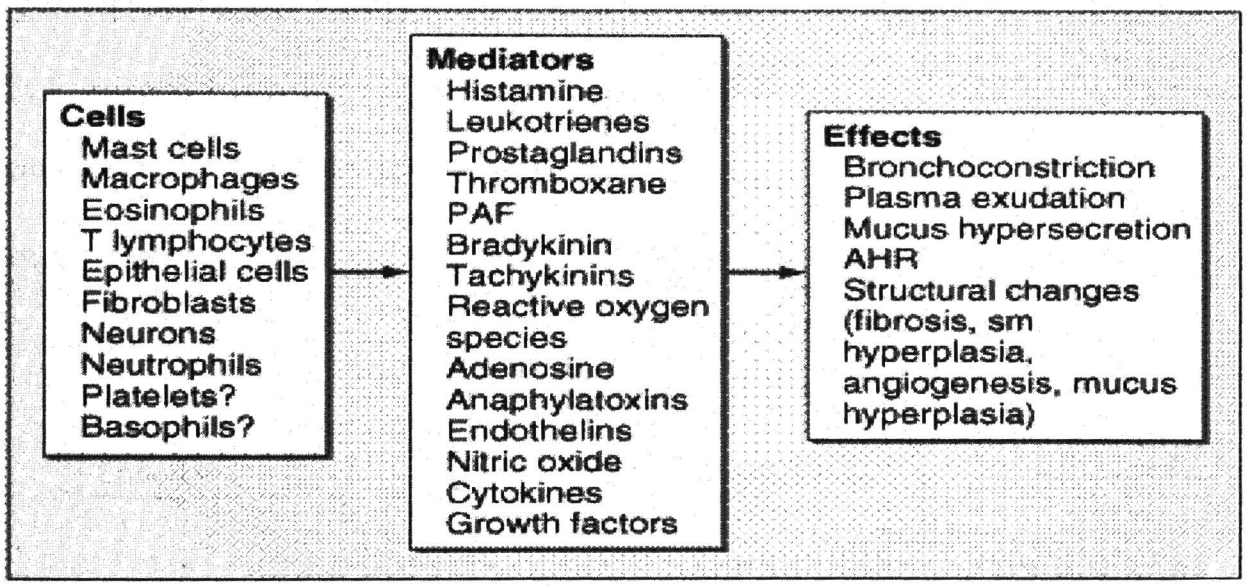
The intention of the present dissertation is to contribute to the knowledge of the prognosis of asthma by studying a large number of asthma cases hospitalized in the state of Texas during 2002, by comparing the level of asthma severity and risk of mortality in the presence or absence of selected potential prognostic factors. The results are hoped to serve as a baseline data for further specific investigations to assess the impact of modifying and removing such factors and thus reducing severity and risk of mortality among hospitalized patients. The identification and assessment of prognostic factors that are not modifiable such as gender, age, and ethnicity will serve to identify high risk groups for severity and mortality in whom more aggressive treatment and management should be considered.

## 2. Pathogenesis

The common feature found in asthmatics is persistent inflammation of the airways. This chronic condition is found in patients with any degree of disease severity. Asthma studies of pathogenesis focused on inflammation as a target for disease control (Slavin & Reisman, 2002). Many cells and cellular elements play a role in the development of inflammation. Particularly, the airways involve changes in eosinophils, T lymphocytes, neutrophils, epithelial and mast cells, even in patients that are

asymptomatic. Other conditions may occur in severe and persistent asthma, such as goblet cell hyperplasia, hypertrophy of the bronchial smooth muscle, and mucus occlusion of the bronchial lumen. Glandular hypertrophy and denudation of the epithelium may also occur. These changes may persist and often do not relate to the severity of the disease in treated patients compounds shown in Figure 1(Busse & Holgate, 2000).

Figure 1: Cellular sources of inflammatory mediators and their physiologic effects. PAF, platelet-activating factor; AHR, antihyaluronidase reaction [Taken from Harrison's, 2005]

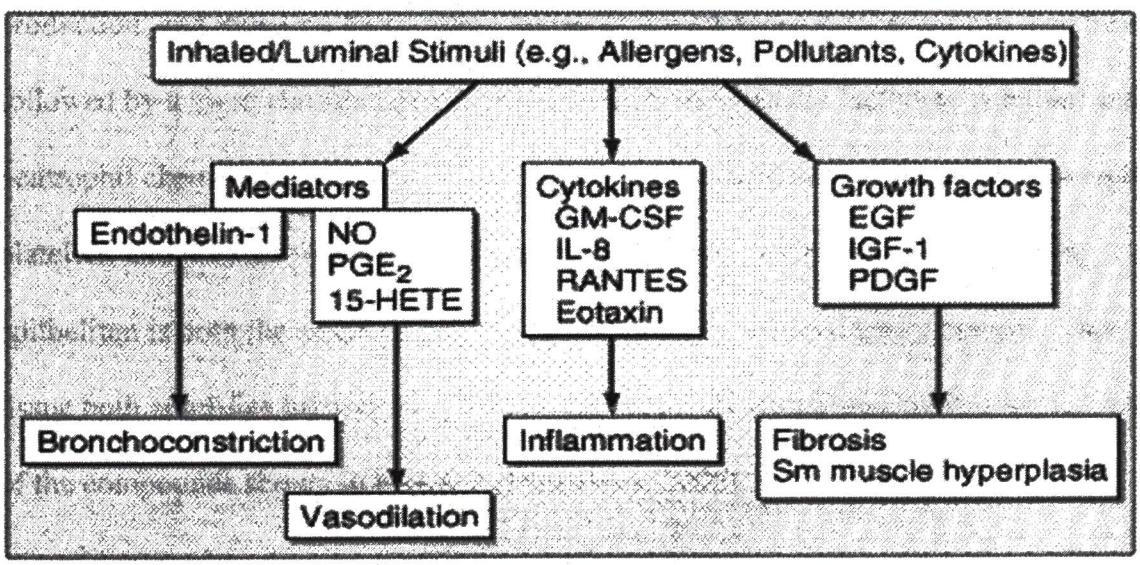



The cellular profile of inflammation provides evidence for the immune reaction of injury and remodeling. The critical physiologic features of asthma derive from the

interaction among the resident and infiltrating inflammatory cells in the epithelial surface of the airway, cytokines, and inflammatory mediators (Harrison's, 2005).

The bronchial reaction varies, depending on the severity, treatment and duration. The cells that are known to play a role in the inflammatory response are mast cells, eosinophils, T lymphocytes, and epithelial cells, as mentioned earlier. Mast cells can produce a variety of cytokines, which can contribute to the development of acute and chronic inflammation compounds (Gershwin & Naguwa, 2005) shown in Figure 2.

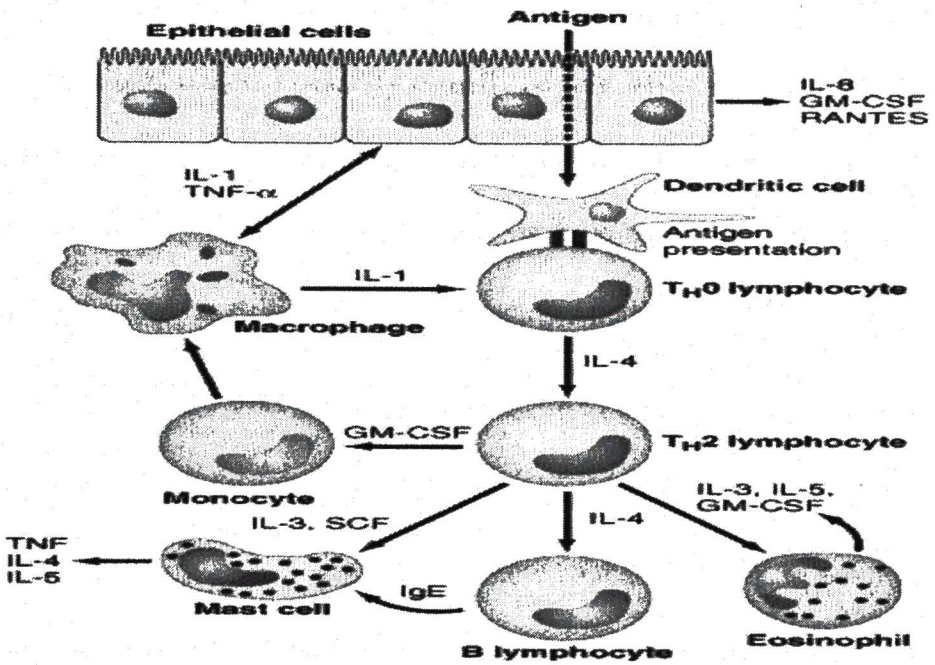
Figure 2: "Inflammatory mediators derived from epithelial sources. Nitrous oxide (NO); $PGE_2$, prostaglandin $E_2$; GM-CSF, granulocyte-macrophage colony-stimulating factor; IL, interleukin; RANTES, regulated on activation, T cell expressed and secreted; EGF, epidermal growth factor; IGF, insulin-like growth factor; PDGF, platelet-derived growth factor" [Taken from Harrison's, 2005].



In addition to the network of cytokines, T lymphocytes appear to play an important role in inflammation. T lymphocytes are involved both in the inception and progression of asthma. Resent research has focused on the idea that an imbalance in T-helper Th1 and Th2 cytokines may explain the development of asthma. If there is an imbalance of the two opposing populations of Th lymphocytes: Th1 and Th2, airway inflammation occurs. Th1 cells are critical in cellular defense mechanisms in response to infection. In contrast, Th2 generates a network of cytokines that can mediate allergic inflammation. Therefore, cytokine imbalance may explain some of the increases in asthma prevalence in Westernized countries. The data on this topic provides new insight into the pattern of airway injury that may lead to new therapies (Barnes, 1998).

The mediators released produce an intense, immediate inflammatory reaction involving bronchoconstriction, vascular congestion, edema formation, increased mucus production, and impaired mucociliary transport. This intense local event can then be followed by a more chronic one. Other elaborated chemotactic factors (eosinophil and neutrophil chemotactic factors of anaphylaxis and leukotriene $B_4$) also bring eosinophils, platelets, and polymorphonuclear leukocytes to the site of the reaction. The airway epithelium is both the target of, and a contributor to, the inflammatory cascade. This tissue both amplifies bronchoconstriction and promotes vasodilatation through the release of the compounds shown in Figure 3 (Harrison's, 2005).

Figure 3: "Cytokine network in allergic asthma. IL, interleukin; GM-CSF, granulocyte-macrophage colony-stimulating factor; RANTES, regulated on activation, T cell expressed and secreted; TNF, tumor necrosis factor; SCS, stem cell factor" [Taken from Harrison's, 2005]




3. Pathophysiology

Reduction in airway diameter is a critical physiological characteristic of asthma. This is due to a number of factors: edema of the bronchial wall, contraction of the bronchial smooth muscle, vascular congestion, and increased accumulation of mucus. These conditions result in a marked increase in airway resistance. The following are physiologic changes that may occur: decreased forced expiratory volume, decreased flow rates, changes in elastic recoil, altered arterial blood gas concentrations, and

hyperinflation of the lungs and thorax. When the lungs hyperinflate and thoracic hyperexpansion occurs, it causes a significant reduction in respiratory muscle efficiency and function. In some patients, changes in ECG are found as a result of pulmonary hypertension and right ventricular hypertrophy. In acutely ill patients, residual volume frequently approaches 400% of normal. At the same time, clinical tests show that acutely ill patient's functional residual capacity actually doubles (Harison's, 2005). The cycle continues. Hypoxia triggers an increase in the respiratory rate, which decreases the dynamic compliance of the lungs. When dynamic compliance is lowered, the lungs become stiff (retrieved on April, 19, 2005 from http://pedsccm.wustl.edu/All-Net/english/pulmpage/asthma/asthma-2.htm).

Hypoxia is a universal finding during acute attacks. In terms of cardiology, the increased intrathoracic pressure impedes venous return, thus decreasing right and left ventricular preload. Hypotension and tachycardia ensue, which may cause further cardiac dysfunction (Harrison's, 2005).

4. Clinical Features

The most common symptoms of asthma are: cough, wheezing and dyspnea. The typical form of asthma presents all three symptoms shown in table 1.

Table 1: Signs of Asthma

| |
|---|
| Coughing or "bronchitis" with every cold |
| Coughing (especially at night) that lingers for weeks |
| Shortness of breath or wheezing with exercise or exposure to allergens |
| Night time wakening with cough or shortness of breath |

Taken from http://www.ovcnet.uoguelph.ca/BioMed/Courses/Public/Pharmacology/pharmsite/98-409/Asthma/asthma_fr.html)

In the initial phase of asthma, patients complain of a sense of constriction in the chest as the wheezing intensifies. As expiration becomes prolonged, patients will often experience tachycardia, tachypnea, and mild systolic hypertension. As the condition advances, the lungs become overinflated. In severe attacks, wheezing becomes high pitched (Harrison's, 2005).

The two most valuable signs for identifying the severity of obstruction are: (1) visible evidence that the accessory muscles are active (2) development of a paradoxical pulse. When these two signs appear, pulmonary function impairment is significant. In critical cases, the production of thick mucus develops, causing the patient to begin gasping. At this point, mechanical ventilatory assistance is necessary to prevent suffocation. A patient may complain of intermittent episodes of nonproductive cough or external dyspnea, although these cases are not typical. These individuals tend to have normal breath sounds but wheeze after repeated forced exhalation. This scenario is an aberration from the norm. If clinical tests show that there is an absence of these two

signs, a bronchoprovacation test is needed to make the correct diagnosis (Harrison's, 2005).

5. Treatment

The preferred pharmacological therapies fall into two categories: (1) drugs that inhibit smooth muscle contraction (2) drugs that prevent or reverse inflammation. Inhaled corticosteroids are the most effective agents available for the symptomatic control of asthma. In children, inhaled corticosteroids provide effective control of symptoms, but when treatment is stopped, symptoms and airway hyperresponsiveness can actually worsen. This reaction raises an important question of whether inhaled corticosteroids modify the nature of the disease. The answer to this question is still under investigation (Harrison's, 2005). Table 2, shows the main approaches for the treatment of asthma.

Table 2: The Three Main Approaches for the Treatment of Asthma

| |
|---|
| Avoidance of factors associated with asthma exacerbations |
| Take drugs that reverse or inhibit bronchoconstriction |
| Take anti-inflammatory drugs as needed |

Modified from http://www.ovcnet.uoguelph.ca/BioMed/Courses/Public/Pharmacology/pharmsite/98-409/Asthma/asthma_fr.html)

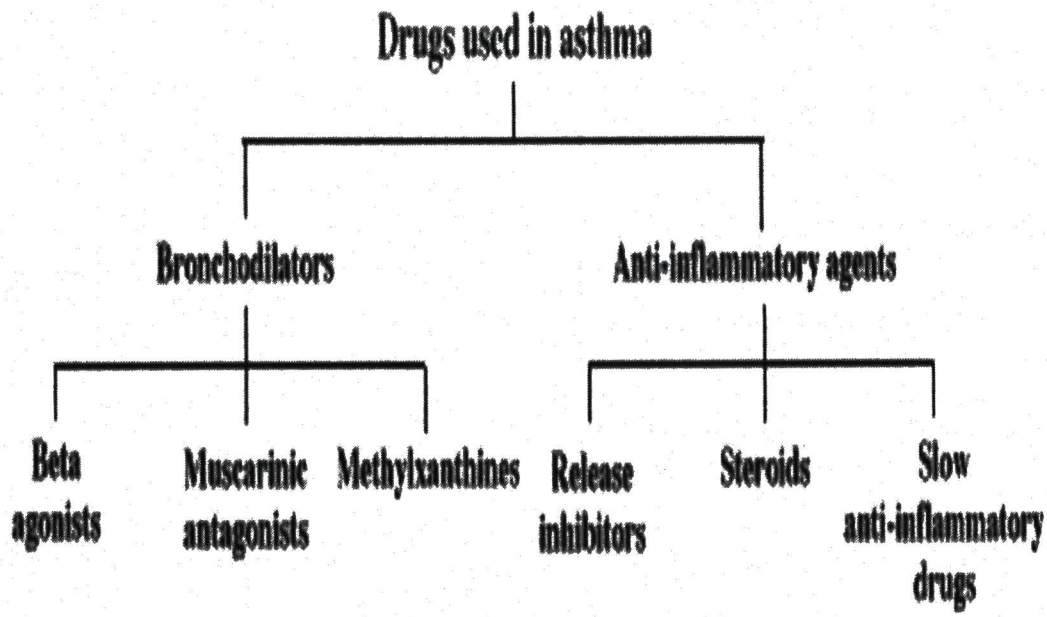
Treatment in general, focuses on eliminating potential causative agents and suspected allergens. These causative agents are found in four categories: (A) inhalant allergens (B) occupational exposures (C) irritants (D) all other factors. (A) Inhalant allergens include: animal allergens, dust mites, pollen, cockroach allergens, molds, and outdoor allergens. (B) Occupational exposures are chemicals and gases found at the workplace. (C) Irritants include tobacco smoke, and indoor/outdoor pollution. (D) The category "all other factors" include: sinusitis, rhinitis, viral respiratory infections, gastroesephageal reflux, aspirin sensitivity, and systemic or topical beta-blockers (Harrison's, 2005). In reality, the list of triggering agents is endless.

When it is clear that a relationship between symptoms and exposure to an unavoidable allergen to which the patient is sensitive, immunotherapy may be considered. In addition, when it is difficult to control specific symptoms with drugs, immunotherapy may be effective. Allergen immunotherapy, also known as desensitisation or hypsensitisation, is the technique for treating IgE-mediated disease. The patient is given injections of the known allergen with the goal of decreasing sensitivity to the specific allergen. Although immunotherapy is effective for many cases, the topic remains to be controversial (Harrison's, 2005).

Current research on asthma continues to investigate the cellular profile of inflammation as it provides evidence of the immune reaction. Although scientific research is advancing in many areas; there is no known cure for asthma---there is no

quick fix or magic bullet. Therefore, the main objective is proper management of the disease. The treatment of asthma is summarized in figure 4, and table 3.

Figure 4: Drugs used in asthma




Taken from http://www.ovcnet.uoguelph.ca/BioMed/Courses/Public/Pharmacology/pharmsite/98-409/Asthma/asthma_fr.html)

Table 3: Asthma Treatment

| Treatment | Name of treatment | Uses |
|---|---|---|
| Bronchodilators | Beta agonists | Increases bronchodilation extensively They are very effective in asthmatics. |
| | Muscarinic antagonists | It only inhibits bronchoconstriction mediated by vagal discharge. |
| | Methyxanthines | |
| Anti-inflammatory Agents | Release Inhibitors | prevents allergen or exercise-induced asthma<br><br>used in asthma that is non-responsive to bronchodilator therapy |
| | Corticosteroids | high dose for several weeks followed by low dose, then given alternate days. |

Taken from http://www.ovcnet.uoguelph.ca/BioMed/Courses/Public/Pharmacology/pharmsite/98-409/Asthma/asthma_fr.html)

6. Epidemiological Patterns and Risk Factors

a. Person

i. Gender

Liou, et al. in 2003 conducted a cross-sectional study of incident patients seen in a specialized asthma treatment center over a 2.5-year period and recorded the prevalence of

contributive factors for asthma severity. They found that male gender was independently associated with moderate/severe asthma (OR = 2.22, 95% CI 1.04, 4.76; p = 0.036) (Liou, et al 2003). According to a cross-sectional study by Skobeloff et al. (1992), there was a higher rate of admission for pre-pubertal males than females. In contrast, there was a higher incidence of asthma admissions for adult females than adult males. Female patients' experienced longer hospital stays per admission as well, and adult females were more severely affected by asthma (Skobeloff et al., 1992).

Rates of asthma have been increasing in all age groups, among both men and women, and across all racial and ethnic groups, and the total deaths from asthma have also risen, from a low of 1,674 in 1977, to 5,637 in 1995 (Mannino, Homa, Pertowski, Ashizawa, Nixon & Johnson et al., 1998).

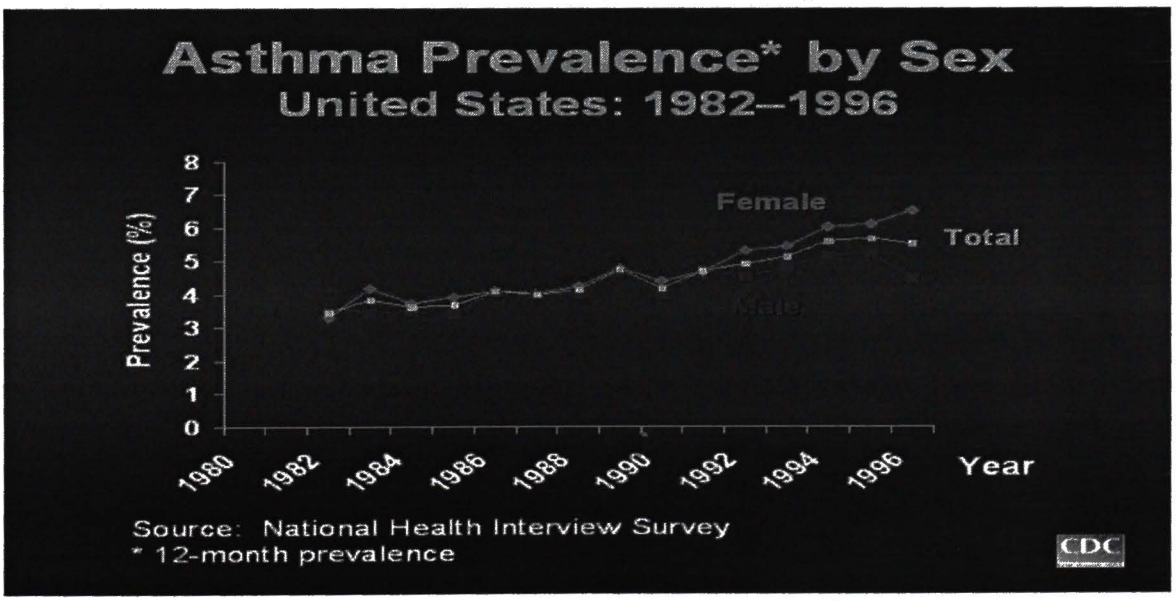
ii. Age

Trends in asthma for children aged 0 to 17 were studied through a cross-sectional design using The National Health Interview Survey (NHIS), the National Ambulatory Medical Care Survey, National Hospital Discharge Survey, and the Mortality Component of the National Vital Statistics System, in that studied they found that Asthma prevalence increased by an average of 4.3% per year from 1980 to 1996, from 3.6% to 6.2%. The peak prevalence was 7.5% in 1995. The asthma hospitalization rate grew by 1.4% per year from 1980 to 1999. The asthma death rate increased by 3.4% per year from 1980 to

1998. Children aged 0 to 4 years had the largest increase in prevalence, but adolescents had the highest (Akinbami and Schoendor 2002). According to a report of the American Lung Association (ALA) called Childhood Asthma Overview, asthma remains as one of the most common chronic childhood diseases (ALA, March 2002).

Asthma in Adults a publication from the American Lung Association reported that adults constitute an important group of the population in which asthma is widespread. Asthma disappears in a proportion of the children when they become adults: the condition still affects beyond childhood in 85 percent of women and 72 percent of men (ALA, 2002), asthma prevalence by sex is shown in table 4.

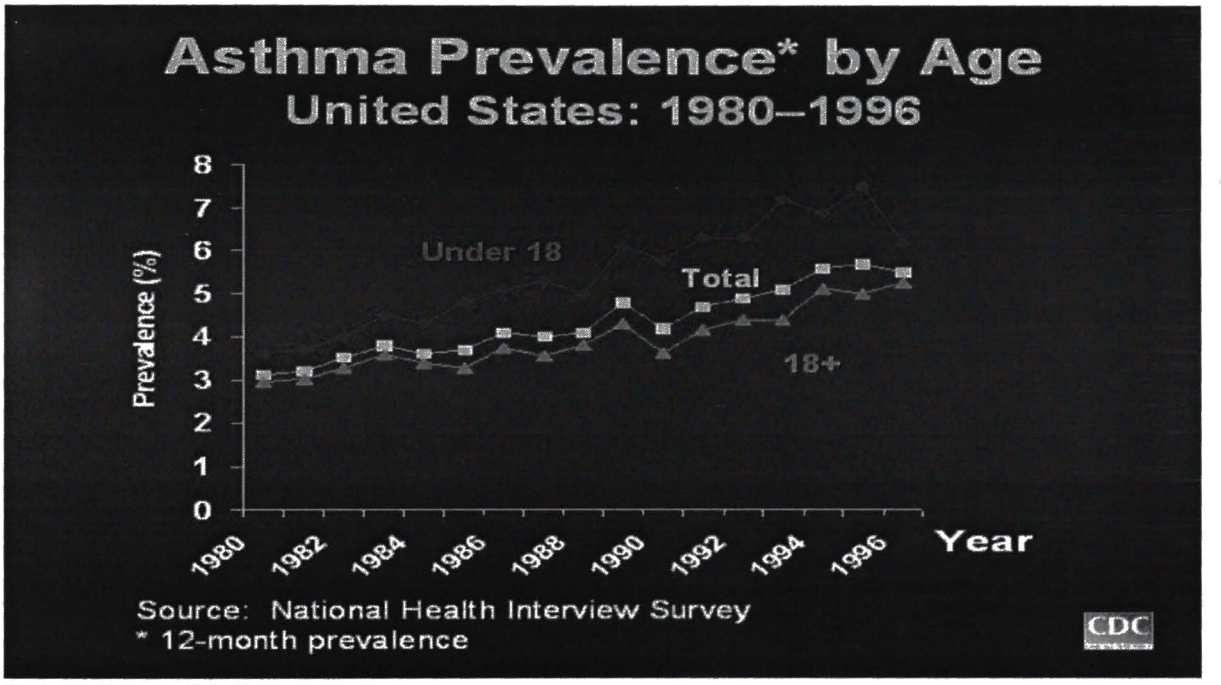
Table 4: Asthma prevalence by gender in the United States 1982-1996




Taken from CDC

According to NHIS in 2002, 30.8 million people (111 people per 1,000) had ever been diagnosed with asthma during their lifetime. Among adults, 106 per 1,000 had a lifetime asthma diagnosis (21.9 million) compared to 122 per 1,000 children 0-17 years (8.9 million), (CDC, 2002) asthma prevalence by age is shown in table 5.

Table 5: Asthma prevalence by age




Taken from: CDC

The age distribution of asthma varies from place to place depending on exposure to triggers. Asthma affects all ages but is more frequent and severe in the two extremes age groups, the very young and the elderly (Harrison's, 2005). Meurer et al, (2000), in a cross-sectional study to assess the trends in asthma severity among patients 18 years and

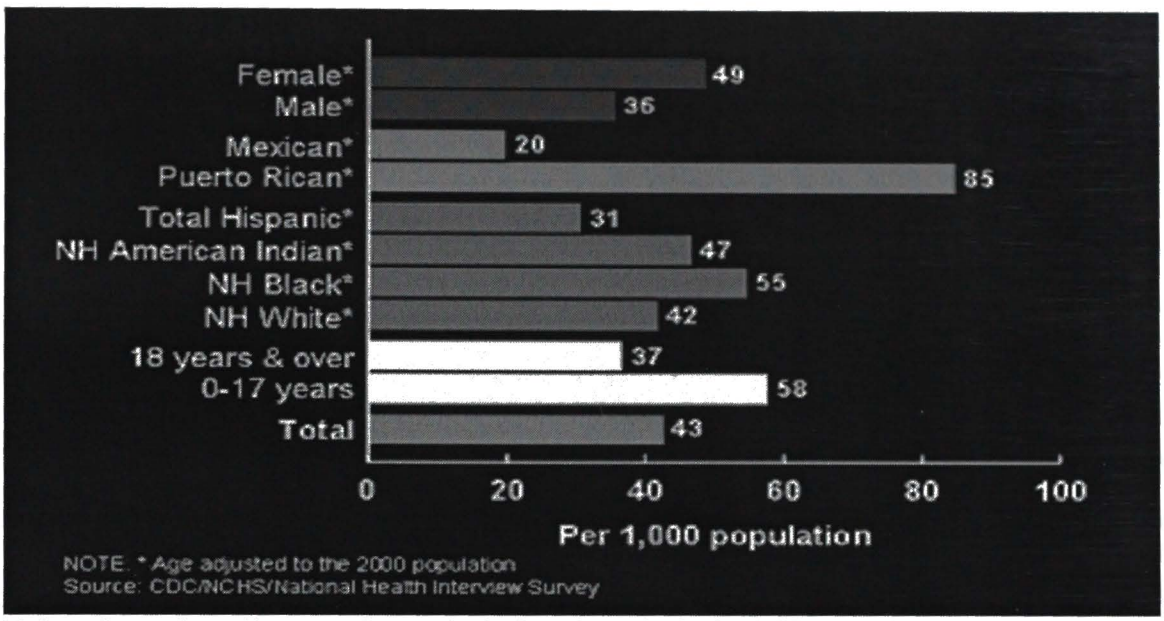
younger who had the principal diagnosis of asthma, were selected the records of 29,077 patients from 746 hospitals in 1990 and 33,443 patients from 811 hospitals in 1995, they found that a greater proportion of adolescents was more likely to have high-severity of asthma than children aged 5 to 12 years, and hospitalized boys were more likely to have high severity asthma than girls (Meurer et al., 2000).

A report from Illinois Health Care Cost Containment Council Members showed that the rate of hospitalization for 1999 was highest "among the very young and the very old", 26.3 out of every 10,000 children 14 and under were discharged from the hospital for asthma, and those 65 years and older experienced higher discharge rates per 10,000 than did other age groups (Illinois Asthma Hospital Guide 2000).

iii. Ethnicity/Race

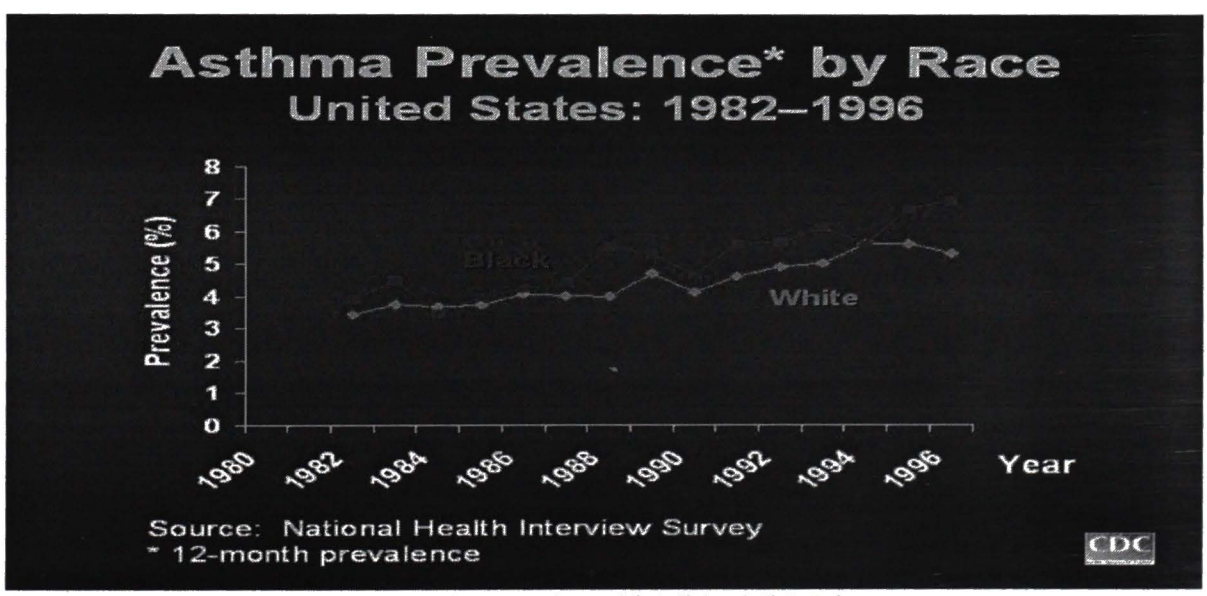
Among all racial and ethnic groups, Puerto Ricans have the highest rate of lifetime asthma (196 per 1,000) and Mexicans the lowest (61 per 1,000). Grouping all Hispanics together masks this difference. Puerto Ricans were almost 80% more likely, and non-Hispanic blacks and American Indians were about 25% more likely to have ever been diagnosed with asthma than non-Hispanic whites. Females were about 7% more likely than males to ever have been diagnosed with asthma, but among children 0-17 years of age, males were more likely to have an asthma diagnosis, 139 per 1,000 versus 104 per 1,000 for females shown in tables 6 and 7 (CDC, 2002).

Table 6: Asthma attack prevalence




Taken from: http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm

Table 7: Asthma prevalence* by race United States; 1982 - 1996




Taken from: http://www.cdc.gov/asthma/speakit/slides/slide7.jpg

The National Center for Health Statistics (NCHS) reported that the African Americans have four times higher rate of emergency department visits than whites, the same rate for children was more than double than for adults, and the rate for women was slightly higher than for men (CDC, 2002).

The particular distribution patterns of asthma in the minorities populations is explained in a publication called Trends in Asthma Morbidity and Mortality, it reported that since 1999 asthma attack prevalence rates in African Americans were 21.6 percent higher than in whites, and a state-by-state study found that asthma was higher among African Americans (8.5 percent) than whites (7.1 percent). Black population in 2001 had an age-adjusted death rate for asthma of 3.6 per 100,000, that it was three times the rate in the white population (1.2 per 100,000), black women had the highest mortality rate due to asthma in the same year 3.8 per 100,000 (ALA, 2002).

Among Hispanic 274 deaths of asthma were reported during 2001, and an age-adjusted death rate of 1.4 per 100,000 population. This ethnic group has an age-adjusted death rate of 61%, which is lower than non-Hispanic blacks, but 17% higher than non-Hispanic whites (ALA 2002). In contrast, a recently published study found that Puerto Ricans had higher age-adjusted death rates than all other Hispanic subgroups as well as non-Hispanic whites and blacks (Beckettt, Belanger, Gent, Holford, & Leaderer, 1996).

In a prospective cohort study that evaluated predictors of asthma morbidity in adults in an urban African American community in New York City, patients with asthma who had previous hospitalizations for asthma within the previous year were followed during 9 to 15 months. The return to the emergency department visits on follow-up were more likely to occur in asthma patients hospitalized in the previous year (OR = 3.9, 95% CI 1.7, 9.0) (Pesola et al., 2004).

iv. Seasonal Trends

In United States the relationship between seasonal trends in asthma-related hospitalizations has been well documented and can be found in multiple textbooks (Harrison's 2005). For example, Overton (2003) reported that in a study of 215 hospitals including three million annual inpatient data. They found the greatest proportion of total asthma-related hospital admissions occurred from September through January, but the rates declined from February through May and were the lowest from June through August. In contrast Pendergraft (2003) in North Carolina reported that intensive care unit admissions were larger during the spring and summer months. However, the percentage of severe cases was the highest in the summer (Overton, 2003). Other recent examples of the seasonality of asthma include the following. In an cross-sectional study to determine if a there is a seasonal pattern to asthma hospitalizations and mortality in New Zealand were studied data for an 18-20 year period, asthma mortality and hospitalization rates peaked in the winter months (July/August). However, among the younger age groups,

mortality and hospitalizations showed different seasonal patterns; the highest hospitalization rates occurred in the early winter months, and the highest mortality in the early summer months (Kimbell-Dunn, Pearce, & Beasley, 2000).

In a cross-sectional study hospital admissions for asthma in England, and the registered deaths due to asthma over the years 1990-7 were examined. Admissions to hospital were similar except in September when higher rates of admission occurred. In the 15-44 age group there were marked mid summer peaks of outpatient visit and deaths but hospital admissions were similar to the annual average. In September/October there were peaks of episodes and admissions whereas deaths peaked in November. In the 45-64 age group a peak in outpatient visits was evident in mid summer when admissions were about average and deaths were at the lowest, and tended to increase gradually with the approach of winter. Finally, in those age over 65 years, outpatient visits, admissions to hospital, and deaths followed similar patterns with substantial peaks in mid winter (Fleming, Sunderland, Cross & Ross, 2000). These examples showed sufficient evidence of the seasonal pattern of asthma outpatient, inpatient and mortality with an important increment in winter months. In a retrospective cohort study of risk factors for death due to asthma in children were reviewed 108 cases of asthma death in 1–19-year-olds in Denmark during the period from 1973 to 1994. Death occurred predominantly in the 15–19-year age group, and more patients died in the summer (Jorgensen, Jensen, Bulow, Dahm, Prahl, & Juel, 2003).

In Maryland, the Health Services Cost Review Commission (HSCRC, Baltimore) used a cross-sectional design to study data for pediatric ED visits and hospital admission for pediatric asthma in Baltimore city and the state of Maryland by registering all the emergency department visits made by children 0–18 years of age in the second quarter of the years 1997 to 1999, and hospital admissions from 1986 to 1999. Distinct peaks in pediatric emergency department visits and hospital asthma admissions occurred each year during the winter–spring and autumn seasons. The same number, timing, and relative magnitude of the major peaks in asthma admissions occurred statewide, implying that the variables affecting these seasonal patterns of acute asthma exacerbations occur statewide. The authors concluded that similar seasonal trends are observed worldwide (Kimes, Levine, Timmins, Weiss, Bollinger, and Blaisdell 2004). Zar et al, 2001, worked with death notification records to investigate the incidence of fatal and near-fatal asthma from South Africa by analyzing a total of 1,506 deaths. They found from all subjects, more deaths occurred in winter (32%) (June to August, inclusive) as compared to autumn (25%), spring (24%) or summer (19%), these differences were statistically significant ($p<0.001$). There was no predominant seasonal distribution of asthma mortality for those aged 5–34 yrs. Overall for those <55 yrs, 26% of deaths occurred in winter compared to 28% in autumn, as well as 26% in spring and 20% in summer (Zar, Stick ells, Toerien, Wilson, Klein & Bateman 2001).

Place, Geographical Distribution and Disease Frequency Worldwide, U.S., and Texas

The Global Initiative for Asthma (GINA) published the "Global Burden of Asthma Report", which includes the prevalence, morbidity, and mortality of asthma in 20 regions around the world. This report indicates that asthma is one of the most common chronic diseases in the world. It is now estimated that as many as 300 million people of all ages, and all ethnic backgrounds, suffer from asthma. As a result, the global burden of this disease to governments, health-care systems, families, and patients is growing worldwide. The rate of asthma increases as communities adopt western lifestyles and become urbanized. For the year 2003, the 10 countries with the highest asthma prevalence were Scotland, England, New Zealand, Australia, Canada, Peru, Trinidad and Tobago, Brazil, United States, and Fiji, and the 10 countries with the lowest were Switzerland, Russia, China, Greece, Georgia, Romania, Nepal, Albania, Indonesia, and Macau (GINA, 2005).

The International Union Against Tuberculosis and Lung Disease (IUATLD) has reported that there are approximately three million of asthmatics in Japan and in France, compared to more than 15 million in India and over a million in Africa. Developed countries present higher prevalence of asthma than undeveloped, but non industrialized world have a higher total number of people with asthma, than in the industrialized countries (IUATLD, 2004).

The Centers for Disease Control and Prevention (CDC) by analyzing the state-specific estimates of self-reported asthma prevalence reported in 1998 an estimated of 17,299,000 asthmatics. The state with the largest estimated number of persons with asthma was California with 2,268,300, followed by New York with 1,236,200, and Texas with 1,175,100 (CDC, 1998).

v. Comorbidities

Asthma is known to be associated with respiratory diseases, especially those that are associated with inflammation of the respiratory tract. Common respiratory conditions such as influenza, rhinitis, bronchitis and bronchiolitis with infectious origin are typical asthma triggers in a large proportion of asthma patients (Busse & Holgate, 2000).

Sinusitis

The prevalence of causative factors for the severity of asthma was studied in a cross-sectional study based on a chart review of 149 patients seen in a specialized asthma treatment center. Patients with mild asthma were compared to moderate/severe asthma.

Chronic sinusitis was found to be independently associated with moderate/severe asthma (OR = 2.22 95% CI 1.08, 4.60; p = 0.032) (Liou et al., 2003).

Bronchiolitis

Wennergren and Kristjansson in 2001, studied the relationship between respiratory syncytial virus bronchiolitis and future obstructive airway diseases by using a literature review of a large number of studies including systematic reviews and meta analyses. The authors concluded that syncytial virus (RSV) bronchiolitis in infancy is often associated with recurrent wheezing and asthma during subsequent years. However, wheezing tends to decrease and, according to the authors, most studies showed no significant increase in wheezing compared to controls (Wennergren, & Kristjansson, 2001).

Upper respiratory infections (URI)

Have been reported to be an important asthma trigger in many publications (Harrison's, 2005). Bayona, et al., 2002, studied 3,000 individuals through a cross-sectional self-reported asthma prevalence survey. They identified patients with more than one visit to the emergency room in the previous 12 months due to asthma exacerbations (cases) and asthmatic patients who did not visit emergency rooms (controls). They compared cases with controls in regards to several factors. The results clearly showed

that previous hospitalizations due to asthma (OR = 7.3, $p < 0.0001$) and frequent respiratory infections (OR = 2.5, $p = 0.0003$) were important prognostic factors associated with increased chance to be seen in the emergency room. The authors concluded that the appropriate management of respiratory infections in asthmatic patients could result in a reduction of up to 60 % of the odds of having asthma requiring emergency treatment, and may reduced by 86.3% hospitalizations (Bayona et al., 2002).

Johnston et al. (1996) conducted a time-trend analysis, comparing the seasonal patterns of respiratory infections and hospital admissions for asthma in adults and children. During a one year follow-up study in the Southampton area of the United Kingdom, 108 school-age children were monitored for upper and lower respiratory conditions and hospital admissions for asthma. Strong correlations were found between the seasonal patterns of upper respiratory infections and hospital admissions for asthma ($r = 0.72$; $p < 0.0001$). This relationship was stronger for pediatric ($r = 0.68$; $p < 0.0001$) than for adult admissions ($r = 0.53$; $p < 0.01$). Upper respiratory infections and admissions for asthma were more frequent during periods of school attendance (87% of pediatric and 84% of total admissions), than during school holiday periods ($p < 0.001$). This study demonstrates that respiratory viral infections are strongly associated in time with hospital admissions for asthma in children and adults (Johnston et al., 1996).

## Otitits media

It is well known that asthma is related to otitis media being an important trigger for asthma exacerbations (Harrison's, 2005). Otitis media is a common complication of upper respiratory infections, and this latter one is related to asthma. This relationship is more frequently seen in children than in adults. Nguyen et al. (2004) carried out a pathological study in which adenoidal tissue biopsies were obtained from 45 patients undergoing simultaneous tympanostomy tube placement for otitis media and adenoidectomy for adenoid hypertrophy. Eleven of the 45 patients with otitis media (24%) were atopic. The results of this study provide evidence that the middle ear may be part of the "united airway" in atopic individuals (Nguyen, 2004).

## Cough

Asthmatic children have cough as a prominent symptom. In a study made by Chang, et al 2002, a total of 21 children with asthma experience exacerbations that were characterized by increased cough as a predominant symptom. According to the authors, cough precedes the onset of an exacerbation and increased inflammation of the respiratory tract (Chang et al., 2002).

## Fever

Fever is a frequent syndrome present in many infections including those of the respiratory airways that are known to be associated with asthma (Harrison's, 2005).

## Hypertension

Salako & Ajayi in 2000, reported the results of two cohort studies. The first one was focused on the blood pressure pattern during and after an acute severe asthma attack. The objective of the second study was to determine the frequency of a severe asthma attack in stable asthmatic patients with and without hypertension. The first study included 12 patients with an acute severe asthma attack in which the mean blood pressure during the attack was 147 mmHg which was higher than the mean blood pressure two weeks after discharge from the hospital without treatment (132 mmHg, $p < 0.05$). The second study included 134 stable asthmatics, 50 with hypertension and 84 without it. There was no difference between the frequency of acute severe asthma attacks in patients with and without hypertension. The authors concluded that transient hypertension may occur during an acute severe asthma attack, but hypertension may not increase the likelihood for a severe asthma attack (Salako & Ajayi 2000). Asthma treatment includes medications such as bronchodilators that may produce increments in the blood pressure

and this fact may explain why during hospital treatment the blood pressure of asthmatics is higher.

Congestive heart failure

Diette et al. (2002) studied asthma in older patients and the factors associated with hospitalization through a one year follow-up prospective cohort study of 6,590 adults with asthma in 15 managed care organizations in the United States. As expected, they found that older patients were more likely to have as a comorbid condition congestive heart failure (8.0%) as compared to younger patients (1%). (Diette, 2002) .

Chest pain

Edmondstone (2000) studied the frequency and characteristics of chest pain and non-respiratory symptoms in 100 patients admitted with acute asthma. Chest pain occurred in 76% of the patients; however, non-respiratory symptoms occur commonly in the prodrome before asthma attacks and become more frequent after onset of the attack. Chest pain is usual during asthma attacks due to inflammation, frequent coughing and respiratory distress (Edmondstone, 2000).

## Gastroesophageal reflux

In the Liou study (2003), they found that gastroesophageal reflux was independently associated with moderate/severe asthma (OR = 2.77, 95% CI 1.20, 6.40, p= 0.015). The characteristics of chest pain and non-respiratory symptoms in patients admitted with acute asthma were analyzed by a cross-sectional study interviewing one hundred individuals (Liou, 2003).

## Obesity

Akerman et al, (2004) analyzed the relationship between asthma and obesity by means of a cross-sectional medical record review of a total of 143 individuals aged 18–88, in which 72% of the sample was obese. They found that the prevalence of obesity increases with increasing asthma severity in adults. The association of asthma severity with obesity suggests that obesity may be a potentially modifiable risk factor for asthma or asthma-like symptoms (Akerman, Calacanis, & Madsen, 2004).

## Type 2 Diabetes

It is well documented the association of asthma and type 2 diabetes. Diabetes is recognized to be an important risk factor for the development of asthma (Harrison's, 2005).

Hypopotassemia

The presence of acidosis or hypopotassemia (hypokalemia) could be very serious and lead to death in severe cases (Harrison's, 2005). Bouachour et al, (1992), in a study called "The Metabolic Acidosis in Severe Acute Asthma, the Effect of Alkaline Therapy", they found among 34 episodes of severe acute asthma with acidosis (pH < 7.35) treated with continuous adrenaline perfusion, that the respiratory acidosis is a frequent indicator of severe acute asthma. They concluded that in more than 50% of the cases respiratory acidosis of severe acute asthma is associated with a metabolic acidosis (Bouachour et al, 1992). Lee et al. (1997) in a cross-sectional review of admissions of severe asthmatic patients needing intensive care in Singapore found that the most severe cases had acidosis and hypopotassemia. Singhi, and Marudkar (1996), by using a case-series study of 290 patient records admitted consecutively to a pediatric intensive care unit over a period of one year examined the frequency, severity, risk factors and mortality of hypokalemia, and efficacy of therapy used for its correction. They found that out of 290 patients forty three (14.8%) patients had 54 episodes of hypokalemia as a common problem among pediatric intensive care unit patients, and one of the diagnoses most

common in hypokalemia cases were acute severe bronchial asthma (20%) (Singhi & Marudkar 1996).

Tobacco Exposure

Mannino et al. (2002) determined the indicators of asthma severity among five hundred twenty-three children with physician-diagnosed asthma in the United States with high and low levels of tobacco smoke exposure, by developing a cross-sectional study of a nationally representative survey of participants in the Third National Health and Nutrition Examination Survey (NHANES 1988 to 1994). They found that asthmatic children with high levels of smoke exposure, compared with those with low levels of exposure, were more likely to have moderate or severe asthma (OR = 2.7 95% CI 1.1,6.8) with decreased lung function (Mannino, 2002).

7. Asthma Severity and Risk of Mortality

Regarding health care resources, asthma contributed to almost 6.5 million office visits in 1985, and acute asthma exacerbations were estimated for 1.8 million emergency room visits annually, asthma hospitalization rates increased during the 1970s, and during the 1980s a modest decline was reported for persons aged 45-64 but a notable increase in hospitalization for children under age 15 (Weiss, Gergen, & Hodgson, 1992). From the

1960s to 1983, asthma hospitalizations among children aged 0-14 years increased threefold in the United States (Mitchell, 1983).

In the late 1990s, asthma as a potentially fatal, chronic disease was responsible in the United States for over 460, 000 hospitalizations per year and over 5,000 deaths per year (Mannino, Homa, Pertowski, Ashizawa, Nixon, Johnson et al., 1998).

Asthma was in 1997 the third-leading cause of preventable hospitalizations in the United States(Pappas, Hadden, Kozack, & Fisher., 1997), also information based on CDC reports stated back then that asthma was the ninth leading cause of hospitalization in United States (CDC, 1995). For the year 2000 asthma was the cause of 4,487 reported deaths, and approximately 465,000 hospitalizations. It was estimated a total of 1.8 million emergency department (ED) visits, and approximately 10.4 million physician office visits during 2002 (CDC, 2003). According to CDC the hospitalization rates for African Americans in 2000 were three times higher than in whites, and were also higher for women than men. (CDC, 1995).

Asthma prevalence in the United States has been showing increments during the last twenty years, and Texas is considered the third state with the largest estimated

number of asthmatics. Approximately 1.5 million of adults in Texas (10.5 percent) have been told they have asthma. Among them, around 900,000 (6.2 per 100 adults) were asthmatics, and from them, 210,000 asthma hospitalizations were reported from 1999 through 2001. Nearly 35 hospitalizations per 10,000 people per year were reported during the same period. African-Americans have higher hospitalization rates than other race-ethnicity groups, as females have higher hospitalization rates than males (CDC, Texas, 2005).

LeSon, and Gershwin 1996, studied risk factors for intubation in young adults as potential severity markers that are predictive of death. They analyzed demographic data from a retrospective cohort of hospitalized asthmatic young adults, including all asthmatics aged 20-34 years admitted over a 10-year period (1984-1994) in California. A total of 550 asthma admissions were reviewed, there were 95 mild, 322 moderate, and 133 severe cases. Thirty-four young adults required intubation for their asthma. They found that language barrier was an important risk factor (OR = 17.3, 95% CI 7.9, 38.0), and, obviously, it is a significant indicator of the relationship between asthma and ethnicity (LeSon & Gershwin 1996).

C. Rationale

United States of America has experienced since the late 1970s the increased of asthma-related morbidity and mortality, also hospitalization rates have increased in young adults, the asthma hospitalization rate is a helpful population-level marker of asthma severity, (Mannino, Homa, Pertowski, Ashizawa, Nixon, & Johnson et al., 1998).

The rate of outpatient visits and emergency department visits for asthma increased since 1985, but the rates of hospitalization and death decreased. Blacks continue to have higher rates of asthma emergency department visits, hospitalizations, and deaths than do Whites (CDC, 2002).

Around 8% of the adult population is affected by asthma, and with adequate treatment they can controlled their mild-to-moderate stages of it. An important 5% to 10% of asthmatics have severe disease that can not get relief with the typical treatment, including corticosteroids (Busse, Banks-Schlegel, & Wenzel., 2000). The World Health Organization (WHO) defined severity of asthma as a primary discharge diagnosis of asthma (ICD-9 code 493) (WHO, 1977).

# CHAPTER II

## AIMS

### A. Main Objective and Hypothesis

#### Objective

Identify and assess prognostic factors for disease severity and risk of mortality among hospitalized Asthma patients in the state of Texas during 2002.

#### Hypothesis

There are factors that affect the likelihood of having severe asthma and high risk of mortality in hospitalized patients.

B. Specific Aim:

Aim 1. Identify and assess risk factors for severe asthma by comparing severe and non-severe hospitalized patients regarding selected demographic, health care characteristics, comorbidities, tobacco dependency, seasonality, and public health region.

Hypothesis 1. There are factors that affect the likelihood of having severe asthma in hospitalized asthma patients.

Aim 2. Identify and assess risk factors for high risk of mortality in asthma by comparing hospitalized asthma patients in high risk with those in minor risk regarding selected demographic, health care characteristics, comorbidities, tobacco dependency, seasonality, and public health region.

Hypothesis 2. There are factors that affect the likelihood of having high risk of mortality of asthma in hospitalized asthma patients.

# CHAPTER III

# METHODS

## A. Study Design and Population under Study

The study population is composed of 27,383 cases of asthma selected from the THCICC database for 2002. Severity and risk of mortality are the two outcomes that were studied as follows:

Asthma patients with major and extreme severe disease, and with moderate severe disease were compared to asthma patients with minor disease severity regarding selected risk factors individually adjusting for all potential confounders simultaneously (i.e., major vs. minor, and moderate vs. minor). Severity of illness relates to the extent of physiologic decompensation or organ system loss of function experienced by the patient as developed by 3M©. Severity of illness is divided in minor, moderate, major and extreme. For the present study, due to the small sample size that major and/or extreme categories included, these two categories were combined. The study categories were: minor, moderate, and major and extreme. The "Minor" category was used as a reference.

Asthma patients with major and extreme risk of death, and with moderate risk of mortality were compared to asthma patients with minor risk of mortality regarding selected risk factors individually adjusting for all potential confounders simultaneously (i.e., major and extreme vs. minor, and moderate vs. minor). Risk of mortality relates to the likelihood of dying as developed by 3M©. Risk for mortality is divided in minor, moderate, major and extreme. For the present study, due to the small sample size that major and/or extreme categories included, these two categories were combined. The study categories were: minor, moderate, and major and extreme. The "Minor" was used as a reference.

This is a cross-sectional study based on hospital records. A total of 27,383 cases of asthma were selected from the THCIC database for 2002. A total of 3,025 of them had major and extreme (severe) disease, 10,441 moderate, and 13,908 minor severity of disease; and 1,049 had major and extreme risk of mortality, 2,866 moderate, and 23,020 minor risk of mortality. These severity categories were included in the THCIC dataset and were composed following the guidelines to assess severity and mortality by means of a score computed by a software from "All Patient Refined (APR) Diagnosis Related Group (DRG) from the 3M APR-DRG Group Version 15 (3M, 2005).

B. Sample Size

After a preliminary analysis, it was found that the sample size was large enough to achieve a power of 80% with a type I error of five percent, to explore odds ratios of 1.2 or larger for exposures that were present in 5% or more in the minor severe or minor risk of mortality group (Fleiss, 1981).

C. Definition of Outcomes

This study uses the 3M© APR-DRG severity and risk of mortality variables included in the dataset under study as the two possible outcomes to assess prognosis (3M, 2005). All patient refined (APR) diagnosis related groups (DRGs) were integrated by 3M© with the purpose to classify patients according to the use, cost and payment of health care services. DRGs were introduced in the early 1980s by the health care industry to classify patients and evaluate health care providers.

3M APR-DRG is a software which uses clinical logic algorithms included in models that calculate probabilities for severe and fatal disease depending on the patient's underlying condition and relates to specific patient clinical attributes. Severity and risk of mortality are considered different patients characteristics, the APR-DRG system assigns each patient a separate subclass for severity of illness and risk of mortality. The system

was designed to be comprehensive and account for all types of patients, ages, comorbidities, procedures and principal diagnosis. This software was developed in 1990 and is updated annually with clinical data form over 1,600 hospitals nationwide. "APR-DGRs were developed with an iterative process of formulating clinical hypothesis and then testing the hypotheses with historical data". Different models were developed for each of the 316 base APR-DRGs. These models include clinical, laboratory and financial data to predict severity and probability of death.

D. Potential Prognostic Factors

Covariates analyzed in this study as potential prognostic factors included demographics (age, gender, race and ethnicity), tobacco dependency, seasonality, type and source of admission, length of hospital stay, concomitant diseases such as obesity, diabetes, hypertension, esophageal reflux, pneumonia, fever, chest pain, chronic airway obstruction, obstructive chronic bronchitis and other respiratory abnormalities, pulmonary fibrosis, acute bronchitis, and the distribution by public health region.

E. Data Analysis

The analysis was divided in five stages. (1) The first one is the crude, univariate or descriptive analysis. This phase was conducted first to become familiar with the

dataset, evaluate and edit the data, find and correct gaps and mistakes, and recode variables as needed for further analysis (Rosner, 2000). (2) The second phase included cross-tabulation to identify crude associations between potential prognostic factors and outcomes while getting familiar with the distribution of observations in such tables (Rosner, 2000; Szklo and Nieto, 2000). During cross-tabulation, the associations of each potential prognostic factor and each outcome were tested by using the Pearson's chi square and the chi square for linear trend (Rosner, 2000; Szklo and Nieto, 2000). (3) The third phase was used to assess the crude associations of each prognostic factor or exposure and each of the outcomes using multinomial logistic regression to calculate the crude odds ratios and their 95% confidence intervals (Kleinbaum et al, 1998, Rothman and Greenland, 1998). (4) The fourth stage in the analysis was used to identify interaction between variables when associated with each of the outcomes as tested by the statistical significance ($p < 0.05$) of first and second-order interaction terms in the multinomial logistic model (Kleinbaum et al, 1998; Rothman and Greenland, 1998). (5) The fifth stage of the analysis was the multivariate analysis. This phase was conducted to assess the adjusted association of each of the exposures or prognostic factors and each of the outcomes adjusting for all confounders simultaneously. The multinomial multiple logistic regression adjusted odds ratio was used as a measure of association in this last phase of the analysis (Kleinbaum et al, 1998, Rothman and Greenland, 1998). The SPSS 13.0 statistical package was used to analyze the data (SPSS 13.0, 2005). The odds ratios adjusted by age, gender, and race/ethnicity and other confounders as needed are reported in the results section of this dissertation.

F. Ethical Issues

No names or other identifiers were used in the present study, and were not available in the dataset. Data was processed and analyzed in an aggregated form and not individually. The present study used publicly available data collected by the THCIC from hospital records in participating hospitals of the State of Texas. The University of North Texas Health Science Center Institutional Review Board (IRB) reviewed and approved (exempt) the project before conducting the data analysis.

# CHAPTER IV

## RESULTS

Tables 8, 9 and 10 show the demographic distribution of the hospitalizations included in the study. A total of 27,383 hospitalized cases of asthma were identified in the THCIC database for 2002 that met the inclusion criteria of having asthma as the admission and main discharge diagnosis. Females were 15,622 (58%), males were 11, 313 (42%), Whites were 11,989 (44%), Hispanics 7,646 (28.1%), African Americans 6,050 (22.2%), and other race/ethnicities were 1,543 (5.7%). A total of 12 age groups were available from 0-1 to 85+. The median was in the 15-24 years of age group. The most numerous age group was the 1-4 years with 5,634 (20.9%) followed by the 5-9 years of age group with 3,385 (12.6%). Between 9 and 34 years of age, the number of hospitalizations is low between 1,492 (5.5%) and 1,704 (6.3%). After age group 25-34 the number of hospitalizations increased up to 2,916 (10.8%) in the 45-54 years of age group, and then decreased to 530 (2.0%) for the last age group of 85 years and older.

Table 11 shows the results of severity and risk of mortality by the gender of the patient. Females were 10 % more likely to have major and extreme severity while they were 20% as likely to have moderate severity when compared to males. Both of these

associations were statistically significant ($p < 0.005$). Females had 10% more probability to present major and extreme risk of mortality than males but this association was not statistically significant ($p = 0.130$). A similar difference (10%) was found between genders in regards to moderate risk of mortality ($p = 0.240$).

Table 12 shows the results of asthma severity by age at discharge. The age group up to one year old was used as a reference. From 1 to 24 years of age, the likelihood of having major and extreme severity was 20 % to 40 % lower than the reference group. From age 25 to the oldest age group, the probability of having major and extreme severity increased from 1.2 up to 14.6 times respectively showing a statistically significant linear trend ($p < 0.001$). Regarding moderate severity, the results were similar than those found for major and extreme severity. From 1 to 24 years of age, the likelihood of having moderate severity was 10 % to 30 % lower than the reference group. From age 25 to the oldest age group, the likelihood of presenting moderate severity increased from 1.2 up to 7.1 times also showing a statistically significant linear trend ($p < 0.001$).

Table 13 illustrates the results of risk of mortality by age at discharge. The age group up to one year old was used as a reference. From 1 to 9 years of age, the chance of having major and extreme risk of mortality was 40 % lower than the reference group. Age group 10 to 14 years of age showed no different likelihood than the reference. From age 15 to the oldest age group, the probability of having major and extreme risk of mortality augmented from 1.7 to 23.3 times showing a statistically significant linear trend

($p < 0.001$). The results for moderate risk of mortality were somewhat comparable than those found for major and extreme risk of death: from 1 to 14 years of age, the probability of having moderate risk of mortality was 19 % to 40 % lesser than the reference group. From age 15 to the oldest age group, the likelihood of presenting moderate risk of mortality increased from 1.2 up to 11.3 times showing a statistically significant linear trend ($p < 0.001$).

The results of severity by race/ethnicity are shown in table 14. Whites were used as a reference group. African Americans were 20 % more likely to have major and extreme severity than Whites ($p = 0.001$). The other race/ethnicity groups did not show important nor statistically significant differences. African Americans had 30 % more probability of a major and extreme risk of mortality than Whites ($p = 0.003$). Hispanics only showed at 10 % increased likelihood that was not statistically significant ($p = 0.407$). The category "Other race/ethnicity" was 50 % more likely to have major and extreme risk of mortality as compared to Whites ($p = 0.001$).

Table 15 shows the asthma severity and risk of mortality by admission day of the week. Saturday was used as a reference. No major differences were found among the days of the week except for major and extreme severity in which admissions on Friday showed 20 % more likelihood. However, this difference was not statistically significant ($p = 0.114$).

Table 16 includes asthma severity by the eleven public health regions. Region eleven Harlingen was used as a reference. Important and statistically significant differences were found for Regions 3 Arlington, 4 Tyler, 6 Houston, and 7 Temple with 50 %, 40 %, 20 %, and 40 % more major and extreme severity respectively as compared to the reference ($p < 0.03$). Region 5 Tyler and 8 San Antonio, showed 30 % and 20 % higher major and extreme severity respectively as compared to the reference. However, these last associations were of borderline statistical significance ($0.05 < p < 0.1$). In regards to moderate severity, Regions 3 Arlington, 6 Houston, 7 Temple, and 8 San Antonio, had 20 %, 30 %, 30 %, and 20 % more likelihood of moderate severity than the reference ($p < 0.007$). Region 9 El Paso had 10 % less likelihood of moderate severity with a borderline statistical significance ($p = 0.091$). Table 17 illustrates the findings of asthma risk of mortality by public health regions. Region 3 Arlington, 4 Tyler, and 7 Temple were 2.0, 1.6, and 1.6 times more likely to have major and extreme risk of mortality than the reference ($p < 0.02$). Region 6 Houston, had 30 % more likelihood of major and extreme risk of mortality than the reference but with a borderline statistical significance ($p = 0.085$). Higher moderate risk of mortality was found in regions 3 Arlington, 4 Tyler, 5S Houston, and 7 Temple, with odds ratios of 1.4 for the first three and 1.3 for the last one ($p < 0.01$). Public health region 10 El Paso was 30 % more likely to have moderate risk of mortality than the reference with a borderline statistical significance of $p = 0.070$.

The findings of asthma severity and risk of mortality by discharge quarter of the year 2002 are included in Table 18. The last quarter of the year (October – December) was used as a reference. Patients discharged the third quarter of the year were 10 % less likely to had major and extreme severity as compared to those discharged in the fourth quarter of the year ($p = 0.013$). Patients discharged in the first and second quarters of the year did not show important difference as compared to the reference. Patients discharged in the first three quarters of the year had 10 % less probability to have moderate severity as compared to those discharged in the last quarter ($p < 0.03$). Patients discharged in first and the second quarter of the year were 30 % more likely to had major and extreme risk of mortality than those discharged in the fourth quarter of the year ($p < 0.006$). No other important or statistically significant differences were found regarding the risk of mortality by discharged quarter of the year.

Table 19 shows the results of asthma severity and risk of mortality by length of stay in days. Those who spent more than three days in a hospital were 4.4 times more likely to have major and extreme severity as compared to those who spent 1 – 2 days in a hospital. Those who spent more than three days in a hospital were two times as likely to have moderate severity. Those who spent more than three days in a hospital were 3.5 and 1.9 times more likely to present major and extreme risk of mortality and moderate risk of mortality than those who spent 1 – 2 days in a hospital. All associations were statistically significant ($p < 0.001$).

Table 20 illustrates the results of severity by type of admission. Elective admission was used as a reference. Those who were admitted as emergency had 10 % more probability to have major and extreme severity as compared to reference. However, this association was of borderline significance ($p = 0.097$). Those admitted as urgency did not show an important difference from the reference regarding major and extreme severity. Concerning to moderate severity those who were admitted as emergency or urgency had 10 % less likelihood to have moderate severity as compared to the reference ($p = 0.091$ and $p < 0.001$ respectively). Those admitted as emergency or urgency were 50 % or 20 % more likely to have major and extreme risk of mortality than the reference respectively. However, the difference was not statistically significant ($p = 0.145$) for those admitted as urgency. Nor major nor statistically significant differences were found for moderate risk of mortality.

The results for asthma severity and risk of mortality by source of admission are included in Table 21. Source of admission was classified in emergency room and other, using "other" as a reference. Those admitted from the emergency room had 10 % higher major and extreme severity ($p = 0.093$) and 40 % more risk of mortality ($p < 0.001$) than the reference. Regarding moderate severity, those admitted through the emergency room had 10 % less likelihood ($p < 0.001$) than those admitted from sources other than emergency. No difference was found regarding source of admission for moderate risk of mortality.

The findings of asthma severity and risk of mortality by patient residence are shown in Table 22. Patient residence was classified as Texas and other. The "other" category was used as a reference. A slightly smaller likelihood of major and extreme severity and risk of mortality was found for Texas residents as compared to residents from "other" states or countries. Only a 10 % increased likelihood for moderate severity and risk of mortality was found for Texas residents as compared to residents from "other" states or countries. None of these differences were statistically significant.

Table 23 depicts asthma severity and risk of mortality by the presence or absence of bronchitis concomitantly. Patients with bronchitis had slightly less probability of having major and extreme severity and risk of mortality as compared to reference. However, these findings were not statistically significant. Patients with bronchitis showed 30 % increased probability of having moderate severity ($p = 0.014$). Having bronchitis also showed a slightly and not statistically significant 10 % less likelihood of moderate risk of mortality.

Table 24 includes the findings of asthma severity and risk of mortality by the presence of sinusitis. Patients with sinusitis were at 50 % grater moderate severity as compared to those without sinusitis ($p < 0.001$). Sinusitis was associated with slight and not statistically significant decreased likelihood risk of mortality.

The results of asthma severity and risk of mortality by post-inflammatory pulmonary fibrosis are shown in table 25. The presence of post-inflammatory pulmonary fibrosis increased considerably the likelihood for severity and risk of mortality. Post-inflammatory pulmonary fibrosis increased 24.3 times the chance for moderate severity and 35.1 times for major and extreme severity ($p < 0.001$). However, the precision of these estimates was poor due to small sample size (3 cases of post-inflammatory pulmonary fibrosis, 1.9 %) in the reference group. Patients with this condition were 3.6 times and 4.6 times more likely to have moderate or major and extreme risk of mortality respectively ($p < 0.001$).

The findings of asthma severity and risk of mortality by acute bronchiolitis are included in Table 26. Patients with acute bronchiolitis did not show any important or statistically significant difference than those that did not have such a condition.

Table 27 illustrates the results of asthma severity and risk of mortality by the presence of upper respiratory infection. Patients with upper respiratory infection had lower likelihood for severity and risk of mortality. Those with this condition, had 20 % and 30 % less chance for moderate and major and extreme severity respectively ($p < 0.001$), and were 40 % less likely to have moderate ($p < 0.001$) and 20 % less chance for major and extreme risk of mortality. However, this last difference was not statistically significant.

Table 28 depicts asthma severity and risk of mortality by the presence of otitis media concomitantly with asthma. Patients with otitis media had slightly lower probability of a severe asthma or increased risk of mortality ($p > 0.200$). Only the moderate risk of mortality was 40 % lower and statistically significant ($p = 0.014$).

The results of asthma severity and risk of mortality by the presence of cough are shown in Table 29. Patients with cough had slightly higher probability of severity and risk of mortality. Presence of cough increased 40 % and 30 % the likelihood of moderate severity and risk of mortality ($p < 0.001$ and $p = 0.064$ respectively).

The results for asthma severity and risk of mortality by the presence of fever are included in Table 30. When fever was detected in the patients, the chance of having severe asthma and risk of mortality increased importantly from 1.5 to 3.1 times. These findings were statistically significant ($p < 0.02$) except major and extreme risk of mortality in which a 30 % increase likelihood did not reach statistical significance ($p = 0.585$). This last finding could be due to the small number of subjects with fever (6, 2.6 %) in this category.

Table 31 includes asthma severity and risk of mortality by the presence of hypertension. When hypertension was found, the probability of having severe asthma and risk of mortality was found higher during the crude analysis ($p < 0.001$). After adjusting for age, gender, ethnicity, and obesity, only moderate severity was found to be 70 %

more likely for those with hypertension ($p = 0.002$), the rest of the association became very modest and not statistically significant.

The findings of risk of mortality by the presence of congestive heart failure are shown in Table 32. Patients with congestive heart failure were 7.5 times more likely to have moderate risk of mortality and 16.5 times more likely to have major and extreme risk of mortality ($p < 0.001$).

Table 33 illustrates the results of asthma severity and risk of mortality by the presence of chest pain. The presence of chest pain was associated with an increased 70 % moderate severity ($p = 0.003$). A higher 10% likelihood of major and extreme severity was found for those with this condition but it was not statistically significant. No major differences in the risk of mortality were found for those with chest pain after adjustment by age, gender, ethnicity, obesity, hypertension, and diabetes.

The results of asthma severity and risk of mortality by the presence of esophageal reflux are shown in Table 34. Patients with esophageal reflux were 3.4 times, and 4.2 times more likely to have an increased major and extreme and moderate severity respectively ($p < 0.001$). The risk of mortality was 20 % less likely to happen among patients with this condition ($p = 0.012$), while not an important difference was found regarding moderate risk of mortality.

The findings of asthma severity and risk of mortality by the presence of morbid obesity are shown in Table 35. Results are show before and after adjustment for age, gender, ethnicity, and hypertension. This condition was associated with much greater severity and risk of mortality. Obese patients were 5.5 and 6.7 times more likely to have moderate, and major and extreme severity respectively ($p < 0.001$). The risk of mortality in patients with obesity was 2.8 and 2.2 times more likely to have moderate, and major and extreme risk of mortality ($p < 0.001$).

Table 36 portrays asthma severity and risk of mortality by the presence of type 2 diabetes concomitantly. Patients with diabetes had considerably larger risk of severity and mortality after adjusting by age, gender, ethnicity, hypertension, and obesity. Diabetics had 11.8 and 13.3 times more likelihood of moderate, and major and extreme severity respectively ($p < 0.001$). Patients with this condition were 3.3 and 2.8 times more likely to have moderate, and major and extreme risk of mortality respectively ($p < 0.001$).

Table 37 illustrates the results of asthma risk of mortality by the presence of acidosis or hypopotassemia. The presence of acidosis increases greatly the risk of mortality. Patients with acidosis were 17.4 and 57.4 times more likely to have moderate, and major and extreme risk of mortality ($p < 0.001$). Regarding hypopotassemia patients that fall in this condition were 50 % and 40 % more likely to have moderate, and major and extreme risk of mortality ($p < 0.001$).

Table 38 depicts the results of asthma risk of mortality by the presence of urinary tract infection. This condition increases the likelihood of the moderate risk of mortality by 2.3 fold, and by 4.0 times the major and extreme risk of mortality ($p < 0.001$).

Table 39 illustrates the results of asthma risk of mortality by the presence of HIV/AIDS concomitantly. The presence of HIV/AIDS in patients with asthma augmented 20 % the chances of moderate risk of mortality ($p = 0.001$), and by 30 % the major and extreme risk of mortality ($p = 0.003$).

The findings of asthma severity and risk of mortality by tobacco dependency in patients older than 14 years of age are included in Table 40. A decreased severity and risk of mortality was seen in patients with tobacco dependency before adjustment procedures. Tobacco dependents were 10 % less likely to have major and extreme severity with a borderline statistical significance ($p = 0.090$), and were 30 % less likely to have moderate, and major and extreme risk of mortality ($p < 0.02$).

# CHAPTER V

# DISCUSSION

A total of 27,383 hospitalizations due to asthma were included in this study from the THCIC database for 2002 (THCIC 2003). The demographic characteristics of the population included the following observations: females accounted for 58% of the study population, Whites were 11,989 (44%), Hispanics 7,646 (28.1%), African Americans 6,050 (22.2%), and other race/ethnicities were 1,543 (5.7%). Age was analyzed as a categorical variable because that was the way it was available in the dataset. It was notable that the most numerous age group was the 1-4 years of age group with 5,634 (20.9%) followed by the 5-9 years of age group with 3,385 (12.6%). After 9 years of age and until patients are 35, the number of hospitalizations is low between 1,492 (5.5%) and 1,704 (6.3%). After age group 25-34 the number of hospitalizations increased up to 2,916 (10.8%) in the 45-54 years of age group, and then decreased to 530 (2.0%) for the last age group of 85 years of age and older.

In the present study, using the age group 0-1 years of age as a reference, from 1 to 24 years of age, the likelihood of having more severe was lower than the reference group. From age 25 to the oldest age group, the probability of having major and extreme severity

increased up to 15 times. Regarding the risk of mortality by age at discharge from 1 to 9 years of age, the chance of having more risk of mortality was lower than the reference group of 0 to 1 years of age. Age group 10 to 14 years of age showed no different likelihood than the reference. From age 15 to the oldest age group, the probability of having major and extreme risk of mortality augmented up to 23 times showing a linear trend. In Illinois, a study of hospital discharge data reported hospitalization rates that show a similar age distribution as the present study dealing with severity and risk of mortality (Illinois Asthma Hospital Guide 2000).

In the present study, females were more likely to have higher severity and risk of mortality due to asthma when compared to males. This finding concurs with the published report from the ALA (2002).

In the present study, African Americans had more probability of having worst severity and risk of mortality than Whites, while Hispanics only showed a difference with Whites if any. The category "Other race/ethnicity" was 50 % more likely to have major and extreme risk of mortality as compared to Whites. According to ALA (2002), during 2001 African American women had the highest mortality rate due to asthma (3.8 per 100,000). Asthma is more prevalent in minorities, especially in African American and Hispanics (CDC, 2002).

In the present study, no major differences were found regarding the admission day of the week except for a 20% more major and extreme severity in Fridays ($p = 0.114$). No published literature refers to asthma severity and mortality by the admission day of the week. Published studies have suggested that patients are more likely to die in the hospital if they are admitted on a weekend than on a weekday due to all causes. For example, a large retrospective cohort study conducted by Ensminger et al. (2004) to determine whether weekend admission to the ICU increases the risk of dying in the hospital. The results of following-up 8,108 admissions and 2,385 deaths showed that the overall adjusted hospital mortality rate (due to all causes) of patients admitted to the ICU on a weekend was not higher than that of patients admitted on a weekday. However, weekend ICU admission to the surgical ICU was associated with an increased hospital mortality rate. The effect of reduced hospital staffing during weekends on in-hospital mortality is largely not known. Cram et al (2004) compared mortality rates between patients admitted on weekends and weekdays and whether weekend-weekday variation in rates differed between patients admitted to teaching and nonteaching hospitals in California ($N = 641,860$). The adjusted odds of death due to all causes for patients admitted on weekends when compared with weekdays was 1.03 (95% CI 1.01, 1.06, $p = 0.0050$). Three diagnoses (cancer of the ovary/uterus, duodenal ulcer, and cardiovascular symptoms) were associated with a statistically significant weekend effect. None of the rest of the 50 diagnoses under study (including asthma) by Cram et al. (2003), demonstrated a statistically significant reduction in mortality for weekend admissions as

compared with weekday admissions. Patients admitted to hospitals on weekends experienced slightly higher risk-adjusted mortality (due to all causes) than did patients admitted on weekdays. While overall mortality was similar for patients admitted to all hospital categories (Cram et al., 2003).

In the present study asthma severity and risk of mortality by the eleven public health regions of Texas showed important and statistically significant differences. These differences appear to be related to urban areas. Arlington, Tyler, Houston and Temple showed worst severity and risk of mortality as compared to the rest of the regions. Arif, et al, (2004), studied the prevalence and correlates of pediatric asthma and wheezing by using a cross-sectional telephone survey of 1500 households in the South Plains/Panhandle region of Texas. They found that living in urban areas was associated significantly with asthma and wheezing (Arif et al, 2004). In contrast, Tong and Drake (1999) in a cross-sectional descriptive study, using hospital records and Australian Bureau of Statistics census data in South Wales Australia, found that hospital admissions and mortality rates were higher in rural as compared to urban populations. However, rates were not age adjusted (Tong and Drake1999).

The findings of asthma severity and risk of mortality by discharge quarter of the year 2002, in the present study, showed that patients discharged during the last quarter of the year (October-December, fall-winter) had higher severity but lower risk of mortality. Kimbell-Dunn, et al, (2000) in a cross-sectional of 185,307 asthma hospitalizations in

New Zealand, found that monthly mortality and hospital discharge rates were calculated for the age groups 5-14, 15-44, and those aged 45 years and older. In the oldest age group (55 +), asthma mortality and hospitalization rates peaked in the winter months (July/August). However, in contrast the younger age groups mortality and hospitalizations showed different seasonal patterns; peak hospitalization occurred in the early winter months, with peak mortality in the early summer months (Kimbell-Dunn, Pearce, and Beasley, 2000). Montealegre et al. (2002), reported from a large cross-sectional study of 55,547 emergency department records of asthmatic patients in the city of Ponce, Puerto Rico that a seasonal variation was evident in the asthma attacks requiring emergency room attention reaching its peak in December, and the lowest in June. (Montealegre et al, 2002). Silverman, Stevenson, and Hastings (2003), by means of a cross-sectional study of 673,141 emergency department visits in New York, found the highest number of visits occurring in the fall and the fewest in the summer. Seasonal fluctuations were highest in children and less seasonal variability was noted with increasing age (Silverman, Stevenson, and Hastings. 2003).

The finding of asthma severity and risk of mortality by length of stay in days, in the present study, showed that those who spent more than three days in a hospital were 4.4 times more likely to have major and extreme severity as compared to those who spent 1 – 2 days in a hospital. Those who spent more than three days in a hospital were 2 times as likely to have moderate severity. Obviously, those who spent more than three days in a hospital were 3.5 and 1.9 times more likely to present major and extreme risk of mortality

and moderate risk of mortality than those who spent 1 – 2 days in a hospital. All associations were statistically significant. Malmstrom et al, 2001, described the need for mechanical ventilation for severe asthma exacerbation in children of Finland from 1976 to 1995, cross-sectional data were reviewed and collected from medical records, thus covering the entire population of about 5 million. There were 632 ICU admissions for acute asthma among 77,421 pediatric hospital admissions for asthma during the study period. The study group consisted of 59 patients who had 66 admissions to the pediatric ICU and who required mechanical ventilation and longer length of stay. The 66 admissions constituted approximately 10% of all ICU admissions for acute asthma during the study period. The mean length of stay in the ICU was 3.8 days (Malmstrom, et al, 2001).

Emergency admission is defined as a condition that requires immediate attention to prevent complications and/or death. Urgency admission is defined as a condition that the patient perceives the need for prompt attention. Elective admission is whenever the health care provider schedules the admission during an outpatient visit. In the present study, those who were admitted as emergency obviously had 10 % more probability to have major and extreme severity as compared to reference. However, those admitted as urgency did not show an important difference from the reference. Regarding to moderate severity those who were admitted as emergency or urgency had 10 % less likelihood to have moderate severity as compared to the reference. Those admitted as emergency or urgency were 50 % or 20 % more likely to have major and extreme risk of mortality than

the reference respectively. The results for asthma severity and risk of mortality by source of admission were carried out by classifying source of admission in emergency room and other, using "other" as a reference. Those admitted from the emergency room had 10 % higher major and extreme severity and 40 % more risk of mortality than the reference. Regarding moderate severity, in the present study, those admitted through the emergency room had 10 % less likelihood. No published literature related to severity and risk of mortality by the type of admission was found. Nevertheless, the frequency of hospitalization by source of admission was published by the Illinois Health Care Cost Containment Council (2002) and reported that over 67% of the asthma hospitalizations occurred after treatment in an emergency room, and for the period 1996 to 2000, emergency room was the source of admission for 66.5% of asthma hospitalizations (Illinois Asthma Hospital Guide 2000).

To study asthma severity and risk of mortality by patient residence, patient residence was classified as Texas and "other than Texas" in the present study. A slightly smaller likelihood of major and extreme severity and risk of mortality was found for Texas residents as compared to residents from "other" states or countries. Only a slight 10 % increased likelihood for moderate severity and risk of mortality was found for Texas residents as compared to residents from "other" states or countries. None of these differences were statistically significant. No bibliography was found comparing differences in severity or risk of mortality by state or comparing the state of Texas with any other individual state or country.

The analysis of asthma severity and risk of mortality by the presence or absence of bronchitis concomitantly showed that patients with bronchitis had slightly less probability of having major and extreme severity and risk of mortality as compared to those without bronchitis in the present study. However, these findings were not statistically significant. Patients with bronchitis shown 30 % increased probability of having moderate severity. Having bronchitis also showed a slightly and not statistically significant 10 % less likelihood of moderate risk of mortality. Similar results were published by Diette et al., in 2002 reporting that older patients were more likely to report comorbid conditions, as chronic bronchitis (OR = 1.12) but was not statistically significant.

The findings of asthma severity and risk of mortality by the presence of sinusitis showed that patients with sinusitis were at 50 % grater moderate severity as compared to those without sinusitis in the present study: Sinusitis was associated with slight and not statistically significant decreased likelihood risk of mortality. However, Liou et al (2003), in a cross-sectional chart review of new patients seen in a specialized asthma treatment center over a 2.5-year period recorded the prevalence of factors for asthma severity. They found, among other factors, that chronic sinusitis was independently associated with more severe asthma (OR = 2.22, 95% CI 1.08, 4.60, p = 0.032) (Liu, 2003).

In the present study, the presence of post-inflammatory pulmonary fibrosis increased considerably the likelihood for severity and risk of mortality. However, the precision of these estimates was poor due to small sample size. No literature was identified reporting severity and risk of mortality of asthma and post-inflammatory pulmonary fibrosis.

Patients with acute bronchiolitis did not show any important or statistically significant difference in severity or risk of mortality than those that did not have such a condition in the present study. This finding was not different than that found by Wennergren and Kristjansson in 2001.

In the present study, the results of asthma severity and risk of mortality by the presence of upper respiratory infections (URI) evidenced that patients with URI had lower likelihood for severity and risk of mortality perhaps because URI is one of the main causes of early hospitalization, that in turn, may prevent worsening of the disease thus decreasing severity and risk of mortality. However, URI has been reported to be an important asthma trigger in many publications such as in Harrison's (2005); Bayona, et al. (2002); and Johnston et al. (1996).

Asthma severity and risk of mortality and the presence of otitis media concomitantly had slightly lower probability for severe asthma and risk of mortality but this finding was not statistically significant in the present study. It is well known that

asthma is related to otitis media being an important trigger for asthma exacerbations (Harrison's, 2005). However, no literature was found relating otitis media with asthma severity or risk of mortality. Otitis media is a common complication of upper respiratory infections, and this latter one has been related to asthma. This relationship is more frequently seen in children than in adults. Nguyen et al. (2004) provided evidence that the middle ear may be part of the "united airway" in atopic individuals explaining the biological plausibility of this association. The discrepancy with published research may be related to the fact that otitis media is not a severe complication of asthma and that pain may bring to medical attention the patients with ear infections, thus decreasing the likelihood to develop severe asthma.

The results of asthma severity and risk of mortality by the presence of cough in the present study had somewhat higher probability of severity and risk of mortality. Presence of cough increased 40 % and 30 % the likelihood of moderate severity and risk of mortality. It is known that cough is a prominent symptom of asthma (Harrison's, 2005). The results of the present study are consistent with a study conducted by Chang, et al. (2002), in which the authors showed that cough precedes the onset of an exacerbation and increased inflammation of the respiratory tract (Chang et al 2002).

Fever increased importantly the chance for severity and higher risk of mortality in the present study. Fever is a frequent syndrome present in many infections including

those of the respiratory airways that are known to be associated with asthma (Harrison's, 2005).

Hypertension in the present study increased the probability of having severe asthma and higher risk of mortality during the crude analysis. After adjusting for age, gender, ethnicity, and obesity, only moderate severity was found to be more likely to be present for those with hypertension, the rest of the associations became very modest and not statistically significant after adjustment. These findings are similar to those of Salako and Ajayi in 2000 reporting the results of two cohort studies findings showing that transient hypertension may occur during an acute severe asthma attack, but hypertension may not increase the likelihood for a severe asthma attack. Asthma treatment includes medications such as bronchodilators that may produce increments in the blood pressure and this fact may explain why during hospital treatment the blood pressure of asthmatics is higher.

In the present study, asthmatic patients with congestive heart failure were more likely to have moderate risk; as well as, major and extreme risk of mortality. These results concur with those of Diette et al. (2002) reporting that older patients were more likely to have as a comorbid condition congestive heart failure as compared to younger patients. In the present study, the results were age adjusted, and congestive heart failure, if advanced, is a serious co-morbidity that could influence the manner some asthmatic patients were classified as having higher risk of mortality. Therefore, even when the

admission diagnosis and the major discharge diagnosis were asthma, it is possible that the higher risk of mortality could mainly be due to advanced congestive heart failure in some of the patients.

The presence of chest pain was associated with an increased severity but no major differences in the risk of mortality were found for those with chest pain after adjustment by age, gender, ethnicity, obesity, hypertension, and diabetes in the present study. Edmondstone (2000) reported that chest pain was usual during asthma attacks due to inflammation, frequent coughing and respiratory distress. Nevertheless, chest pain may not be necessarily indicative of worst prognosis as shown in the present study.

In the present study, patients with esophageal reflux were more likely to have an increased severity. In contrast, the risk of mortality was lower or not associated among patients with this condition. Liou et al, (2003) studied the prevalence of factors associated with more severe asthma through a cross-sectional chart review of new patients seen in a specialized asthma treatment center. They found that symptomatic gastroesophageal reflux disease was associated with more severe asthma (Liou, et al 2003).

Results of the present study show before and after adjustment for age, gender, ethnicity, and hypertension that obesity was associated with much greater severity and risk of mortality. Several studies have reported obesity as a risk factor for asthma

(Harrison's, 2005). However, little is known about the association of obesity and asthma severity and risk of mortality. A recent study by Akerman et al. (2004) found that the prevalence of obesity increases with increasing asthma severity in adults.

Patients with type 2 diabetes as comorbidity in the present study had considerably larger risk of severity and mortality after adjusting by age, gender, ethnicity, hypertension, and obesity. It is well documented the association of asthma and type 2 diabetes. Diabetes is recognized to be an important risk factor for the development of asthma (Harrison's, 2005). However, no literature was available on the impact of type 2 diabetes on the severity or risk of mortality of asthma.

The presence of acidosis or hypopotassemia (hypokalemia) increases greatly the risk of mortality due to asthma. Acidosis or hypopotassemia are typical complications of severe respiratory distress commonly found in asthma. They could be very serious and lead to death in severe cases (Harrison's, 2005). Bouachour et al, (1992) reported that in more than 50% of the cases respiratory acidosis of severe acute asthma is associated with a metabolic acidosis (Bouachour et al, 1992). Lee et al. (1997) found that the most severe cases had acidosis and hypopotassemia. Singhi and Marudkar (1996), found hypokalemia as a common problem among pediatric intensive care unit patients, and one of the diagnoses most common in hypokalemia cases were acute severe bronchial asthma.

The present study results show evidence that the presence of urinary tract infection increases the likelihood of mortality with an increasing trend from moderate to major risk of mortality. No literature was found regarding the influence of urinary tract infection on the severity or risk of mortality of asthma.

The presence of HIV/AIDS in patients with asthma augmented 20 % the chances of moderate risk of mortality, and by 30 % the major and extreme risk of mortality in the present study. No literature was available relating HIV/AIDS as a factor for the severity or risk of mortality of asthma.

In the present study, a lower likelihood for asthma severity and risk of mortality was seen in patients with tobacco dependency before adjustment procedures. Many longitudinal studies have demonstrated that tobacco exposure is an important irritant of the respiratory airways and thus an asthma trigger (Harrison's, 2005; Bayona et al., 2002). Patients with severe asthma usually quit smoking to prevent asthma attacks, but this is not necessarily true for those that have milder asthma or in whom tobacco exposure does not aggravate the condition (Bayona et al., 2002). Therefore, a cross-sectional study that cannot elucidate the temporal relationship of associations like the present one, could find tobacco exposure as a protective prognostic factor for severity and risk of mortality (Szklo and Nieto, 2000).

The present study included an extensive review of several variables that were considered importantly related to prognosis of asthma on the basis of previous medical and epidemiologic research. More research is necessary to confirm the results of the present study. Further investigations should be carried out focusing on each individual factor included in the analysis of the present study and exploring all comorbidities that may be related with such an association.

# CHAPTER VI

## CONCLUSIONS

In the present study, the worst severity was found in children up to one year of age, females, African Americans, discharged in Oct-Dec, living in public health regions with more urban areas, and those with diabetes, hypertension, chest pain, sinusitis, post-inflammatory pulmonary fibrosis, fever, with longer length of stay in the hospital, and obese individuals. The worst risk of mortality was found in children up to one year of age, African Americans, discharged in Jan-Mar and Apr-June, living in public health regions with more urban areas, and those with diabetes, congestive heart failure, urinary tract infections, post-inflammatory pulmonary fibrosis, HIV/AIDS, fever, and obese individuals. Original results of this study include associations of severity and risk of mortality with type and source of admission, place of residency, presence of post-inflammatory pulmonary fibrosis, urinary tract infection, type 2 diabetes, and HIV/AIDS.

Asthma is a major public health problem in the United States. The disease affects approximately 15 million people. Approximately, five million of asthmatics are younger than 18 years of age. Asthma produces around half a million hospitalizations every year, two million emergency department visits, and almost 5,000 asthma-related deaths in the

United States. This problem is of major concern because mortality rates from most natural causes in the United States are decreasing (NIH, 2005).

Extensive research has been published on the study of risk factors for the development of asthma but little is known about prognostic factors for severity and risk of mortality due to asthma. Asthma is a chronic condition that could be mild or subclinical for long periods until an exacerbation is trigger by, allergens, irritants, stress, respiratory infections, and/or exercise. Once an exacerbation develops, many factors play important roles on the prognosis such as age, gender, access to adequate health care, and comorbidities such as obesity and diabetes. However, the specific importance of these factors and their impact in both severity and mortality of asthma are largely unknown.

The purpose of this research was to identify and assess prognostic factors for severity and risk of mortality among 27,383 hospitalized asthma patients in the state of Texas during 2002, by using the public available Texas Hospital Inpatient data, collected by The Texas Health Care Information Council (THCICC). In order to achieve this purpose the present study tested two hypotheses: "there are factors that affect the likelihood of having severe asthma in hospitalized patients" and "there are factors that affect the likelihood of having high risk of mortality in hospitalized asthma patients". The results suggest the importance of prognostic factors. Factors such as smoking, obesity, and hypertension should be modified or controlled, and non-modifiable risk factors should be identified by health care providers in patients requiring medical

attention to be placed in more rigorous treatment and management protocols. Therefore, the results of the present study can be used to develop tertiary prevention in asthma.

# APPENDICES

# APPENDIX A

# TABLES OF RESULTS

**Table 8**
**Asthma Severity and Risk of Death by Race/Ethnicity.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) |
|---|---|---|---|
| **Severity** | | | |
| Other race /ethnicity | 185 (12.0) | 549 (35.6) | 809 (52.4) |
| Hispanic | 625 (8.2) | 2680 (35.1) | 4341 (56.8) |
| African American | 719 (11.9) | 2246 (37.1) | 3085 (51.0) |
| White | 1487 (12.4) | 4916 (41.0) | 5586 (46.6) |
| Total | 3016 (11.1) | 10391 (38.2) | 13821 (50.8) |
| **Risk of Mortality** | | | |
| Other race /ethnicity | 77 (5.0) | 139 (9.0) | 1327 (86.0) |
| Hispanic | 224 (2.9) | 674 (8.8) | 6748 (88.3) |
| African American | 247 (4.1) | 663 (11.0) | 5140 (85.0) |
| White | 548 (4.6) | 1447 (12.1) | 9994 (83.4) |
| Total | 1096 (4.0) | 2923 (10.7) | 23209 (85.2) |

**Source: Texas Hospital Data 2002.**

**Table 9**
**Asthma Severity by Patient Gender and Age at Discharge.**

| Variable Age at Discharge | Females | | | Males | | |
|---|---|---|---|---|---|---|
| | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) |
| 85+ | 36 (8.5)* | 111 (26.1) | 279 (65.5) | 63 (7.0) | 285 (31.5) | 557 (61.5) |
| 1 – 4 | 107 (5.3) | 520 (25.9) | 1378 (68.7) | 200 (5.5) | 884 (24.4) | 2545 (70.1) |
| 5 – 9 | 71 (5.6) | 389 (30.6) | 812 (63.8) | 120 (5.7) | 590 (27.9) | 1401 (66.4) |
| 10 – 14 | 52 (7.4) | 191 (27.3) | 456 (65.2) | 60 (6.0) | 272 (27.1) | 671 (66.9) |
| 15 – 24 | 48 (5.3) | 278 (30.8) | 578 (63.9) | 39 (6.6) | 145 (24.7) | 403 (68.7) |
| 25 – 34 | 110 (9.0) | 427 (35.1) | 679 (55.8) | 35 (8.3) | 135 (32.1) | 251 (59.6) |
| 35 – 44 | 210 (10.6) | 927 (46.9) | 840 (42.5) | 58 (10.3) | 220 (38.9) | 287 (50.8) |
| 45 – 54 | 307 (13.6) | 1159 (51.2) | 797 (35.2) | 76 (11.7) | 309 (47.4) | 267 (41.0) |
| 55 – 64 | 289 (16.3) | 969 (54.6) | 518 (29.2) | 83 (17.2) | 237 (49.2) | 162 (33.6) |
| 65 – 74 | 286 (19.8) | 796 (55.2) | 360 (25.0) | 98 (20.4) | 240 (50.0) | 142 (29.6) |
| 75 – 84 | 329 (27.2) | 645 (53.3) | 237 (19.6) | 80 (21.1) | 221 (58.3) | 78) (20.6) |
| 0 - 1 | 126 (29.2) | 244 (56.6) | 61 (14.2) | 28 (28.3) | 51 (51.5) | 20 (20.2) |
| Total | 1971 (12.6) | 6656 (42.6) | 6995 (44.8) | 940 (8.3) | 3589 (31.7) | 6784 (60.0) |

Source: Texas Hospital Data 2002.
*Percentage for each age group out of the total number of patients for each column.

**Table 10**
**Asthma Risk of Mortality by Patient Gender and Age at Discharge.**

| Variable Age at Discharge | Females | | | Males | | |
|---|---|---|---|---|---|---|
| | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) |
| Up to 1 | 5 (1.2) | 29 (6.8) | 392 (92) | 11 (1.2) | 35 (3.9) | 859 (94.9) |
| 1 – 4 | 11 (0.5) | 60 (3.0) | 1934 (96.5) | 20 (0.6) | 124 (3.4) | 3485 (96.0) |
| 5 – 9 | 7 (0.6) | 48 (3.8) | 1217 (95.7) | 9 (0.4) | 87 (4.1) | 2015 (95.5) |
| 10 – 14 | 10 (1.4) | 34 (4.9) | 655 (93.7) | 12 (1.2) | 36 (3.6) | 955 (95.2) |
| 15 – 24 | 17 (1.9) | 50 (5.5) | 837 (92.6) | 14 (2.4) | 33 (5.6) | 540 (92.0) |
| 25 – 34 | 51 (4.2) | 137 (11.3) | 1028 (84.5) | 17 (4.0) | 47 (11.2) | 357 (84.8) |
| 35 – 44 | 91 (4.6) | 274 (13.9) | 1612 (81.5) | 18 (3.2) | 84 (14.9) | 463 (81.9) |
| 45 – 54 | 109 (4.8) | 353 (15.6) | 1801 (79.6) | 29 (4.4) | 85 (13.0) | 538 (82.5) |
| 55 – 64 | 120 (6.8) | 287 (16.2) | 1369 (77.1) | 33 (6.8) | 72 (14.9) | 377 (78.2) |
| 65 – 74 | 132 (9.2) | 307 (21.3) | 1003 (69.6) | 40 (8.3) | 100 (20.8) | 340 (70.8) |
| 75 – 84 | 160 (13.2) | 319 (26.3) | 732 (60.4) | 47 (12.4) | 102 (26.9) | 230 (60.7) |
| 85+ | 72 (16.7) | 134 (31.1) | 225 (52.2) | 14 (14.1) | 29 (29.3) | 56 (56.6) |
| Total | 785 (5.0) | 2032 (13.0) | 12805 (82.0) | 264 (2.3) | 834 (7.4) | 10215 (90.3) |

**Source: Texas Hospital Data 2002.**

**Table 11**
**Asthma Severity and Risk of Mortality by Patient Gender. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| Female | 1971 (12.6) | 6656 (42.6) | 6995 (44.8) | 1.1 (1.0, 1.2) | 1.0 (1.0, 1.3) | 1.1 (1.0, 1.2) | 1.2 (1.1, 1.2) |
| Male | 940 (8.3) | 3589 (31.7) | 6784 (60.0) | $p = 0.004$ | $p < 0.004$ | $p < 0.001$ | $p < 0.001$ |
| **Risk of Mortality** | | | | | | | |
| Female | 785 (5.0) | 2023 (13.0) | 12805 (82.0) | 1.1 (0.9, 1.3) | 1.0 (1.0, 1.3) | 1.0 (0.9, 1.1) | 1.1 (1.0, 1.2) |
| Male | 264 (2.3) | 834 (7.4) | 10215 (90.3) | $p = 0.062$ | $p = 0.130$ | $p = 0.139$ | $p = 0.240$ |

**Source: Texas Hospital Data 2002.**
***Adjusted by age and ethnicity**

**Table 12**
**Asthma Severity by Age at Discharge. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Age at Discharge** | | | | | | | |
| Up to 1 | | | | | | | |
| 1 – 4 | 99 (7.4) | 396 (29.8) | 836 (62.8) | 0.1 (0.04, 0.1) p < 0.001 | 0.07 (0.05, 0.1) p < 0.001 | 01 (0.1, 0.1) p < 0.001 | 0.1 (0.1, 0.2) p < 0.001 |
| 5 – 9 | 307 (5.4) | 1404 (24.9) | 3923 (69.6) | 0.04 (0.03, 0.1) p < 0.001 | 0.04 (0.03, 0.06) p < 0.001 | 0.1 (0.1, 0.1) p < 0.001 | 0.1 (0.1, 0.2) p < 0.001 |
| 10 – 14 | 191 (5.6) | 979 (28.9) | 2213 (65.4) | 0.05 (0.03, 0.1) p < 0.001 | 0.05 (0.03, 0.1) p < 0.001 | 0.1 (0.1, 0.2) p < 0.001 | 0.1 (01, 0.2) p < 0.001 |
| 15 – 24 | 112 (6.6) | 463 (27.2) | 1127 (66.2) | 0.1 (0.04, 0.1) p < 0.001 | 0.05 (0.04, 0.1) p < 0.001 | 0.1 (0.1, 0.1) p < 0.001 | 0.1 (0.9, 0.1) p < 0.001 |
| 25 – 34 | 87 (5.8) | 423 (28.4) | 981 (65.8) | 0.05 (0.03, 0.1) p < 0.001 | 0.05 (0.03, 0.07) p < 0.001 | 0.1 (0.1, 0.2) p < 0.001 | 0.1 (0.1, 0.2) p < 0.001 |
| 35 – 44 | 145 (8.9) | 562 (34.3) | 930 (56.8) | 0.1 (0.06, 0.1) p < 0.001 | 0.08 (0.06, 0.1) p < 0.001 | 0.2 (0.1, 0.2) p < 0.001 | 0.2 (0.1,0.2) p < 0.001 |
| 45 – 54 | 268 (10.5) | 1147 (45.1) | 1127 (44.3) | 0.125 (0.1, 0.2) p < 0.001 | 0.1 (0.09, 0.2) p < 0.001 | 0.3 (0.2, 0.4) p < 0.001 | 0.3 (0.2, 0.4) p < 0.001 |
| 55 – 64 | 383 (13.1) | 1468 (50.4) | 1064 (36.5) | 0.2 (0.1, 0.3) p < 0.001 | 0.2 (0.1, 0.2) p < 0.001 | 0.4 (0.3, 0.5) p < 0.001 | 0.4 (0.3, 0.5) p < 0.001 |
| 65 – 74 | 372 (16.5) | 1206 (53.4) | 680 (30.1) | 0.3 (0.2, 0.4) p < 0.001 | 0.3 (0.2, 0.4) p < 0.001 | 0.5 (0.4, 0.6) p < 0.001 | 0.5 (0.4, 0.6) p < 0.001 |
| 75 – 84 | 384 (20.0) | 1036 (53.9) | 502 (26.1) | 0.4 (0.3, 0.5) p < 0.001 | 0.4 (0.3, 0.5) p < 0.001 | 0.6 (0.4, 0.7) p < 0.001 | 0.6 (0.4, 0.7) p < 0.001 |
| 85+ | 409 (25.7) | 866 (54.5) | 315 (19.8) | 0.7 (0.5, 1.0) p = 0.015 | 0.7 (0.5, 1.0) p = 0.009 | 0.8 (0.6, 1.0) p = 0.047 | 0.7 (0.6, 1.0) p = 0.040 |
| | 154 (29.1) | 295 (55.7) | 81 (15.3) | | | | |

**Source: Texas Hospital Data 2002.**
***Adjusted by age, gender and ethnicity**

**Table 13**
**Asthma Risk of Death by Age at Discharge. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Age at Discharge** Up to 1 | 16 (1.2) | 64 (4.8) | 1251 (94.0) | 0.04 (0.02, 0.1) p < 0.001 | 0.04 (0.02, 0.08) p < 0.001 | 0.1 (0.1, 0.1) p < 0.001 | 0.09 (0.06, 0.1) p < 0.001 |
| 1 – 4 | 31 (0.6) | 184 (3.3) | 5419 (96.2) | 0.02 (0.01, 0.03) p < 0.001 | 0.02 (0.01, 0.03) p < 0.001 | 0.06 (0.05, 0.08) p < 0.001 | 0.06 (0.04, 0.07) p < 0.001 |
| 5 – 9 | 16 (0.5) | 135 (4.0) | 3232 (95.5) | 0.02 (0.01, 0.03) p < 0.001 | 0.02 (0.01, 0.03) p < 0.001 | 0.7 (0.06, 0.1) p < 0.001 | 0.07 (0.05, 0.1) p < 0.001 |
| 10 – 14 | 22 (1.3) | 70 (4.1) | 1610 (94.6) | 0.05 (0.03, 0.1) p < 0.001 | 0.04 (0.03, 0.1) p < 0.00 | 0.08 (0.06. 0.1) p < 0.001 | 0.07 (0.05, 0.1) p < 0.001 |
| 15 – 24 | 31 (2.1) | 83 (5.6) | 1377 (92.4) | 0.1 (0.05, 0.1) p < 0.001 | 0.1 (0.05, 0.1) p < 0.001 | 0.1 (0.07, 0.1) p < 0.001 | 0.1 (0.08, 0.1) p < 0.001 |
| 25 – 34 | 68 (4.2) | 184 (11.2) | 1385 (84.6) | 0.2 (0.1, 0.2) p < 0.001 | 0.2 (0.1, 0.2) p < 0.001 | 0.2 (0.1, 0.3) p < 0.001 | 0.2 (0.2, 0.3) p < 0.001 |
| 35 – 44 | 109 (4.3) | 358 (14.1) | 2075 (81.6) | 0.3 (0.2, 0.4) p < 0.001 | 0.2 (0.1, 0.2) p < 0.001 | 0.3 (0.2, 0.4) p < 0.001 | 0.3 (0.2, 0.4) p < 0.001 |
| 45 – 54 | 138 (4.7) | 438 (15.0) | 2339 (80.2) | 0.2 (0.1, 0.3) p < 0.001 | 0.2 (0.1, 0.3) p < 0.001 | 0.3 (0.3, 0.4) p < 0.001 | 0.3 (0.3, 0.4) p < 0.001 |
| 55 – 64 | 153 (6.8) | 359 (15.9) | 1746 (77.3) | 0.3 (0.2, 0.4) p < 0.001 | 0.3 ()0.2, 0.4 p < 0.001 | 0.4 (0.3, 0.4) p < 0.001 | 0.3 (0.3, 0.4) p < 0.001 |
| 65 – 74 | 172 (8.9) | 407 (21.2) | 1343 (69.9) | 0.4 (0.3, 0.6) p < 0.001 | 0.4 (0.3, 0.5) p < 0.001 | 0.5 (0.4, 0.7) p < 0.001 | 0.5 (0.4, 0.6) p < 0.001 |
| 75 – 84 | 207 (13.0) | 421 (26.5) | 962 (60.5) | 0.7 (0.5, 1.0) p = 0.015 | 0.7 (0.5, 1.0) p < 0.001 | 0.8 (0.6, 1.0) p = 0.014 | 0.7 (0.6, 1.0) p = 0.10 |
| 85+ | 86 (16.2) | 163 (30.8) | 281 (53.0) | | | | |

**Source: Texas Hospital Data 2002.**
***Adjusted by age, gender and ethnicity**

## Table 14

**Asthma Severity and Risk of Mortality by Race/Ethnicity. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| Other race /ethnicity | 185 (12.0) | 549 (35.6) | 809 (52.4) | 0.8 (0.7, 1.0) p = 0.079 | 1.1 (0.9, 1.2) p = 0.238 | 0.7 (0.6, 0.8) p < 0.001 | 0.9 (0.8, 1.1) p = 0.251 |
| Hispanic | 625 (8.2) | 2680 (35.1) | 4341 (56.8) | 0.5 (0.4, 0.5) p < 0.001 | 0.8 (0.7, 0.9) p = 0.001 | 0.7 (0.6, 0.7) p < 0.001 | 0.9 (0.9, 1.0) p = 0.220 |
| African American | 719 (11.9) | 2246 (37.1) | 3085 (51.0) | 0.8 (0.7, 0.9) p = 0.009 | 1.2 (1.1, 1.3) p = 0.001 | 0.8 (0.7, 0.8) p < 0.001 | 1.0, (1.0, 1.1) p = 0.392 |
| White | 1487 (12.4) | 4916 (41.0) | 5586 (46.6) | | | | |
| **Risk of Mortality** | | | | | | | |
| Other race /ethnicity | 77 (5.0) | 139 (9.0) | 1327 (86.0) | 1.0 (0.8, 1.3) p = 0.651 | 1.5 (1.1, 1.9) p = 0.001 | 0.7 (0.6, 0.8) p = 0.001 | 0.9 (0.7, 1.1) p = 0.430 |
| Hispanic | 224 (2.9) | 674 (8.8) | 6748 (88.3) | 0.6 (0.5, 0.7) p < 0.001 | 1.1 (0.9, 1.2) p = 0.407 | 0.6 (0.6, 0.7) p < 0.001 | 1.1 (0.9, 1.2) p = 0.268 |
| African American | 247 (4.1) | 663 (11.0) | 5140 (85.0) | 0.8 (0.7, 1.0) p = 0.093 | 1.3 (1.1, 1.5) p = 0.003 | 0.8 (0.8, 0.9) p = 0.021 | 1.2 (1.1, 1.3) p = 0.001 |
| White | 548 (4.6) | 1447 (12.1) | 9994 (83.4) | | | | |

**Source: Texas Hospital Data 2002.**

***Adjusted by age and gender**

**Table 15**
**Asthma Severity and Risk of Mortality by Admission Day of the Week. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| Sunday | 570 (11.5) | 1919 (38.6) | 2484 (49.9) | 1.1 (0.9, 1.3) p = 0.101 | 1.1 (0.9, 1.3) p = 0.271 | 1.1 (1.0, 1.2) p = 0.035 | 1.1 (1.0, 1.2) p = 0.147 |
| Monday | 442 (10.2) | 1654 (38.2) | 2236 (51.6) | 0.9 (0.8, 1.1) p = 0.734 | 1.0 (0.8, 1.2) p = 0.845 | 1.0 (0.9, 1.1) p = 0.239 | 1.1 (1.0, 1.2) p = 0.319 |
| Tuesday | 459 (11.1) | 1558 (37.8) | 2107 (51.1) | 1.0 (0.9, 1.2) p = 0.365 | 1.1 (0.9, 1.3) p = 0.383 | 1.0 (0.9, 1.1) p = 0.248 | 1.0 (0.9, 1.2) 0.442 |
| Wednesday | 426 (11.0) | 1526 (39.5) | 1910 (49.5) | 1.0 (0.9, 1.2) p = 0.235 | 1.0 (0.9, 1.2) p = 0.687 | 1.1 (1.0, 1.2) p = 0.008 | 1.1 (1.0, 1.2) p = 0.121 |
| Thursday | 432 (11.3) | 1492 (39.0) | 1902 (49.7) | 1.1 (0.9, 1.3) p = 0.156 | 1.1 (0.9, 1.3) p = 0.482 | 1.1 (1.0, 1.2) p = 0.022 | 1.1 (1.0, 1.2) p = 0.166 |
| Friday | 344 (11.6) | 1082 (36.5) | 1535 (51.8) | 1.1 (0.9, 1.3) p = 0.236 | 1.2 (1.0, 1.4) 0.114 | 1.0 (0.9, 1.1) 0.853 | 1.0 (0.9, 1.2) p = 0.598 |
| Saturday | 352 (10.7) | 121 (36.7) | 1734 (52.6) | | | | |
| **Risk of Mortality** | | | | | | | |
| Sunday | 201 (4.0) | 556 (11.2) | 4216 (84.8) | 1.0 (0.8, 1.2) p = 0.831 | 1.0 (0.8, 1.2) p = 0.853 | 1.0 (0.9, 1.2) p = 0.391 | 1.0 (0.9, 1.2) p = 827 |
| Monday | 164 (3.8) | 467 (10.8) | 3701 (85.4) | 0.9 (0.7, 1.2) p = 0.685 | 1.0 (0.7, 1.2) p = 0.139 | 1.00 (0.8, 1.1) p = 0.811 | 1.0 (0.9, 1.2) p = 0.818 |
| Tuesday | 169 (4.1) | 414 (10.0) | 3541 (85.9) | 1.0 (0.8, 1.2) p = 0.830 | 1.0 (1.8, 1.3) p = 0.969 | 0.9 (0.8, 1.0) p = 0.449 | 0.9 (0.8, 1.1) p = 0.303 |
| Wednesday | 153 (4.0) | 413 (10.7) | 3296 (85.3) | 0.9 (0.7, 1.2) p = 0.986 | 0.9 (0.7, 1.2) p = 0.542 | 1.0 (0.8, 1.1) p = 0.887 | 1.0 (0.8, 1.1) p = 0.532 |
| Thursday | 156 (4.1) | 440 (11.5) | 3230 (84.4) | 1.0 (0.819, 1.3) p = 0.757 | 1.0 (0.8, 1.2) p = 0.798 | 1.0 (0.9, 1.2) p = 0.215 | 1.0 (0.9, 1.2) p = 0.635 |
| Friday | 126 (4.3) | 299 (10.1) | 2536 (85.6) | 1.0 (0.8, 1.3) p = 0.6 | 1.1 (0.9, 1.4) p = 0.433 | 0.9 (0.8, 1.1) p = 0.550 | 1.0 (0.8, 1.2) p = 0.818 |
| Saturday | 131 (4.0) | 349 (10.6) | 2816 (85.4) | | | | |

Source: Texas Hospital Data 2002. *Adjusted by age, gender and ethnicity

**Table 16**
**Asthma Severity by Public Health Region. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value Crude | Odds Ratios Major and Extreme/Minor (95% CI) p-value Adjusted* | Odds Ratios Moderate/Minor (95% CI) p-value Crude | Odds Ratios Moderate/Minor (95% CI) p-value Adjusted |
|---|---|---|---|---|---|---|---|
| **Public Health Region** | | | | | | | |
| 1. Lubbock | 93 (9.1) | 361 (35.3) | 570 (55.70) | | | | |
| 2. Arlington | 51 (8.3) | 224 (36.4) | 341 (55.4) | 1.0 (0.8, 1.3) p = 0.590 | 1.1 (0.8, 1.5) p = 0.448 | 1.0 (0.8, 1.2) p = 0.699 | 1.0 (0.9, 1.2) p = 0.601 |
| 3. Arlington | 875 (12.) | 2680 (38.4) | 3433 (49.1) | 0.9 (0.7, 1.3) p = 0.924 | 0.9 (0.6, 1.3) p = 0.551 | 1.0 (0.8, 1.2) p = 0.482 | 1.0 (0.8, 1.3) p = 0.815 |
| 4. Tyler | 190 (13.4) | 539 (38.0) | 691 (48.7)) | 1.6 (1.4, 1.9) p < 0.001 | 1.5 (1.3, 1.9) p < 0.001 | 1.2 (1.1, 1.3) p < 0.001 | 1.2 (1.1, 1.4) p < 0.001 |
| 5. Tyler | 122 (12.7) | 366 (38.2) | 471 (49.1) | 1.8 (1.4, 2.2) p < 0.001 | 1.4 (1.1, 1.8) p = 0.003 | 1.2 (1.1, 1.4) p = 0.001 | 1.1 (1.0, 1.3) p = 0.127 |
| 6. Houston | 619 (10.8) | 2298 (40.1) | 2820 (49.2) | 1.7 (1.3, 2.1) p < 0.001 | 1.3 (1.0, 1.7) p = 0.065 | 1.2 (1.0, 1.4) p = 0.004 | 1.1 (0.9, 1.3) p = 0.571 |
| 7. Temple | 296 (12.9) | 997 (43.4) | 1005 (43.7) | 1.4 (1.2, 1.7) p < 0.001 | 1.2 (1.0, 1.5) p = 0.020 | 1.3 (1.2, 1.4) p < 0.001 | 1.3 (1.1, 1.4) p < 0.001 |
| 8. San Antonio | 286 (9.2) | 1172 (37.9) | 1637 (52.9) | 1.9 (1.6, 2.3) p < 0.001 | 1.4 (1.2, 1.8) p = 0.001 | 1.6 (1.4, 1.8) p < 0.001 | 1.3 (1.1, 1.5) p < 0.001 |
| 9. El Paso | 72 (7.9) | 295 (32.3) | 546 (59.8) | 1.1 (0.9, 1.3) p = 0.142 | 1.2 (1.0, 1.5) p = 0.087 | 1.1 (1.0, 1.3) p = 0.007 | 1.2 (1.1, 1.3) p = 0.006 |
| 10. El Paso | 111 (10.7) | 362 (35.0) | 561 (54.3) | 0.8 (0.6, 1.1) p = 0.324 | 0.8 (0.6, 1.1) p = 0.127 | 0.8 (0.7, 1.0) p = 0.123 | 0.9 (0.7, 1.0) p = 0.091 |
| 11. Harlingen | 234 (8.6) | 946 (34.8) | 1540 (56.6) | 1.3 (1.0, 1.6) p = 0.035 | 1.1 (0.8, 1.4) p = 0.706 | 1.0 (0.9, 1.2) p = 0.534 | 0.9 (0.8, 1.1) p = 0.450 |

**Source: Texas Hospital Data 2002.**
***Adjusted by age, gender and ethnicity**

## Table 17
## Asthma Risk of Mortality by Public Health Region. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value Crude | Odds Ratios Major and Extreme/Minor (95% CI) p-value Adjusted* | Odds Ratios Moderate/Minor (95% CI) p-value Crude | Odds Ratios Moderate/Minor (95% CI) p-value Adjusted |
|---|---|---|---|---|---|---|---|
| **Risk of Mortality** | | | | | | | |
| **Public Health Region** | | | | | | | |
| 1. Lubbock | 22 (2.1) | 98 (9.6) | 904 (88.3) | 0.7 (0.4, 1.1) p = 0.219 | 0.9 (0.6, 1.5) p = 0.704 | 1.1 (0.8, 1.2) p = 0.430 | 1.2 (0.9, 1.5) p = 0.228 |
| 2. Arlington | 23 (3.7) | 58 (9.4) | 535 (86.9) | 1.3 (0.8, 2.1) p = 0.266 | 1.5 (0.9, 2.5) p = 0.125 | 1.1 (0.8, 1.2) p = 0.518 | 1.1 (0.8, 1.5) p = 0.520 |
| 3. Arlington | 348 (5.0) | 787 (11.3) | 5853 (83.8) | 1.8 (1.4, 2.3) p < 0.001 | 2.0 (1.5, 2.7) p < 0.001 | 1.3 (1.1, 1.3) p < 0.001 | 1.4 (1.1, 1.6) p = 0.001 |
| 4. Tyler | 64 (4.5) | 182 (12.8) | 1174 (82.7) | 1.6 (1.1, 2.3) p = 0.003 | 1.6 (1.1, 2.3) p = 0.019 | 1.5 (1.1, 1.4) p < 0.001 | 1.4 (1.1, 1.7) p = 0.009 |
| 5. Tyler | 35 (3.6) | 131 (13.7) | 793 (82.7) | 1.3 (0.8, 2.0) p = 0.154 | 1.3 (0.8, 1.9) p = 0.315 | 1.6 (1.0, 1.4) p < 0.001 | 1.4 (1.1, 1.8) p = 0.008 |
| 6. Houston | 217 (3.8) | 594 (10.4) | 4926 (85.9) | 1.3 (1.0, 1.7) p = 0.028 | 1.3 (1.0, 1.7) p = 0.085 | 1.2 (1.2, 1.4) p = 0.011 | 1.1 (0.9, 1.3) p = 0.195 |
| 7. Temple | 124 (5.4) | 312 (13.6) | 1862 (81.0) | 2.0 (1.5, 2.7) p < 0.001 | 1.6 (1.2, 2.3) p = 0.003 | 1.7 (1.4, 1.8) p < 0.001 | 1.3 (1.1, 1.6) p = 0.004 |
| 8. San Antonio | 91 (2.6) | 282 (9.1) | 2722 (87.9) | 1.0 (0.7, 1.3) p = 0.910 | 1.1 (0.8, 1.6) p = 0.422 | 1.0 (1.0, 1.3) p = 0.558 | 1.1 (0.9, 1.3) p = 0.429 |
| 9. El Paso | 26 (2.8) | 78 (8.5) | 809 (88.6) | 0.9 (0.6, 1.5) p = 0.924 | 1.1 (0.7, 1.7) p = 0.764 | 0.9 (0.7, 1.0) p = 0.898 | 1.0 (0.8, 1.4) p = 0.821 |
| 10. El Paso | 41 (4.0) | 122 (11.8) | 871 (84.2) | 1.4 (0.9, 2.1) p = 0.067 | 1.1 (0.8, 1.7) p = 0.521 | 1.4 (0.9, 1.2) p = 0.003 | 1.3 (1.0, 1.6) p = 0.070 |
| 11. Harlingen | 79 (2.9) | 236 (8.7) | 2405 (88.4) | | | | |

**Source: Texas Hospital Data 2002.**
***Adjusted by age, gender and ethnicity**

## Table 18
## Asthma Severity and Risk of Mortality by Discharge Quarter of the Year 2002. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Discharge Quarter of the Year 2002** | | | | | | | |
| Jan - Mar | 948 (11.9) | 3122 (39.3) | 3881 (48.8) | 1.1 (1.0, 1.3) p = 0.001 | 0.9 (0.8, 1.0) p = 0.249 | 1.0 (1.0, 1.1) p = 0.018 | 0.9 (0.9, 1.0) p = 0.012 |
| Apr - Jun | 639 (11.7) | 2093 (38.4) | 2714 (49.8) | 1.1 (1.0, 1.2) p = 0.021 | 1.0 (0.8, 1.1) p = 0.465 | 1.0 (0.9, 1.1) p = 0..320 | 0.9 (0.8, 1.0) p = 0.023 |
| Jul - Sep | 547 (9.9) | 2011 (36.3) | 2987 (53.9) | 0.8 (0.7, 0.9) p = 0.045 | 0.9 (0.8, 1.0) p = 0.013 | 0.9 (0.8, 0.9) p = 0.008 | 0.9 (0.8, 0.9) p = 0.001 |
| Oct – Dec | 891 (10.6) | 3211 (38.1) | 4321 (51.3) | | | | |
| **Risk of Mortality** | | | | | | | |
| **Discharge Quarter of the Year 2002** | | | | | | | |
| Jan - Mar | 388 (4.9) | 976 (12.3) | 6587 (82.8) | 1.6 (1.3, 1.9) p < 0.001 | 1.3 (1.1, 1.5) p = 0.005 | 1.2 (1.1, 1.4) p < 0.001 | 1.1 (0.9, 1.2) p = 0.343 |
| Apr - Jun | 260 (4.8) | 583 (10.7) | 4603 (84.5) | 1.5 (1.3, 1.8) p < 0.001 | 1.3 (1.1, 1.6) p < 0.005 | 1.1 (0.9, 1.2) p = 0.073 | 0.9 (0.8, 1.1) p = 0.378 |
| Jul - Sep | 187 (3.4) | 542 (9.8) | 4816 (86.9) | 1.0 (0.8, 1.2) p = 0.471 | 1.1 (0.9, 1.3) p = 0.389 | 0.9 (0.8, 1.1) p = 0.787 | 1.0 (0.9, 1.1) p = 0.628 |
| Oct – Dec | 265 (3.1) | 837 (9.9) | 7321 (86.9) | | | | |

**Source: Texas Hospital Data 2002.**
***Adjusted by age, gender and ethnicity**

## Table 19
## Asthma Severity and Risk of Mortality by Length of Stay in Days. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Length of Stay in Days** | | | | | | | |
| More than three days | 2473 (16.5) | 6765 (45.1) | 5762 (38.4) | 6.3 (5.7, 7.0) | 4.4 (4.0, 5.0) | 2.6 (2.4, 2.7) | 2.0 (1.9, 2.1) |
| 1 – 2 days | 551 (4.5) | 3676 (29.7) | 8146 (65.8) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |
| **Risk of Mortality** | | | | | | | |
| **Length of Stay in Days** | | | | | | | |
| More than three days | 947 (6.3) | 2205 (14.7) | 11848 (79.0) | 6.0 (5.0, 7.1) | 3.5 (2.9, 4.2) | 2.9 (2.6, 3.1) | 1.9 (1.8, 2.1) |
| 1 – 2 days | 152 (1.2) | 733 (5.9) | 11488 (92.8) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 20
## Asthma Severity and Risk of Mortality by Type of Admission. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Type of Admission** | | | | | | | |
| Emergency | 1955 (11.9) | 6381 (38.7) | 8146 (49.4) | 1.2 (1.1, 1.4) | 1.1 (1.0, 1.2) | 1.0 (0.9, 1.1) | 0.9 (0.9, 1.0) |
| Urgent | 563 (9.9) | 2051 (36.1) | 3067 (54.0) | p < 0.001 | p = 0.097 | p = 0.176 | p = 0.091 |
| Elective | 499 (9.7) | 1980 (38.6) | 2647 (51.6) | 0.9 (0.8, 1.1) | 0.9 (0.8, 1.1) | 0.8 (0.8, 0.9) | 0.9 (0.8, 0.9) |
| | | | | p = 0.691 | p = 0.289 | p = 0.007 | p < 0.001 |
| **Risk of Mortality** | | | | | | | |
| **Type of Admission** | | | | | | | |
| Emergency | 761 (4.6) | 1822 (11.1) | 13899 (84.3) | 1.7 (1.4, 2.0) | 1.5 (1.2, 1.8) | 1.0 (0.9, 1.2) | 0.9 (0.8, 1.0) |
| Urgent | 194 (3.4) | 569 (10.0) | 4918 (86.6) | p < 0.001 | p < 0.001 | p = 0.124 | p = 0.280 |
| Elective | 142 (2.8) | 538 (10.5) | 4446 (86.7) | 1.2 (0.9, 1.5) | 1.2 (0.9, 1.5) | 0.9 (0.8, 1.0) | 0.9 (0.8, 1.1) |
| | | | | p = 0.06 | p = 0.145 | p = 0.480 | p = 0.197 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 21
## Asthma Severity and Risk of Mortality by Source of Admission. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Source Admission** | | | | | | | |
| Emergency Room | 2008 (12.2) | 6266 (38.0) | 8195 (49.8) | 1.4 (1.3, 1.5) | 1.0 (1.1, 1.2) | 1.1 (.9, 1.1) | 0.9 (0.8, 0.9) |
| Other | 979 (9.3) | 4027 (38.2) | 5528 (52.5) | p < 0.001 | 0.093 | p = .069 | p < 0.001 |
| **Risk of Mortality** | | | | | | | |
| **Source Admission** | | | | | | | |
| Emergency Room | 797 (4.8) | 1897 (11.5) | 13775 (83.6) | 1.8 (1.5, 2.0) | 1.4 (1.2, 1.6) | 1.2 (1.1, 1.3) | 1.0 (0.9, 1.1) |
| Other | 294 (2.8) | 1004 (9.5) | 9236 (87.5) | p < 0.001 | p < 0.001 | p < 0.001 | p = 0.998 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 22
## Asthma Severity and Risk of Mortality by Patient Residence. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Patient Residence** | | | | | | | |
| Texas | 2966 (11.0) | 10286 (38.1) | 13714 (50.9) | 0.6 (0.5, 0.9) | 0.8 (0.6, 1.1) | 0.9 (0.7, 1.1) | 1.0 (0.8, 1.3) |
| Other | 59 (14.7) | 153 (38.1) | 190 (47.3) | p = 0.016 | p = 0.345 | p = 0.516 | p = 0.609 |
| **Risk of Mortality** | | | | | | | |
| **Patient Residence** | | | | | | | |
| Texas | | | | | | | |
| Other | 1073 (4.0) | 2894 (10.7) | 22999 (85.3) | 0.5 (0.3, 0.8) | 0.7 (0.4, 1.0) | 0.9 (0.6, 1.3) | 1.0 (0.7, 1.5) |
| | 27 (6.7) | 44 (10.9) | 331 (82.3) | p = 0.006 | p = 0.096 | p = 0.734 | p = 0.589 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 23
## Asthma Severity and Risk of Mortality by Bronchitis. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Bronchitis** | | | | | | | |
| Present | 38 (9.4) | 188 (46.3) | 180 (44.3) | 0.9 (0.6, 1.3) | 0.8 (0.5, 1.1) | 1.3 (1.1, 1.7) | 1.1 (0.9, 1.4) |
| Absent | 2987 (11.1) | 10253 (38.0) | 13728 (50.9) | p = 0.866 | p = 0.238 | p = 0.001 | p = 0.112 |
| **Risk of Mortality** | | | | | | | |
| **Bronchitis** | | | | | | | |
| Present | 15 (3.7) | 45 (11.1) | 346 (85.2) | 0.9 (0.5, 1.5) | 0.7 (0.4, 1.2) | 1.0 (0.7, 1.4) | 0.8 (0.6, 1.1) |
| Absent | 1085 (4.0) | 2893 (10.7) | 22990 (85.2) | p = 0.749 | p = 0.255 | p = 0.836 | p = 0.329 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 24
## Asthma Severity and Risk of Mortality by Unspecified Sinusitis. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Unspecified Sinusitis** | | | | | | | |
| Present | 78 (9.1) | 415 (48.7) | 360 (42.2) | 0.9 (0.7, 1.2) | 1.0 (0.8, 1.3) | 1.5 (1.3, 1.7) | 1.5 (1.3, 1.8) |
| Absent | 2947 (11.1) | 10026 (37.8) | 13548 (51.1) | p = 0.975 | p = 0.879 | p < 0.001 | p < 0.001 |
| **Risk of Mortality** | | | | | | | |
| **Unspecified Sinusitis** | | | | | | | |
| Present | 26 (3.0) | 88 (10.3) | 739 (86.6) | 0.7 (0.4, 1.1) | 0.7 (0.5, 1.1) | 0.9 (0.7, 1.1) | 0.9 (0.7, 1.2) |
| Absent | 1074 (4.0) | 2850 (10.7) | 22597 (85.2) | p = 0.136 | p = 0.124 | p = 0.616 | p = 0.538 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 25
## Asthma Severity and Risk of Mortality by Post-inflammatory Pulmonary Fibrosis. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity Post-inflammatory Pulmonary Fibrosis** | | | | | | | |
| Present | 52 (32.9) | 103 (65.2) | 3 (1.9) | 81.1 (25.3, 259.7) | 35.1 (10.8, 113.9) | 46.1 (14.6, 145.5) | 24.3 (7.7, 77.2) |
| Absent | 2973 (10.9) | 10338 (38.0) | 13905 (51.1) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |
| **Risk of Mortality Post-inflammatory Pulmonary Fibrosis** | | | | | | | |
| Present | 31 (32.9) | 60 (38.0) | 67 (42.4) | 10.0 (6.5, 15.4) | 4.6 (2.9, 7.2) | 7.2 (5.1, 10.2) | 3.6 (2.5, 5.2) |
| Absent | 1069 (3.9) | 2878 (10.6) | 23269 (85.5) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 26
## Asthma Severity and Risk of Mortality by Acute Bronchiolitis. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Acute Bronchiolitis** | | | | | | | |
| Present | 27 (6.2) | 120 (27.7) | 286 (66.1) | 0.4 (0.2, 0.6) | 1.0 (0.7, 1.6) | 0.5 (0.4, 0.6) | 1.0 (0.8, 1.3) |
| Absent | 2998 (11.1) | 10321 (38.3) | 13622 (50.6) | p < 0.001 | p = 0.871 | p < 0.001 | P = 0.856 |
| **Risk of Mortality** | | | | | | | |
| **Acute Bronchiolitis** | | | | | | | |
| Present | 4 (0.9) | 18 (4.2) | 411 (94.9) | 0.2 (0.0, 0.5) | 1.1 (0.4, 3.0) | 0.3 (0.2, 0.5) | 1.0 (0.6, 1.6) |
| Absent | 1096 (4.1) | 2920 (10.8) | 22925 (85.1) | p = 0.002 | p = 0.789 | p < 0.001 | p = 0.941 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 27
## Asthma Severity and Risk of Mortality by Upper Respiratory Infection. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| Present | 72 (6.0) | 351 (29.1) | 783 (64.) | 0.4 (0.3, 0.5) | 0.5 (0.4, 0.7) | 0.5 (0.5, 0.6) | 0.7 (0.6, 0.8) |
| Absent | 2953 (11.3) | 10090 (38.6) | 13125 (50.2) | p < 0.001 | p < 0.001 | p < 0.001 | p < 0.001 |
| **Risk of Mortality** | | | | | | | |
| Present | 22 (1.8) | 60 (5.0) | 1124 (93.2) | 0.4 (0.2, 0.6) | 0.6 (0.4, 1.0) | 0.4 (0.3, 0.5) | 0.5 (04, 0.7) |
| Absent | 1078 (4.1) | 2878 (11.0) | 22212 (84.9) | p < 0.001 | p = 0.076 | p < 0.001 | p < 0.001 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 28
## Asthma Severity and Risk of Mortality by Unspecified Otitis Media. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Unspecified Otitis Media** | | | | | | | |
| Present | 67 (5.2) | 356 (27.9) | 854 (66.9) | 0.3 (0.2, 0.4) | 0.8 (0.6, 1.1) | 0.5 (0.4, 0.6) | 1.0 (0.9, 1.2) |
| Absent | 2958 (11.3) | 10085 (38.6) | 13054 (50.0) | p < 0.001 | p = 0.211 | p < 0.001 | P = 0.565 |
| **Risk of Mortality** | | | | | | | |
| **Unspecified Otitis Media** | | | | | | | |
| Present | 10 (.8) | 35 (2.7) | 1232 (96.5) | 0.1 (0.0, 0.3) | 0.9 (0.5, 1.7) | 0.2 (0.1, 0.3) | 0.6 (0.4, 0.9) |
| Absent | 1090 (4.2) | 2903 (11.1) | 22104 (84.7) | p < 0.001 | p = 0.721 | p < 0.001 | p = 0.014 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

## Table 29
## Asthma Severity and Risk of Mortality if Cough was Present. Crude and adjusted odds ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Cough** | | | | | | | |
| Present | 45 (7.9) | 245 (43.1) | 279 (49.0) | 0.7 (0.5, 1.0) | 0.9 (0.7, 1.3) | 1.1 (0.9, 1.3) | 1.4 (1.2, 1.7) |
| Absent | 2977 (11.1) | 10192 (38.0) | 13624 (50.8) | p = 0.061 | p = 0.718 | p = 0.070 | p < 0.001 |
| **Risk of Mortality** | | | | | | | |
| **Cough** | | | | | | | |
| Present | 21 (3.7) | 64 (11.2) | 484 (85.1) | 0.9 (0.5, 1.4) | 1.2 (0.8, 2.0) | 1.0 (0.8, 1.4) | 1.3 (1.0, 1.7) |
| Absent | 1079 (4.0) | 2873 (10.7) | 22841 (85.2) | p = 0.706 | p = 0.364 | p = 0.710 | p = 0.064 |

**Source: Texas Hospital Data 2002.**

***Adjusted by age, gender and ethnicity**

**Table 30**
**Asthma Severity and Risk of Mortality by the Presence of Fever. Crude and adjusted odds ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted* | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Fever** | | | | | | | |
| Present | 29 (12.5) | 93 (40.1) | 110 (47.4)) | 1.2 (0.8, 1.8) | 1.7 (1.1, 2.7) | 1.1 (0.8, 1.4) | 1.5 (1.1, 2.0) |
| Absent | 2993 (11.0) | 10334 (38.1) | 13793 (50.8) | p = 0.353 | p = 0.015 | p = 0 .397 | p = 0.006 |
| **Risk of Mortality** | | | | | | | |
| **Fever** | | | | | | | |
| Present | 6 (2.6) | 45 (19.4) | 181 (78.0) | 0.7 (0.3, 1.5) | 1.3 (0.5, 3.0) | 1.9 (1.4, 2.7) | 3.1 (2.1, 4.4) |
| Absent | 1094 (4.0) | 2892 (10.7) | 23144 (85.3) | p = 0.394 | p = 0.585 | p < 0.001 | p < 0.001 |

**Source: Texas Hospital Data 2002.**
***Adjusted by age, gender and ethnicity**

## Table 31
## Asthma Severity and Risk of Mortality by the Presence of Hypertension. Crude and adjusted odds ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Hypertension** | | | | | | | |
| Present | 911 (17.5) | 3116 (59.8) | 1186 (22.8) | 4.6 (4.1, 5.0) | 1.1 (0.7, 1.8) | 4.5 (4.2, 4.9) | 1.7 (1.2, 2.3) |
| Absent | 2114 (9.5) | 7325 (33.1) | 12722 (57.4) | $p < 0.001$ | $p = 0.613$ | $p < 0.001$ | $p = 0.002$ |
| **Risk of Mortality** | | | | | | | |
| **Hypertension** | | | | | | | |
| Present | 388 (7.4) | 1038 (59.8) | 3787 (72.6) | 2.8 (2.5, 3.0) | 0.9 (0.5, 1.5) | 2.8 (2.5, 3.0) | 1.0 (0.7, 1.4) |
| Absent | 712 (3.2) | 1900 (8.6) | 19549 (88.2) | $p < 0.001$ | $p = 0.700$ | $p < 0.001$ | $p = 0.952$ |

**Source: Texas Hospital Data 2002.**

**Adjusted by age, gender, ethnicity and obesity**

## Table 32
## Asthma Risk of Mortality by the Presence of Congestive Heart Failure. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Risk of Mortality Congestive Heart Failure** | | | | | | | |
| Present | 414 (58.0) | 611 (43.) | 392 (27.7) | 35.3 (30.1, 41.3) | 16.5 (13.9, 19.6) | 15.3 (13.4, 17.5) | 7.5 (6.5, 8.6) |
| Absent | 686 (2.6) | 2327 (9.0) | 22944 (88.4) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by age, gender and ethnicity**

## Table 33
## Asthma Severity and Risk of Mortality by the Presence of Chest Pain. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Chest Pain** | | | | | | | |
| Present | 35 (13.9) | 155 (61.5) | 62 (24.6) | 2.6 (1.7, 3.9) | 1.1 (0.7, 1.8) | 3.3 (2.5, 4.5) | 1.7 (1.2, 2.3) |
| Absent | 2987 (11.0) | 10282 (37.9) | 13841 (51.1) | $p < 0.001$ | $p = 0.602$ | $p < 0.001$ | $p = 0.003$ |
| **Risk of Mortality** | | | | | | | |
| **Chest Pain** | | | | | | | |
| Present | 16 (6.3) | 46 (18.3) | 190 (75.4) | 1.7 (1.0, 3.0) | 0.9 (0.5, 1.5) | 1.9 (1.4, 2.6) | 1.0 (0.7, 1.4) |
| Absent | 1084 (4.0) | 2891 (10.7) | 23135 (85.3) | $p = 0.025$ | $p = 0.646$ | $p < 0.001$ | $p = 0.790$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by: age, gender, ethnicity, obesity, hypertension, and diabetes**

**Table 34**
**Asthma Severity and Risk of Mortality by the Presence of Esophageal Reflux. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Esophageal Reflux** | | | | | | | |
| Present | 370 (16.2) | 1493 (65.4) | 421 (18.4) | 4.4 (3.8, 5.1) | 3.4 (2.9, 3.9) | 5.3 (4.7, 5.9) | 4.2 (3.7, 4.7) |
| Absent | 2655 (10.6) | 8948 (35.7) | 13487 (53.8) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |
| **Risk of Mortality** | | | | | | | |
| **Esophageal Reflux** | | | | | | | |
| Present | 101 (4.4) | 356 (15.6) | 1827 (80.0) | 1.1 (0.9, 1.4) | 0.8 (0.6, 0.9) | 1.6 (1.4, 1.8) | 1.1 (1.0, 1.2) |
| Absent | 999 (4.0) | 2582 (10.3) | 21509 (85.7) | $p = 0.104$ | $p = 0.012$ | $p < 0.001$ | $P = 0.158$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by age, gender and ethnicity**

**Table 35**

**Asthma Severity and Risk of Mortality by the Presence of Morbid Obesity and Other Hyperalimentation. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Morbid Obesity and Other Hyperalimentation** | | | | | | | |
| Present | 406 (20.4) | 1322 (66.5) | 261 (13.1) | 4.9 (6.9, 9.5) | 6.7 (5.6, 7.9) | 7.5 (6.6, 8.6) | 5.5 (4.8, 6.3) |
| Absent | 2619 (10.3) | 9119 (35.9) | 13647 (53.8) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |
| **Risk of Mortality** | | | | | | | |
| **Morbid Obesity and Other Hyperalimentation** | | | | | | | |
| Present | 152 (7.6) | 520 (26.1) | 1317 (66.2) | 2.6 (2.2, 3.2) | 2.2 (1.8, 2.6) | 3.5 (3.2, 4.0) | 2.8 (2.5, 3.1) |
| Absent | 948 (3.7) | 2418 (9.5) | 22019 (86.7) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**

**Adjusted by age, gender, ethnicity and hypertension**

## Table 36
## Asthma Severity and Risk of Mortality by the Presence of Type 2 Diabetes. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Severity** | | | | | | | |
| **Diabetes Type 2** | | | | | | | |
| Present | 723 (24.0) | 2139 (71.0) | 150 (5.0) | 28.8 (24.0, 34.5) $p < 0.001$ | 13.3 (11.0, 16.1) $p < 0.001$ | 23.6 (19.9, 27.9) $p < 0.001$ | 11.8 (9.9, 14.0) $p < 0.001$ |
| Absent | 2302 (9.4) | 8302 (34.1) | 13758 (56.5) | | | | |
| **Risk of Mortality** | | | | | | | |
| **Diabetes Type 2** | | | | | | | |
| Present | 342 (11.4) | 964 (32.0) | 1706 (56.6) | 5.7 (4.9, 6.5) $p < 0.001$ | 2.8 (2.4, 3.3) $p < 0.001$ | 6.1 (5.6, 6.7) $p < 0.001$ | 3.3 (3.0, 3.7) $p < 0.001$ |
| Absent | 758 (3.1) | 1974 (8.1) | 21630 (88.8) | | | | |

**Source: Texas Hospital Data 2002.**

**Adjusted by age, gender, ethnicity, hypertension and obesity**

## Table 37
## Asthma Risk of Mortality by Acidosis and Hypopotassemia. Crude and Adjusted Odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Risk of Mortality** | | | | | | | |
| **Acidosis** | | | | | | | |
| Present | 114 (38.4) | 111 (37.4) | 72 (24.2) | 37.3 (27.6, 50.5) | 57.4 (40.4, 81.3) | 12.6 (9.4, 17.1) | 17.4 (12.6, 24.1) |
| Absent | 986 (3.6) | 2827 (10.4) | 23264 (85.9) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |
| **Hypopotassemia** | | | | | | | |
| Present | 73 (7.0) | 199 (19.0) | 775 (74.0) | 2.0 (1.6, 2.6) | 1.4 (1.0, 1.8) | 2.1 (1.8, 2.4) | 1.5 (1.3, 1.8) |
| Absent | 1027 (3.9) | 2739 (10.4) | 22561 (85.7) | $p < 0.001$ | $p = 0.023$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by age, gender and ethnicity.**

## Table 38
## Asthma Risk of Mortality by the Presence of Urinary Tract Infection. Crude and Adjusted odds Ratios.

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Risk of Mortality Urinary Tract Infection** | | | | | | | |
| Present | 76 (18.2) | 110 (26.3) | 232 (55.5) | 7.3 (5.6, 9.6) | 4.0 (3.0, 5.3) | 3.8 (3.0, 4.8) | 2.3 (1.8, 2.9) |
| Absent | 1024 (3.8) | 2828 (10.5) | 23104 (85.7) | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by age, gender and ethnicity.**

**Table 39**
**Asthma Risk of Mortality by the Presence of HIV AIDS. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Risk of Mortality** | | | | | | | |
| **HIV AIDS** | | | | | | | |
| Present | 10 (21.7) | 11 (23.9) | 25 (54.3) | 3.5 (4.1, 17.8) | 1.3 (1.1, 1.5) | 33.5 (1.7, 7.1) | 1.2 (1.1, 1.3) |
| Absent | 1090 (4.0) | 2927 (10.7) | 23311 (85.3) | $p < 0.001$ | $p = 0.003$ | $p = 0.001$ | $p = 0.001$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by age, gender and ethnicity.**

**Table 40**
**Asthma Severity and Risk of Mortality by Tobacco Dependency*. Crude and Adjusted Odds Ratios.**

| Variable | Major and Extreme No. (%) | Moderate No. (%) | Minor No. (%) | Odds Ratios Major and Extreme/ Minor (95% CI) p-value | | Odds Ratios Moderate/ Minor (95% CI) p-value | |
|---|---|---|---|---|---|---|---|
| | | | | Crude | Adjusted | Crude | Adjusted |
| **Severity** | | | | | | | |
| Present | 211 (11.6) | 857 (47.0) | 756 (41.4) | 0.7 (0.6, 0.8) | 0.9 (0.7, 1.0) | 0.9 (0.8, 1.0) | 1.0 (0.9, 1.1) |
| Absent | 1991 (15.2) | 6146 (47.1) | 4924 (37.7) | $p < 0.001$ | $p = 0.090$ | $p = 0.072$ | $P = 0.737$ |
| **Risk of Mortality** | | | | | | | |
| Present | 78 (4.3) | 205 (11.2) | 1541 (84.5) | 0.6 (0.4, 0.7) | 0.7 (0.6, 1.0) | 0.6 (0.5, 0.7) | 0.7 (0.6, 0.8) |
| Absent | 886 (6.84.0) | 2208 (16.9) | 9967 (76.3) | $p < 0.001$ | $p = 0.018$ | $p < 0.001$ | $p < 0.001$ |

**Source: Texas Hospital Data 2002.**
**Adjusted by age, gender and ethnicity.**
***Patients older than 14 years of age.**

# REFERENCES


Texas Hospital Inpatient Discharge Public Use Data File, Texas Health Care Information Council, Austin, Texas. (2002).

Pearce, Neal., Beasley, Richard., Burgess, Carl., Crane, Julian. (1998). *Asthma Epidemiology Principles and Methods*. New York: Oxford University Press.

Giembycz, M. A. and B. O'Connor (2000). *Asthma : epidemiology, anti-inflammatory therapy, and future trends*. Basel ; Boston, Birkhäuser Verlag.

Harrison's *Principles of Internal Medicine*, Sixteenth Edition. (2005). The McGraw-Hill Companies, Inc

Bayona, M., Montealegre, F., Gomes de Andrade, V.L., Trevino, F. (2002). Prognostic factors of severe asthma in Puerto Rico. *Puerto Rico Health Science Journal*, Sep;21(3):213-9.

Slavin, R.G., Reisman, R.E. (2002). *Asthma*. JA Majors Co.

Busse, William, Holgate, Stephen. (2000). *Asthma and Rhinitis* (2nd Edition). Blackwell Science.

Gershwin, M.E., Naguwa, M. (2005). *Allergy and Immunology Secrets*. Elsevier Science Health Science Division.

Barnes, P.J., Pedersen, S., Busse, W.W. (1998). Efficacy and safety of inhaled corticosteroids. New developments. *American Journal of Respiratory and Critical Care Medicine*, 157: 51-553.

Liou A, Grubb, J.R., Schechtman, K.B., Hamilos, D.L. (2003). Causative and contributive factors to asthma severity and patterns of medication use in patients seeking specialized asthma care. *Chest,* Nov;124(5):1781-8.

Skobeloff, E.M., Spivey, W.H., St. Clair, S.S., Schoffstall, J.M. (1992). The influence of age and sex on asthma admissions. *Journal of the American Medical Association,* 268:3437–3440

Mannino, D.M., Homa, C.A., Pertowski, A., Ashizawa, L.L., Nixon, C.A., Johnson, L.B., Ball, E., Kang, D.S. (1998). Surveillance for asthma–United States, 1960-1995. *Morbidity and Mortality Weekly Report* 47(SS-1):1-28.

Akinbami, Lara, J., Schoendorf, Kenneth, C. (2002). Trends in Childhood Asthma: Prevalence, Health Care Utilization and Mortality. *Pediatrics.* 110:315-322.

American Lung Association. (2002). Childhood Asthma Overview. Retrieved on February 26, 2005 from http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=22782

American Lung Association. Fact Sheet: Asthma in Adults. Retrieved February 26, 2005 from http://www.lungusa.org/site/pp.asp?c=dvLUK9O0E&b=22596

Centers for Disease Control and Prevention (2002). Asthma Prevalence, Health

Care Use and Mortality. Retrieved February 26, 2005 from http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm.

Meurer, J.R., George, V., Subichin, S., Yauck, J., Layde, P. (2000). Asthma severity among children hospitalized in 1990 and 1995. *Archives of Pediatrics & Adolescent Medicine,* 154:143 –149.

American Lung Association. Epidemiology and Statistics Unit, Best Practices and Program Services. (21002). *Trends in Asthma Morbidity and Mortality.* Retrieved on February 23, 2005 from http://www.kintera.org/atf/cf/%7B7A8D42C2-FCCA-4604-8ADE-7F5D5E762256%7D/ASTHMA1.PDF

Beckett, W.S., Belanger, K., Gent, J.F., Holford, T.R., Leaderer, B.P. (1996). Asthma among Puerto Rican Hispanics: a multi-ethnic comparison study of risk factors. *American Journal of Respiratory Critical Care Medicine,*154:894-899.

Pesola, G. R., Xu, F., Ahsan, H., Sternfels, P., Meyer, I.H., Ford, J.G. (2004). Predicting Asthma Morbidity in Harlem Emergency Department Patients. *Academic Emergency Medicine,* 11:9; 944-950.

Overton, Stacie (2003). Seasonal Variations in Asthma Severity. Retrieved on March 12, 2005 from http://www.ivanhoe.com/channels/p_printStory.cfm?storyid=5607

Kimbell-Dunn, M., Pearce, N., Beasley, R. (2000). Seasonal variation in asthma hospitalizations and death rates in New Zealand. *Respirology,* 5:241–246.

Fleming, D.M., Sunderland, R., Cross, K.W., Ross, A.M. (2000). Declining incidence of episodes of asthma: a study of trends in new episodes presenting to general practitioners in the period 1989-98. *Thorax,* 55:657-661.

Jørgensen, I. M., Jensen, V.B., Bülow, S., Dahm, T. L., Prahl, P., Juel K. (2003). *Pediatric Pulmonology,* 36:142–147.

Kimes, D., Levine, E., Timmins, S., Weiss, S.R., Bollinger, M.E., Blaisdell, C. (2004). Temporal dynamics of emergency department and hospital admissions of pediatric asthmatics. *Environmental Research*, January; 94(1):7-17.

Zar, H.J., Stickells, D., Toerien, A., Wilson, D., Klein1, M., Bateman, E.D. (2001). Changes in fatal and near-fatal asthma in an urban area of South Africa from 1980–1997. European Respiratory *Journal,* 18, 33-37

Global Initiative for Asthma (GINA). Pocket guide for asthma management and prevention. A pocket guide for physicians and nurses. Revised 2002. National Heart, Lung, and Blood Institute, National Institutes of Health. Retrieved February 15, 2005 from http://www.ginasthma.com

International Union Against Tuberculosis and Lung Disease (2004). Factsheets: Asthma: a worldwide problem. Retrieved October 5, 2004 from http://www.iuatld.org/pdf/en/fichesasthma.pdf.

Centers for Disease Control and Prevention (1998). Forecasted State-Specific Estimates of Self-Reported Asthma Prevalence United States. *Morbidity and Mortality Weekly Report,* 47(47), 1022-1025.

Wennergren, G., Kristjansson, S. (2001). Relationship between respiratory syncytial virus bronchiolitis and future obstructive airway diseases. *European Respiratory Journal,* 18:1044–1058.

Johnston, S.L., Pattemore, P.K., Sanderson, G., Smith, S., Campbell, M.J., Josephs, L.K., Cunningham, A., Robinson, B.S., Myint, S.H., Ward, M.E., Tyrrell, D.A., Holgate, S.T. (1996). The relationship between upper respiratory infections and hospital admissions for asthma: a time-trend analysis. American Journal of Respiratory Critical Care Medicine,Vol 154, No. 3, 1996, 654-660.

Nguyen, L.H., Manoukian, J.J., Sobol, S.E., Tewfik, T.L., Mazer, B.D., Schloss, M.D., Taha, R., Hamid, Q.A. (2004). Similar allergic inflammation in the middle ear and the upper airway: evidence linking otitis media with effusion to the united airways concept. *Journal of Allergy and Clinical Immunology,* Nov;114(5):1110.

Chang, A.B., Harrhy, V.A., Simpson, J., Masters, I.B,, Gibson, P.G. (2002 ). Cough, airway inflammation, and mild asthma exacerbation. *Archive of Disease in Childhood,* Apr;86(4):270-5.

Diette GB, Krishnan JA, Dominici F, Haponik E, Skinner EA, Steinwachs D, Wu AW. (2002). Asthma in older patients: factors associated with hospitalization. *Archives of Internal Medicine,* May 27;162(10):1123-32.

Edmondstone, W.M. (2000). Chest pain and non-respiratory symptoms in acute Asthma. *Postgradate Medicine Journal,* 76:413-414.

Akerman, M.J.H., Calacanis, C.M., Madsen, M.K. (2004). Relationship Between Asthma Severity and Obesity. *Journal of Asthma,* 41:521-6.

Bouachour, G., Tirot, P., Varache, N., Harry, P., Alquier, P. (1992). Metabolic acidosis in severe acute asthma. Effect of alkaline therapy. *Review Pneumology Clinica,* 48(3):115-9.

Lee, K.H., Tan, W.C., Lim, T.K. (1997). Severe asthma. *Singapore Medical Journal*, Jun;38(6):238-40, 243.

Singhi, S., Marudkar, A. (1996). Hypokalemia in a pediatric intensive care unit. *Indian Pediatrics,* Jan;33(1):9-14.

Mannino, D.M., Homa, D.M., Redd, S.C. 2002. Involuntary smoking and asthma severity in children: data from the Third National Health and Nutrition Examination Survey. *Chest*, 122:409-415.

Mitchell, E. A. 1985. International trends in hospital admission rates for asthma. *Archives of Disease in Childhood*, Vol 60, 376-378.

Pappas, G., Hadden, W.C., Kozack, L.J., Fisher, G.F. (1997). Potentially avoidable hospitalizations: inequalities in rates between US socioeconomic groups. *American journal of Public Health,* 87:811-816.

Centers for Disease Control and Prevention. (1995). Asthma -- United States, 1982-1992. *Morbidity and Mortality Weekly Report,* 43:952-955.

CDC, National Center for Health Statistics. Asthma prevalence, health care use

and mortality, 2000-2001. Retrieved March 15, 2005 from http://www.cdc.gov/nchs/products/pubs/pubd/hestats/asthma/asthma.htm.

LeSon, S., Gershwin, M.E. (1996). Risk factors for asthmatic patients requiring intubation. III. Observations in young adults. *Journal of Asthma,* 33:27-35.

World Health Organization. Manual of the international statistical classification of diseases, injuries, and causes of death. 9th revision. Geneva, Switzerland: World Health Organization, 1977.

Zureik, M., Neukirch, C., Leynaert, B., Liard, R., Bousquet, J., Neukirch, F. (2002). Sensitisation to airborne moulds and severity of asthma: cross sectional study from European Community respiratory health survey. *British Medical Journal,* ;325:411–14.

All Patient Refined (APR) Diagnosis Related Group (DRG) from the 3M APR-DRG Group Version 15 (3M, 2005).

Fleiss, J.L. (1981). Statistical methods for rates and proportions. 2nd Edition. New York: John Wiley and Sons.

Rosner, B. (2000). Fundamentals of biostatistics (5th Edition). New York: Duxbury Press.

Szklo, M. & Nieto, F.J. (2000). Epidemiology: Beyond the Basics. Gaithersburg: Aspen Publishers, Inc.

Kleinbaum, D.G., Kupper, L.L., & Morgenstern, H. (1998). *Epidemiologic Research. Principles and Quantitative Methods*. Lifetime learning Publications. Belmont, California.

Rothman, K.J. & Greenland, S. (1998). *Modern Epidemiology* (2nd Edition). Philadelphia: Lippincott Williams & Wilkins.

Statistical Package for the Social Sciences 13 (2005).

Asthma Hospital Guide 2000, from the Illinois Health Care Cost Containment Council Members Retrieved on March 26, 2005 from http://www.state.il.us/agency/hcccc/freepubs/Asthma2000.pdf

Ensminger, S. A., Morales, I.J., Peters, S.G., Keegan, M.T., Finkielman, J.D., Lymp, J.F. Afessa, B. (2004). The Hospital Mortality of Patients Admitted to the ICU on Weekends. *Chest,* 126:1292-1298.

Cram, P., Hillis, S.L., Barnett, M., Rosenthal, G.E. (2004). Effects of weekend admission and hospital teaching status on in-hospital mortality. *American Journal Medicine,* 117:151-7.

Arif, A.A., Borders, T.F., Patterson, P.J., Rohrer, J.E., Xu, K.T. (2004). Prevalence and correlates of paediatric asthma and wheezing in a largely rural USA population. *Journal of Paediatrics and Child Health,* Apr;40(4):189-94.

Shilu, Tong., Peter, Drake. (1999). Hospital Admission and Mortality Differentials of Asthma Between Urban and Rural Populations in New South Wales. *Australian Journal of Rural Health,* Volume 7 Issue 1 Page 18 - February 1999.

Montealegre, F., Bayona, M., Chardon, D., Trevino, F. (2002). Age, gender and seasonal patterns of asthma in emergency departments of southern Puerto

Rico. *Puerto Rico Health Science Journal,* Sep;21(3):207-12.

Silverman, R.A., Stevenson, L., Hastings, H.M. (2003). Age-related seasonal patterns of emergency department visits for acute asthma in an urban environment. *Annals Emergency Medicine*, Oct;42(4):577-86.

Malmstrom, K., Kaila, M., Korhonen, K., Dunder, T., Nermes, M., Klaukka, T., Sarna, S., Juntunen-Backman, K. (2001). Mechanical ventilation in children with severe asthma. *Pediatric Pulmonology*, Jun;31(6):405-11.