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Controversy has surrounded the topic of breastfeeding and if it provides a protective effect against childhood asthma. The objective of this study was to assess whether a relationship exists between breastfeeding and childhood asthma. This study also examined several significant predictors of childhood asthma.

A cross-sectional study was conducted using NHANES 1999-2000 data to identify and assess the crude and multivariate associations between the above mentioned variables and asthma and the effect that breastfeeding has on these relationships. Prevalence of asthma in this study was 12.5 per 100. Mexican Americans were found to have a protective association with the development of asthma. A strong protective association was found for those who were breastfed and the development of childhood asthma (OR = 0.693, p-value = 0.014).

ASSOCIATION BETWEEN BREASTFEEDING AND

ASTHMA: A CROSS-SECTIONAL STUDY

Ann M. Trombley, B.S.

APPROVED:

Major Professor

Committee Member

Committee Member

TRACK DIRECTOR

Dean, School of Public Health

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A CROSS-SECTIONAL STUDY

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Ann Trombley, B.S.

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CHAPTER I

INTRODUCTION TO THE STUDY

Asthma is a chronic inflammatory airway disease, the most common chronic disease in childhood (Pearce, Beasley, Burgess, & Crane, 1998; Hu, Perskey, Flay, Zelli, Cooksey, & Richardson, 1997). The prevalence and severity of childhood asthma is steadily increasing, 5% per year and 500,000 new cases every year. (Weiss, 2001) Asthma prevalence increased by 74% from 1980 to 1995 and during that same time frame increased in children aged 0 to 4 years 163% (Chulada, Arbes, & Zeldin, 2003). The Centers for Disease Prevention and Control (CDC) has documented that asthma cases have more than doubled from 6.8 million in 1980 to 17.3 million in 1998 (Weiss, 2001). The prevalence of asthma is highest in the young, with children aged one to four years of age accounting for up to 50% of all emergency visits where the chief complaint is asthma-related (Dell & To, 2001). Asthma currently affects 15 million people in the United States, five million of whom are under the age of 18 years (Schwab, Cullen, & Schwartz, 2000). Asthma has been estimated to affect five to nine percent of children age six months to eleven years in the United States (Nelson, Johnson, Divine, Stauchman, Joseph, & Qwnby, 1997). In the United States, 9 - 16% of children use asthma medication regularly and 0.4% are hospitalized for asthma annually (Peat & Li, 1999).

The morbidity of childhood asthma is a significant source of health care costs for young children (1 to 4 years of age). Asthma is estimated to cost the US economy $11 billion dollars in health care costs and significant lost productivity each year (Schwab, Cullen, & Schwartz, 2000). Asthma is the number one cause of hospitalization in children and the number one cause for missed school days (Weiss, 2001).

The International Study of Asthma and Allergy in Children, ISAAC, conducted a study on the prevalence of asthma in 1999. This study rated the United States as second in prevalence of asthma (Peat & Li, 1999). The United States, Brazil, Canada, and Peru had a prevalence of 25 per 100 population and Australia, Ireland, New Zealand, and the United Kingdom had a prevalence of 30 per 100 population (Peat & Li, 1999). Developed nations have consistently higher asthma rates than developing nations. This has been attributed to many different factors. Differences between developing and developed nations include the following: urban environments, high body mass index (BMI), antibiotics, high fat processed food, lack of parasites, low endotoxins, and low particulate air pollution (Weiss, 2001). Many hypotheses have been made to explain the dramatic increase and differences between nations. One hypothesis states that the westernized diet is lacking in antioxidants which has resulted in a weaker host response to allergens and an increase in asthma and atopy (Pearce, et al., 1998). Other studies have suggested that the increase in asthma is due to global changes in exposure to infectious organisms through improved sanitation and widespread use of antibiotics (Wright, Sherill, Holberg, Halonen, & Martinez, 1999). The increase in asthma is also hypothesized to be directly proportional to the increases in outdoor and indoor pollution,

and familial factors, and in how asthma is diagnosed (Pearce et al., 1998). It has also been suggested that a period effect; that is, an increase in asthma due to an increase in exposure to environmental allergens, or a cohort effect explained by changes in environmental exposures have increased the incidence of disease in subsequent generations of children (Peat & Li, 1999). When examining the difference between the United States and Australia, Australia and New Zealand have lower asthma rates than in the United States. In Australia, 50% of infants are breastfed for more than four months and 25% for more than six months. In contrast, in the United States only 27% of infants were breastfeed for their first moth of life and 13% until their third month (Peat, 1998; Raisler et al., 1999). These findings encourage more research that is currently being conducted on infant diet in the first months of life and the relationship with asthma rates. The interest lies in whether the protective effect that breastfeeding extends from conditions such as otitis media and necrotizing enterocolitis also extends to childhood asthma (Wright, Bauer, Naylor, Sutcliffe, & Clark, 1998).

Many studies have shown that exposures early in childhood may contribute to the development of asthma. An early life preventive measure could possibly decrease the prevalence and severity of asthma and save in health care costs. It is biologically plausible that breastfeeding may offer some protection against the occurrence of asthma by decreasing allergic sensitization and/or accentuating the infant's immune system (Dell & To, 2001). However, in the United States Raisler et al. (1999) found that only 27% of mothers breastfed their children in the first month, 13% in the third month, and only 2% of mothers breastfed at 6 months in 1988. This study also observed that lower incidence

of breastfeeding was found in black, poor, young and less educated mothers (Raisler, Alexander, & O'Campo, 1999). Breastfeeding is becoming increasingly more common. The number of women who breastfed their children has risen from 20 - 60% from 1970 to 1995 respectively (Rust, Thompson, Minor, Davis-Mitchell, Holoway, & Murray, 2001).

Approximately 80 - 90% of all childhood asthma is diagnosed by the age of six years (Weiss, 2001). This demonstrates a link to exposures in early childhood and in utero. Genetics plays a large role in the development of asthma. A child with one asthmatic parent has approximately a 30 - 40% probability of developing asthma, whereas a child whose parents are not asthmatic has a 15 - 20% probability.

There is much controversy over whether breastfeeding protects against the development of asthma. In a recent national survey of physicians, many physicians did not promote breastfeeding to their patients because they did not believe that it was the most beneficial form of infant feeding available (Raisler, Alexander, & O'Campo, 1999). Some studies show a significant decrease in the risk of developing asthma and other studies suggest that breastfeeding may be related to a higher prevalence and increased risk of asthma and atopy in pre-adolescence (Gdalevich, Minouni, & Minouni, 2001; Sears, Greene, William, Taylor, Flannery, Cowan, Herbison, & Poulton, 2002; Oddy, deKlerk, Sly, & Holt, 2002). Gdalevich, et al. (2001) conducted a systematic review of twelve prospective studies. This study concluded that exclusive breastfeeding during the first months after birth is associated with lower asthma rates during childhood (Gdalevich, Minouni, & Minouni, 2001). A long follow-up study in New Zealand concluded that breastfeeding does not protect children against atopy and asthma and breastfeeding may

even increase the risk (Sears et al., 2002). These two studies give an indication that more research is needed in the area of breastfeeding and asthma.

The Problem and Purpose

The research hypothesis for the present study was to investigate if a statistical relationship exists between breastfeeding and asthma exists. Breastfeeding has been shown to confer passive immunity to infants based on maternal immunologic memory (Wold & Adlerberth, 1998). Breastfeeding has been associated with decreased respiratory infections, decreased ear infections (otitis media) and decreased gastrointestinal infections (necrotizing enterocolitis) (Wright et al., 1998). Some studies show that breastfeeding can reduce the chance of microbial invasiveness (Hanson, Hahn-Zoric, Wiedermann, Ludin, Dahlman-Hoglund, Saalman, Erling, Dahlaren, & Telemo, 1996). The factors that reduce the incidence of these conditions could also contribute to a decreased risk in asthma rates. Many studies have shown that a protective effect does exist between breastfeeding and asthma (Oddy et al., 2002; Gdalevich et al., 2001). However, there have been a few studies that show breastfeeding confers no effect or even a negative effect in relation to risk of asthma (Sears et al., 2002).

Multiple objectives were examined within this study. The first objective was to test whether a protective association between breastfeeding and childhood asthma exists. A second objective was to assess a dose-response relationship between the length of breastfeeding from birth and the development of asthma. The third objective was to identify if there were any confounding or interaction effects on the association of asthma and breastfeeding from selected variables available in the data set.

This study utilized epidemiological data from the National Health and Nutrition Examination Survey, NHANES, 1999-2000. A cross-sectional study design was utilized to analyze this data. The present study measured the prevalence of asthma in the surveyed population and studied the connection between asthma and breastfeeding and other factors that have some degree of confounding.

CHAPTER II

BACKGROUND AND RATIONALE

The pathophysiology of asthma consists of some very complicated pathways. Asthma is clinically characterized by three factors: reversible bronchial airway inflammation, increased mucous production, and airway hyper-responsiveness (King, 1994). These three factors also lead to the symptoms that are commonly associated with asthma: wheezing, breathlessness, chest tightness, cough and sputum production (Pearce et al., 1998). The inflammatory process is regulated by CD4+ T-cells. However, in asthmatics, CD4+ T-cells do not seem to be able to regulate and seem to actually be over stimulated. These produce cytokines (IL-4, IL-5, IL-6, IL-9, IL-10 and IL-13) that stimulate the growth, differentiation and recruitment of mast cells, basophils, eosinophils and B cells (King, 1994). The mast cells release histamine, prostaglandins, leukotriene, platelets activating factor, bradykinin, eosinophils, and neutrophil chemotactic factors (Cruse & Lewis, 1999). The release of these factors results in an immediate immune response and inflammation of the airways. The immediate response includes bronchoconstriction, microvascular leakage with mucosal edema and activation of intercellular adhesion of molecules (ICAM) (King, 1994). These factors also produce a late phase response. This involves inflammatory cells, i.e. eosinophils, alveolar macrophages, and lymphocytes, which migrate and activate ICAM. ICAM are cell-selective proteins that recruit and retain inflammatory cells to bronchial walls. This causes the epithelium to be damaged

and exposes nerve endings. The result is increased microvascular permeability, mucous production, dilated bronchial vessels and bronchospasms (King, 1994). In asthmatics this inflammatory response is amplified causing severe bronchial constriction. Asthma is a Th-2 type disease (T-helper cell (2) mediated immunity); this is demonstrated by the large numbers of Il-4 and Il-5. Il-4 and Il-5 directs the Th1/Th2 balance towards allergic hypersensitivity.

Breastfeeding has proven to be beneficial to infants for a multitude of reasons. Breastfeeding has been connected to the reduction of gastrointestinal infections, pneumonia, otitis media, and necrotizing enterocolitis (Wright et al., 1998). There is also evidence that breast milk can promote immunostimulatory and immunosupression of anti-inflammatory factors. Some studies have shown a link between breastfeeding and a reduction in allergic response. A connection can also be made for breastfeeding and a reduction of asthma incidence and/or severity. Another recent study showed that respiratory syncytial virus (RSV) neutralizing activity was detectable in 21 samples of *Clostridium*, 18 also contained specific IgA and IgG (Burr, Limb, Maguire, Amarah, Eldridge, Layzell, & Merrett, 1993). This suggests that breastfeeding has biological benefits.

Human milk contains many substances that can provide passive immunity and protection against respiratory and gastrointestinal infections. Breast milk contains secretory IgA (SIgA), which can provide infants with much needed mucosal defense. These efficiently prevent microorganisms from entering tissues and are non-inflammatory (Hanson, 1998). Multiple other factors are contained within human milk. Some of these

factors have anti-inflammatory activity, including cytokines and growth factors. These are important for the control and maturation of the infant's immune system and intestinal mucosa (Hanson, 1998). A list of cytokines found within breast milk is extensive: IL-1, IL-2, IL-3, IL-4, IL-6, IL-8, IL-10, TNF-alpha, TGF-beta, and IFN-gamma (Cruse & Lewis, 1999). Milk macrophages can produce IL-1alpha, IL-1beta, IL-1ra, IL-6, IL-8 and IL-10 (Hanson, 1998). It is estimated that on average two billion polymorphonuclear leukocytes (PMNs) and mononuclear cells are ingested during the first four days by the breastfed baby (Pabst, 1997).

Lactoferrin is a protein that is also found in human milk. Lactoferrin has many beneficial properties such as lymphostimulatory, anti-inflammatory, bactericidal, viricidal, and fungicidal properties (Xanthou, Bines, & Walker, 1995). Its main function is to be a carrier of iron. However, lactoferrin suppresses production of certain cytokines, IL-6, IL-8, and TNF-alpha (Cruse & Lewis, 1999). This could result in anti-inflammatory actions. Lactoferrin prevents the recruitment and activation of leukocytes to sites of inflammation (Xanthou, Bines, & Walker, 1995). It also activates leukocytes.

Oligosaccharides are also found in human milk in large numbers. Human milk is rich in long chain fatty acids that are thought to prevent allergic responses by preventing inflammation developing in the airways (Peat & Li, 1998). Other factors include complement, C3 and C4, lysozome (bactericidal), and fibronectin (important in inflammation and wound healing).

IgE (1% of the immunoglobulins) is the immunoglobulin that acts as a portion of the anaphylactic hypersensitivity response (Cruse & Lewis, 1999). IgE may act to stimulate

the infant's immune system towards antimicrobial (Th1) rather than allergic (Th2) response (Wright et al., 1999). IgE may also act to develop the intestinal colonization to develop the Th1 response. Another suggested pathway for protective effect of breastfeeding is the decreased exposure of the infant to external antigens during exclusive breastfeeding, which reduces the risk of sensitization (Gdalevich, Mimouni, & Mimouni, 2001). Human milk contains multiple anti-inflammatory properties. These includes the role of SIgA in human milk and its ability to interfere with the binding of bacteria and toxins to epithial cells, poor representation of the biochemical pathways that produce inflammation, enzymes that degrade the mediators of inflammation, and cytokines that can reduce inflammation (Xanthou, Bines, & Walker, 1995).

Multiple studies have shown a link between breastfeeding as the primary mode of nutrition for infants and reduction in atopy, allergy, and other childhood illnesses. This demonstrates the immunological strengthening ability of human milk. In the Dundee infant feeding study (Wilson, Forsyth, Greene, Irvine, Uau, & Howie, 1998), a cohort of children were followed prospectively for feeding habits and demographics for the first two years of life and then in a seven year follow up. Examining feeding patterns as they happen removes the possibility of subject bias and recall bias. This study concluded that the probability of respiratory illness occurring at any time during in the first seven years of life is significantly reduced if the child is fed exclusively breast milk for 15 weeks and no solid foods are introduced during this time (Wilson et al., 1998) (Table 1).

Due to similarities in the immune response for allergy and asthma, this study shows a positive protective factor between breastfeeding and reduction in respiratory illness. The definition of atopy is used to refer to allergic conditions that tend to cluster in families including hay fever, asthma, atopic eczema and other specific and non-specific states (Pearce et al., 1998). Asthma and atopy are strongly associated; therefore, a connection can be made that if breastfeeding is beneficial at reducing atopy then the same may be true for asthma. Asthma and atopy can occur separately and one can not use atopy as a surrogate measure for asthma (Pearce et al., 1998). This study leans towards the conclusion that their results are more attributable to the time of introduction of solid foods into an infant's diet.

Table 1: Estimated Proportions (95% confidence intervals) adjusted for Parental History of Atopic Disease, Gender, and Social Class

	Wheezing	Cough	Respiratory Illness	Asthma
Exclusive Breastfeeding	12.8(11.3-14.3)	11.3(10.7-11.9)	17.0(15.9-18.1)	12.1(10.9-3.4)
Partial Breastfeeding	21.2(16.2-26.1)	22.2(195.-24.9)	31.0(26.8-35.2)	21.7(17.3-26.1)
Bottle feeding	18.6 (17.0-20.1)	24.6(23.6-25.6)	32.2(30.7-33.7)	18.6(17.2-20.0)

(Wilson, 1998, 23)

A cross-sectional study by Raisler et al. (1999) proposed an investigation into whether the protective effect seen in breastfeeding was due to a dose-response relationship. This study utilized the National Maternal and Infant Health Survey (NMIHS) and included 7,092 infants. Breastfeeding was divided into five categories for the first six months.

These categories included full breastfeeding (all breast), most breastfeeding (breast > other), equal breastfeeding (breast = other), less breastfeeding (breast < other), or no breastfeeding (Table 2). The results demonstrated that sick baby visits were 30% less frequent in children who were exclusively breastfed. This study demonstrates the likelihood that it is not just the act of breastfeeding, but the length and exclusiveness that provides the protective quality.

Table 2: Summary of Adjusted Odds Ratios (95% Confidence Intervals) of Illness by Breastfeeding: National Maternal and Infant Health Survey 1988

Outcome	Full Breastfeeding	Most Breastfeeding	Equal Breastfeeding	Less Breastfeeding
Total Illness Score	0.8(0.7-0.9)	0.9(0.8-1.0)	0.9(0.8-1.0)	1.0(0.9-1.1)
Any Illness Score	0.7 (0.7-0.8)	0.9(0.9-1.0)	0.9(0.8-1.1)	1.05(0.9-1.2)
Sick Baby Visits	0.7 (0.6-0.8)	1.0 (0.9-1.2)	0.9(0.7-1.1)	1.06(0.9-1.2)
Well Baby Visits	1.1(1.1-1.2)	1.1(1.0-1.1)	1.0(0.9-1.1)	0.97(0.9-1.0)

(Raisler, 1999, 28)

Bloch, et al. (2002) conducted a meta-analysis of six prospective studies with the subject of breastfeeding and allergic rhinitis (AR). This systematic review analyzed prospective studies where breastfeeding was assessed for the first three months of life. The summary odds ratio of 0.74 (95% Confidence Interval 0.54-1.01) showed a non-significant but protective effect for breastfeeding and asthma (Bloch, Mimouni, Mimouni, & Gadalevich, 2002). Accounting for family history of atopy, the resulting odds of breastfeeding and its effect on asthma was 0.87 (95% CI 0.48-1.58). This study showed that the practice of exclusive breastfeeding for the first three months gives a

protective effect against allergic rhinitis in families with or without a history of AR. Bloch's study extends past the primary premise of breastfeeding's protective effects. This study examines maternal influence in the structuring of the infant's immune system. Even with a maternal history of asthma or atopy, breastfeeding can reduce the chance of developing asthma.

In 1998, an innovative approach, a population based cohort study, was taken to study the effects of breastfeeding. Wright et al. (1998) concluded that an increase in the proportion of infants in a community that are exclusively breastfed resulted in an overall decrease in infant illness. A breastfeeding initiative was encouraged as an experimental public health intervention in a Navajo community. Women who breastfed their children exclusively increased from 16.4% before the intervention to 54.6% after the intervention (Wright et al., 1998). Values connected with infant morbidity were analyzed before and after the initiative. This study examined the following infant illnesses: wheezing, lower respiratory tract illnesses, pneumonia, upper respiratory tract illness, otitis media, gastroenteritis, meningitis, and necrotizing enterocolitis (Wright et al., 1998). This study categorized breastfeeding to include the wide variations in the definition of breastfeeding. The four categories were as follows: never breastfed, breastfed but also formula fed from birth, exclusively breastfed for any period of time (postponed formula), and exclusively breastfed (Table 3). This study also showed a positive protective effect with breastfeeding. One hypothesis presented is that breastfeeding reduces the incidence of viral and bacterial illnesses, which in turn reduces the prevalence of respiratory infections associated asthma.

In a prospective study that examined infant feeding and the incidence of wheeze (Burr et al., 1993), findings showed breastfed children had a lower incidence of wheeze than those not breastfed (59% and 74% respectively). This study showed a protective effect that lasted up to 7 years of age. This study used individuals with a family history of atopy or asthma. This study had an interesting aspect of examining the effect of the protein found in cow's milk and how it related to the development of asthma. It has been suggested in other studies that exposure to this protein in infancy predisposes children to asthma later in life. Burr et al found that withholding cow's milk did not reduce the frequency of wheeze, asthma, eczema or allergic rhinitis (Burr et al., 1993). During the first year of life, wheezing occurred twice as frequently in those who were never breastfed as in those who had received any breast milk. This relationship could not be accounted for by other factors such as social class, maternal smoking or overcrowding (Burr et al., 1993). Burr et al. (1993) suggests that it is the introduction of cow's milk to the infant's feeding regime that has caused the increase in the prevalence of childhood asthma.

Many studies have been conducted to provide information regarding breastfeeding and its effect on the development of asthma. Since the 1930s it has been suggested in literature that breastfeeding provides an increased immunocompetence in infancy. Recently many studies have shown that breastfeeding has no effect on the asthma pathway or even that it can cause greater sensitivity to allergens and the development of asthma in later life.

In a systematic review of twelve prospective studies (Gdalevich, Mimouni, & Mimouni, 2000), exclusive breastfeeding was found to lower asthma rates during

childhood. This study suggests that several factors should be considered when examining an infant feeding study: maternal recall, duration of breastfeeding (less than four weeks is too short to convey any benefit and more than six months creates bias within the group), exclusiveness of breastfeeding, diagnostic criteria, and control for confounding (Gdalevich, Mimouni, & Mimouni, 2000). This review controlled for the following confounding factors: age, socioeconomic status, family history of atopy, and parental smoking. (Gdalevich, Mimouni, & Mimouni, 2001) The meta-analysis included 8,183 subjects. The odds ratio was 0.47 (95% CI, 0.34 - 0.66) for 1,788 subjects with less than two years follow up. In studies, with two or more years of follow up, odds ratio equaling 0.72 (95% CI, 0.62 - 0.84) were discovered (Gdalevich, Mimouni, & Mimouni, 2001). The summary odds ratio for the protective effect of breastfeeding was 0.70 (95% CI 0.60 - 0.81). For children with a family history of atopy, the resulting odds ratio was 0.73 (Gdalevich, Mimouni, & Mimouni, 2001). This suggests that breastfeeding would be most beneficial for infants with a first-degree relative with a history of atopy. Gdalevich's review of these prospective studies showed that a protective effect does exist with breastfeeding and asthma. The study also demonstrates that there is a connection between maternal history of asthma and the outcome of asthma, unlike the study by Bloch, et al. (1993).

In a prospective cohort study by Oddy et al. (1999), the association between duration of exclusive breastfeeding and development of asthma by age six was examined. Some factors that Oddy examined were being male, low birth weight, preterm birth, young maternal age, maternal smoking, and early cessation of exclusively breast feeding

(Oddy, Holt, Sly, Read, Landau, Stanley, Kendall, & Burton, 1999). The cumulative incidence of both asthma ($p= 0.001$) and wheeze ($p<0.001$) was higher if other milk was introduced before 4 months of age (Oddy et al., 1999) (Table 3). This study suggests that it was the age that other milk was introduced, with allergenic components, rather than the duration of breastfeeding that was associated with asthma (Oddy et al., 1999). This is similar to the results of the study conducted by Burr et al. (1993). However, this study cannot disclude the protective effect of breastfeeding, providing immunomodulatory, anti-inflammatory, and nutritional mechanisms.

Table 3:Asthma and Feeding Variables after Adjustment for Sex, Gestational Age, Smoking and Day Care Attendance

Exposure	Asthma Diagnosed by Physician	p-value	Wheezing in the past year	p-value
Introduction to Other Milk				
3 Months	1.2 (0.9 - 1.5)	0.084	1.2 (0.9 - 1.5)	0.135
4 Months	1.3 (1.0 - 1.5)	0.029	1.3 (1.1 - 1.6)	0.016
5 Months	1.2 (0.9 - 1.5)	0.063	1.3 (1.1 - 1.6)	0.018
6 Months	1.3 (1.0 - 1.5)	0.023	1.3 (1.0 - 1.6)	0.046
Breastfeeding Stopped by:				
3 Months	1.1 (0.9 - 1.3)	0.273	1.1 (0.9 - 1.4)	0.329
4 Months	1.1 (0.9 - 1.4)	0.187	1.1 (0.9 - 1.4)	0.478
5 Months	1.2 (0.9 - 1.5)	0.073	1.1 (0.9 - 1.4)	0.305
6 Months	1.2 (0.9 - 1.5)	0.101	1.1 (0.9 - 1.4)	0.261

(Oddy, 1999, 816)

Dell & To (2001) used a population-based cross-sectional study to examine the connection between breastfeeding and asthma. Data was obtained from the Canadian National Longitudinal Survey of Children and Youth (1994 - 1995). This was a questionnaire covering topics of child health and development. Prevalence of asthma was determined to equal 6.3 per 100 (Dell & To, 2001). This study had approximately 44% of

children that were breastfed and the other 56% that were not or breastfed for less than two months. Children were examined until the age of two years. A dose-response relationship was found to be statistically significant for groups that were breastfed for more than nine months. The protective effect for breastfeeding longer than six and nine months was stronger than the effect of smoking on asthma (prenatally and postnatally) in the unadjusted and adjusted analyses (Dell & To, 2001). The significant results from this study are those that were breastfed for greater than nine months.

In the retrospective cohort study by Sears et al. (2002), the researchers examined the asthma and breastfeeding connection within a birth cohort. The follow-up for this study was twenty-six years. Sears studied asthma status in children from the age of seven to the age of twenty-six. Sears study took extra precautions using strict diagnostic criteria, and a prospective design; it reduced recall bias and better ascertained infant feeding history. Pulmonary function tests were used to assess the presence of asthma, unlike many studies that rely on simply answering the question "Do you have physician diagnosed asthma?" They suggest that other studies are not following their subjects for enough time and that is what allows some studies to show protective effects of breastfeeding. The exposure status was divided between two groups - never breastfed or breastfed for greater than four weeks. Of the 1,037 children that were followed, 533 (51%) were not breastfed and 504 (49%) were breastfed (Sears et al., 2002). The mean of time breastfeeding was 21.1 weeks. This study found that no duration of exclusive breastfeeding had a protective effect against the development of atopy and asthma in later childhood, that is age seven to twenty-six years (Sears et al., 2002). The results concluded that children who were

breastfed were more likely than those who were not to have current asthma with hyper-responsiveness or current wheeze with airway hyper-responsiveness from seven to twenty-six years (Sears et al., 2001). Sears' research identified a statistically significant predictive connection between breastfeeding and asthma. An odds ratio of 1.83 (95% CI 1.35 - 2.47) was found for current asthma at the age of nine. This is an extremely strong study and adds to the controversy of whether breastfeeding is protective against or promotes the development of asthma. Another hypothesis presented in this study is that breastfeeding affects the balance of intestinal bacteria and this could enhance the chances of atopy and asthma. This study is in the minority of literature that exists to suggest that breastfeeding can have a negative effect.

The Sears study, however, had some issues. Breastfeeding was divided into more than or less than four weeks. Other studies have shown six to nine months necessary to convey the protective effect of breastfeeding. The cohort contained 1,139 children from New Zealand from the years 1972-73 (Sears et al., 2002). The increase in asthma rates began climbing in the 1980's. Some believe that the rising incidence of asthma is due to better diagnostic criteria. New Zealand and Australia are in the highest category of asthma rates and the lowest rates of breastfeeding at the time of this study. There were also no determinations made for exclusive breastfeeding, and the findings are only applicable for children older than six years of age. In the present study, children are under the age of six. This study suggests children who are breastfed are more apt to have asthma as an adolescent or young adult.

The Tokorozawa Childhood Asthma and Pollinosis study (2000) study found a higher prevalence of asthma in preadolescence in those infants who had been breastfed. This study was a large cross-sectional study with 2,315 cases of asthma and 21,513 controls. These statistics were obtained from a questionnaire and was administered in junior high and high schools in Tokorozawa, Japan (Takemura, Sakurai, Honjo, Kusakari, Hara, Gibo, Tokimatsu & Kugai, 2001). Takemura et al. (2001) provided the hypothesis that fat-soluble chemicals accumulating in breast milk might induce asthma. A second hypothesis is that foreign protein antigens are passed through breast milk which results in hypersensitivity, triggering asthma in pre-adolescence. This study examined feeding patterns of infants for up to three months. An odds ratio of 1.2 (95% CI 1.054 – 1.363) was found which was interpreted to be a positive effect of asthma on breastfed infants (Takemura et al., 2001). However, the odds found in this study showed a weak association . Feeding patterns were only monitored for the first three months. This has been disputed in a number of previously examined studies, suggesting that any solid food introduced or even the introduction of cow's milk prior to four months of age could promote childhood asthma. This study found a connection between the prevalence of asthma and infant feeding patterns. Breastfeeding alone had a prevalence of 10.32%, mixed feeding patterns 9.56% and artificial feeding (bottle) 8.67% (Takemura et al., 2000). The positive aspect of this study include the large population size (n= 25,767), creating a powerful study.

These two conflicting studies found in the literature do not convey the extent of the controversy that remains concerning asthma and breastfeeding. Both of these studies are

from outside the United States and both used participants that were over the age of six years. This is important to the present study, due to the fact that the present study showed results for a nation wide sample from the United States and all survey participants were under the age of six years.

Many studies have identified "high-risk" indicators for the development of asthma. These children have been known to have the following criteria: family history or genetic markers (parental history of asthma), ethnicity, race (Black), low socioeconomic status, gender (male), and birth order (higher in the birth order) (Rust et al., 2001; Lindbaek et al., 2003). Within socioeconomic status, many studies consider maternal age, maternal education and income level to be significant in whether a child will development asthma. Other factors concerned with asthma etiology have been identified as being linked to the likelihood of developing asthma. These include infections in early life and perinatal factors, such as low birth weight and disproportionate fetal growth (Seidman et al., 1991). These help identify direct causal mechanisms at a cellular level (Peat & Li, 1999).

Two of the identifiers of high-risk children are gender and ethnicity. In a cross-sectional study of a homogeneous suburban area by Nelson et al. (1997), the lifetime prevalence of asthma was 9.5% (12% for blacks and 6% for whites) and higher in boys (14%) then girls (5%) (Nelson et al., 1997). Another cross-sectional study by Hu et al. (1997), found boys to be significantly more likely to have physician diagnosed asthma than girls (odds ratio = 1.7). This suggests biological differences exist between races and genders. This study accounted for differences often seen in studies concerning racial differences, socioeconomic status. One possible mechanism is the amount of IgE an

individual produces. Certain studies have found a strong correlation between serum IgE levels and the prevalence of asthma (Hanson et al., 1996). These studies also suggest that blacks have a higher IgE level than whites and males have higher levels than females (Hu, Persky, Flay, Zelli, Cooksey, & Richardson, 1997). A second possible explanation for variation between males and females is anatomic differences. Boys tend to have smaller airways at a given lung size than girls, (Hu et al., 1997). Another factor is that boys tend to have higher incidence of lower tract and upper tract respiratory infections (Hu et al., 1997).

Lindbaek et al. (2003) conducted a cohort study that evaluated the effect of socioeconomic factors on a child's asthma status. This study examined children between the ages of four to five years in Norway. This study indicated that a higher percentage of asthmatic children had less than five rooms in their home, at least one parent with a chronic disease (most likely asthma), a higher frequency of having a single parent, and a low level of parental education (Lindbaek, Wefring, Grangard, & Ovsthus, 2003). A cumulative prevalence of asthma was 8.7 per 100 in this study in children aged four to five years (Lindbaek et al., 2003). This is important to consider in the present study because these factors were not available for analysis. The socioeconomic status is a large risk factor for asthma.

Another prenatal factor that contributes to childhood asthma is maternal smoking during the pregnancy. Hu et al. (1997) cross-sectional study also reported that maternal smoking during pregnancy was significantly associated with childhood asthma (adjusted OR = 1.9; 95% CI 1.1 to 3.5) (Hu et al., 1997). This study also found that cord blood IgE

concentrations were elevated significantly in infants whose mothers smoked during pregnancy and this might predispose infants to subsequent sensitization and allergy (Hu et al., 1997). It has also been suggested that intrauterine exposure to smoking could cause changes in pulmonary structure and function.

Dell & To (2001) used a population based cross-sectional study to examine the effects of prenatal exposure to cigarette smoke. They found that children who were exposed prenatally to smoke were 96% more likely to develop asthma when compared to children who were not exposed. Dell & To also showed that exposure to postnatal smoke was a contributor to childhood asthma (OR = 1.52). These finding were statistically significant. Other studies have found that children exposed to smoking are 30-240% more likely to have asthma (Peat, 1998).

Gilland et al. (2002) studied the effects of in utero exposure to cigarette smoking. This longitudinal study examined lung functions in 5,933 children. Their research demonstrated a lower FEV1/FVC in children with in utero exposure to tobacco and a history of family asthma. This research suggests that the in utero exposure during critical periods of fetal lung development could permanently alter the lung structure and cause an increase risk of asthma development (Gilliand, Berhane, Lit, Rappaport, & Peters, 2002). This study showed that in utero exposure to household smoke and maternal smoking increased the risk of developing childhood asthma, but environmental exposure to cigarette smoke did not.

Along with other socioeconomic factors, day care attendance has been known to be a predictive factor for asthma. One explanation could be an increase in lower respiratory

infections in children who attend day care. Children who attend day care are more likely to develop infections with respiratory synsctial virus (RSV) and hepatitis A infections (Infante-Rivard, Amre, Gautrin, & Malo, 2001). These infections have been suggested to promote asthma later in childhood (Oddy et al., 2002). However, a prospective birth cohort study by Celedon et al. found that day care attendance for infants without family history of asthma were less likely to develop asthma (OR = 0.3, 95% CI 0.1-0.8) (Celedon, Wright, Litojuna, Sredie, Ryan, Weiss, & Gold, 2002). However, those children with a maternal history of asthma were 4.3 times more likely to have asthma if they attended day care in the first year of life. The hygiene hypothesis is the basis for this theory. This hypothesis suggests that exposure to other children and exposure to low-grade infections can create less allergen sensitization and result in less asthma symptoms (Liu & Murphy, 2003). This point is a disputed topic in asthma prevention. A case-control study by Infante-Rivard et al. (2001), however, found that increased exposure to infection can in fact decrease the risk of asthma. Daycare attendance before age one showed to have a protective effect against asthma (OR = 0.83). However, day care attendance before the age 3-4 showed a two times greater risk (OR = 2.37) (Infante-Rivard et al., 2001).

Yet another factor is genetic predisposition, the presence of maternal asthma. The role that parental asthma plays in the development of childhood asthma has always been considered a major risk factor for asthma. However, some research suggests that asthmatic mothers should breastfed their children to reduce the likelihood of their children developing asthma. Oddy et al., 2002, examined a cohort of 2,602 Australian

children in a prospective cohort study. At age six, 17% of children had current asthma, 22% had wheeze in the last year, and 31% had physician-diagnosed asthma ever (Oddy et al., 2002). Fifteen percent of the mothers from this cohort had current asthma. In this study maternal history of asthma did not affect the relationship found between asthma and length of breastfeeding. The risk of childhood asthma increased if other milk was introduced before four months (OR = 1.28, 95% CI 1.01 - 1.62) (Oddy et al., 2002). The risk was not changed when adjusted for maternal asthma status.

Another study by Wright, et al. (2001), used information from the Tucson Children's Respiratory Study (CRS). This prospective longitudinal study found that maternal history of asthma did affect the relationship between asthma and breastfeeding. The data collected on 1,043 children was stratified by history of maternal asthma and length of breastfeeding. No significant difference was observed in the incidence of asthma in relation to breastfeeding between mothers without history of asthma and mothers with a history of asthma (Table 5). In children with non-asthmatic mothers the percentage with asthma by age three was unrelated to breastfeeding, in children with a maternal history of asthma there was a direct relation between duration of breastfeeding and asthma by age three (Wright et al., 2001).

Table 4: Percentage with Recurrent Wheeze in the First Three Years of Life and at 6-13 Years of Life

	Never Breastfed	Exclusively Breastfed < 4 months	Exclusively Breastfed > 4 months
AGE < 3 YEARS			
Maternal Asthma	27.3	19.2	14.3
No Maternal Asthma	14.4	12.5	7.9
AGE 6–13 YRS			
Maternal Asthma	25.0	29.8	42.2
No Maternal Asthma	20.1	13.7	15.7

(Wright, 2001,194)

Two hypotheses for this finding were proposed by this research. 1) The milk of asthmatic mothers may have cytokines that would influence the infant's immune system. Other differences in the milk of asthmatic mothers are the levels of long chain polyunsaturated fatty acids, CD14 and levels of IgE (Wright et al., 2001). 2) Asthmatic mothers may represent a population bias by reporting and being more diligent in the treatment and ascertainment of a diagnosis of asthma (Wright et al., 2001). Asthmatic mothers may also use medications during pregnancy that would influence the immune system (Wright et al., 2001).

In the first cohort study to examine low birth weight (<2500g) and asthma, Seidman et al. (1991) concluded a positive correlation between the two. They examined 20,312 subjects at 17 years of age. They observed that low birth weight children were 44% more likely to develop asthma by the age of 17 when compared to children of normal birth weight (Seidman, Gale, Stevenson, & Danon, 1991). Prematurity contributes to lower respiratory infections that could lead to a history of asthma later in life. This study did adjust for the low socioeconomic status; this is important because it

has been shown that low socioeconomic women are more likely to have low birth weight babies (Seidman et al., 1991). Socioeconomic status was identified by geographic residence, paternal education level, and maternal age. Another factor that Seidman adjusted for was maternal smoking, which is another cause of low birth weight in children. This is relevant to the present study because socioeconomic status was not available for adjustment.

A more recent cohort study examined the relationship between asthma and low birth weight (LBW) within the African American population (Joseph, Ownby, Peterson, & Johnson, 2002). African Americans, when compared to non-African Americans, are at a higher risk for both LBW (16.6% vs. 3.9%) and asthma (12.5% vs. 5.3%) (Joseph et al., 2002). After adjusting for race and gender, a relationship was still observed between asthma and LBW (ORadj= 5.3, 95% CI 0.8 – 33.1) (Joseph et al., 2002). However, the sample size was very small, only 126 children. The small sample size resulted in a wide variance and a non-significant result. The prevalence of physician diagnosed asthma found in this study was 10.3% (Joseph et al., 2002).

Differences in breastfeeding infants and non-breastfed infants are greater than just in feeding practices. Breastfed infants have less exposure than bottle-fed infants to crowded households and cigarette smoke, but were more likely to be in day care. Breastfed babies were more likely to receive health care from a private doctor or health maintenance organization (HMO); where as bottle-fed babies were more likely to attend clinics (Raisler, Alexander, & O'Campo, 1999). There are differences observed between mothers who breastfeed and those who do not. These differences may offer some

explanation to the differences seen in risk of the development of asthma between breastfed and non-breastfed infants. Mothers are more likely to breast feed exclusively for greater than months if they had completed college, where non-Hispanic, or did not smoke in the child's first year of life (Wright et al., 1999).

Two studies were found that conducted research investigating the protective effect of breastfeeding against asthma using the NHANES III data (1988 -1994) (Chulada et al., 2003; Rust et al., 2001). Both cross-sectional studies demonstrated a not significant association between breastfeeding and asthma after adjustment for confounders. These two studies are extremely relevant to this research because they utilize the same survey and the same sampling procedures as the present study. Although they used NHANES III data and had access to different variables, the survey and examination portion of these studies are consistent with our research. These two studies also utilized weighted variables.

The first study by Chulada, et al. (2003) examined breastfeeding in infants up to 72 months (six years) utilizing NHANES III data (cross-sectional study). In the crude analysis an association between breastfeeding and asthma existed (OR= 0.68, 95% CI 0.51-0.90). After adjusting for confounders, however, the association, still protective, was no longer statistically significant (OR = 0.85, 95% CI 0.64-1.13). Children with asthma were more likely to be non-Hispanic black, low birth weight, have attended daycare and had a mother who smoked during her pregnancy (Chulada, et al., 2003). Some other covariates examined were parental history of asthma, education of mother and exposure to environmental smoke. This study also analyzed a dose-response

relationship between asthma and breastfeeding. This study found that exclusive breastfeeding at or greater than four months provided a protective effect, although not statistically significant (OR = 0.56, 95% CI 0.29-1.11) (Chulada et al., 2003). Chulada et al. (2003) found an interesting interaction between environmental tobacco smoke and breastfed children. Children who were "ever breastfed" in a household of one or more smokers were at a lower risk of being diagnosed with asthma than children who were "ever breastfed" in a non-smoking household. Those children in a household with one or more smokers who were breastfed were 44% less likely to develop asthma than those in a similar environment who were not breastfed (Chulada et al., 2003). This is compared to a household with no smokers and a breastfed child who is only 10% less likely to develop asthma, although not significant (Chulada et al., 2003).

The second study that utilized the NHANES III data (1988-94) was conducted by Rust et al. (2001). The average number of days of breastfeeding for this study was 157. Children with asthma were again more likely to be male, non-Hispanic black and from low-income families (Rust et al., 2001). This study found that non-Hispanic blacks were the least likely to breastfeed their children (25.3%) and those children from higher income families (>20,000 per year) were 59.1% more likely of all races to breastfeed their children (Rust et al., 2001). Maternal age was found in this study to be a predictive factor for childhood asthma. The odds ratio of a child having asthma was decreased by 0.08 for each year of increase in maternal age (Rust et al., 2001). Mothers with children who have asthma were a mean age of 24.6 years and those mothers with children without asthma were a mean age of 25.9 years. After adjusting for confounders this study also found no

significant association between asthma and breastfeeding (OR=0.89, 95% CI 0.47-1.66) (Rust et al., 2001). Rust et al. (2001) also found that breastfeeding did not reduce the asthma rates even in children with a family history of asthma and/or atopy.

Due to the increasing prevalence of childhood asthma, a multitude of studies have examined potential opportunities for primary and secondary prevention. Reducing indoor allergens, i.e. dust mites, is considered a possible intervention. Viral events early in childhood, RSV or parainfluenza, have been shown to increase the likelihood of developing asthma (Pearce et al., 1998). Others include educating and reducing the percentage of parental smoking, both prenatal and postnatal and addition of omega-3 fatty acids to infant diets. The primary prevention this research focuses on is the inclusion and duration of breastfeeding.

CHAPTER III

STUDY DESIGN AND METHODOLOGY

Study Design

This research was conducted as a cross-sectional study based on data from National Health and Nutrition Examination Survey, NHANES, 1999-2000. The study design, cross-sectional, was chosen based on the nature of the data set and how it was configured. The data set consisted of information from 1,259 children up to six years of age. Children with asthma were compared to children without asthma regarding history of breastfeeding to identify and assess its possible protective effect. Demographic, medical and epidemiological variables were included in the study to adjust for potential confounding and study possible effect modifications of the association between breastfeeding and asthma.

Study Population

The study population was composed of respondents to the National Health and Nutrition Examination Survey (NHANES), 1999-2000. NHANES is part of the National center for Health Statistics (NCHS). The 99-00 data contains information collected between March 1999 and December 2000 throughout the whole United States. The total number of individuals surveyed during this time period equaled 9,965.

The original population of 9,965 individuals was reduced when age limits were introduced with the use of the household Youth Questionnaire. This portion of the survey limited the age range to those 15 years of age and younger with the Household Youth Survey (CDC, 2003). However, the information concerning breastfeeding practices was only a valid question for those children from 0 to 6 years (72 months) of age. Of those respondents to the Youth Questionnaire (3,449), only 1,262 were within this age range, and only 1,259 answered the questions about breastfeeding. Three interviewees answered "Don't know" and were excluded. The interview of these participants was only conducted for mothers with children under the age of six.

Of the 1, 262 survey participants 679 were males (53.8%) and 583 were females (46.2%). Ethnicity was divided by NHANES into five categories. Mexican Americans consisted of 37.5% (n = 474) of the population, 81 were other Hispanics (6.4%), 331 were non-Hispanic white (26.3%), 306 were non-Hispanic black (24.2%) and 70 were multi-racial (5.6%). (Table 6) All races and ethnicities were included in this study. The racial divisions used in the present study were those set forth by NHANES. Hispanics in some initial analysis were composed of both Mexican Americans and other Hispanics (crude analysis of breastfeeding and race and Hispanics versus non-Hispanics and asthma). However, the differences between these two ethnicities were significant to our analysis. It appeared that the protective effect seen by Mexican Americans was masking the effect of other Hispanics. Therefore, when comparing all racial groups, using non-Hispanic Whites as a reference group, to asthma, all races were treated separately. Using

all five categories for racial and ethnic division has been used in previous studies using NHANES III (Chulada et al., 2003; Rust et al., 2001).

A total of 158 cases of asthma and 1,104 non-cases were available for the present study. The power of the sample was determined using EPI INFO with a 0.05 type I error for a 6.98 ratio of non-cases per cases (1,104 / 158), percent of exposure among non-cases 53.2%, for an odds ratio of 0.592 (Dean, et al., 1998). This sample size was enough to reach an 86.7% power for the association of breastfeeding and asthma (Fleiss, 1982).

Sampling Procedures

NHANES 1999-2000 is a complex, stratified, multi-stage probability sample of the civilian non-institutionalized population of the United States (CDC, 2003). The survey collects information on diet, activity levels, medication usage, and hospital and clinic utilization. The 1999 – 2000 public use data set came from information collected over a two-year period. Past NHANES surveys were conducted in 15 US locations per year, surveying approximately 5,000 persons annually. The 1999-2000 survey was designed to give statistical data annually that represents the nation. The 99-00 survey only contains two years worth of data and not six years like in past available NHANES data sets. This constitutes a smaller sample size and fewer geographic locations were surveyed. The participants for the NHANES survey were selected with the use of 1990 census data. NHANES has divided cities into communities and these communities into neighborhoods. From these neighborhoods, certain random households are approached for eligibility in the survey.

Outcome Definition

The study individuals were those whose mothers answered NHANES questionnaire data item MCQ010 (Has a doctor or other health professional ever told you that you have asthma?) Through the NHANES questionnaire, cases of asthma were identified as those who answered "yes" to data item MCQ010 and these cases were compared to individuals who answered "no" to the same question. Those who answered "Don't know" were excluded. Past studies have used varying definitions of asthma. Most studies use physician diagnosed asthma. However, there is no "gold standard" for definition of asthma in asthma research. In analyzing this data set, physician diagnosed asthma was used as a definitive diagnosis. This definition was also utilized as a definitive definition other studies that examined breastfeeding and asthma with NHANES III data (Chulada et al., 2003; Rust et al., 2001). These two studies and the present study use physician diagnosed asthma as the definitive diagnosis for asthma.

Exposure Variable

Main exposure status was based on two variables. First, those who answered questionnaire data item DBQ010 (Ever been breastfed or fed breast milk?). Second, how long the individual was breastfed (DBD 020). This second variable was categorized by having been breastfed for four, six, and nine months or never breastfed. This variable comes from the question "Was the child ever breastfed or fed breast milk (yes/no)?" Also the age at which breastfeeding was stopped was used as a way to show a period of time in which breastfeeding occurred. This variable was also used in two other studies concerning breastfeeding practices and asthma (Chulada et al., 2003; Rust et al., 2001).

Three cut-off points were used in the present study as they are supported in the literature, four, six and nine months (Chulada et al., 2003; Oddy et al., 1999; Wright et al., 2001, Nafstad et al., 1996, Dell & To, 2001).

Variables Included

Variables analyzed in this study were based solely on questions available in the Youth NHANES questionnaire. The following are the variables included in the study:

Major Variables:
MCQ010 Ever been told you have asthma? (asthma yes/no)
DBQ010 Ever breastfed or fed breast milk? (breastfeeding yes/no)
DBD030 Age stopped breastfeeding (days)?

Additional variables:
RIGGEN Gender
RIGETH Race and Ethnicity
RIGAGE What was the child's age at the time of screening (years)?
ECD100 Did the child ever attend daycare (yes/no)?
ECQ060 Did the child receive newborn care at a hospital or special facility?
ECQ020 Did the mother smoke when pregnant? (yes/no)

The selection of variables was made following previous research both in NHANES and other studies: maternal smoking (Gilliland et al., 2003), day care attendance (Infante-Rivard et al., 2001), and received newborn care in a hospital facility (Oddy et al., 2002).

Data Analyses

Univariate Analysis

Frequency distributions of all variables were carried out to find gaps and errors. Once gaps and errors were corrected frequency distributions were used to study the frequency of each category and the distribution of the variables (Rosner, 2000).

To determine the prevalence of asthma, the proportion of cases in the study population was calculated by using frequency distributions as well. All variables were considered to be categorical. Therefore, cross-tabulations were used to determine the association between breastfeeding and the outcome namely asthma by comparing asthma (cases) to individuals without asthma (non-cases) in regards to exposure to breastfeeding (Rothman, 1998). The Woolf's 95% confidence intervals were used to assess the precision of the odds ratio estimate (Woodward, 1999), and the Fisher's exact test (two tailed) was used to assess the statistical significance of the odds ratio (Szklo & Nieto, 2000).

Stratified Analysis

After univariate analysis, stratified analysis was carried out to explore for confounding and interacting effects. Cases and non-cases were compared regarding exposure to breastfeeding stratifying by each of the rest of the variables included in the study. Confounding was evaluated by comparing the crude and the Mantel-Haenszel adjusted odds ratio (Szklo & Nieto, 2000). Whenever, a ratio of 15% or more between the crude and the adjusted odds ratio was present, a confounding effect worth considering for further analysis was noted. Effect modification was explored by comparing the stratum specific odds ratios. The Breslow and Day test for homogenetity was used to assess the significance of the effect modification (interaction) (Woodward, 1999).

Multivariate Analysis

After stratified analysis, unconditional multiple logistic regression was used to assess the association of breastfeeding and asthma while adjusting for all confounding factors simultaneously. Multiple adjustment procedures were also used to further explore possible interactions (Szklo & Nieto, 2000; Rosner, 2000).

CHAPTER IV

RESULTS

The demographics of this population were determined with the use of frequency tables. The study sample consisted of 1,262 persons; however, only 1,259 were used in the analysis. The mean age of this sample was 3.2 years.

Table 5: Age and Gender Distribution of Asthma in Children 6 years of age and younger: NHANES 1999-2000

	Asthmatic			Non-Asthmatic			TOTAL
Age	Male	Female	Total	Male	Female	Total	
One	11(10.6)*	5 (9.3)	16 (1.3)^	146 (25.4)	100 (18.9)	246(19.5)	262 (20.7)
Two	19 (18.3)	9 (1.7)	28(2.2)	118 (20.5)	114 (21.5)	232(18.4)	260 (20.6)
Three	18 (17.3)	10 (18.5)	28(2.2)	90 (15.6)	70 (13.2)	160(12.7)	188 (14.9)
Four	28 (26.9)	12 (22.2)	40(3.2)	76 (13.2)	82 (15.5)	158(12.5)	198 (15.7)
Five	7 (6.7)	11 (20.4)	18(1.4)	65 (11.3)	90 (17.0)	155(12.3)	173 (13.7)
Six	21 (20.2)	7 (13.0)	28(2.2)	80 (13.9)	73 (13.8)	153(12.1)	181 (14.3)
Total	104 (100)	54 (100)	158(12.5)	575 (100)	529 (100)	1104(87.4)	1262

* Percentage for each age group out of the total number of children for each column.
^ Percentage for each total group out of total number of children in the study

Table 5 shows the distribution of age and gender of asthma in children under the age of six years. The greatest percentage of asthmatics was observed at age four. A decrease in the number of asthmatics is seen at age five years and then the number increases again at age six years. Differences in percentages are noted between male and female

asthmatics. Males consistently show the higher percentage in those who are asthmatics. Males were slightly more numerous than females with 53.8% males and 46.2% females (Table 5). Of the males in our study, 15.3% had asthma and 9.3% of the females had asthma.

The largest proportion of the population in this study was Mexican-American (37.5%). The racial/ethnic composition is represented in Table 6. The use of all five racial groups, Hispanics and Mexican Americans separated, was used due differences between the two groups. These differences are represented in regards to their associations with asthma are shown in Table 11. Multi-racial consists of all of those that are not categorized in the other four racial divisions.

Table 6: Race and Ethnicity Distribution within the population and Percentage with Asthma for NHANES 99-00

	Frequency	(%) in total population	Number with Asthma	Asthma Prevalence per 100
Mexican American	475	37.5	34	7.2
Other Hispanic	81	6.4	18	22.5
Non-Hispanic White	333	26.3	42	12.7
Non-Hispanic Black	306	24.2	58	19.0
Other- including multi racial	71	5.6	6	8.7
Total	1,266	100.0	158	12.5

The prevalence of asthma in the study sample was 12.5 per 100 (158/1,262). This prevalence rate was based on the answer to the question: "Have you ever been told by a

physician or other medical personnel that you have asthma?" The criterion used for establishing breastfeeding was based on the answer to the question: "Have you ever breastfed or been fed breast milk?" The prevalence of breastfeeding in our study was 59.4% (n = 746). Breastfeeding was more common in males (32.3%) as compared to females (27%).

Table 7: Age and Gender Distribution of Breastfeeding in Children 6 years and younger: NHANES 1999-2000

	Breast Fed			Non-Breast Fed			Total
Age	Male	Female	Total	Male	Female	Total	
One	109 (26.8)*	70 (20.6)	179(14.2)^	48 (17.6)	34 (14.3)	82(6.5)	261 (20.7)
Two	80 (19.7)	70 (20.6)	150(11.9)	56 (16.5)	52 (21.8)	108(8.6)	258 (20.5)
Three	63 (15.4)	44 (12.9)	107(8.5)	47 (17.2)	35 (14.6)	82(6.5)	189 (15.0)
Four	52 (12.8)	60 (17.6)	112(8.9)	52 (15.3)	34 (14.2)	86(6.8)	198 (15.7)
Five	41 (10.0)	56 (16.5)	97(7.7)	31 (11.4)	44 (18.4)	75(6.0)	172 (13.7)
Six	62 (15.2)	40 (11.8)	102(8.1)	39 (14.3)	40 (16.7)	79(6.2)	181 (14.3)
Total	407 (100)	340 (100)	747(59.3)	273(100)	239 (100)	512(40.6)	1259(100)

* Percentage for each age group out of the total number of children for each column.
^ Percentage for each total group out of total number of children in the study

Table 8 shows the crude analysis conducted to determine the association of breastfeeding with selected variables. Several associations were found between breast feeding and selected variables. Breastfeeding was not associated with gender, attending daycare or receiving newborn care at a hospital facility. In contrast, mothers who smoked during their pregnancy were 59% less likely to have breastfed their children. This finding was highly significant. Blacks were also less likely to have breastfed their children (OR =

0.3, 95% CI 0.2-0.4). In contrast, Hispanics were found to be twice as likely as non-Hispanics to have breastfed their children. Children who were interviewed before 24 months of age were 33% more likely to be breastfed than those who were older than 24 months of age.

Table 8: Crude Associations between Breastfeeding and selected variables in children age 6 or younger: NHANES 1999-2000

Variable	Breastfed	non-breastfed	Crude OR(95% CI)	p-value
Gender				
Male	407	273	1.1(0.8-1.3)	0.687
Female	340	239	1.00	
Age				
< 24 months	329	190	1.3(1.1–1.7)	0.014
> 24 month	418	322	1.00	
Race				
Black	110	194	0.3(0.3-0.4)	<0.001
non Black	637	318	1.00	
Hispanic	387	168	2.2(1.7-2.8)	<0.001
non Hispanic	360	344	1.00	
Attended Day Care				
Yes	381	268	0.9(0.8-1.1)	0.700
no	365	244	1.00	
Newborn Care				
Yes	84	66	0.9(0.6-1.2)	0.426
No	660	446	1.00	
Mom Smoked				
Yes	67	98	0.4(0.3-0.6)	<0.001
No	678	411	1.00	

Table 9: Associations of breastfeeding and asthma and other selected variables in children age 6 and younger: NHANES 1999-2000

Variable	Cases	Non-Cases	Crude OR (95 % CI)	Adjusted OR (95% CI)	p-value
Breastfed					
Yes	76	670	0.59(0.42-0.83)	0.69(0.45-0.91)	0.014
No	82	428	1.00	1.00	
Started other foods					
< 4 months	54	384	1.00	1.00	
> 4 months	22	277	0.57(0.34-0.95)	0.46(0.26-0.82)	0.009
Mother Smoked					
Yes	34	131	2.02(1.32-3.07)	2.01(1.28-3.18)	0.003
No	124	964	1.00	1.00	
Day Care Attendance					
Yes	98	552	1.63(1.16-2.30)	1.44(0.98-2.11)	0.062
No	60	551	1.00	1.00	
Newborn care					
Yes	32	117	2.13(1.38-3.28)	2.08(1.32-3.29)	0.002
No	126	981	1.00	1.00	

Adjusted for age, gender, ethnicity, race, maternal smoking, newborn care, daycare attendance and breastfeeding

Table 9 shows the associations of each study variable and the outcome namely asthma. The analysis showed a significant association between breastfeeding and the development of asthma before and after adjusting for potential confounders (OR = 0.6, 95% CI 0.4 - 0.9). Another factor that was examined was when solid foods were introduced into the infant's diet. Literature has reported that four months is a significant cut off point (Oddy et al., 2000). The present study shows a protective association if foods were introduced after four months of age. (OR = 0.5, 95% CI 0.3 - 0.8). All variables were adjusted for all other variables and breastfeeding except "Started other foods at more than or less than

four months". This variable was not adjusted for breastfeeding due to co linearity between the two variables.

Daycare attendance was shown to increase the likelihood of asthma by 43%. Maternal smoking during pregnancy was also associated with greater odds of asthma. Mothers who smoked were twice as likely to have asthmatic children. Newborn care was found to also be associated with a two times greater odds of having asthma.

Table 10: Associations between asthma and demographic variables in children age 6 and younger: NHANES 1999-2000

Variable	Cases	Non - Cases	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p-value
Gender					
Male	104	575	1.77(1.25-2.51)	1.88(1.31-2.72)	<0.001
Female	54	529	1.00	1.00	
Age					
One	16	246	1.00	1.00	
Two	28	232	1.86(.978-3.52)	1.79(0.91-3.5)	0.090
Three	28	160	2.69(1.41-5.12)	2.39(1.20-4.74)	0.013
Four	40	158	3.89(2.10-7.19)	3.28(1.70-6.33)	<0.001
Five	18	155	1.79(0.88-3.60)	1.85(.874-3.91)	0.107
Six	28	153	2.81(1.47-5.38)	2.49(1.25-4.95)	0.009

Adjusted for age, gender, race, ethnicity, mother smoking, newborn care, daycare attendance and breastfeeding

Table 10 shows the associations of study variables gender and age and the outcome, asthma. Males were found to be more likely to develop asthma than females. A significant association was still present after adjustment for confounders: that is, males were 88% more likely to develop asthma. Age was shown to also be a significant factor in the development of asthma. The relationship between age and asthma was not as clear for children five years of age as the association dropped from OR = 3.28 to OR = 1.85, when comparing them to the 0-1 years old group. The last age group association

increased again from OR = 1.85 to OR = 2.49. The differences observed among our age groups show an inconsistency. Since the present study measures prevalence, the amount of asthma should continue to increase and not drop at age five. It is suggested that this drop could be due to more recent definitions of asthma for the children under the age of five. The increase at age six could be due to children entering school and being diagnosed with asthma. In spite of this imperfect relationship, the linear trend was statistically significant (p=0.002).

Table 11: Associations between asthma and race and ethnicity in children age 6 and younger: NHANES 1999-2000

Variable	Cases	Non-Cases	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	p-value
Race					
Hispanic	52	503	0.56(0.30-0.40)	0.73(0.51- 1.10)	0.729
Non-Hispanic	106	601	1.00	1.00	
Black	58	248	2.2(1.40-2.90)	1.61(1.10-2.40)	0.014
Non Black	100	856	1.00	1.00	
White	42	290	1.0(0.69-1.50)	0.93(0.63-1.40)	0.702
Non-White	116	814	1.00	1.00	
Race in 5 categories					
Non-Hispanic White	42	290	1.00	1.00	
Non- Hispanic Black	58	248	1.62(1.10-2.50)	1.47(0.93 -2.30)	0.097
Mixed Race	6	63	0.66 (0.27-1.60)	0.73 (0.29-1.80)	0.449
Mexican American	34	441	0.53(0.33-0.86)	0.63 (0.38-1.10)	0.075
Hispanic (other)	18	62	2.00 (1.1-3.72)	2.38 (1.25-4.5)	0.008

Adjusted for age, breastfeeding, maternal smoking, daycare attendance, newborn care and gender

Table 11 shows the associations between race and ethnicity and asthma. Race and ethnicity were categorized in different manners. Race and ethnicity were divided in three separate groups. Blacks versus non-Black individuals were examined and the same categorization was carried out for Hispanics and for Whites. Hispanics for this division included Mexican Americans and other Hispanics. Blacks were 61% more likely to have asthma than non-Blacks and Hispanics were 27% less likely to have asthma than non-Hispanics. When comparing Whites to non-Whites no important nor statistically significant difference was found. The only statistically significant difference was found between Blacks and non-Blacks and asthma.

Secondly, our groups were compared among the five categories: White, Black, Mixed Race, Mexican American and other Hispanic, using Whites as a reference group. When analyzing these categories, similar findings were discovered after adjustment for other confounders. Non-Hispanic Blacks were 47% more likely to develop asthma than non-Hispanic Whites, and other Hispanics were 238% more likely to develop asthma than Whites. Mexican Americans were 37% less likely to develop asthma when compared to Whites. The differences observed between Mexican Americans and other Hispanics was the background purpose for dividing the two. These divisions were already utilized by NHANES and previous studies that utilized NHANES.

Table 12 shows a dose-response relationship between length of breastfeeding and the development of asthma. Breastfeeding was examined at intervals of greater than or less than four, six and nine months as suggested in the literature. Breastfeeding was compared in two different manners to study if a dose-response relationship was present.

Breastfeeding was first divided into four categories including no breastfeeding, and breastfed for periods of one to three months, four to six months, and greater than six months.

Table 12: Dose-Response Relationship between breastfeeding length (months) and the development of asthma using the 1999 -2000 NHANES data

Variable	Cases	Non Cases	Crude OR and 95% CI	Adjusted OR and 95% CI	p value
No breastfeeding	90	511	1.0		
Breastfeeding 1-3 months	26	201	0.73(0.46-1.7)	0.768(0.47-1.25)	0.285
Breastfeeding 4-6 months	19	157	0.687(0.41-1.16)	0.679(0.39-1.17)	0.161
Breastfeeding > 6 months	23	222	0.588(0.36-0.95)	0.593(0.35-1.0)	0.052
Breastfeeding					
< 4 months	124	768	1.0	1.0	
> 4 months	34	323	0.652(0.44-0.97)	0.650(0.42-0.99)	0.048
< 6 months	126	799	1.0	1.0	
> 6 months	32	292	0.695(0.5-1.1)	0.69(0.45-1.07)	0.098
< 9 months	139	915	1.0	1.0	
> 9 months	19	176	0.71(0.43-1.18)	0.70(0.40-1.23)	0.214

Adjusted for gender, age, race, ethnicity, newborn care, daycare attendance, and maternal smoking

This assessment showed a dose-response relationship with significant and important associations: Children who were breastfed for one to three months were 24% less likely to develop asthma than those that were not breastfed, children who were breastfed for a period of four to six months were 33% less likely to develop asthma than those not breastfed, and those who were breastfed for more than six months were 41% less likely to

develop asthma than those children who were never breastfed. This dose-response relationship showed a statistically significant linear trend ($p = 0.017$).

The length of breastfeeding was then divided using three different cut-off point criteria, again, as suggested in the literature (i.e., four, six, and nine months). The first compared children who breastfeed more than four months with those who were breastfeed less than four months. This showed a significant association with children who were breastfed for greater than four months being 35% less likely than those who were breastfed for less than four months. Those children that were breastfed for more than six months were 31% less likely to develop asthma as compared to those who were breastfeed less than six months. This association, however, was of borderline statistical significance. The third comparison included greater than and less than nine months. When assessing the relationship at nine months, children who were breastfed for greater than nine months were 30% less likely to develop asthma. However, this was shown to be a weak difference that was not statistically significant.

Analysis was carried out to assess if any confounding or interaction had taken place between asthma and other variables. No interaction or confounding was found. Analysis was also used to examine the relationship between breastfeeding and selected study variables. No interaction or confounding was assessed (Appendix F).

CHAPTER V

CONCLUSIONS AND DISCUSSION

Summary of Results

It is important to highlight a few relevant results of the present study. First, children up to the age of six years who were ever breastfed were less likely to be diagnosed with asthma when compared to those that were never breastfed. Second, a dose-response protective effect was found with the length of breastfeeding with a statistically significant linear trend. Third, the present study found that being Mexican American was protective against asthma while the rest of children of Hispanic origin were more likely to have asthma as compared to Non-Hispanic Whites. This is the first time that such a finding is reported. Previous reports in the literature show higher asthma rates among Mexican Americans as compared to Non-Hispanic Whites. The prevalence of asthma in the present study was found to be 12.5 per 100. Also, prevalence rates have been documented in other studies to range from five to nine percent in children aged six months to eleven years (Nelson et al., 1997). Two previous studies that utilized NHANES III (1988-1994) (Chulada et al., 2003; Rust et al., 2001) to examine the relationship between breastfeeding and asthma found prevalence of 5.9% and 5.7%, respectively. The present study shows a greater than two fold increase in the prevalence from 1988-1994 to 1999-2000. This increase in prevalence could be attributed to a

decrease in the case fatality rate. A greater number of infants are being born extremely premature and surviving, these infants are more prone to asthma development.

Discussion

The controversy surrounding breastfeeding and the development of asthma has been well documented (Chulada et al., 2003; Sears et al., 2002). The present study using NHANES 1999-2000 showed a protective effect between breastfeeding and the development of asthma (OR = 0.693; 95% CI 0.448-0.913). The findings in the present study are consistent with at least four other studies found in the literature (Oddy et al., 1999; Wilson et al., 1998; Gdalevich, Mimouni, & Mimouni, 2001; Dell & To, 2001).

Oddy et al. (1999) conducted a prospective study of 2,187 children adjusted by gender, gestational age, smoking, daycare and when breastfeeding ended (OR = 1.25 (1.02 -1.52) (Oddy et al., 1999). Dell & To. (2001) found a prevalence of 6.3 per 100 population and observed a dose-response protective effect against asthma up to nine months of breastfeeding (Dell & To, 2001). Gdalevich et al. (2001) provided a review of prospective studies that demonstrated a summary odds ratio of 0.70 (95% CI 0.60 -0.81), and Wilson et al. (1998) concluded that breastfeeding for 15 weeks created a protective effect against childhood asthma.

Associations with asthma found in the present study that are consistent with past studies in the literature include age, gender, smoking during pregnancy and having newborn care. Males showed higher odds of having asthma than females. This is consistent with other studies that have shown this same relationship (Chulada et al., 2003; Rust et al., 2001;Oddy et al., 1999). Males in the present study were shown to be 88%

more likely to develop asthma than females. However, no differences were found on breastfeeding practices between genders (Appendix F). Several studies have shown that males are more likely to have asthma than females (e.g. Nelson et al., 1997, Hu et al., 1997, Rust et al., 2001, Chulada et al., 2003). This has been attributed to such biological factors as respiratory anatomy (lung size and bronchial lability), males tend to have more incidence of lower respiratory tract infections, and males higher levels of IgE (Hu et al., 1997).

When comparing the Black with non-Black individuals in the present study, results showed that Blacks were more likely to have childhood asthma than non-Blacks. This finding agrees with several previous studies (e.g. Chulada et al., 2003; Rust et al., 2001, Raisler et al., 1999). In the present study, for the first time, it is reported that Blacks were 72% less likely to breastfeed their children when compared to non-Blacks and it could be speculated that this may be one of the reasons why they were 61% more likely to have asthma than non-Blacks.

A risk factor that has been examined in several studies is the effect that maternal smoking during pregnancy has on the development of childhood asthma. Maternal smoking is a known risk factor for poor fetal development (Rust et al., 2001; Chulada et al., 2003). Studies suggest that maternal smoking is directly linked to an increase in the amount of lower tract respiratory infections that a child will contract during their childhood (Oddy et al., 2002). The present study also found maternal smoking during pregnancy associated with childhood asthma at an odds ratio of 2.01, after adjusting for age, gender, race, and ethnicity (Table 9). The present study also provides evidence that

this may partially be due to the fact that mothers who did smoke during pregnancy were 59% less likely to breastfed their infants (Table 8).

Another variable that was analyzed was whether the infant had received newborn care at a hospital facility. Although not statistically significant, children who received newborn care at a hospital facility were 14% less likely to be breastfed and were twice as likely to have asthma as those who did not received newborn care (Table 9). This variable examined if an infant received any newborn care in an intensive care unit, premature nursery or any other type of special care facility. It is possible that breastfeeding was discouraged by health care providers or that some mothers were not able to breastfed their children for a medical reason. The increased risk for asthma for these children could also be due to an increased risk of infection from the hospital setting, especially in children requiring extensive hospital care, or if they were intubated. If these infants were intubated and on mechanical ventilation for extended periods of time, they were less likely to be breastfed and more likely to get a respiratory infection, which may be linked to an increase in developing asthma. Similar results were reported by Oddy et al. (2002). Children who were in these medical facilities are more likely to be low birth weight, have respiratory problems from being premature with underdeveloped lungs, have congenital anomalies, and increased risk for respiratory infections from intubation and mechanical ventilation.

Several differences were found between the present study and other recent studies that also utilized children under the age of six years. Previous studies using NHANES III in the literature indicate an increased likelihood of having asthma for Mexican Americans

(Chulada et al., 2003; Rust et al., 2001). Rust et al. (2001) found that Mexican Americans were 51% more likely than Non-Hispanic Whites to have been diagnosed with asthma. The present study utilized two divisions when examining Hispanics and asthma. First, the two categories, Mexican Americans and other Hispanics, were analyzed as one and then separated for further analysis. When non-Hispanics versus Hispanics was compared a protective association was found (OR=0.73). This was not consistent with past literature. Therefore, the present study divided out Mexican Americans and compared this group and other Hispanic to non-Hispanic White. In the present study, 37.5% were Mexican Americans and 6.4% other Hispanic. Mexican Americans were 37% less likely to have asthma as compared to non-Hispanic Whites ($p = 0.075$) in the present study. Other Hispanics were found to be 238% more likely to have asthma when compared to non-Hispanic Whites (Table 11).

Another risk factor that was found to be differently associated between the present study and a past study was day care attendance. Celedon et al. (2003) study, based on a follow-up daycare data from Boston, was that day care attendance decreased the risk of asthma by 30% ($p > 0.05$); while in the present study, day care increased the odds by 44% ($p = 0.062$). However, Celedon's study also found a 3.7 fold increase risk of asthma for infants with maternal history of asthma ($p > 0.05$). Celedon et al. argue that exposure to other children intensified the immune response and protected against asthma among those with no maternal history of asthma. Other studies report that an increase in daycare attendance results in greater susceptibility to lower respiratory infections, such as RSV,

and therefore resulted in a greater incidence of asthma in those children who attended day care (Nafstad et al., 1996: Oddy et al., 2002).

The present study examined a dose-response relationship between the length of breastfeeding and the development of asthma (Table 12). A statistically significant linear relationship was found between the length of breastfeeding and asthma outcome. However, the relationships examined at one to three months and four to six months as compared to not breastfeeding were not statistically significant. This may be due to the fact that the sample size was not large enough to detect as significant associations of that magnitude.

A second comparison was conducted with dichotomous breastfeeding categories (Table 12). These three comparisons grouped children into greater than or less than four months of breastfeeding, greater than or less than six months of breastfeeding and greater than and less than nine months of breastfeeding. All three comparisons showed a protective effect. However, the only association that was statistically significant was the association found at the four months cut-off point. Similar results were found by other authors recently (Chulada et al., 2003; Rust et al., 2001; Oddy et al., 1999).

Limitations

Some of the limitations of this study are inherent to the study design and the study population. The study design used in the present study was a cross-sectional survey. However, some questions were retrospectively recorded including the main exposure (breastfeeding history), and mother's smoking habit during pregnancy. For the rest of the variables, the most important limitation is how to elucidate the temporal relationship

between exposure and outcome. Therefore, it is possible to say that for some study participants the correct sequence exposure to outcome occurred. However, for some others the outcome may have preceded the exposure. In the present study only one exposure may have been affected by this limitation: infants with early asthma will report more often newborn care than those without asthma. Therefore, the outcome in some of these children may have preceded the exposure. Recall bias may be a problem for variables recorded in the past. However, the present study only included individuals under the age of six. This somewhat short period of time reduces the potential recall bias.

Another important limitation was that the present study was conducted on a secondary analysis of a data set. Some variables that are know predictors of asthma could not be analyzed due to the lack of available data. For example, there was not enough information on birth weight to do a proper analysis. Therefore, birth weight was not included. Low birth weight has been associated with childhood asthma in many studies (i.e., Joseph et al., 2002; Seidman et al., 1991). Another potential variable that was not available for the analysis was that of having a family history of asthma, especially maternal asthma status. These questions had no responses listed for the infants included in the data set of the present study. Family history has been a predictor of asthma status in previous studies (Celedon et al., 2003; Wright et al., 1999; Litonjua et al., 1998).

There is a possibility that many of the covariates in the present study that were found to be significantly associated with asthma are interrelated with variables that were not available. For example, many factors such as maternal smoking, low birth weight, race may be directly or indirectly associated with socioeconomic status (Lindbaek et al.,

2003). Socioeconomic status could be evaluated in later studies using NHANES 1999-2000 by utilizing income level or maternal educational level.

Other factors that influence the development of asthma in children that were not analyzed in this study include: environmental factors have been shown to be important predictors for asthma development. Exposure to environmental tobacco smoke was not assessed, or the exposure to outdoor pollution (Chulada et al., 2003). Other variables that were unavailable included: maternal age, education and overall maternal health. An increase in maternal age and education has been suggested to be related to lower asthma rates (Chulada et al., 2003). These also are indicators of socioeconomic status. Maternal health is an indicator of the quality of breast milk that she could produce for her infant. This could also be considered a proxy socioeconomic factor; the better nutrition a woman receives the greater the quality of breast milk she would produce.

An additional limitation to the data analyses of the present study was due to lack of accessibility to proper software and the data set was not weighted to accurately calculate variance for complex sampling. The NHANES data is collected from multi-stage complex sampling, as stated in chapter III of this thesis. NHANES 1999 to 2000 over-sampled low-income persons, adolescents 12-19 years of age, African-Americans and Mexican Americans (CDC, 2003). Not weighting the data produces a slight underestimation of the variance. This limitation does not affect the magnitude of the estimates (i.e., odds ratios in the present study), but the precision of the estimates (95% confidence intervals) may be slightly wider, and borderline statistically significant results may in fact not be statistically significant. However, the significance level of the main

finding in the present study (breastfeeding and asthma) was strong (OR = 0.693) with a p-value of 0.014, after adjusting for other confounders. This suggests of the fact that even with weighting, the present study will still show a statistically significant protective effect.

Need For Further Research

Since the data set lacks some important covariates that are related to breastfeeding and/or with asthma, more research in this area is warranted by using solid and representative data such as NHANES. More studies are also needed on further details concerning the biological plausibility of the association between breastfeeding and asthma. It seems to be that breastfeeding has a definitive protective effect against asthma up to six years of age. However, after six years of age, some studies have found it protective and some do not. This may reflect the presence of an interaction or effect modification by age or other variables that have not been analyzed up to now. More research is needed on gender and asthma. A systematic literature review, including age as a potential effect modifier of the association between asthma and breastfeeding, should be conducted to settle the controversy of this association after six years of age.

Conclusions

The present study found a significant association between breastfeeding and asthma. The findings of the present study may be summarized as follows:

- Children up to six years of age who were breastfed for any period of time were less likely to have asthma than those who were not breastfed.

- A dose-response protective effect was found between the length of breastfeeding and having asthma.
- Males were more likely to have asthma than females. However, no difference in breastfeeding practices was observed.
- Blacks, who were less likely to be breastfed, were more likely to have asthma than Non-Blacks.
- Other Hispanics were more likely to be breastfed and more likely to have asthma when compared to non-Hispanic Whites. However, Mexican Americans, who were less slightly less likely to breastfeed than other Hispanics, were less likely to have asthma when compared to non-Hispanic Whites.
- Mothers who smoked during pregnancy were less likely to breastfeed and more likely to have children who develop asthma when compared to women who do not smoke.
- Children who received newborn care in a hospital facility or other special care facility were slightly less likely to breastfeed and more likely to have asthma than children who did not.
- Children who attended day care were more likely to have asthma than those who never attended day care. However, no differences were detected in breastfeeding practices.

Even though this study has important limitations, the results show a statistical protective effect between asthma and breastfeeding, there was a dose-response relationship, and the study is consistent with multiple other studies in the literature which also suggest biological plausibility.

APPENDIX

APPENDIX A

FREQUENCIES AND DISTRIBUTION OF VARIABLES

Have You Ever been told you have Asthma

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	158	12.5	12.5	12.5
	no	1104	87.2	87.5	100.0
	Total	1262	99.7	100.0	
Missing	System	4	.3		
Total		1266	100.0		

Have you ever been breastfed or fed breast milk?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	747	59.0	59.3	59.3
	no	512	40.4	40.7	100.0
	Total	1259	99.4	100.0	
Missing	System	7	.6		
Total		1266	100.0		

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	682	53.9	53.9	53.9
	female	584	46.1	46.1	100.0
	Total	1266	100.0	100.0	

Age at Screening

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	263	20.8	20.8	20.8
	2.00	261	20.6	20.6	41.4
	3.00	190	15.0	15.0	56.4
	4.00	198	15.6	15.6	72.0
	5.00	173	13.7	13.7	85.7
	6.00	181	14.3	14.3	100.0
	Total	1266	100.0	100.0	

Race and Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Whites (Non-Hispanic)	333	26.3	26.3	26.3
	Blacks (Non-Hispanic)	306	24.2	24.2	50.5
	Mixed races	71	5.6	5.6	56.1
	Mexican Americans	475	37.5	37.5	93.6
	Hispanics (other)	81	6.4	6.4	100.0
	Total	1266	100.0	100.0	

Have you Ever attend day care or preschool

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	652	51.5	51.6	51.6
	no	612	48.3	48.4	100.0
	Total	1264	99.8	100.0	
Missing	System	2	.2		
Total		1266	100.0		

Have you ever Received newborn care at hospital facility

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	150	11.8	11.9	11.9
	no	1109	87.6	88.1	100.0
	Total	1259	99.4	100.0	
Missing	System	7	.6		
Total		1266	100.0		

Did the mother smoked when pregnant

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	165	13.0	13.1	13.1
	no	1091	86.2	86.9	100.0
	Total	1256	99.2	100.0	
Missing	System	10	.8		
Total		1266	100.0		

APPENDIX B

CRUDE ASSOCIATIONS BETWEEN ASTHMA AND OTHER DICHOTOMOUS VARIBLES

Ever been told you have asthma?* Ever been breastfed or fed breast milk?

			A Ever been told you have Asthma		
			yes	no	Total
A Have you ever been breastfed?	yes	Count	76	670	746
		% within A Have you ever been breastfed?	10.2%	89.8%	100.0%
		% within A Ever been told you have Asthma	48.1%	61.0%	59.4%
		% of Total	6.1%	53.3%	59.4%
	no	Count	82	428	510
		% within A Have you ever been breastfed?	16.1%	83.9%	100.0%
		% within A Ever been told you have Asthma	51.9%	39.0%	40.6%
		% of Total	6.5%	34.1%	40.6%
Total		Count	158	1098	1256
		% within A Have you ever been breastfed?	12.6%	87.4%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.6%	87.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	9.558[b]	1	.002		
Continuity Correction[a]	9.030	1	.003		
Likelihood Ratio	9.397	1	.002		
Fisher's Exact Test				.002	.001
Linear-by-Linear Association	9.551	1	.002		
N of Valid Cases	1256				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.16.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A Have you ever been breastfed? (yes / no)	.592	.424	.828
For cohort A Ever been told you have Asthma = yes	.634	.474	.848
For cohort A Ever been told you have Asthma = no	1.070	1.023	1.119
N of Valid Cases	1256		

Ever been told you have asthma?* Gender

			A Ever been told you have Asthma		
			yes	no	Total
A Gender - Adjudicated.	male	Count	104	575	679
		% within A Gender - Adjudicated.	15.3%	84.7%	100.0%
		% within A Ever been told you have Asthma	65.8%	52.1%	53.8%
		% of Total	8.2%	45.6%	53.8%
	female	Count	54	529	583
		% within A Gender - Adjudicated.	9.3%	90.7%	100.0%
		% within A Ever been told you have Asthma	34.2%	47.9%	46.2%
		% of Total	4.3%	41.9%	46.2%
Total		Count	158	1104	1262
		% within A Gender - Adjudicated.	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.5%	87.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.498[b]	1	.001		
Continuity Correction[a]	9.952	1	.002		
Likelihood Ratio	10.706	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	10.489	1	.001		
N of Valid Cases	1262				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 72.99.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A Gender - Adjudicated. (male / female)	1.772	1.249	2.513
For cohort A Ever been told you have Asthma = yes	1.654	1.213	2.254
For cohort A Ever been told you have Asthma = no	.933	.896	.973
N of Valid Cases	1262		

Ever been told you have asthma?*Hispanic vs. Non-Hispanics

			A Ever been told you have Asthma		
			yes	no	Total
Hispanics vs Non Hispanics	Hispanic	Count	52	503	555
		% within Hispanics vs Non Hispanics	9.4%	90.6%	100.0%
		% within A Ever been told you have Asthma	32.9%	45.6%	44.0%
		% of Total	4.1%	39.9%	44.0%
	Non Hispanics	Count	106	601	707
		% within Hispanics vs Non Hispanics	15.0%	85.0%	100.0%
		% within A Ever been told you have Asthma	67.1%	54.4%	56.0%
		% of Total	8.4%	47.6%	56.0%
Total		Count	158	1104	1262
		% within Hispanics vs Non Hispanics	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.5%	87.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.978[b]	1	.003		
Continuity Correction[a]	8.472	1	.004		
Likelihood Ratio	9.192	1	.002		
Fisher's Exact Test				.003	.002
Linear-by-Linear Association	8.971	1	.003		
N of Valid Cases	1262				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 69.48.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Hispanics vs Non Hispanics (Hispanic / Non Hispanics)	.586	.412	.834
For cohort A Ever been told you have Asthma = yes	.625	.457	.854
For cohort A Ever been told you have Asthma = no	1.066	1.023	1.111
N of Valid Cases	1262		

Ever been told you have asthma? * Black versus Non-Black

			A Ever been told you have Asthma		
			yes	no	Total
Black vs. Non Black	Black	Count	58	248	306
		% within Black vs. Non Black	19.0%	81.0%	100.0%
		% within A Ever been told you have Asthma	36.7%	22.5%	24.2%
		% of Total	4.6%	19.7%	24.2%
	non black	Count	100	856	956
		% within Black vs. Non Black	10.5%	89.5%	100.0%
		% within A Ever been told you have Asthma	63.3%	77.5%	75.8%
		% of Total	7.9%	67.8%	75.8%
Total		Count	158	1104	1262
		% within Black vs. Non Black	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.5%	87.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.270[b]	1	.000		
Continuity Correction[a]	14.504	1	.000		
Likelihood Ratio	14.106	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	15.258	1	.000		
N of Valid Cases	1262				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 38.31.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Black vs. Non Black (Black / non black)	2.002	1.406	2.849
For cohort A Ever been told you have Asthma = yes	1.812	1.347	2.438
For cohort A Ever been told you have Asthma = no	.905	.854	.960
N of Valid Cases	1262		

Ever been told you have asthma?*White versus Non-White

			A Ever been told you have Asthma		
			yes	no	Total
White vs. non White	white	Count	42	290	332
		% within White vs. non White	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	26.6%	26.3%	26.3%
		% of Total	3.3%	23.0%	26.3%
	non white	Count	116	814	930
		% within White vs. non White	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	73.4%	73.7%	73.7%
		% of Total	9.2%	64.5%	73.7%
Total		Count	158	1104	1262
		% within White vs. non White	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.5%	87.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.007[b]	1	.933		
Continuity Correction[a]	.000	1	1.000		
Likelihood Ratio	.007	1	.933		
Fisher's Exact Test				.923	.500
Linear-by-Linear Association	.007	1	.933		
N of Valid Cases	1262				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 41.57.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for White vs. non White (white / non white)	1.016	.697	1.482
For cohort A Ever been told you have Asthma = yes	1.014	.729	1.411
For cohort A Ever been told you have Asthma = no	.998	.952	1.047
N of Valid Cases	1262		

Ever been told you have asthma? * Race and Ethnicity

			A Ever been told you have Asthma		
			yes	no	Total
Race/ethnicity new	Whites (Non-Hispanic)	Count	42	290	332
		% within Race/ethnicity new	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	26.6%	26.3%	26.3%
	Blacks (Non-Hispanic)	Count	58	248	306
		% within Race/ethnicity new	19.0%	81.0%	100.0%
		% within A Ever been told you have Asthma	36.7%	22.5%	24.2%
	Mixed races	Count	6	63	69
		% within Race/ethnicity new	8.7%	91.3%	100.0%
		% within A Ever been told you have Asthma	3.8%	5.7%	5.5%
	Mexican Americans	Count	34	441	475
		% within Race/ethnicity new	7.2%	92.8%	100.0%
		% within A Ever been told you have Asthma	21.5%	39.9%	37.6%
	Hispanics (other)	Count	18	62	80
		% within Race/ethnicity new	22.5%	77.5%	100.0%
		% within A Ever been told you have Asthma	11.4%	5.6%	6.3%
Total		Count	158	1104	1262
		% within Race/ethnicity new	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

Ever been told you have asthma? * Mother smoked during pregnancy?

			A Ever been told you have Asthma		
			yes	no	Total
A mother smoked when pregnant	yes	Count	34	131	165
		% within A mother smoked when pregnant	20.6%	79.4%	100.0%
		% within A Ever been told you have Asthma	21.5%	12.0%	13.2%
		% of Total	2.7%	10.5%	13.2%
	no	Count	124	964	1088
		% within A mother smoked when pregnant	11.4%	88.6%	100.0%
		% within A Ever been told you have Asthma	78.5%	88.0%	86.8%
		% of Total	9.9%	76.9%	86.8%
Total		Count	158	1095	1253
		% within A mother smoked when pregnant	12.6%	87.4%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.6%	87.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.026[b]	1	.001		
Continuity Correction[a]	10.206	1	.001		
Likelihood Ratio	9.748	1	.002		
Fisher's Exact Test				.002	.001
Linear-by-Linear Association	11.017	1	.001		
N of Valid Cases	1253				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 20.81.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A mother smoked when pregnant (yes / no)	2.018	1.324	3.074
For cohort A Ever been told you have Asthma = yes	1.808	1.284	2.546
For cohort A Ever been told you have Asthma = no	.896	.827	.971
N of Valid Cases	1253		

Ever been told you have asthma? * Received newborn care at hospital facility?

			A Ever been told you have Asthma		
			yes	no	Total
A Received newborn care at hospital facility	yes	Count	32	117	149
		% within A Received newborn care at hospital facility	21.5%	78.5%	100.0%
		% within A Ever been told you have Asthma	20.3%	10.7%	11.9%
		% of Total	2.5%	9.3%	11.9%
	no	Count	126	981	1107
		% within A Received newborn care at hospital facility	11.4%	88.6%	100.0%
		% within A Ever been told you have Asthma	79.7%	89.3%	88.1%
		% of Total	10.0%	78.1%	88.1%
Total		Count	158	1098	1256
		% within A Received newborn care at hospital facility	12.6%	87.4%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.6%	87.4%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	12.168[b]	1	.000		
Continuity Correction[a]	11.268	1	.001		
Likelihood Ratio	10.602	1	.001		
Fisher's Exact Test				.001	.001
Linear-by-Linear Association	12.158	1	.000		
N of Valid Cases	1256				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 18.74.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A Received newborn care at hospital facility (yes / no)	2.129	1.381	3.283
For cohort A Ever been told you have Asthma = yes	1.887	1.332	2.673
For cohort A Ever been told you have Asthma = no	.886	.813	.966
N of Valid Cases	1256		

Ever been told you have asthma? * Ever attended day care?

			A Ever been told you have Asthma		
			yes	no	Total
Ever attend day care or preschool	yes	Count	98	552	650
		% within Ever attend day care or preschool	15.1%	84.9%	100.0%
		% within A Ever been told you have Asthma	62.0%	50.0%	51.5%
		% of Total	7.8%	43.8%	51.5%
	no	Count	60	551	611
		% within Ever attend day care or preschool	9.8%	90.2%	100.0%
		% within A Ever been told you have Asthma	38.0%	50.0%	48.5%
		% of Total	4.8%	43.7%	48.5%
Total		Count	158	1103	1261
		% within Ever attend day care or preschool	12.5%	87.5%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	12.5%	87.5%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	7.942[b]	1	.005		
Continuity Correction[a]	7.469	1	.006		
Likelihood Ratio	8.024	1	.005		
Fisher's Exact Test				.005	.003
Linear-by-Linear Association	7.935	1	.005		
N of Valid Cases	1261				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 76.56.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Ever attend day care or preschool (yes / no)	1.630	1.158	2.296
For cohort A Ever been told you have Asthma = yes	1.535	1.135	2.076
For cohort A Ever been told you have Asthma = no	.942	.903	.982
N of Valid Cases	1261		

Ever been told you have asthma* Race in three (White, Black, and Hispanic)

			A Ever been told you have Asthma		
			yes	no	Total
white, black, and hispanic	white	Count	42	290	332
		% within white, black, and hispanic	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	27.6%	27.9%	27.8%
	black	Count	58	248	306
		% within white, black, and hispanic	19.0%	81.0%	100.0%
		% within A Ever been told you have Asthma	38.2%	23.8%	25.6%
	hispanic	Count	52	503	555
		% within white, black, and hispanic	9.4%	90.6%	100.0%
		% within A Ever been told you have Asthma	34.2%	48.3%	46.5%
Total		Count	152	1041	1193
		% within white, black, and hispanic	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

Ever been told you have asthma * Gender * Age

Count

Age at Screening Adjudicated - Recoded.			A Ever been told you have Asthma		Total
			yes	no	
1.00	A Gender - Adjudicated.	male	11	146	157
		female	5	100	105
	Total		16	246	262
2.00	A Gender - Adjudicated.	male	19	118	137
		female	9	114	123
	Total		28	232	260
3.00	A Gender - Adjudicated.	male	18	90	108
		female	10	70	80
	Total		28	160	188
4.00	A Gender - Adjudicated.	male	28	76	104
		female	12	82	94
	Total		40	158	198
5.00	A Gender - Adjudicated.	male	7	65	72
		female	11	90	101
	Total		18	155	173
6.00	A Gender - Adjudicated.	male	21	80	101
		female	7	73	80
	Total		28	153	181

Chi-Square

Age at Adjudicated -		Valu	d	Asymp. (2-	Exact (2-	Exact (1-
1.0	Pearson Chi-	.55 [b]	1	.45		
	Continuity [a]	.23	1	.63		
	Likelihood	.56	1	.45		
	Fisher's Exact				.60	.32
	Linear-by-Associati	.55	1	.45		
	N of Valid	26				
2.0	Pearson Chi-	2.89[c]	1	.08		
	Continuity [a]	2.25	1	.13		
	Likelihood	2.96	1	.08		
	Fisher's Exact				.11	.06
	Linear-by-Associati	2.88	1	.08		
	N of Valid	26				
3.0	Pearson Chi-	.62 [d]	1	.42		
	Continuity [a]	.34	1	.55		
	Likelihood	.63	1	.42		
	Fisher's Exact				.53	.28
	Linear-by-Associati	.62	1	.42		
	N of Valid	18				
4.0	Pearson Chi-	6.13[e]	1	.01		
	Continuity [a]	5.29	1	.02		
	Likelihood	6.30	1	.01		
	Fisher's Exact				.01	.01
	Linear-by-Associati	6.10	1	.01		
	N of Valid	19				
5.0	Pearson Chi-	.06 [f]	1	.80		
	Continuity [a]	.00	1	1.00		
	Likelihood	.06	1	.80		
	Fisher's Exact				1.00	.50
	Linear-by-Associati	.06	1	.80		
	N of Valid	17				
6.0	Pearson Chi-	4.95[g]	1	.02		
	Continuity [a]	4.07	1	.04		
	Likelihood	5.20	1	.02		
	Fisher's Exact				.03	.02
	Linear-by-Associati	4.92	1	.02		
	N of Valid	18				

a Computed only for a

b 0 cells (.0%) have expected count less than 5. The minimum

c 0 cells (.0%) have expected count less than 5. The minimum

Risk Estimate

Age at Screening Adjudicated - Recoded.		Value	95% Confidence Interval	
			Lower	Upper
1.00	Odds Ratio for A Gender - Adjudicated. (male / female)	1.507	.508	4.470
	For cohort A Ever been told you have Asthma = yes	1.471	.526	4.112
	For cohort A Ever been told you have Asthma = no	.976	.919	1.037
	N of Valid Cases	262		
2.00	Odds Ratio for A Gender - Adjudicated. (male / female)	2.040	.886	4.695
	For cohort A Ever been told you have Asthma = yes	1.895	.891	4.032
	For cohort A Ever been told you have Asthma = no	.929	.855	1.010
	N of Valid Cases	260		
3.00	Odds Ratio for A Gender - Adjudicated. (male / female)	1.400	.608	3.223
	For cohort A Ever been told you have Asthma = yes	1.333	.651	2.731
	For cohort A Ever been told you have Asthma = no	.952	.846	1.072
	N of Valid Cases	188		
4.00	Odds Ratio for A Gender - Adjudicated. (male / female)	2.518	1.195	5.302
	For cohort A Ever been told you have Asthma = yes	2.109	1.139	3.905
	For cohort A Ever been told you have Asthma = no	.838	.728	.964
	N of Valid Cases	198		
5.00	Odds Ratio for A Gender - Adjudicated. (male / female)	.881	.324	2.395
	For cohort A Ever been told you have Asthma = yes	.893	.364	2.192
	For cohort A Ever been told you have Asthma = no	1.013	.915	1.122
	N of Valid Cases	173		
6.00	Odds Ratio for A Gender - Adjudicated. (male / female)	2.738	1.099	6.817
	For cohort A Ever been told you have Asthma = yes	2.376	1.064	5.307
	For cohort A Ever			

Ever told you have asthma? * Age at greater than or less than 24 months?

Crosstab

Count

		A Ever been told you have Asthma		
		yes	no	Total
Age at screening greater than or less than 24 months	less than 24 months	44	478	522
	greater than 24 months	114	626	740
Total		158	1104	1262

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	13.601[b]	1	.000		
Continuity Correction[a]	12.972	1	.000		
Likelihood Ratio	14.170	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	13.591	1	.000		
N of Valid Cases	1262				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 65.35.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age at screening greater than or less than 24 months (less than 24 months / greater than 24 months)	.505	.350	.730
For cohort A Ever been told you have Asthma = yes	.547	.394	.761
For cohort A Ever been told you have Asthma = no	1.082	1.040	1.127
N of Valid Cases	1262		

Ever been told you have asthma? * Started eating other foods at >or< 4 months?

A Started eating other foods at greater than 4 mo? * A Ever been told you have Asthma Crosstabulation

			A Ever been told you have Asthma		
			yes	no	Total
A Started eating other foods at greater than 4 mo?	greater than 4 mo	Count	22	277	299
		% within A Started eating other foods at greater than 4 mo?	7.4%	92.6%	100.0%
		% within A Ever been told you have Asthma	28.9%	41.9%	40.6%
	less than 4 mo	Count	54	384	438
		% within A Started eating other foods at greater than 4 mo?	12.3%	87.7%	100.0%
		% within A Ever been told you have Asthma	71.1%	58.1%	59.4%
Total		Count	76	661	737
		% within A Started eating other foods at greater than 4 mo?	10.3%	89.7%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.748[b]	1	.029		
Continuity Correction[a]	4.225	1	.040		
Likelihood Ratio	4.927	1	.026		
Fisher's Exact Test				.036	.019
Linear-by-Linear Association	4.741	1	.029		
N of Valid Cases	737				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 30.83.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A Started eating other foods at greater than 4 mo? (greater than 4 mo / less than 4 mo)	.565	.336	.949
For cohort A Ever been told you have Asthma = yes	.597	.372	.958
For cohort A Ever been told you have Asthma = no	1.057	1.008	1.108
N of Valid Cases	737		

APPENDIX C

DOSE-RESPONSE RELATIONSHIP BETWEEN LENGTH OF BREASTFEEDING AND ASTHMA

Ever been told you have asthma?* Breastfed for > or < four months?

Crosstab

			A Ever been told you have Asthma		
			yes	no	Total
breastfeeding 4	4 mo and less	Count	124	768	892
		% within breastfeeding 4	13.9%	86.1%	100.0%
		% within A Ever been told you have Asthma	78.5%	70.4%	71.4%
	> 4 mo	Count	34	323	357
		% within breastfeeding 4	9.5%	90.5%	100.0%
		% within A Ever been told you have Asthma	21.5%	29.6%	28.6%
Total		Count	158	1091	1249
		% within breastfeeding 4	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.422[b]	1	.035		
Continuity Correction[a]	4.034	1	.045		
Likelihood Ratio	4.643	1	.031		
Fisher's Exact Test				.038	.020
Linear-by-Linear Association	4.418	1	.036		
N of Valid Cases	1249				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 45.16.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for breastfeeding 4 (4 mo and less / > 4 mo)	1.534	1.027	2.291
For cohort A Ever been told you have Asthma = yes	1.460	1.019	2.090
For cohort A Ever been told you have Asthma = no	.952	.912	.993
N of Valid Cases	1249		

Ever been told you have asthma? * Breastfed for > or < six months?

Crosstab

			A Ever been told you have Asthma		
			yes	no	Total
breast fed 6 mo	< 6	Count	126	799	925
		% within breast fed 6 mo	13.6%	86.4%	100.0%
		% within A Ever been told you have Asthma	79.7%	73.2%	74.1%
	> =6	Count	32	292	324
		% within breast fed 6 mo	9.9%	90.1%	100.0%
		% within A Ever been told you have Asthma	20.3%	26.8%	25.9%
Total		Count	158	1091	1249
		% within breast fed 6 mo	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.046[b]	1	.081		
Continuity Correction[a]	2.716	1	.099		
Likelihood Ratio	3.188	1	.074		
Fisher's Exact Test				.098	.047
Linear-by-Linear Association	3.043	1	.081		
N of Valid Cases	1249				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 40.99.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for breast fed 6 mo (< 6 / > =6)	1.439	.955	2.169
For cohort A Ever been told you have Asthma = yes	1.379	.956	1.990
For cohort A Ever been told you have Asthma = no	.958	.917	1.002
N of Valid Cases	1249		

Ever been told you have asthma? * Breastfed for > or < nine months?

Crosstab

			A Ever been told you have Asthma		
			yes	no	Total
breastfed 9 mo	up to 9 mo	Count	139	915	1054
		% within breastfed 9 mo	13.2%	86.8%	100.0%
		% within A Ever been told you have Asthma	88.0%	83.9%	84.4%
	9 mo and greater	Count	19	176	195
		% within breastfed 9 mo	9.7%	90.3%	100.0%
		% within A Ever been told you have Asthma	12.0%	16.1%	15.6%
Total		Count	158	1091	1249
		% within breastfed 9 mo	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.767[b]	1	.184		
Continuity Correction[a]	1.469	1	.226		
Likelihood Ratio	1.874	1	.171		
Fisher's Exact Test				.199	.111
Linear-by-Linear Association	1.765	1	.184		
N of Valid Cases	1249				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 24.67.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for breastfed 9 mo (up to 9 mo / 9 mo and greater)	1.407	.849	2.334
For cohort A Ever been told you have Asthma = yes	1.353	.859	2.132
For cohort A Ever been told you have Asthma = no	.962	.913	1.013
N of Valid Cases	1249		

Ever been told you have asthma? * Breastfed in three categories – no breastfeeding?, breastfed one to three months?, breastfed four to six months?, and breastfed for greater than six months?

			A Ever been told you have Asthma		
			yes	no	Total
breastfed into 4	no breastfed	Count	90	511	601
		% within breastfed into 4	15.0%	85.0%	100.0%
		% within A Ever been told you have Asthma	57.0%	46.8%	48.1%
	one to three mo bf	Count	26	201	227
		% within breastfed into 4	11.5%	88.5%	100.0%
		% within A Ever been told you have Asthma	16.5%	18.4%	18.2%
	four to six mo bf	Count	19	157	176
		% within breastfed into 4	10.8%	89.2%	100.0%
		% within A Ever been told you have Asthma	12.0%	14.4%	14.1%
	more than 6 mo	Count	23	222	245
		% within breastfed into 4	9.4%	90.6%	100.0%
		% within A Ever been told you have Asthma	14.6%	20.3%	19.6%
Total		Count	158	1091	1249
		% within breastfed into 4	12.7%	87.3%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%

APPENDIX D

CRUDE ASSOCIATIONS BETWEEN BREASTFEEDING AND OTHER DICHOTOMOUS VARIABLES

Ever been breastfed or fed breast milk? * Gender

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
A Gender - Adjudicated.	male	Count	407	273	680
		% within A Gender - Adjudicated.	59.9%	40.1%	100.0%
		% within A Have you ever been breastfed?	54.5%	53.3%	54.0%
	female	Count	340	239	579
		% within A Gender - Adjudicated.	58.7%	41.3%	100.0%
		% within A Have you ever been breastfed?	45.5%	46.7%	46.0%
Total		Count	747	512	1259
		% within A Gender - Adjudicated.	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.166[b]	1	.684		
Continuity Correction[a]	.122	1	.727		
Likelihood Ratio	.166	1	.684		
Fisher's Exact Test				.687	.363
Linear-by-Linear Association	.166	1	.684		
N of Valid Cases	1259				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 235.46.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A Gender - Adjudicated. (male / female)	1.048	.836	1.313
For cohort A Have you ever been breastfed? = yes	1.019	.930	1.117
For cohort A Have you ever been breastfed? = no	.973	.851	1.112
N of Valid Cases	1259		

Ever been breastfed or fed breast milk? * Hispanic versus Non-Hispanic

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
Hispanics vs Non Hispanics	Hispanic	Count	387	168	555
		% within Hispanics vs Non Hispanics	69.7%	30.3%	100.0%
		% within A Have you ever been breastfed?	51.8%	32.8%	44.1%
	Non Hispanics	Count	360	344	704
		% within Hispanics vs Non Hispanics	51.1%	48.9%	100.0%
		% within A Have you ever been breastfed?	48.2%	67.2%	55.9%
Total		Count	747	512	1259
		% within Hispanics vs Non Hispanics	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	44.465[b]	1	.000		
Continuity Correction[a]	43.698	1	.000		
Likelihood Ratio	45.053	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	44.430	1	.000		
N of Valid Cases	1259				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 225.70.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Hispanics vs Non Hispanics (Hispanic / Non Hispanics)	2.201	1.742	2.781
For cohort A Have you ever been breastfed? = yes	1.364	1.245	1.493
For cohort A Have you ever been breastfed? = no	.619	.535	.718
N of Valid Cases	1259		

Ever been breastfed or fed breast milk? * Black versus Non-Black

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
Black vs. Non Black	Black	Count	110	194	304
		% within Black vs. Non Black	36.2%	63.8%	100.0%
		% within A Have you ever been breastfed?	14.7%	37.9%	24.1%
	non black	Count	637	318	955
		% within Black vs. Non Black	66.7%	33.3%	100.0%
		% within A Have you ever been breastfed?	85.3%	62.1%	75.9%
Total		Count	747	512	1259
		% within Black vs. Non Black	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	89.003[b]	1	.000		
Continuity Correction[a]	87.743	1	.000		
Likelihood Ratio	88.024	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	88.933	1	.000		
N of Valid Cases	1259				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 123.63.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Black vs. Non Black (Black / non black)	.283	.216	.371
For cohort A Have you ever been breastfed? = yes	.542	.464	.634
For cohort A Have you ever been breastfed? = no	1.916	1.694	2.168
N of Valid Cases	1259		

Ever breastfed or fed breast milk? * White versus Non-White

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
White vs. non White	white	Count	209	123	332
		% within White vs. non White	63.0%	37.0%	100.0%
		% within A Have you ever been breastfed?	28.0%	24.0%	26.4%
	non white	Count	538	389	927
		% within White vs. non White	58.0%	42.0%	100.0%
		% within A Have you ever been breastfed?	72.0%	76.0%	73.6%
Total		Count	747	512	1259
		% within White vs. non White	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.448[b]	1	.118		
Continuity Correction[a]	2.248	1	.134		
Likelihood Ratio	2.464	1	.116		
Fisher's Exact Test				.119	.067
Linear-by-Linear Association	2.446	1	.118		
N of Valid Cases	1259				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 135.02.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for White vs. non White (white / non white)	1.229	.949	1.590
For cohort A Have you ever been breastfed? = yes	1.085	.982	1.198
For cohort A Have you ever been breastfed? = no	.883	.753	1.035
N of Valid Cases	1259		

Ever breastfed or fed breast milk? * Age

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
Age at Screening Adjudicated - Recoded.	1.00	Count	179	82	261
		% within Age at Screening Adjudicated - Recoded.	68.6%	31.4%	100.0%
		% within A Have you ever been breastfed?	24.0%	16.0%	20.7%
	2.00	Count	150	108	258
		% within Age at Screening Adjudicated - Recoded.	58.1%	41.9%	100.0%
		% within A Have you ever been breastfed?	20.1%	21.1%	20.5%
	3.00	Count	107	82	189
		% within Age at Screening Adjudicated - Recoded.	56.6%	43.4%	100.0%
		% within A Have you ever been breastfed?	14.3%	16.0%	15.0%
	4.00	Count	112	86	198
		% within Age at Screening Adjudicated - Recoded.	56.6%	43.4%	100.0%
		% within A Have you ever been breastfed?	15.0%	16.8%	15.7%
	5.00	Count	97	75	172
		% within Age at Screening Adjudicated - Recoded.	56.4%	43.6%	100.0%
		% within A Have you ever been breastfed?	13.0%	14.6%	13.7%
	6.00	Count	102	79	181
		% within Age at Screening Adjudicated - Recoded.	56.4%	43.6%	100.0%
		% within A Have you ever been breastfed?	13.7%	15.4%	14.4%
Total		Count	747	512	1259
		% within Age at Screening Adjudicated - Recoded.	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.895[a]	5	.036
Likelihood Ratio	12.167	5	.033
Linear-by-Linear Association	6.553	1	.010
N of Valid Cases	1259		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 69.95.

Ever been breastfed or fed breast milk? * Race in three :White, black and Hispanic

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
white, black, and hispanic	white	Count	209	123	332
		% within white, black, and hispanic	63.0%	37.0%	100.0%
		% within A Have you ever been breastfed?	29.6%	25.4%	27.9%
	black	Count	110	194	304
		% within white, black, and hispanic	36.2%	63.8%	100.0%
		% within A Have you ever been breastfed?	15.6%	40.0%	25.5%
	hispanic	Count	387	168	555
		% within white, black, and hispanic	69.7%	30.3%	100.0%
		% within A Have you ever been breastfed?	54.8%	34.6%	46.6%
Total		Count	706	485	1191
		% within white, black, and hispanic	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	94.137[a]	2	.000
Likelihood Ratio	93.613	2	.000
Linear-by-Linear Association	10.277	1	.001
N of Valid Cases	1191		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 123.80.

Ever been breastfed or fed breast milk? * Received newborn care at hospital facility?

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
A Received newborn care at hospital facility	yes	Count	84	66	150
		% within A Received newborn care at hospital facility	56.0%	44.0%	100.0%
		% within A Have you ever been breastfed?	11.3%	12.9%	11.9%
	no	Count	660	446	1106
		% within A Received newborn care at hospital facility	59.7%	40.3%	100.0%
		% within A Have you ever been breastfed?	88.7%	87.1%	88.1%
Total		Count	744	512	1256
		% within A Received newborn care at hospital facility	59.2%	40.8%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.739[b]	1	.390		
Continuity Correction[a]	.594	1	.441		
Likelihood Ratio	.734	1	.392		
Fisher's Exact Test				.426	.220
Linear-by-Linear Association	.738	1	.390		
N of Valid Cases	1256				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 61.15.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A Received newborn care at hospital facility (yes / no)	.860	.610	1.213
For cohort A Have you ever been breastfed? = yes	.938	.808	1.090
For cohort A Have you ever been breastfed? = no	1.091	.898	1.325
N of Valid Cases	1256		

Ever breastfed or fed breast milk? * Mother smoked during pregnancy?

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
A mother smoked when pregnant	yes	Count	67	98	165
		% within A mother smoked when pregnant	40.6%	59.4%	100.0%
		% within A Have you ever been breastfed?	9.0%	19.3%	13.2%
	no	Count	678	411	1089
		% within A mother smoked when pregnant	62.3%	37.7%	100.0%
		% within A Have you ever been breastfed?	91.0%	80.7%	86.8%
Total		Count	745	509	1254
		% within A mother smoked when pregnant	59.4%	40.6%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	27.859[b]	1	.000		
Continuity Correction[a]	26.968	1	.000		
Likelihood Ratio	27.313	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	27.837	1	.000		
N of Valid Cases	1254				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 66.97.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for A mother smoked when pregnant (yes / no)	.414	.297	.579
For cohort A Have you ever been breastfed? = yes	.652	.539	.789
For cohort A Have you ever been breastfed? = no	1.574	1.358	1.824
N of Valid Cases	1254		

Ever breastfed or fed breast milk? * Ever attended day care or preschool?

Crosstab

			A Have you ever been breastfed?		
			yes	no	Total
Ever attend day care or preschool	yes	Count	381	268	649
		% within Ever attend day care or preschool	58.7%	41.3%	100.0%
		% within A Have you ever been breastfed?	51.1%	52.3%	51.6%
	no	Count	365	244	609
		% within Ever attend day care or preschool	59.9%	40.1%	100.0%
		% within A Have you ever been breastfed?	48.9%	47.7%	48.4%
Total		Count	746	512	1258
		% within Ever attend day care or preschool	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.197[b]	1	.658		
Continuity Correction[a]	.149	1	.700		
Likelihood Ratio	.197	1	.658		
Fisher's Exact Test				.688	.350
Linear-by-Linear Association	.196	1	.658		
N of Valid Cases	1258				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 247.86.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Ever attend day care or preschool (yes / no)	.950	.759	1.190
For cohort A Have you ever been breastfed? = yes	.980	.894	1.073
For cohort A Have you ever been breastfed? = no	1.031	.902	1.178
N of Valid Cases	1258		

Ever been breastfed or fed breast milk? * Age at screening < or > 24 months?

Age less than 1 year and Greater than 1 year * A Have you ever been breastfed? Crosstabulation

			A Have you ever been breastfed?		
			yes	no	Total
Age less than 1 year and Greater than 1 year	one year or less	Count	179	82	261
		% within Age less than 1 year and Greater than 1 year	68.6%	31.4%	100.0%
		% within A Have you ever been breastfed?	24.0%	16.0%	20.7%
	greater than 1 year old	Count	568	430	998
		% within Age less than 1 year and Greater than 1 year	56.9%	43.1%	100.0%
		% within A Have you ever been breastfed?	76.0%	84.0%	79.3%
Total		Count	747	512	1259
		% within Age less than 1 year and Greater than 1 year	59.3%	40.7%	100.0%
		% within A Have you ever been breastfed?	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	11.675[b]	1	.001		
Continuity Correction[a]	11.196	1	.001		
Likelihood Ratio	11.950	1	.001		
Fisher's Exact Test				.001	.000
Linear-by-Linear Association	11.665	1	.001		
N of Valid Cases	1259				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 106.14.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age less than 1 year and Greater than 1 year (one year or less / greater than 1 year old)	1.653	1.237	2.208
For cohort A Have you ever been breastfed? = yes	1.205	1.092	1.329
For cohort A Have you ever been breastfed? = no	.729	.601	.884
N of Valid Cases	1259		

APPENDIX E

STRATIFIED ANALYSIS BETWEEN BREASTFEDING AND ASTHMA AND OTHER STUDY VARIABLES

Ever been told you have asthma? * Ever breastfed or fed breast milk? * Gender

A Gender -				A Ever been have		Tot
				ye	n	
mal	A Have you ever breastf	ye	Cou	5	35	40
			% within A ever been	13.1	86.9	100.0
			% within A Ever told you have	51.0	61.6	60.0
			% of	7.8	52.1	60.0
		n	Cou	5	22	27
			% within A ever been	18.8	81.2	100.0
			% within A Ever told you have	49.0	38.4	40.0
			% of	7.5	32.5	40.0
	Tot		Cou	10	57	67
			% within A ever been	15.4	84.6	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	15.4	84.6	100.0
fema	A Have you ever breastf	ye	Cou	2	31	34
			% within A ever been	6.8	93.2	100.0
			% within A Ever told you have	42.6	60.4	58.7
			% of	4.0	54.7	58.7
		n	Cou	3	20	23
			% within A ever been	13.0	87.0	100.0
			% within A Ever told you have	57.4	39.6	41.3
			% of	5.4	35.9	41.3
	Tot		Cou	5	52	57
			% within A ever been	9.3	90.7	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	9.3	90.7	100.0

Chi-Square Tests

A Gender - Adjudicated.		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
male	Pearson Chi-Square	4.154[b]	1	.042		
	Continuity Correction[a]	3.723	1	.054		
	Likelihood Ratio	4.091	1	.043		
	Fisher's Exact Test				.050	.027
	Linear-by-Linear Association	4.148	1	.042		
	N of Valid Cases	677				
female	Pearson Chi-Square	6.392[c]	1	.011		
	Continuity Correction[a]	5.679	1	.017		
	Likelihood Ratio	6.277	1	.012		
	Fisher's Exact Test				.013	.009
	Linear-by-Linear Association	6.381	1	.012		
	N of Valid Cases	579				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 41.63.

c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 22.29.

Risk Estimate

A Gender - Adjudicated.		Value	95% Confidence Interval	
			Lower	Upper
male	Odds Ratio for A Have you ever been breastfed? (yes / no)	.648	.426	.985
	For cohort A Ever been told you have Asthma = yes	.694	.488	.987
	For cohort A Ever been told you have Asthma = no	1.071	1.000	1.147
	N of Valid Cases	677		
female	Odds Ratio for A Have you ever been breastfed? (yes / no)	.487	.276	.858
	For cohort A Ever been told you have Asthma = yes	.522	.312	.871
	For cohort A Ever been told you have Asthma = no	1.071	1.012	1.134
	N of Valid Cases	579		

Tests for Homogeneity of the Odds Ratio

Statistics		Chi-Squared	df	Asymp. Sig. (2-sided)
Conditional Independence	Cochran's	9.905	1	.002
	Mantel-Haenszel	9.350	1	.002
Homogeneity	Breslow-Day	.630	1	.427
	Tarone's	.630	1	.427

Under the conditional independence assumption, Cochran's statistic is asymptotically distributed as a 1 df chi-squared distribution, only if the number of strata is fixed, while the Mantel-Haenszel statistic is always asymptotically distributed as a 1 df chi-squared distribution. Note that the continuity correction is removed from the Mantel-Haenszel statistic when the sum of the differences between the observed and the expected is 0.

Mantel-Haenszel Common Odds Ratio Estimate

Estimate			.585
ln(Estimate)			-.536
Std. Error of ln(Estimate)			.172
Asymp. Sig. (2-sided)			.002
Asymp. 95% Confidence Interval	Common Odds Ratio	Lower Bound	.418
		Upper Bound	.819
	ln(Common Odds Ratio)	Lower Bound	-.873
		Upper Bound	-.200

The Mantel-Haenszel common odds ratio estimate is asymptotically normally distributed under the common odds ratio of 1.000 assumption. So is the natural log of the estimate.

Ever been told you have asthma? * Ever breastfed or fed breast milk? * Received newborn care at a hospital facility?

A Received care at hospital				A Ever been told have		Tot
				ye	n	
ye	A Have you ever breastfe	ye	Cou	1	7	8
			% within A Have ever been	15.5	84.5	100.0
			% within A Ever told you have	40.6	60.7	56.4
			% of	8.7	47.7	56.4
		n	Cou	1	4	6
			% within A Have ever been	29.2	70.8	100.0
			% within A Ever told you have	59.4	39.3	43.6
			% of	12.8	30.9	43.6
	Tot		Cou	3	11	14
			% within A Have ever been	21.5	78.5	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	21.5	78.5	100.0
n	A Have you ever breastfe	ye	Cou	6	59	65
			% within A Have ever been	9.6	90.4	100.0
			% within A Ever told you have	50.0	60.9	59.7
			% of	5.7	54.0	59.7
		n	Cou	6	38	44
			% within A Have ever been	14.2	85.8	100.0
			% within A Ever told you have	50.0	39.1	40.3
			% of	5.7	34.6	40.3
	Tot		Cou	12	97	110
			% within A Have ever been	11.4	88.6	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	11.4	88.6	100.0

Chi-Square Tests

A Received newborn care at hospital facility		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
yes	Pearson Chi-Square	4.111[b]	1	.043		
	Continuity Correction[a]	3.336	1	.068		
	Likelihood Ratio	4.086	1	.043		
	Fisher's Exact Test				.047	.034
	Linear-by-Linear Association	4.083	1	.043		
	N of Valid Cases	149				
no	Pearson Chi-Square	5.553[c]	1	.018		
	Continuity Correction[a]	5.108	1	.024		
	Likelihood Ratio	5.462	1	.019		
	Fisher's Exact Test				.021	.012
	Linear-by-Linear Association	5.548	1	.019		
	N of Valid Cases	1104				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.96.

c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 50.79.

Risk Estimate

A Received newborn care at hospital facility		Value	95% Confidence Interval	
			Lower	Upper
yes	Odds Ratio for A Have you ever been breastfed? (yes / no)	.443	.200	.984
	For cohort A Ever been told you have Asthma = yes	.529	.283	.991
	For cohort A Ever been told you have Asthma = no	1.194	.997	1.431
	N of Valid Cases	149		
no	Odds Ratio for A Have you ever been breastfed? (yes / no)	.641	.442	.930
	For cohort A Ever been told you have Asthma = yes	.675	.487	.937
	For cohort A Ever been told you have Asthma = no	1.054	1.007	1.102
	N of Valid Cases	1104		

Tests for Homogeneity of the Odds Ratio

Statistics		Chi-Squared	df	Asymp. Sig. (2-sided)
Conditional Independence	Cochran's	9.010	1	.003
	Mantel-Haenszel	8.478	1	.004
Homogeneity	Breslow-Day	.677	1	.411
	Tarone's	.677	1	.411

Under the conditional independence assumption, Cochran's statistic is asymptotically distributed as a 1 df chi-squared distribution, only if the number of strata is fixed, while the Mantel-Haenszel statistic is always asymptotically distributed as a 1 df chi-squared distribution. Note that the continuity correction is removed from the Mantel-Haenszel statistic when the sum of the differences between the observed and the expected is 0.

Mantel-Haenszel Common Odds Ratio Estimate

Estimate			.599
ln(Estimate)			-.512
Std. Error of ln(Estimate)			.172
Asymp. Sig. (2-sided)			.003
Asymp. 95% Confidence Interval	Common Odds Ratio	Lower Bound	.428
		Upper Bound	.839
	ln(Common Odds Ratio)	Lower Bound	-.848
		Upper Bound	-.175

The Mantel-Haenszel common odds ratio estimate is asymptotically normally distributed under the common odds ratio of 1.000 assumption. So is the natural log of the estimate.

Ever been told you have asthma? * Ever breastfed or fed breast milk? Ever attended day care or preschool?

Ever attend care or				A Ever been told have		Tot
				ye	n	
ye	A Have you ever breastfe	ye	Cou	4	33	38
			% within A Have ever been	12.9	87.1	100.0
			% within A Ever told you have	50.0	60.3	58.7
			% of	7.6	51.2	58.7
		n	Cou	4	21	26
			% within A Have ever been	18.4	81.6	100.0
			% within A Ever told you have	50.0	39.7	41.3
			% of	7.6	33.7	41.3
	Tot		Cou	9	54	64
			% within A Have ever been	15.1	84.9	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	15.1	84.9	100.0
n	A Have you ever breastfe	ye	Cou	2	33	36
			% within A Have ever been	7.4	92.6	100.0
			% within A Ever told you have	45.0	61.7	60.0
			% of	4.4	55.6	60.0
		n	Cou	3	21	24
			% within A Have ever been	13.6	86.4	100.0
			% within A Ever told you have	55.0	38.3	40.0
			% of	5.4	34.5	40.0
	Tot		Cou	6	54	60
			% within A Have ever been	9.9	90.1	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	9.9	90.1	100.0

Chi-Square Tests

Ever attend day care or preschool		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
yes	Pearson Chi-Square	3.634[b]	1	.057		
	Continuity Correction[a]	3.222	1	.073		
	Likelihood Ratio	3.588	1	.058		
	Fisher's Exact Test				.059	.037
	Linear-by-Linear Association	3.628	1	.057		
	N of Valid Cases	647				
no	Pearson Chi-Square	6.270[c]	1	.012		
	Continuity Correction[a]	5.594	1	.018		
	Likelihood Ratio	6.130	1	.013		
	Fisher's Exact Test				.018	.010
	Linear-by-Linear Association	6.260	1	.012		
	N of Valid Cases	608				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 40.44.

c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 23.98.

Risk Estimate

Ever attend day care or preschool		Value	95% Confidence Interval	
			Lower	Upper
yes	Odds Ratio for A Have you ever been breastfed? (yes / no)	.659	.428	1.014
	For cohort A Ever been told you have Asthma = yes	.703	.488	1.011
	For cohort A Ever been told you have Asthma = no	1.067	.996	1.143
	N of Valid Cases	647		
no	Odds Ratio for A Have you ever been breastfed? (yes / no)	.508	.297	.870
	For cohort A Ever been told you have Asthma = yes	.545	.336	.882
	For cohort A Ever been told you have Asthma = no	1.072	1.012	1.135
	N of Valid Cases	608		

Tests for Homogeneity of the Odds Ratio

Statistics		Chi-Squared	df	Asymp. Sig. (2-sided)
Conditional Independence	Cochran's	9.326	1	.002
	Mantel-Haenszel	8.789	1	.003
Homogeneity	Breslow-Day	.544	1	.461
	Tarone's	.544	1	.461

Under the conditional independence assumption, Cochran's statistic is asymptotically distributed as a 1 df chi-squared distribution, only if the number of strata is fixed, while the Mantel-Haenszel statistic is always asymptotically distributed as a 1 df chi-squared distribution. Note that the continuity correction is removed from the Mantel-Haenszel statistic when the sum of the differences between the observed and the expected is 0.

Mantel-Haenszel Common Odds Ratio Estimate

Estimate			.595
ln(Estimate)			-.519
Std. Error of ln(Estimate)			.171
Asymp. Sig. (2-sided)			.002
Asymp. 95% Confidence Interval	Common Odds Ratio	Lower Bound	.425
		Upper Bound	.833
	ln(Common Odds Ratio)	Lower Bound	-.855
		Upper Bound	-.183

The Mantel-Haenszel common odds ratio estimate is asymptotically normally distributed under the common odds ratio of 1.000 assumption. So is the natural log of the estimate.

Ever been told you have asthma? * Ever breastfed or fed breast milk? * Mother smoked during pregnancy?

A mother when				A Ever been told have		Tot
				ye	n	
ye	A Have you ever breastfe	ye	Cou	1	5	6
			% within A Have ever been	19.4	80.6	100.0
			% within A Ever told you have	38.2	41.2	40.6
			% of	7.9	32.7	40.6
		n	Cou	2	7	9
			% within A Have ever been	21.4	78.6	100.0
			% within A Ever told you have	61.8	58.8	59.4
			% of	12.7	46.7	59.4
	Tot		Cou	3	13	16
			% within A Have ever been	20.6	79.4	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	20.6	79.4	100.0
n	A Have you ever breastfe	ye	Cou	6	61	67
			% within A Have ever been	9.3	90.7	100.0
			% within A Ever told you have	50.8	63.8	62.3
			% of	5.8	56.5	62.3
		n	Cou	6	34	40
			% within A Have ever been	14.9	85.1	100.0
			% within A Ever told you have	49.2	36.2	37.7
			% of	5.6	32.0	37.7
	Tot		Cou	12	96	108
			% within A Have ever been	11.4	88.6	100.0
			% within A Ever told you have	100.0	100.0	100.0
			% of	11.4	88.6	100.0

Chi-Square Tests

A mother smoked when pregnant		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
yes	Pearson Chi-Square	.100[b]	1	.752		
	Continuity Correction[a]	.014	1	.905		
	Likelihood Ratio	.100	1	.751		
	Fisher's Exact Test				.846	.455
	Linear-by-Linear Association	.099	1	.753		
	N of Valid Cases	165				
no	Pearson Chi-Square	7.930[c]	1	.005		
	Continuity Correction[a]	7.385	1	.007		
	Likelihood Ratio	7.726	1	.005		
	Fisher's Exact Test				.006	.004
	Linear-by-Linear Association	7.923	1	.005		
	N of Valid Cases	1086				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 13.81.

c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 46.70.

Risk Estimate

A mother smoked when pregnant		Value	95% Confidence Interval	
			Lower	Upper
yes	Odds Ratio for A Have you ever been breastfed? (yes / no)	.883	.407	1.915
	For cohort A Ever been told you have Asthma = yes	.905	.488	1.680
	For cohort A Ever been told you have Asthma = no	1.026	.877	1.200
	N of Valid Cases	165		
no	Odds Ratio for A Have you ever been breastfed? (yes / no)	.585	.402	.852
	For cohort A Ever been told you have Asthma = yes	.624	.449	.868
	For cohort A Ever been told you have Asthma = no	1.066	1.017	1.117
	N of Valid Cases	1086		

Tests for Homogeneity of the Odds Ratio

Statistics		Chi-Squared	df	Asymp. Sig. (2-sided)
Conditional Independence	Cochran's	7.065	1	.008
	Mantel-Haenszel	6.592	1	.010
Homogeneity	Breslow-Day	.879	1	.348
	Tarone's	.878	1	.349

Under the conditional independence assumption, Cochran's statistic is asymptotically distributed as a 1 df chi-squared distribution, only if the number of strata is fixed, while the Mantel-Haenszel statistic is always asymptotically distributed as a 1 df chi-squared distribution. Note that the continuity correction is removed from the Mantel-Haenszel statistic when the sum of the differences between the observed and the expected is 0.

Mantel-Haenszel Common Odds Ratio Estimate

Estimate			.635
ln(Estimate)			-.454
Std. Error of ln(Estimate)			.173
Asymp. Sig. (2-sided)			.009
Asymp. 95% Confidence Interval	Common Odds Ratio	Lower Bound	.452
		Upper Bound	.891
	ln(Common Odds Ratio)	Lower Bound	-.793
		Upper Bound	-.116

The Mantel-Haenszel common odds ratio estimate is asymptotically normally distributed under the common odds ratio of 1.000 assumption. So is the natural log of the estimate.

Ever been told you have asthma? * Ever breastfed or fed breast milk? * Hispanic versus Non- Hispanic

Crosstab

Hispanics vs Non Hispanics				A Ever been told you have Asthma		
				yes	no	Total
Hispanic	A Have you ever been breastfed?	yes	Count	30	356	386
			% within A Have you ever been breastfed?	7.8%	92.2%	100.0%
			% within A Ever been told you have Asthma	57.7%	70.9%	69.7%
			% of Total	5.4%	64.3%	69.7%
		no	Count	22	146	168
			% within A Have you ever been breastfed?	13.1%	86.9%	100.0%
			% within A Ever been told you have Asthma	42.3%	29.1%	30.3%
			% of Total	4.0%	26.4%	30.3%
	Total		Count	52	502	554
			% within A Have you ever been breastfed?	9.4%	90.6%	100.0%
			% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
			% of Total	9.4%	90.6%	100.0%
Non Hispanics	A Have you ever been breastfed?	yes	Count	46	314	360
			% within A Have you ever been breastfed?	12.8%	87.2%	100.0%
			% within A Ever been told you have Asthma	43.4%	52.7%	51.3%
			% of Total	6.6%	44.7%	51.3%
		no	Count	60	282	342
			% within A Have you ever been breastfed?	17.5%	82.5%	100.0%
			% within A Ever been told you have Asthma	56.6%	47.3%	48.7%
			% of Total	8.5%	40.2%	48.7%
	Total		Count	106	596	702
			% within A Have you ever been breastfed?	15.1%	84.9%	100.0%
			% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
			% of Total	15.1%	84.9%	100.0%

Chi-Square Tests

Hispanics vs Non Hispanics		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Hispanic	Pearson Chi-Square	3.900[b]	1	.048		
	Continuity Correction[a]	3.299	1	.069		
	Likelihood Ratio	3.698	1	.054		
	Fisher's Exact Test				.057	.037
	Linear-by-Linear Association	3.893	1	.048		
	N of Valid Cases	554				
Non Hispanics	Pearson Chi-Square	3.108[c]	1	.078		
	Continuity Correction[a]	2.747	1	.097		
	Likelihood Ratio	3.112	1	.078		
	Fisher's Exact Test				.091	.049
	Linear-by-Linear Association	3.103	1	.078		
	N of Valid Cases	702				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.77.

c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 51.64.

Risk Estimate

Hispanics vs Non Hispanics		Value	95% Confidence Interval	
			Lower	Upper
Hispanic	Odds Ratio for A Have you ever been breastfed? (yes / no)	.559	.312	1.002
	For cohort A Ever been told you have Asthma = yes	.593	.353	.998
	For cohort A Ever been told you have Asthma = no	1.061	.994	1.133
	N of Valid Cases	554		
Non Hispanics	Odds Ratio for A Have you ever been breastfed? (yes / no)	.689	.454	1.044
	For cohort A Ever been told you have Asthma = yes	.728	.511	1.038
	For cohort A Ever been told you have Asthma = no	1.058	.993	1.126
	N of Valid Cases	702		

Tests for Homogeneity of the Odds Ratio

Statistics		Chi-Squared	df	Asymp. Sig. (2-sided)
Conditional Independence	Cochran's	6.562	1	.010
	Mantel-Haenszel	6.111	1	.013
Homogeneity	Breslow-Day	.324	1	.569
	Tarone's	.324	1	.569

Under the conditional independence assumption, Cochran's statistic is asymptotically distributed as a 1 df chi-squared distribution, only if the number of strata is fixed, while the Mantel-Haenszel statistic is always asymptotically distributed as a 1 df chi-squared distribution. Note that the continuity correction is removed from the Mantel-Haenszel statistic when the sum of the differences between the observed and the expected is 0.

Mantel-Haenszel Common Odds Ratio Estimate

Estimate			.644
ln(Estimate)			-.440
Std. Error of ln(Estimate)			.173
Asymp. Sig. (2-sided)			.011
Asymp. 95% Confidence Interval	Common Odds Ratio	Lower Bound	.458
		Upper Bound	.905
	ln(Common Odds Ratio)	Lower Bound	-.780
		Upper Bound	-.100

The Mantel-Haenszel common odds ratio estimate is asymptotically normally distributed under the common odds ratio of 1.000 assumption. So is the natural log of the estimate.

Ever been told you have asthma? * Ever breastfed or fed breast milk? * Black versus Non-Black

Crosstab

Black vs. Non Black				A Ever been told you have Asthma		Total
				yes	no	
Black	A Have you ever been breastfed?	yes	Count	19	91	110
			% within A Have you ever been breastfed?	17.3%	82.7%	100.0%
			% within A Ever been told you have Asthma	32.8%	37.0%	36.2%
			% of Total	6.3%	29.9%	36.2%
		no	Count	39	155	194
			% within A Have you ever been breastfed?	20.1%	79.9%	100.0%
			% within A Ever been told you have Asthma	67.2%	63.0%	63.8%
			% of Total	12.8%	51.0%	63.8%
	Total		Count	58	246	304
			% within A Have you ever been breastfed?	19.1%	80.9%	100.0%
			% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
			% of Total	19.1%	80.9%	100.0%
non black	A Have you ever been breastfed?	yes	Count	57	579	636
			% within A Have you ever been breastfed?	9.0%	91.0%	100.0%
			% within A Ever been told you have Asthma	57.0%	68.0%	66.8%
			% of Total	6.0%	60.8%	66.8%
		no	Count	43	273	316
			% within A Have you ever been breastfed?	13.6%	86.4%	100.0%
			% within A Ever been told you have Asthma	43.0%	32.0%	33.2%
			% of Total	4.5%	28.7%	33.2%
	Total		Count	100	852	952
			% within A Have you ever been breastfed?	10.5%	89.5%	100.0%
			% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
			% of Total	10.5%	89.5%	100.0%

Chi-Square Tests

Black vs. Non Black		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Black	Pearson Chi-Square	.364[b]	1	.546		
	Continuity Correction[a]	.204	1	.652		
	Likelihood Ratio	.368	1	.544		
	Fisher's Exact Test				.649	.328
	Linear-by-Linear Association	.363	1	.547		
	N of Valid Cases	304				
non black	Pearson Chi-Square	4.846[c]	1	.028		
	Continuity Correction[a]	4.364	1	.037		
	Likelihood Ratio	4.676	1	.031		
	Fisher's Exact Test				.033	.020
	Linear-by-Linear Association	4.841	1	.028		
	N of Valid Cases	952				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 20.99.

c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 33.19.

Risk Estimate

Black vs. Non Black		Value	95% Confidence Interval	
			Lower	Upper
Black	Odds Ratio for A Have you ever been breastfed? (yes / no)	.830	.453	1.522
	For cohort A Ever been told you have Asthma = yes	.859	.523	1.411
	For cohort A Ever been told you have Asthma = no	1.035	.927	1.157
	N of Valid Cases	304		
non black	Odds Ratio for A Have you ever been breastfed? (yes / no)	.625	.410	.952
	For cohort A Ever been told you have Asthma = yes	.659	.454	.956
	For cohort A Ever been told you have Asthma = no	1.054	1.002	1.108
	N of Valid Cases	952		

Tests for Homogeneity of the Odds Ratio

Statistics		Chi-Squared	df	Asymp. Sig. (2-sided)
Conditional Independence	Cochran's	4.533	1	.033
	Mantel-Haenszel	4.149	1	.042
Homogeneity	Breslow-Day	.567	1	.451
	Tarone's	.567	1	.452

Under the conditional independence assumption, Cochran's statistic is asymptotically distributed as a 1 df chi-squared distribution, only if the number of strata is fixed, while the Mantel-Haenszel statistic is always asymptotically distributed as a 1 df chi-squared distribution. Note that the continuity correction is removed from the Mantel-Haenszel statistic when the sum of the differences between the observed and the expected is 0.

Mantel-Haenszel Common Odds Ratio Estimate

Estimate			.688
ln(Estimate)			-.374
Std. Error of ln(Estimate)			.178
Asymp. Sig. (2-sided)			.035
Asymp. 95% Confidence Interval	Common Odds Ratio	Lower Bound	.486
		Upper Bound	.975
	ln(Common Odds Ratio)	Lower Bound	-.722
		Upper Bound	-.026

The Mantel-Haenszel common odds ratio estimate is asymptotically normally distributed under the common odds ratio of 1.000 assumption. So is the natural log of the estimate.

Ever been told you have asthma? * Ever breastfed or fed breast milk? * Age at screening was > or < 24 months?

Age at screening greater than or less than 24 months * A Ever been told you have Asthma Crosstabulation

			A Ever been told you have Asthma		
			yes	no	Total
Age at screening greater than or less than 24 months	less than 24 months	Count	44	478	522
		% within Age at screening greater than or less than 24 months	8.4%	91.6%	100.0%
		% within A Ever been told you have Asthma	9.1%	16.1%	15.2%
		% of Total	1.3%	13.9%	15.2%
	greater than 24 months	Count	439	2482	2921
		% within Age at screening greater than or less than 24 months	15.0%	85.0%	100.0%
		% within A Ever been told you have Asthma	90.9%	83.9%	84.8%
		% of Total	12.8%	72.1%	84.8%
Total		Count	483	2960	3443
		% within Age at screening greater than or less than 24 months	14.0%	86.0%	100.0%
		% within A Ever been told you have Asthma	100.0%	100.0%	100.0%
		% of Total	14.0%	86.0%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	15.995[b]	1	.000		
Continuity Correction[a]	15.452	1	.000		
Likelihood Ratio	17.872	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	15.990	1	.000		
N of Valid Cases	3443				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 73.23.

Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Age at screening greater than or less than 24 months (less than 24 months / greater than 24 months)	.520	.376	.720
For cohort A Ever been told you have Asthma = yes	.561	.417	.754
For cohort A Ever been told you have Asthma = no	1.078	1.046	1.111
N of Valid Cases	3443		

APPENDIX F

MULTIPLE LOGISTIC REGRESSION OUTPUTS, ADJUSTED ANALYSIS

Crude associations with race and asthma (1/x)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ARACENEW			30.300	4	.000			
	ARACENEW(1)	-.479	.220	4.732	1	.030	.619	.402	.954
	ARACENEW(2)	.419	.458	.837	1	.360	1.521	.620	3.732
	ARACENEW(3)	.630	.243	6.742	1	.009	1.878	1.167	3.023
	ARACENEW(4)	-.695	.315	4.888	1	.027	.499	.269	.924
	Constant	1.932	.165	136.968	1	.000	6.905		

a. Variable(s) entered on step 1: ARACENEW.

Variables in the Equation calcuate reciprocal of OR and 95% CI 1/x crude associations of

		B	S.E	Wal	d	Sig	Exp(	95.0% C.I.for	
								Low	Upp
Ste 1[a]	On			22.90	5	.00			
	Tw	-	.32	3.58	1	.05	.53	.28	1.02
	Thre	-	.32	9.02	1	.00	.37	.19	.70
	Fou	-	.31	18.85	1	.00	.25	.13	.47
	Fiv	-	.35	2.61	1	.10	.56	.27	1.13
	Si	-	.33	9.82	1	.00	.35	.18	.67
	Consta	2.73	.25	112.19	1	.00	15.36		

a Variable(s) entered on step 1:

Race in five categories adjusted for all variables (1/x)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ARACENEW			21.007	4	.000			
	ARACENEW(1)	-.385	.232	2.751	1	.097	.681	.432	1.072
	ARACENEW(2)	.316	.468	.457	1	.499	1.372	.548	3.433
	ARACENEW(3)	.456	.256	3.181	1	.075	1.578	.956	2.605
	ARACENEW(4)	-.865	.327	6.999	1	.008	.421	.222	.799
	ADAYCARE	.175	.195	.808	1	.369	1.191	.814	1.744
	ANGENDER	.634	.184	11.922	1	.001	1.885	1.315	2.703
	AGE	-.145	.053	7.439	1	.006	.865	.779	.960
	ANMOSMOK	.631	.229	7.619	1	.006	1.880	1.201	2.944
	ANBREAST	-.304	.187	2.639	1	.104	.738	.512	1.065
	ANBCARE	.692	.231	8.942	1	.003	1.997	1.269	3.143
	Constant	-.686	.795	.746	1	.388	.503		

a. Variable(s) entered on step 1: ARACENEW, ADAYCARE, ANGENDER, AGE, ANMOSMOK, ANBREAST, ANBCARE.

Age categorical adjusted for all variables (1/x)

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B) Lower	Upper
Step 1[a]	ANGENDER	.628	.188	11.200	1	.001	1.874	1.297	2.708
	ANMOSMOK	.662	.234	8.008	1	.005	1.938	1.226	3.065
	ADAYCARE	.320	.197	2.649	1	.104	1.377	.937	2.024
	ANBCARE	.729	.236	9.577	1	.002	2.074	1.307	3.291
	ANBREAST	-.426	.183	5.440	1	.020	.653	.457	.934
	AGE			14.448	5	.013			
	AGE(1)	-.580	.342	2.872	1	.090	.560	.286	1.095
	AGE(2)	-.869	.351	6.141	1	.013	.419	.211	.834
	AGE(3)	-1.189	.335	12.630	1	.000	.305	.158	.587
	AGE(4)	-.615	.382	2.595	1	.107	.540	.256	1.143
	AGE(5)	-.910	.351	6.743	1	.009	.402	.202	.800
	RACE3	.064	.113	.323	1	.570	1.066	.855	1.330
	Constant	-.797	.827	.929	1	.335	.451		

a. Variable(s) entered on step 1: ANGENDER, ANMOSMOK, ADAYCARE, ANBCARE, ANBREAST, AGE, RACE3.

Adjusted for Hispanic versus Non-Hispanic and all variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B) Lower	Upper
Step 1[a]	ANGENDER	.640	.182	12.302	1	.000	1.896	1.326	2.711
	ANMOSMOK	.603	.226	7.112	1	.008	1.827	1.173	2.846
	ADAYCARE	.265	.193	1.881	1	.170	1.303	.893	1.902
	ANBCARE	.734	.229	10.317	1	.001	2.084	1.331	3.262
	ANBREAST	-.376	.180	4.383	1	.036	.686	.482	.976
	AGE	-.142	.053	7.220	1	.007	.868	.782	.962
	HISPVSNO	-.294	.196	2.253	1	.133	.746	.508	1.094
	Constant	-.314	.904	.120	1	.729	.731		

a. Variable(s) entered on step 1: ANGENDER, ANMOSMOK, ADAYCARE, ANBCARE, ANBREAST, AGE, HISPVSNO.

Adjusted for Black versus Non-Black and all variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B) Lower	Upper
Step 1[a]	ANGENDER	.627	.183	11.788	1	.001	1.873	1.309	2.679
	ANMOSMOK	.655	.226	8.415	1	.004	1.924	1.237	2.995
	ADAYCARE	.266	.189	1.985	1	.159	1.304	.901	1.887
	ANBCARE	.740	.229	10.448	1	.001	2.095	1.338	3.281
	ANBREAST	-.298	.185	2.592	1	.107	.742	.516	1.067
	AGE	-.138	.053	6.834	1	.009	.871	.785	.966
	BLACKVNO	.479	.196	5.980	1	.014	1.614	1.100	2.369
	Constant	-1.820	.857	4.515	1	.034	.162		

a. Variable(s) entered on step 1: ANGENDER, ANMOSMOK, ADAYCARE, ANBCARE, ANBREAST, AGE, BLACKVNO.

Adjusted for White versus Non-Whites and all variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANGENDER	.637	.182	12.212	1	.000	1.891	1.323	2.702
	ANMOSMOK	.650	.226	8.273	1	.004	1.915	1.230	2.982
	ADAYCARE	.359	.186	3.721	1	.054	1.431	.994	2.060
	ANBCARE	.772	.228	11.460	1	.001	2.165	1.384	3.385
	ANBREAST	-.412	.178	5.347	1	.021	.662	.467	.939
	AGE	-.135	.053	6.622	1	.010	.873	.788	.968
	WHITEVNO	-.077	.201	.146	1	.702	.926	.625	1.373
	Constant	-.910	.814	1.250	1	.264	.402		

a. Variable(s) entered on step 1: ANGENDER, ANMOSMOK, ADAYCARE, ANBCARE, ANBREAST, AGE, WHITEVNO.

Started eating other foods at 4 months adjusted for all other variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANMOSMOK	1.104	.368	8.986	1	.003	3.016	1.465	6.208
	ANBCARE	.700	.352	3.944	1	.047	2.013	1.009	4.015
	ADAYCARE	.320	.296	1.170	1	.279	1.377	.771	2.459
	ANGENDER	.813	.277	8.577	1	.003	2.254	1.308	3.882
	AGE	-.244	.079	9.504	1	.002	.784	.671	.915
	RACE3	.039	.153	.065	1	.798	1.040	.771	1.402
	ANFOOD4	-.767	.293	6.867	1	.009	.464	.262	.824
	Constant	-.775	1.286	.364	1	.546	.461		

a. Variable(s) entered on step 1: ANMOSMOK, ANBCARE, ADAYCARE, ANGENDER, AGE, RACE3, ANFOOD4.

Breastfeeding at 4 cut-off points adjusted for all other variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANMOSMOK	.714	.232	9.502	1	.002	2.042	1.297	3.214
	ANBCARE	.753	.234	10.388	1	.001	2.124	1.343	3.357
	ADAYCARE	.361	.196	3.398	1	.065	1.435	.977	2.108
	ANGENDER	.639	.186	11.753	1	.001	1.895	1.315	2.731
	AGE	-.141	.054	6.783	1	.009	.869	.781	.966
	RACE3	.071	.112	.405	1	.524	1.074	.862	1.337
	BR4			5.059	3	.168			
	BR4(1)	.264	.247	1.145	1	.285	1.302	.803	2.111
	BR4(2)	.387	.276	1.961	1	.161	1.472	.857	2.530
	BR4(3)	.523	.269	3.770	1	.052	1.686	.995	2.858
	Constant	-2.074	.741	7.840	1	.005	.126		

a. Variable(s) entered on step 1: ANMOSMOK, ANBCARE, ADAYCARE, ANGENDER, AGE, RACE3, BR4.

Breastfeeding at > or< 4 months adjusted for all other variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANMOSMOK	.743	.229	10.476	1	.001	2.101	1.340	3.295
	ANBCARE	.755	.233	10.482	1	.001	2.127	1.347	3.360
	ADAYCARE	.340	.195	3.024	1	.082	1.405	.958	2.060
	ANGENDER	.630	.186	11.463	1	.001	1.878	1.304	2.705
	AGE	-.144	.054	7.082	1	.008	.866	.779	.963
	RACE3	.078	.111	.489	1	.485	1.081	.869	1.344
	MO4BF	.430	.218	3.912	1	.048	1.538	1.004	2.355
	Constant	-2.443	.766	10.159	1	.001	.087		

a. Variable(s) entered on step 1: ANMOSMOK, ANBCARE, ADAYCARE, ANGENDER, AGE, RACE3, MO4BF.

Breastfeeding at > or < 6 months adjusted for all other variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANMOSMOK	.752	.229	10.771	1	.001	2.122	1.354	3.325
	ANBCARE	.760	.233	10.638	1	.001	2.138	1.354	3.376
	ADAYCARE	.336	.195	2.952	1	.086	1.399	.954	2.052
	ANGENDER	.637	.186	11.711	1	.001	1.890	1.313	2.722
	AGE	-.142	.054	6.983	1	.008	.867	.780	.964
	RACE3	.077	.111	.485	1	.486	1.080	.869	1.343
	MO6BF	.370	.223	2.735	1	.098	1.447	.934	2.242
	Constant	-2.393	.769	9.693	1	.002	.091		

a. Variable(s) entered on step 1: ANMOSMOK, ANBCARE, ADAYCARE, ANGENDER, AGE, RACE3, MO6BF.

Breastfeeding at > or < 9 months adjusted for all other variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANMOSMOK	.760	.229	10.978	1	.001	2.138	1.364	3.352
	ANBCARE	.763	.233	10.730	1	.001	2.144	1.358	3.384
	ADAYCARE	.337	.195	2.977	1	.084	1.401	.955	2.055
	ANGENDER	.618	.186	11.011	1	.001	1.855	1.288	2.673
	AGE	-.143	.054	7.077	1	.008	.867	.780	.963
	RACE3	.076	.111	.466	1	.495	1.079	.868	1.340
	MO9BF	.353	.284	1.544	1	.214	1.424	.815	2.486
	Constant	-2.327	.776	9.005	1	.003	.098		

a. Variable(s) entered on step 1: ANMOSMOK, ANBCARE, ADAYCARE, ANGENDER, AGE, RACE3, MO9BF.

Ever been told you have asthma * Ever breastfed or fed breast milk * Day care attendance

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANBREAST	-.159	.518	.094	1	.759	.853	.309	2.357
	ADAYCARE	.876	.560	2.444	1	.118	2.400	.801	7.196
	ADAYCARE by ANBREAST	-.259	.351	.543	1	.461	.772	.388	1.537
	Constant	1.452	.818	3.148	1	.076	4.273		

a. Variable(s) entered on step 1: ANBREAST, ADAYCARE, ADAYCARE * ANBREAST .

Ever been told you have asthma * Ever been breastfed or fed breast milk * Gender

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANBREAST	-.149	.517	.083	1	.773	.861	.313	2.372
	ANGENDER	1.012	.578	3.063	1	.080	2.752	.886	8.549
	ANBREAST by ANGENDER	-.285	.360	.628	1	.428	.752	.371	1.522
	Constant	1.318	.817	2.604	1	.107	3.737		

a. Variable(s) entered on step 1: ANBREAST, ANGENDER, ANBREAST * ANGENDER .

Ever been told you have asthma * Ever been breastfed or fed breast milk * Age at screening

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANBREAST	-1.022	.396	6.660	1	.010	.360	.166	.782
	AGE	-.358	.156	5.281	1	.022	.699	.515	.949
	AGE by ANBREAST	.148	.100	2.200	1	.138	1.159	.954	1.409
	Constant	3.914	.627	38.918	1	.000	50.097		

a. Variable(s) entered on step 1: ANBREAST, AGE, AGE * ANBREAST .

Ever been told you have asthma * Ever been breastfed or fed breast milk * Received Newborn Care

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANBREAST	-1.182	.835	2.004	1	.157	.307	.060	1.576
	ANBCARE	.181	.726	.062	1	.804	1.198	.289	4.971
	ANBCARE by ANBREAST	.369	.449	.675	1	.411	1.446	.600	3.485
	Constant	2.331	1.357	2.948	1	.086	10.284		

a. Variable(s) entered on step 1: ANBREAST, ANBCARE, ANBCARE * ANBREAST .

Ever been told you have asthma * Ever been breastfed or fed breast milk * Mother smoked during pregnancy

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ANBREAST	.286	.813	.124	1	.725	1.331	.271	6.550
	ANMOSMOK	1.264	.729	3.003	1	.083	3.538	.847	14.771
	ANBREAST by ANMOSMOK	-.411	.439	.875	1	.350	.663	.280	1.568
	Constant	.285	1.363	.044	1	.834	1.330		

a. Variable(s) entered on step 1: ANBREAST, ANMOSMOK, ANBREAST * ANMOSMOK .

Ever been told you have asthma * Ever been breastfed or fed breast milk * Race/Ethnicity

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	ANBREAST	-.741	.411	3.251	1	.071	.477
	ANBREAST by RIDRETH1	.115	.131	.779	1	.378	1.122
	RIDRETH1	-.374	.204	3.366	1	.067	.688
	Constant	3.559	.622	32.755	1	.000	35.124

a. Variable(s) entered on step 1: ANBREAST, ANBREAST * RIDRETH1 , RIDRETH1.

Analysis of breastfeeding and asthma adjusted for all study variables

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	ADAYCARE	.363	.195	3.474	1	.062	1.438	.981	2.107
	ANGENDER	.636	.186	11.644	1	.001	1.888	1.311	2.720
	AGE	-.132	.054	5.934	1	.015	.876	.788	.975
	ANMOSMOK	.700	.233	9.050	1	.003	2.013	1.276	3.175
	ANBCARE	.734	.233	9.905	1	.002	2.084	1.319	3.291
	RACE3	.066	.112	.349	1	.555	1.068	.858	1.330
	ANBREAST	-.448	.182	6.069	1	.014	.639	.448	.913
	Constant	-1.185	.806	2.165	1	.141	.306		

a. Variable(s) entered on step 1: ADAYCARE, ANGENDER, AGE, ANMOSMOK, ANBCARE, RACE3, ANBREAST.

References

American Lung Association. (1996). Hispanic Children Have Higher Rate of Asthma. Retrieved on June 28, 2003 from http://www.lungusa.org/ press /medical /medhispanicchild.html

Bloch, A.M., Mimouni, D., Mimouni, M., & Gdalevich, M. (2002). Does breastfeeding protect against allergic rhinitis during childhood? A meta-analysis of prospective studies. *Acta Paediatric, 91*, 275-79.

Burke, W., Fesinmeyer, M., Reed, K., Hampson, L., & Carlsten, C. (2003). Family history as a predictor of asthma risk. *American Journal of Preventative Medicine, 24*(2), 160-68.

Burr, M.L., Limb, E.S., Maguire, M.J., Amarah, L., Eldridge, B.A., Layzell, J.C., & Merrett, T.G. (1993). Infant feeding, wheezing and allergy: A prospective study. *Archives of Disease in Childhood, 68*, 724-28.

Celedon, J.C., Wright, R.J., Litojuna, A.A., Sredie, D., Ryan, L., Weiss, S.T., & Gold, D.R. (2003). Day Care attendance in early life, Maternal history of asthma, and Asthma at the age of 6 years. *American Journal of Respiratory and Critical Care Medicine, 167*(9), 1239-43.

Centers for Disease Control. (2003). National Helath and Nutrition Examination Survey. Retrieved on June 26, 2003 from www.cdc.gov/nchs/nhanes.htm.

Chulada, P.C., Arbes, S.J., Dunson, D. & Zeldin, D.C. (2003). Breast-feeding and the prevalence of asthma and wheeze in children: Analyses from the Third National Health and Nutrition Examination Survey, 1988-1994. *Journal of Allergy and Clinical Immunology, 111*(2), 328-36.

Csoma, Z., Kharitonov, S.A., Balint, B., Bush, A., Wilson, N.M. & Barnes, P.J. (2002). Increased leukotrienes in exhaled breath condensate in childhood asthma. *American Journal of Respiratory and Critical Care Medicine, 166*, 1345-49.

Cruse, J.M. & Lewis, R.E. (1999). *Atlas of Immunology.* New York: CRC Press LLC.

Dean, A.G., Dean, J.A., Coulobier, D., Brendel, K.A., Smith, D.C., Burton, A.H., Dicker, R.C., Sullivan, K., Fagan, R.F., Arner, T.G. Epi Info, Version 6; Aword-Processing, Database, and Statistics Program for Public Health on IBM-compatible Microcomputers. Centers for Disease Control and Prevention, Atlanta, Georgia, U.S.A., 1995.

Dell, S. & To, T. (2001). Breastfeeding and asthma in young children. *Archives of Pediatrics and Adolescence Medicine, 155*, 1261-65.

Friis, R.H.& Sellers, T.A. (1996). *Study designs in Epidemiology for public health practice.* Gaithersburg: Aspen Publishing, Inc.

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

Fuhibrigge, A.L., Adams, R.J., Guilbert, T.W., Grant, E., Lozano, P., Janson, S.L., Martinez, F., Weiss, K.B. & Weiss, S.T. (2001). The burden of asthma in the United States: Level and distribution are dependent on interpretation of the National Asthma Education and Prevention program Guidelines. *American Journal of Respiratory and Critical Care Medicine, 166*(8), 1044-49.

Gdalevich, M., Mimouni, D. & Minnouni, M. (2001). Breast-feeding and the risk of bronchial asthma in childhood: A systematic review with meat-analysis of prospective studies. *Journal of Pediatrics, 139*(2), 261-66.

Gilliland, F.D., Berhane, K., Lit, Y., Rappaport, E.B. & Peters, J.M. (2003). Effects of early onset asthma and *In Utero* exposure to maternal smoking on childhood lung function. *American Journal of Respiratory and Critical Care Medicine, 167*(6), 917-24.

Hanson, L.A., Hahn-Zoric, M., Wiedermann, U., Ludin, S., Dahlman-Hoglund, A., Saalman, R., Erling, V., Dahlaren, V. & Telemo, E. (1996). Early dietary influence on later immunocompetence. *Nutrition Reviews, 54*(2), s23-27.

Hanson, L. A. (1998). Breastfeeding provides passive and likely long-lasting active immunity. *Annals of Allergy, Asthma and Immunology, 81*, 523-29.

Hu, F.B., Persky, V., Flay, B.R., Zeli, A., Cooksey, J., & Richardson, J. (1997). Prevalence of asthma in public schoolchildren: Association with maternal smoking during pregnancy. *Annals of Allergy, Asthma, & Immunology, 79*, 80-84.

Infante-Rivard, C., Amre, D., Gautrin, D., & Malo, J. (2001). Family size, day-care attendance, and breastfeeding in relation to the incidence of childhood asthma. *American Journal of Epidemiology, 153*(7), 653-57.

Jaakkola, J.J. (1997). Secular trend in the occurrence of asthma among children and young adults: Critical appraisal of repeated cross-sectional surveys. *British Medical Journal,314*, 1795-99.

Joseph, C.L., Ownby, D.R., Peterson, E.L. & Johnson, C.C. (2002). Does low birth weight help to explain the increased prevalence of asthma among African-Americans? *Annals of Allergy, Asthma, and Immunology, 88*, 507-12.

Lindbaek, M., Wefring, K.W., Grangard, E.H.& Ovsthus, K. (2003). Socioeconomical conditions as risk factors for bronchial asthma in children aged 4-5 years. *European Respiratory Journal, 21*(1), 105-8.

Litonjua, A.A., Carey, V.J., Burge, H.A., Weiss, S.T. & Gold, D.R. (1998). Parental history and risk for childhood asthma. *American Journal of Respiratory and Critical Care, 158*, 176-81.

Liu, A.H. & Murphy, J.R. (2003). Hygiene hypothesis: Fact or fiction? *Journal of Allergy and Clinical Immunology, 111*(3), 471-77.

Mannino, D.M., Homa, D.M., Akinbami, L.J., Moorman, J.E., Gwynn, C. & Redd, S.C. (2002). Surveillance for asthma- U.S. 1980-1999. *MMWR, 51*(SS01), 1-13.

Mellis, C.M. (2002). Is asthma prevention possible with dietary manipulation? *MJA, 177*(6), s78-80.

Montealegre, F. & Bayona, M. (1996). An estimate of the prevalence, severity and seasonality of asthma in visitors to a Ponce shopping center. *PRHSJ, 15*(2), 113-17.

Nafstad, P., Jaakkola, J.J., Hagen, J.A., Botten, G. & Kongerud, J. (1996). Breastfeeding, maternal smoking and lower respiratory tract infections. *European Respiratory Journal, 9*, 2623-29.

Nelson, D.A., Johnson, C.C., Divine, G.W., Strauchman, C., joseph, C.L., & Ownby, D.R. (1997). Ethnic differences in the prevalence of asthma in middle class children. *Annals of Allergy, Asthma, & Immunology, 78*, 21-25.

Oddy, W.H., Holt, P.G., Sly, P.D., Read, A.W., Landau, L.I., Stanley, F.J., Kendall, G.E. & Burton, P.R. (1999). Association between breastfeeding and asthma in 6 year old children: Findings of a prospective birth cohort study. *British Medical Journal, 319*, 815-19.

Oddy, W.H., Peat, J.K. & deKlerk, N.H. (2002). Maternal asthma, infant feeding, and the risk of asthma in childhood. *Journal of Allergy and Clinical Immunology, 110*(1), 65-67.

Oddy, W.H., DeKlerk, N.H., Sly, P.D. & Holt, P.G. (2002). The effects of respiratory infections, atopy, and breastfeeding on childhood asthma. *European Respiratory Journal, 19*, 899-905.

Pabst, H.F. (1997). Immunodulation by breastfeeding. *Pediatric Infectious Disease Journal, 16*(10), 991-94.

Pearch, N., Beasley, R., Burgess, C. & Crane, J. (1998). *Asthma Epidemiology: Principles and methods.* New York: Oxford University Press.

Peat, J.K. & Li, J. (1999). Reversing the trend: Reducing the prevalence of asthma. *Journal of Allergy and Clinical Immunology, 103*(1), 1-8.

Peat, J.K. (1998). Can asthma be prevented? Evidence from epidemiological studies of children in Australia and New Zealand in the last decade. *Clinical and Experimental Allergy, 28*, 261-65.

Raisler, J., Alexander, C. & O'Campo, P. (1999). Breastfeeding and infant illness: A dose- response relationship? *American Journal of Public Health, 89*(1), 25-29.

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

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

Rust, G.S., Thompson, C.J., Minor, P., Davis-Mitchell, W., Holoway, K. & Murray, V. (2001). Does breastfeeding protect children from asthma? Analysis of NHANES III Survey Data. *Journal Of the National Medical Association, 93*(4), 139-47.

Schwab, N.C., Cullen, M.R., & Schwartz, J.E. (2000). A survey of the prevalence of asthma among school age children in Connecticut. Environment and Human Health, Inc.

Sears, M.R., Greene, J.M., William, A.R., Taylor, D.R., Flannery, E.M., Cowan, J.O., Herbison, G.P. & Poulton, R. (2002). Long term relation between breastfeeding and development of atopy and asthma in children and young adults: A longitudinal study. *Lancet, 360*, 901-6.

Seidman, D.S., Gale, r., Stevenson, D.K. & Danon, Y.L. (1991). Is low birth weight a risk factor for asthma during adolescence? *Archives of Disease in Childhood, 66*, 584-86.

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

Takemura, Y., Sakurai, Y., Satoshi, H., Kusakari, A., Hara, T., Gibo, M., Tokimatsu, A., & Kugai, N. (2001). Relationship between breastfeeding and the prevalence of asthma: The Tokorozawa Childhood Asthma and Pollinosis Study. *American Journal of Epidemiology, 154*(2), 115-19.

Weiss, S.T. (2001). Epidemiology and heterogeneity of asthma. *Annals of Allergy, Asthma and Immunology, 87*, 5-8.

Wilson, A.C., Forsyth, J.S., Greene, S.A., Irvine, L., Uau, C. & Howie, P.W. (1998). Relation of infant diet to childhood health: Seven year follow up of cohort of children in Dundee Infant Feeding Study. *British Medical Journal, 316*, 21-25.

Wold, A.E. & Adlerberth, I. (1998). Does breastfeeding affect the infant's immune responsiveness? *Acta Pediatrics, 87*, 19-21.

Woodward, M. (1999). *Epidemiology: Study design and data analysis.* Boca Raton: Chapman & Hall/CRC.

Wright, A.L., Holberg, C.J., Taussig, L.M. & Martinez, F.D. (2001). Factors influencing the relation of infant feeding to asthma and recurrent wheeze in childhood. *Thorax, 56*, 192-97.

Wright, A.L., Bauer, M., Naylor, A., Sutcliffe, E. & Clark, L. (1998). Increasing breastfeeding rates to reduce infant illness at the community level. *Pediatrics, 101*(5), 837-43.

Wright, A.L., Sherrill, D., Holberg, C.J., Halonen, M. & Martinez, F.D. (1999). Breastfeeding, maternal IgE, and total serum IgE in childhood. *Journal of Allergy and Clinical Immunology, 104*(3), 589-93.

Xanthou, M., Bines, J. & Walker, W.A. (1995). Human milk and intestinal host defense in newborns: An update. *Advances in Pediatrics, 42*, 171-99.