

Asthma in Minnesota

2008 Epidemiology Report



Asthma Program
Chronic Disease and Environmental Epidemiology
Health Promotion and Chronic Disease
Minnesota Department of Health



Protecting, maintaining and improving the health of all Minnesotans

January 2009

Dear Colleague:

I am pleased to present the *Asthma in Minnesota: 2008 Epidemiology Report*. This report contains the most recent data on asthma from the Minnesota Department of Health's Asthma Program. New since the 2005 *Asthma in Minnesota* report are data on asthma among Minnesota youth from the Minnesota School Survey and the Minnesota Youth Tobacco and Asthma Survey. Also new is detailed information on adults and children with asthma from the Minnesota Asthma Callback Survey.

Asthma affects an estimated 388,000 Minnesota children and adults who currently have the disease. The good news is that many indicators of the burden of asthma are on the decline: rates of asthma-related hospitalizations have decreased in the Twin Cities metropolitan area, and rates of asthma deaths have decreased statewide. However, there is still work to do to improve asthma control. Young adults who have asthma are more likely than those who do not have asthma to be exposed to secondhand smoke, which can make asthma worse.

An electronic version of this report is available on the MDH Asthma Program website: <http://www.health.state.mn.us/divs/hpcd/cdee/asthma/Research.html>. For more information about the report, please contact Wendy Brunner at 651-201-5895 or wendy.brunner@state.mn.us.

Sincerely,

A handwritten signature in black ink that reads "Sanne Magnan". The signature is fluid and cursive, with a long horizontal stroke at the end.

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2008 Epidemiology Report



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December 2008

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This work was supported by Cooperative Agreement #U59/CCU522470 from the Centers for Disease Control and Prevention (CDC). Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

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This report is available on the web at:

<http://www.health.state.mn.us/divs/hpcd/cdee/asthma/Research.html>

Suggested citation: Asthma in Minnesota: 2008 Epidemiology Report. Minnesota Department of Health. Minneapolis, MN. December 2008.

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EXECUTIVE SUMMARY

Asthma is one of the most common chronic diseases in the United States, characterized by inflammation and narrowing of the airways. Asthma accounted for 490,000 hospitalizations and 1.8 million visits to the emergency room nationally in 2005. Asthma is a cause of missed days from school and work, interrupted sleep and limited physical activity. While it cannot be cured, it can be controlled through adequate access to medical care, medications and self-management.

The Minnesota Department of Health Asthma Program has established an asthma surveillance system to better understand and describe the burden of asthma in Minnesota. Tracking different aspects of asthma—the number of people with the disease, visits to the hospital and the emergency room, quality of life, and mortality—are important guides to planning education and intervention programs and to developing policies that are necessary for preventing and controlling asthma in the future.

Since the 2005 “*Asthma in Minnesota*” report, a number of new data sources have become available to add to the picture of asthma in Minnesota, including statewide data on asthma prevalence in children from the Behavioral Risk Factor Surveillance System (BRFSS); data on asthma prevalence among middle and high school students from the Minnesota School Survey; data on tobacco use, secondhand smoke and asthma from the Minnesota Youth Tobacco and Asthma Survey; and comprehensive data on asthma in adults and children from the Minnesota Asthma Callback Survey.

The new data add much to our knowledge of asthma in Minnesota; however, the picture remains incomplete. A continuing gap is the lack of data on rates of asthma-related hospitalizations and emergency department visits by race and ethnicity that would increase our understanding of disparities in the burden of asthma. Other gaps include the lack of data on asthma rates at the community or neighborhood level.

Overall, many of the measures of the burden of asthma have improved since the 2005 report. Asthma hospitalization rates have declined in the Twin Cities metro area, particularly among children. Asthma mortality rates have decreased dramatically. However, there is still much work to be done, both in terms of improving the quality of life for people with asthma and improving the data that is used to track the impact of that work.

Key Findings:

ADULTS WITH ASTHMA

- An estimated 10.9% of Minnesota adults age 18 and older report having ever been told by a doctor they had asthma, while 7.7% currently have asthma. That translates to an estimated 429,000 Minnesota adults who have a history of asthma and an estimated 303,000 who currently have asthma.

Executive Summary

- The percentage of Minnesota adults who currently have asthma has increased since 2000; this may be due to a true increase in new asthma cases and/or increased awareness and diagnosis of asthma.
- Women are more likely than men to report having asthma.
- Adults living in the Twin Cities metropolitan area are more likely to report having asthma than adults in Greater Minnesota.

CHILDREN WITH ASTHMA

- An estimated 9.5% of Minnesota children under the age of 18 have ever been told by a doctor they had asthma, while approximately 7.0% currently have asthma. That translates to an estimated 116,000 Minnesota children with a history of asthma and an estimated 85,000 who currently have asthma.

ASTHMA CONTROL

- 33.0% of adults with asthma and 66.4% of children with asthma report that they had been free of symptoms of asthma in the past two weeks

ASTHMA SELF-MANAGEMENT EDUCATION

- 34.2% of adults and 51.4% of children with asthma report ever having been given an asthma action plan, a key tool in asthma self-management

ASTHMA MANAGEMENT

- 52.7% of adults and 73.8% of children with asthma report having had a routine checkup for asthma in the past year
- 49.5% of adults and 51.4% of children with asthma report having had a flu shot in the past year

ENVIRONMENTAL FACTORS THAT AFFECT ASTHMA

- 42.9% of adults and 25.7% of children with asthma have been advised by a healthcare professional to change things in their home, school or work to improve their asthma

CO-MORBID CONDITIONS THAT AFFECT ASTHMA

- 32.7% of adults with asthma also report a diagnosis of depression
- 29.5% of adults with asthma also report a diagnosis of chronic obstructive pulmonary disease

RISK FACTORS ASSOCIATED WITH ASTHMA

- Adults with asthma are just as likely as adults without asthma to be smokers (19.3% vs. 18.4%)
- High school students with asthma are more likely to smoke than their peers who do not have asthma (23.4% vs. 15.5%).
- Middle and high school students with asthma are more likely than students without asthma to be exposed to secondhand smoke.
- Adults with asthma are more likely to be obese than adults without asthma (30.7% vs. 23.6%).

COSTS OF CARE

- Asthma cost Minnesota an estimated \$363.9 million in 2003, including \$208.6 million in direct costs of office visits, ED visits, hospitalizations and medication, and \$155.3 in indirect costs of missed school and work days.
- Approximately 4% of adults and 9% of children with asthma do not have health insurance.

WORK-RELATED ASTHMA

- 53.3% of adults with asthma report that their asthma was caused or is aggravated by a current or previous job.

ASTHMA-RELATED EMERGENCY DEPARTMENT VISITS AND HOSPITALIZATIONS

- There were more than 15,800 emergency department visits for asthma in 2006.
- Rates of asthma hospitalizations have been declining since 1999 toward the CDC target of 7.9 visits per 10,000 population.

ASTHMA MORTALITY

- Asthma mortality rates have decreased dramatically since 1999 with the greatest declines among those 65 and older.
- In 2006, there were 47 deaths due to asthma among Minnesota residents, down from 104 in 1999.

INTRODUCTION

Asthma is a chronic respiratory disease characterized by episodes of bronchoconstriction (tightening of the muscles around the airways in the lungs) and inflammation (swelling of the bronchial airways). Symptoms of asthma can include wheezing, breathlessness, chest tightness, and coughing. Asthma attacks or episodes can be triggered by allergens, irritants or other factors, like exercise. These factors are well known; however, the factors that cause asthma to develop in the first place are largely unknown.

Asthma is one of the most common chronic diseases in the United States. An estimated 22.2 million adults and 6.5 million children in this country have asthma. In 2005, asthma accounted for 490,000 hospitalizations and 1.8 million emergency department visits. Asthma is a cause of missed days from school and work, interrupted sleep, and limited physical activity, and is associated with \$14.7 billion in direct costs of health care and medication, and \$5 billion in indirect costs such as lost work time. While asthma cannot be cured, it can be controlled and managed with adequate access to medical care, medications, trigger avoidance, and self-management.

Asthma has been of increasing concern in Minnesota and across the country due to rising incidence rates, most notably in children, since the mid-1980s. There are indications that the rate of increase in asthma prevalence may be leveling off. In addition, rates of asthma-related hospitalizations and deaths due to asthma are decreasing. Despite these promising signs, disparities in the burden of asthma persist.

About this report:

We are happy to be able to include several new sources of asthma data that have become available since the 2005 “*Asthma in Minnesota*” report. These new data sources include: the Minnesota Student Survey, the Minnesota Youth Tobacco and Asthma Survey, the Minnesota Asthma Callback Survey and data on asthma-related emergency department visits. Information on these new data sources, as well as details on ongoing data sources, is provided in the Data Sources section at the end of the report.

This report also includes data on asthma from the “STEPS to a Healthier Minnesota” program which surveyed adults and youth in the communities of Willmar, Rochester, St. Paul and Minneapolis. These data were used, along with data from the ongoing Hennepin County Survey of the Health of All the Population and the Environment (SHAPE), to produce the Local Data Profiles. (Profiles by Minnesota Asthma Coalition region will be available in 2009.) In addition, detailed data tables, including rates of asthma-related emergency department visits and hospitalizations by county of patient’s residence, are included in Appendix C.

Because much of the data used in this report comes from surveys, *confidence intervals* have been included, when available, as an indication of the margin of error associated with the survey results. The statistical definition of a 95% confidence interval is the range of possible values within which the true value is expected to fall 95 times out of 100. A “wide” confidence interval indicates that a relatively small number of individuals were included in

the survey and the estimate is less reliable. Confidence intervals can also be calculated for rates, as shown in the county tables in Appendix C.

Since the 2005 “*Asthma in Minnesota*” report, the National Heart, Lung, and Blood Institute (NHLBI) released an updated version of its national guidelines, “*Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma*”. When possible, this report has been organized around the new national guidelines, specifically, the four key components of asthma care: (1) assessment and monitoring of asthma symptoms, (2) medications, (3) education provided to patients on how to manage their asthma, and (4) recognition and control of comorbid conditions and environmental factors that can make asthma worse.

The purpose of this report is to use all available data sources to describe the burden of asthma in Minnesota. It establishes baselines for asthma prevalence, health care utilization, quality of life and mortality that can be used to evaluate the impact of future public health efforts, plan education and intervention programs, and develop policies that are necessary for preventing and controlling asthma in the future.

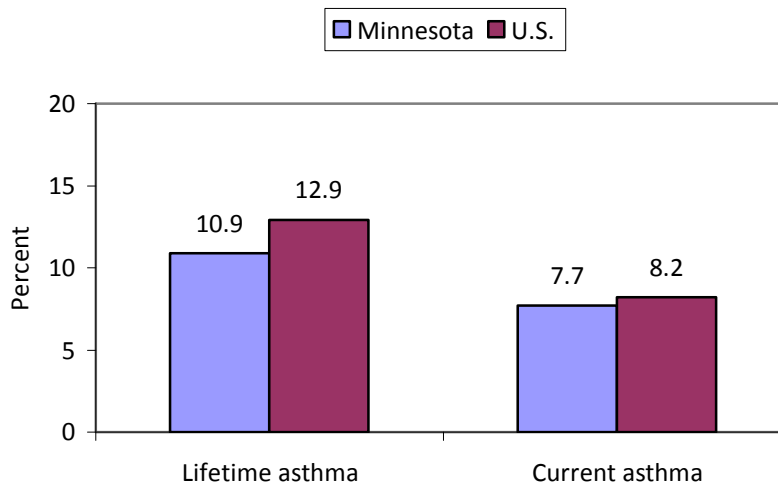
ASTHMA PREVALENCE

Asthma prevalence is a measure of the percentage of people who have asthma—both newly-diagnosed and existing cases—in a particular population at a particular time. Typically, asthma prevalence is measured using surveys. The question “Has a doctor or nurse ever told you that you had asthma?” is used to measure *lifetime asthma prevalence*, followed by “Do you still have asthma?” to measure *current asthma prevalence*. Note that these questions only track diagnosed asthma; thus, trends in asthma prevalence are also affected by trends in asthma awareness and diagnosis.

In Minnesota, the prevalence of asthma in adults is tracked using the Behavioral Risk Factor Surveillance System (BRFSS), while the prevalence of asthma in children is tracked using BRFSS, the Minnesota Student Survey and the Minnesota Youth Tobacco and Asthma Survey. Local data on asthma prevalence is available for Hennepin County through the Survey of the Health of the All Population and the Environment (SHAPE), and for the cities of Minneapolis, St. Paul, Rochester and Willmar through the “STEPS to a Healthier Minnesota” program.

Adult Asthma Prevalence

Figure 1. Lifetime and current asthma prevalence among adults, Minnesota and U.S., 2007

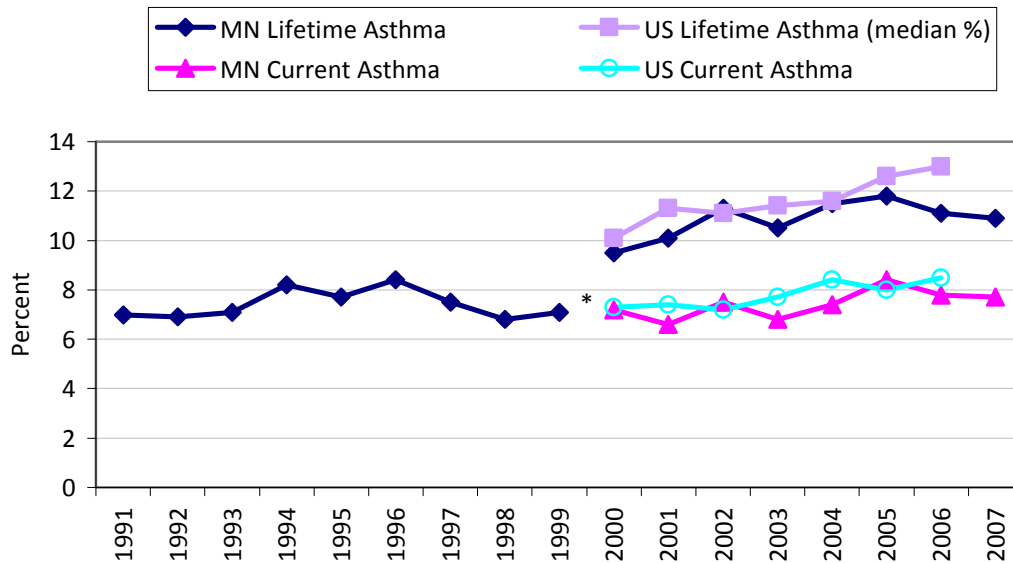


Source: Minnesota BRFSS, 2007

In 2007, 10.9% of adults reported that they had been told sometime in their lifetime that they had asthma; 7.7% reported that they still had asthma. That translates to an estimated 429,000 Minnesota adults who have a history of asthma and an estimated 303,000 who currently have asthma. The prevalence of asthma among Minnesota adults is lower than the median estimate for all states for both lifetime and current asthma.

Among Minnesota adults with asthma, 41.9% report that they were diagnosed in childhood (under age 18), while 58.1% report receiving a diagnosis as an adult. (Minnesota Asthma Callback Survey, 2005)

Figure 2. Lifetime and current asthma prevalence, Minnesota vs US Adults, 1991-2007



*Change in wording and order of questions in 2000.

Source: Minnesota BRFSS, 1991-2007; US data: BRFSS, 2000-2006 www.cdc.gov/brfss.

Lifetime asthma prevalence among adults in Minnesota remained fairly stable between 1991 and 1999, ranging from a low of 6.8% in 1998 to a high of 8.4% in 1996. In 2000, the survey questions were changed to track both lifetime and current asthma. Between 2000 and 2007, the percentage of Minnesota adults who reported having current asthma increased from 7.2% in 2000 to 8.4% in 2005, and has decreased since then to 7.7% in 2007; however, the difference in the prevalence between the years 2000 and 2007 was not statistically significant (i.e., may be due to random variation and not a true increase). Increases in asthma prevalence over time may be due to a true increase in the number of new cases of asthma and/or increased recognition and diagnosis of the disease. Because of the changes made to the BRFSS survey in 2000, data before and after 2000 cannot be compared.

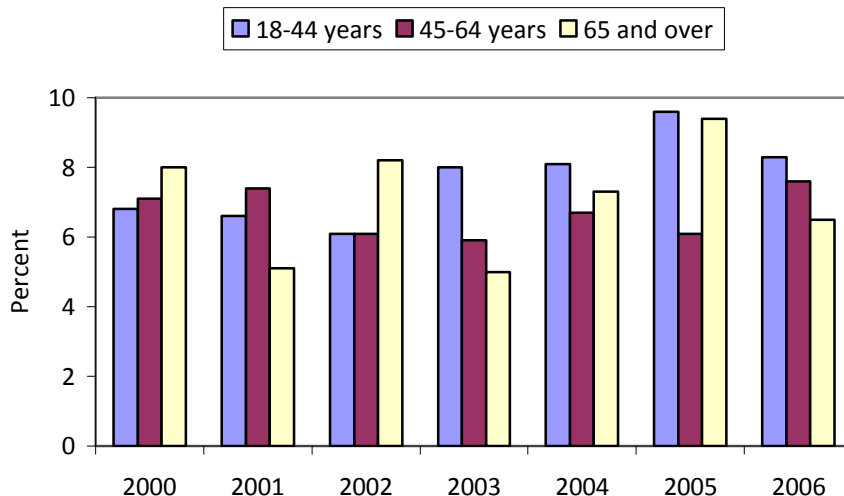
**Figure 3. Current asthma prevalence by sex,
Minnesota adults, 2000-2007**



Source: Minnesota BRFSS, 2000-2007

Women are more likely than men to report that they currently have asthma. In 2007, the prevalence of asthma among Minnesota women was slightly lower than that for U.S. women (9.6% vs. 10.4%); similarly, the prevalence among Minnesota men was slightly lower than that for U.S. men (5.8% vs. 6.4%). (U.S. data: www.cdc.gov/BRFSS)

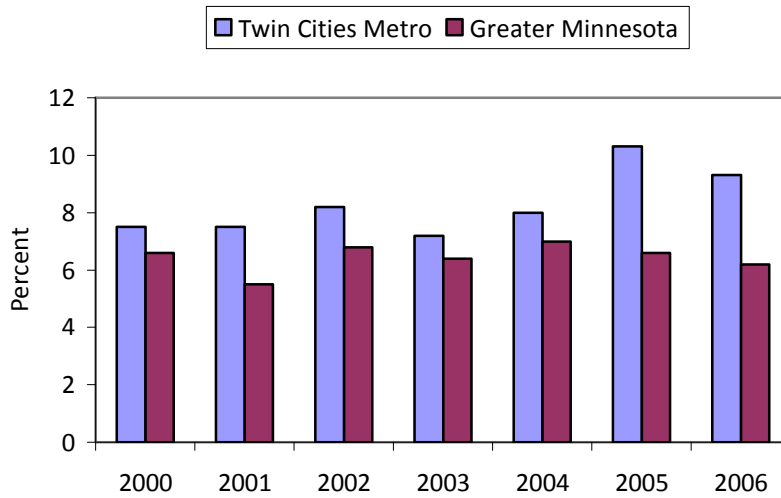
Figure 4. Current asthma prevalence by age group, Minnesota adults, 2000-2006



Source: Minnesota BRFSS, 2000-2006

Between 2000 and 2006, there have been no clear trends in adult asthma prevalence by age group. Some of the variation may be due to the relatively small numbers of respondents in each age group. In 2006, 8.3% of 18-44 year olds reported current asthma, 7.6% of 45-64 year olds, and 6.5% of 65+ year olds, indicating slightly higher prevalence of current asthma in younger adults.

Figure 5. Current asthma prevalence by residence, Minnesota adults, 2000-2006

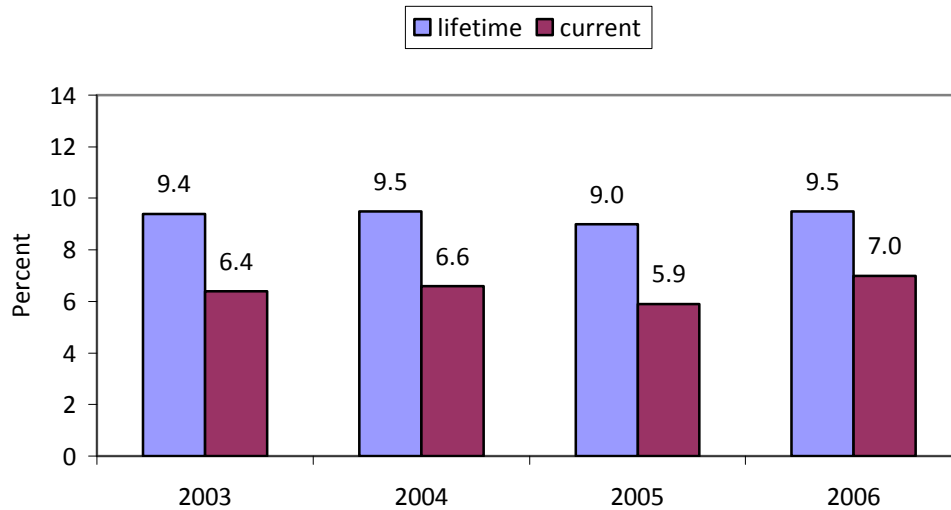


Source: Minnesota BRFSS, 2000-2006

Minnesota adults who are residents of the seven-county Twin Cities metropolitan area (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties) are more likely to report having asthma than adults in Greater Minnesota (which includes all other Minnesota counties). From 2000 to 2006, Twin Cities metro-resident adults have consistently reported a higher prevalence of current asthma than adults in Greater Minnesota. In 2006, 9.3% of adults in the metro area reported current asthma, while 6.2% of Greater Minnesota adults reported current asthma. See the Local Data Profiles section for more detailed information on asthma prevalence within the Twin Cities metro area.

Child Asthma Prevalence

Figure 6. Lifetime and current asthma prevalence, Minnesota children, 2003-2006



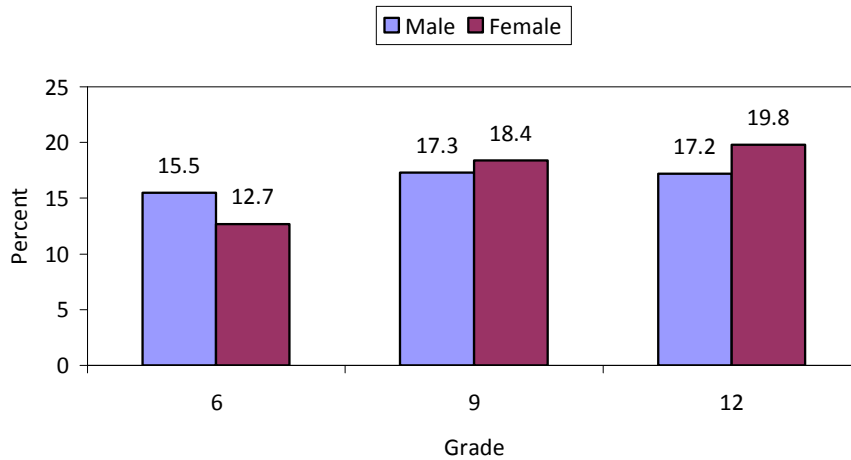
Source: Minnesota BRFSS, 2003-2006.

The prevalence of asthma among children (age 0-17) in Minnesota has remained stable since 2003 when it was first measured by the MN BRFSS. In 2006, 9.5% of children were reported to have ever been diagnosed with asthma, and 7.0% were reported to currently have asthma. That translates to an estimated 116,000 children with lifetime asthma and 85,000 with current asthma.

Currently, national estimates for the prevalence of asthma among U.S. children from BRFSS are not available. According to the National Health Interview Survey (NHIS), 13.5% of U.S. children have ever been diagnosed with asthma and 9.3% currently have asthma. (Source: NHIS, 2006; <http://www.cdc.gov/asthma/nhis/06/data.htm>) Note that some of the difference between the national NHIS estimates and the Minnesota BRFSS estimates for children may be due to slightly different wording of the survey questions and different survey methods (i.e., in-person versus telephone interviews).

Data from the Minnesota Student Survey shows a clear pattern of asthma prevalence by sex and grade. Boys are more likely than girls in grade 6 to have ever been diagnosed with asthma, but by grade 9, girls are more likely than boys to have a history of asthma, and the difference persists through grade 12. Data on asthma prevalence by county and grade can be found in Appendix C.

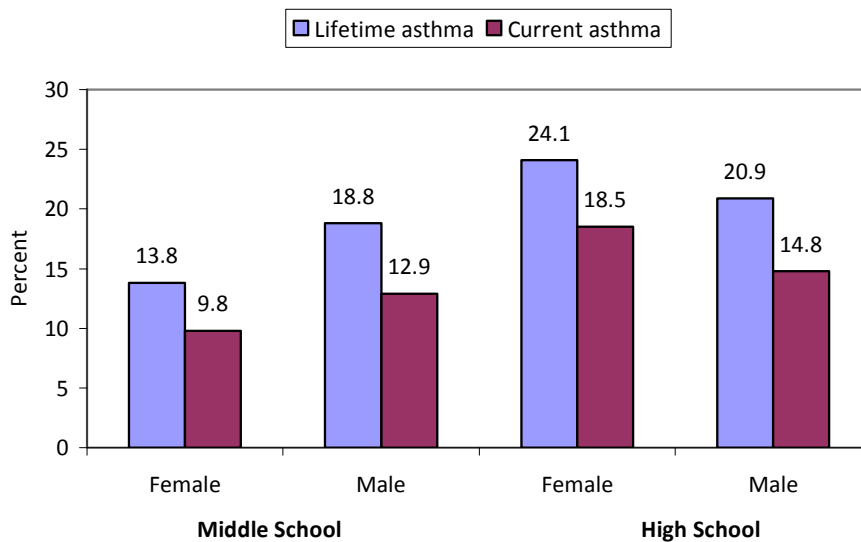
Figure 7. Lifetime asthma prevalence among Minnesota middle and high school students by grade and sex, 2007



Source: Minnesota Student Survey, 2007.

Similarly, the Youth Tobacco and Asthma Survey shows that middle school boys (grades 6-8) are more likely than girls to have asthma, while in high school (grades 9-12), girls are more likely than boys to have asthma.

Figure 8. Lifetime and current asthma prevalence among Minnesota youth, 2008



Source: Minnesota Youth Tobacco and Asthma Survey, 2008.

ASTHMA CONTROL

The severity of asthma in an individual *prior to treatment* can be assessed based on the frequency of daytime and nighttime asthma symptoms, the need for quick-relief medication, activity limitations and the results of lung function testing. The “*Expert Panel Report 3 (EPR-3) Guidelines for the Diagnosis and Management of Asthma*,” released in 2007 by the National Asthma Education and Prevention Program (NAEPP), emphasizes the importance of asthma control; that is, the reduction of asthma symptoms through appropriate use of medication and control of environmental factors and comorbid conditions (e.g., gastroesophageal reflux) (National Heart, Lung, and Blood Institute 2007).

Overall, 33.0% of adults and 66.4% of children with current asthma report that they were symptom-free in the past 2 weeks (Asthma Callback Survey),¹ an indication of well-controlled asthma. Note that some of the difference between adults and children may be due to the fact that the figure for adults is based on self-report while that for children is based on parent-report.

Table 1. Factors used to classify asthma control in individuals age 12 and older.

Components of Asthma Control		Classification of Asthma Control (≥12 years of age)		
		Well Controlled	Not Well Controlled	Very Poorly Controlled
Impairment:	Symptoms	≤2 days/week	>2 days/week	Throughout the day
	Nighttime awakenings	≤2x/month	1-3x/week	≥4x/week
	Short-acting beta2-agonist use for symptom control	≤2 days/week	>2 days/week	Several times per day
	FEV1 or peak flow	>80% predicted/ personal best	60-80% predicted/ personal best	<60% predicted/ personal best
Risk:	Exacerbations requiring oral systemic corticosteroids	0-1/year	≥2/year	
	Progressive loss of lung function	Evaluation requires long-term followup care		
	Treatment-related adverse effects	Medication side effects can vary in intensity from none to very troublesome and worrisome. The level of intensity does not correlate to specific levels of control but should be considered in the overall assessment of risk.		

Source: Expert Panel Report 3 (EPR-3) Guidelines for the Diagnosis and Management of Asthma.

¹ Responded “14” for: “During the past 2 weeks, on how many days were you symptom-free, that is no coughing, wheezing, or other symptoms of asthma?”

The measures of impairment used to assess asthma control in youth (age 12 and older) and adults are shown in Table 1. (A similar table for children can be found in the EPR-3 Guidelines.) The EPR-3 Guidelines define impairment as “frequency and intensity of symptoms and functional limitations the patient is experiencing currently or has recently experienced” (National Heart, Lung, and Blood Institute 2007). Table 2 shows data from the Asthma Callback Survey regarding impairment among adults and children in Minnesota with current asthma.

Table 2. Measures of impairment among adults and children with current asthma, Minnesota, 2005.

	Adults % (95% CI) [^]	Children % (95% CI) [^]
Had symptoms in past 30 days ¹	71.9 (65.4-78.4)	39.4 (25.8-52.9)
Sleep disrupted by asthma in past 30 days ²	24.1 (18.2-29.9)	*
Asthma attack or episode in past 12 months ³	51.7 (44.4-58.9)	40.7 (28.7-52.7)
Unable to work or carry out usual activities due to asthma in past 12 months ⁴	68.6 (61.7-75.4)	51.8 (37.6-66.0)
Had ≥1 urgent office visits for worsening symptoms in past 12 months ⁵	17.7 (12.5-22.8)	26.7 (15.7-37.7)
Had ≥1 emergency department visits for asthma in past 12 months ⁶	11.0 (6.4-15.5)	15.4 (6.9-24.0)
Missed 1 or more school days in past year due to asthma ⁷	-	28.5 (17.0-40.0)

Source: Minnesota Asthma Callback Survey, 2005.

[^]95% C.I. = 95% confidence interval

*Percentage not shown if the unweighted sample size for the denominator was <50 or if the relative standard error is ≥30%

¹“One or more” to: “During the past 30 days, on how many days did you or your child have any symptoms of asthma?”

²“One or more” to: “During the past 30 days, on how many days did symptoms of asthma make it difficult for you or your child to stay asleep?”

³“Yes” to: “During the past 12 months, have you or has your child had an episode of asthma or an asthma attack?”

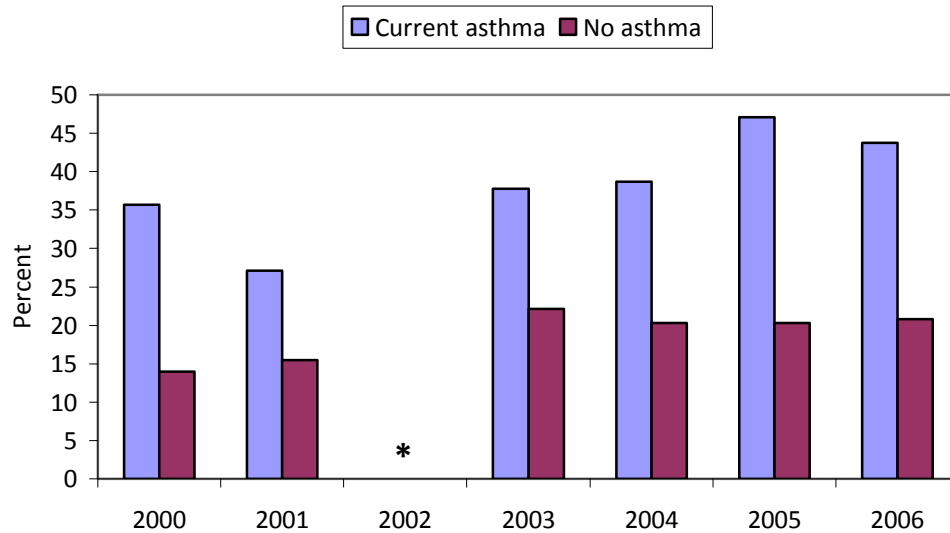
⁴“One or more days” to: “During the past 12 months, how many days were you or your child unable to work or carry out your usual activities because of your asthma?” and responded “a little”, “moderate” or “a lot” to: “During the past 12 months, would you say you or your child limited your usual activities due to asthma not at all, a little, a moderate amount, or a lot?”

⁵“One or more” to: “During the past 12 months, how many times did you or your child see a doctor or other health professional for urgent treatment of worsening asthma symptoms or for an asthma episode or attack?”

⁶“One or more” to: “During the past 12 months, how many times did you or your child visit an emergency room or urgent care center because of your asthma?”

Theoretically, people with asthma should be able to lead healthy, active lives. Since 2000, adults with current asthma have been more likely than adults without asthma to report activity limitations. In 2006, 43.8% of adults with current asthma reported activity limitations, whereas only 20.8% of adults without asthma reported activity limitations.

Figure 9. Activity limitations by asthma status, Minnesota, 2000-2006

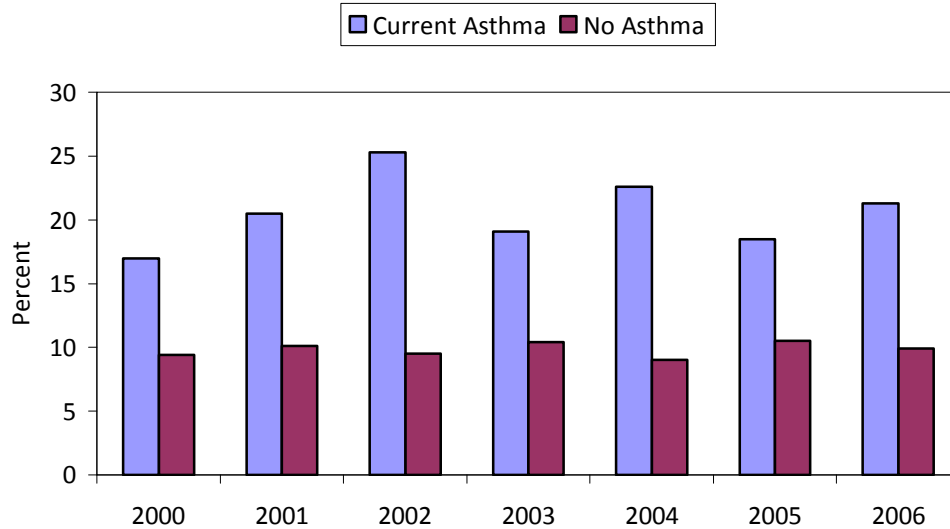


*Question not asked in 2002.

Source: Minnesota BRFSS, 2000-2006.

Uncontrolled asthma can negatively impact one's quality of life. Since 2000, a higher proportion of adults with current asthma have reported fair or poor health compared to adults without asthma. In 2006, 21.3% of adults with current asthma described their health as fair or poor health versus 9.9% of adults without asthma.

Figure 10. Fair or poor health by asthma status, Minnesota adults, 2000-2006



Source: Minnesota BRFSS, 2000-2006

ASTHMA MANAGEMENT

According to the NHLBI guidelines, the goals of asthma management include the prevention of recurring asthma symptoms and exacerbations, and maintenance of normal levels of physical activity (National Heart, Lung, and Blood Institute 2007). The EPR-3 describes four components of asthma care to achieve those goals: assessment and monitoring of symptoms, medication use, asthma self-management education, and control of comorbid conditions and environmental factors that can make asthma worse. The previous section addressed the first component, data in this section address the second, along with other steps taken to manage asthma. They are followed by sections with data addressing the third and fourth components.

Medication Use

There are two major categories of medication used to treat asthma: long-term control medications and quick-relief medication. Examples of long-term control medication include corticosteroids, long-acting beta₂-agonists and leukotriene modifiers; examples of quick-relief medication include short-acting beta₂-agonists and anticholinergics. The table below lists the percentage of adults and children with current asthma taking different types of asthma medication in the past 3 months. Note that survey respondents were asked to name the medications they (or their children) were taking; responses were then categorized into the medication types listed in the table below.

Table 6. Medication use among adults and children with current asthma, Minnesota, 2005.

	Adults % (95% C.I.)	Children % (95% C.I.)
Used any prescription asthma medication in past 3 months ¹	73.2 (66.5-80.0)	65.2 (52.5-78.0)
Used inhaled corticosteroid in past 3 months ²	41.1 (34.3-47.9)	25.2 (14.3-36.1)
Used inhaled long-acting beta ₂ agonist in past 3 months ³	28.3 (22.2-34.5)	*
Used leukotriene modifier in past 3 months ⁴	10.5 (6.4-14.6)	14.9 (7.6-22.3)
Used inhaled anti-inflammatory in past 3 months ⁵	0	*
Used inhaled anticholinergic in past 3 months ⁶	4.8 (2.6-7.0)	*
Used inhaled short-acting beta ₂ -agonist in past 3 months ⁷	59.2 (52.2-66.3)	46.8 (34.3-59.2)

Source: Minnesota Asthma Callback Survey, 2005

*Percentage not shown if the unweighted sample size for the denominator was <50 or if the relative standard error is ≥30%

¹"Yes" to "In the past 3 months _____?" to any of the following:

...have you taken any prescription asthma medicine using an inhaler?"

...have you taken any prescription asthma medication in pill form?"

...have you taken any prescription asthma medication in syrup form?"

...were any of your asthma medicines used with a nebulizer?"

²"One or more" to: Inhaled corticosteroid in past 3 months.

³"One or more" to: Inhaled long-acting beta₂-agonist in past 3 months.

⁴"One or more" to: Leukotriene modifier in past 3 months.

⁵"One or more" to: Inhaled anti-inflammatory in past 3 months.

⁶"One or more" to: Inhaled anticholinergic in past 3 months.

⁷"One or more" to: Inhaled short-acting beta₂-agonist in past 3 months.

According to the Minnesota Asthma Callback Survey, 31.1% of adults and 21.6% of children with current asthma have ever used over-the-counter medications for their asthma.

Routine Checkups

As reported by parents/guardians of children with asthma and adults with current asthma, children are more likely than adults to have had a routine checkup for asthma in the past year.

Table 5. Routine checkups for asthma* among adults and children with current asthma, Minnesota, 2005.

	% (95% C.I.)
Adults	52.7 (45.4-59.9)
Children	73.8 (62.1-85.5)

Source: Minnesota Asthma Callback Survey, 2005

*“One or more” to: “During the past 12 months, how many times did you [your child] see a doctor or other health professional for a routine checkup of your [his/her] asthma?”

School-Based Asthma Management

Because children spend a portion of their day at school, it is important for them to be able to manage their asthma while in school. Table 7 lists the responses to two school-based asthma management questions asked of parents/guardians of children with current asthma.

The national guidelines recommend that healthcare providers provide a written asthma action plan for their patients with asthma. Asthma action plans include instructions for everyday asthma care (e.g., daily medications) and steps to take when symptoms worsen. (Data on asthma action plans for adults and children are also included in tables 3 and 4.)

Table 7. School-based asthma management among children with current asthma, Minnesota, 2005.

	% (95% C.I.)
Allowed to carry asthma medications at school ¹	61.6 (45.3-77.9)
Has a written asthma action plan (AAP) on file at school ²	35.8 (21.9-49.6)

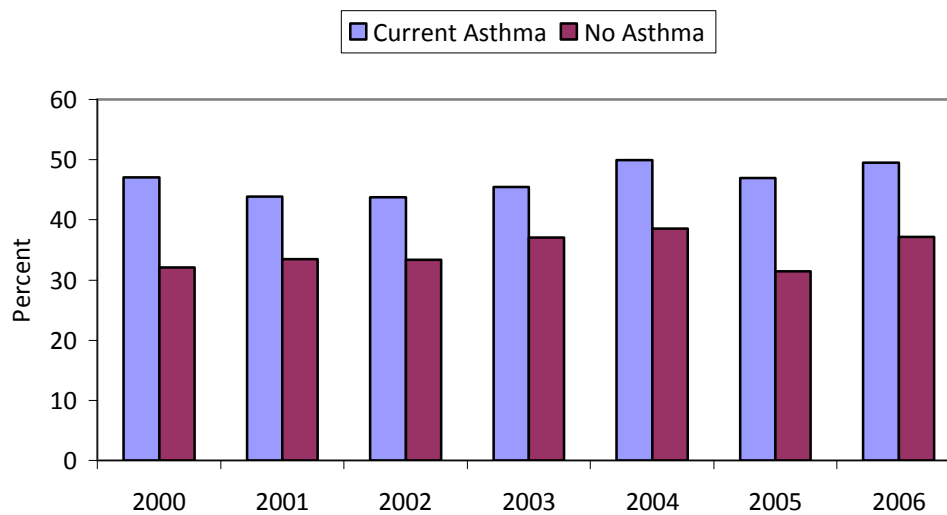
¹“Yes” to: “Is your child allowed to carry his or her asthma medicine with him or her at school?”

²“Yes” to: “Does your child have a written asthma action plan or asthma management plan on file at school?” where an asthma action plan was defined as “a form with instructions about when to change the amount or type of medicine, when to call the doctor for advice, and when to go the emergency room.”

Flu shots

The CDC recommends annual flu shots for people of all ages with asthma (Centers for Disease Control and Prevention 2008). In 2006, 49.5% of Minnesota adults with asthma received a flu shot versus 37.2% of adults without asthma. According to the Minnesota Asthma Callback Survey, 51.4%* of Minnesota children with asthma received a flu shot in 2005. These results are encouraging since people with asthma are more likely to become seriously ill if they contract influenza. Nonetheless, there is clearly a need to increase the proportion of people with asthma who receive an annual flu shot.

Figure 11. Flu shot in past year by asthma status, Minnesota adults, 2000-2006



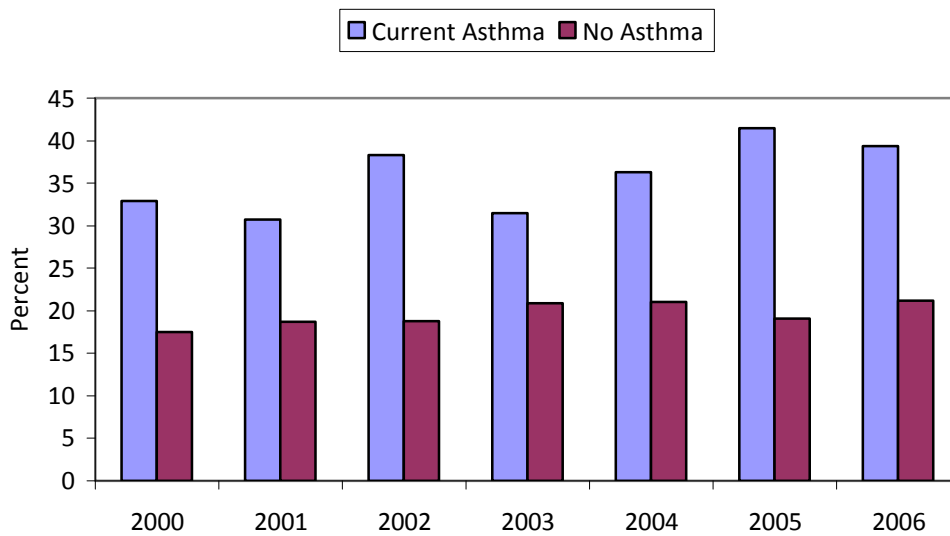
Source: Minnesota BRFSS, 2000-2006.

*Responded “Yes” to: “During the past 12 months, did your child have a flu shot?”

Pneumonia Vaccine

Adults with asthma are more likely than those without asthma to report ever having received a pneumococcal vaccine in their lifetime. This trend has been consistent since 2000. The pneumococcal vaccine protects against invasive pneumococcal disease, including meningitis and some pneumonias. In 2006, the percentage of people with current asthma who had ever received the vaccine was 39.4% versus 21.2% of adults without asthma. A recent study suggests that adults with asthma may be more likely to develop serious pneumococcal disease (Juhn, Kita et al. 2008).

Figure 12. Ever had pneumonia vaccine by asthma status, Minnesota adults, 2000-2006



Source: Minnesota BRFSS, 2000-2006.

ASTHMA SELF-MANAGEMENT EDUCATION

A key component of asthma care is self-management education. According to the national guidelines, this involves teaching persons with asthma how to monitor their level of asthma control, take medication correctly (e.g. inhaler technique), and avoid environmental triggers, as well as developing and providing a written asthma action plan (National Heart, Lung, and Blood Institute 2007).

Table 3. Asthma self-management education among Minnesota and US adults with current asthma.

	MN adults, 2005 % (95% C.I.)	U.S. adults, 2003 % (95% C.I.)
Taught to recognize early signs of an asthma attack	63.2 (56.1-70.2)	55.1 (52.5-57.6)
Taught how to respond to an asthma attack	77.4 (72.0-82.7)	64.8 (62.4-67.2)
Taught how to monitor peak flow	47.6 (40.3-54.9)	45.0 (42.4-47.8)
Ever given an asthma action plan	34.2 (27.0-41.5)	33.6 (31.2-36.1)
Taken a class on asthma management	7.7 (4.1-11.4)	12.4 (10.8-14.3)

Sources: Minnesota Asthma Callback Survey, 2005; Centers for Disease Control and Prevention, Asthma Self-Management Education Among Youths and Adults-United States, 2003; Morbidity and Mortality Weekly Report 2007, 56(35): 912-915.

Approximately one-third of Minnesota adults with current asthma report having ever received an asthma action plan. Less than two-thirds have been taught to recognize the early signs of an asthma attack. The percentages for Minnesota adults are higher than the national average for every measure except asthma management classes; however, there is still room for improvement.

Table 4. Asthma self-management education among children with current asthma, Minnesota, 2005.

	% (95% CI)
Taught to recognize early signs of an asthma attack ¹	78.2 (65.9-90.6)
Taught how to respond to an asthma attack ²	73.1 (58.7-87.6)
Taught how to monitor peak flow ³	50.7 (38.7-62.7)
Ever given an asthma action plan ⁴	51.4 (37.7-65.1)
Shown how to use an inhaler by a health professional ⁵	87.1 (74.7-99.5)
Health professional watched child use inhaler ⁶	84.3 (74.7-93.9)

Source: Minnesota Asthma Callback Survey, 2005

¹“Yes” to: “Has a doctor or other health professional ever taught you or your child how to recognize early signs or symptoms of an asthma episode?”

²“Yes” to: “Has a doctor or other health professional ever taught you or your child what to do during an asthma episode or attack?”

³“Yes” to: “Has a doctor or other health professional ever taught you or your child how to use a peak flow meter to adjust your daily medications?” where a peak flow meter was defined as “a hand held device that measures how quickly you can blow air out of your lungs.”

⁴“Yes” to: “Has a doctor or other health professional EVER given you or your child an asthma action plan?”

⁵“Yes” to: “Has your child ever used a prescription inhaler?” AND responded “yes” to: “Did a health professional show your child how to use the inhaler?”

⁶“Yes” to: “Did a doctor or other health professional watch your child use the inhaler?”

ENVIRONMENTAL FACTORS THAT AFFECT ASTHMA

Many environmental factors in the home can act as triggers of asthma episodes. The tables below present data from the Minnesota Asthma Callback Survey on environmental triggers in the homes of adults and children with asthma and steps taken to decrease these exposures. The same questions were asked of adults and parents of children with asthma. Several responses for children are not presented due to small numbers.

Table 8. Environmental triggers in the homes of adults and children with current asthma¹, Minnesota, 2005

	Adults % (95% C.I.)	Children % (95% C.I.)
Gas used for cooking ²	34.4 (27.8-41.0)	40.3 (27.8-52.9)
Mold in home ³	12.0 (7.9-16.1)	*
Has pets inside home ⁴	52.7 (45.5-59.8)	71.5 (61.0-82.0)
Pets allowed in bedroom ⁵	68.3 (59.1-77.5)	66.8 (50.7-83.0)
Mice or rats seen in home ⁶	5.8 (3.3-8.4)	*
Wood burning fireplace/stove ⁷	12.2 (8.0-16.3)	*
Gas fireplace or unvented gas stove ⁸	3.8 (1.7-5.8)	*
Smoking inside home in past week ⁹	18.5 (12.6-24.4)	*
Carpeting or rugs in bedroom ¹⁰	70.5 (64.0-77.0)	79.2 (69.1-89.2)
Ever advised to change environment ¹¹	42.9 (35.6-50.1)	25.7 (14.9-36.4)

Source: Minnesota Asthma Callback Survey, 2005

*Percentage not shown if the unweighted sample size for the denominator was <50 or if the relative standard error is ≥30%

Unless otherwise specified, responded “Yes” to:

¹“Have you ever been told by a doctor or other health professional that you have asthma?” and “Do you still have asthma?”

²“Is gas used for cooking?”

³“In the past 30 days, has anyone seen or smelled mold or a musty odor inside your home?”

⁴“Does your household have pets such as dogs, cats, hamsters, birds or other feathered or furry pets that spend time indoors?”

⁵Responded “yes” or “some are, some aren’t” to: “Are pets allowed in your bedroom?”

⁶“In the past 30 days, has anyone seen mice or rats inside your home?”

⁷“Is a wood burning fireplace or wood burning stove used in your home?”

⁸“Are unvented gas logs, unvented gas fireplace or unvented gas stove used in your home?”

⁹“In the past week, has anyone smoked inside your home?”

¹⁰“Do you have carpeting or rugs in your bedroom?”

¹¹“Has a health professional ever advised you to change things in your home, school, or work to improve your asthma?”

Table 9. Environmental modifications in the homes of adults and children with current asthma¹, Minnesota, 2005

	Adults % (95% C.I.)	Children % (95% C.I.)
Air cleaner or purifier regularly used ²	28.8 (22.7-34.9)	25.3 (12.9-37.7)
Dehumidifier regularly used ³	45.3 (38.3-52.4)	45.0 (31.1-58.9)
Exhaust fan in kitchen regularly used ⁴	58.5 (51.3-65.6)	64.4 (51.4-77.3)
Mattress cover used ⁵	19.8 (14.2-25.4)	24.4 (12.6-36.20)
Pillow cover used ⁶	20.1 (14.7-25.5)	27.4 (15.3-39.4)
Exhaust fan in bathroom used regularly ⁷	63.1 (56.3-69.9)	65.3 (51.6-78.9)
Sheets and pillowcases washed in hot water ⁸	38.1 (31.3-44.9)	38.6 (25.4-51.8)

Source: Minnesota Asthma Callback Survey, 2005

Unless otherwise specified, responded "Yes" to:

¹"Have you ever been told by a doctor or other health professional that you have asthma?" and "Do you still have asthma?"

²"Is an air cleaner or purifier regularly used inside your home?"

³"Is a dehumidifier regularly used to reduce moisture inside your home?"

⁴"Is an exhaust fan that vents to the outside used regularly when cooking in your kitchen?"

⁵"Do you use a mattress cover that is made especially for controlling dust mites?"

⁶"Do you use a pillow cover that is made especially for controlling dust mites?"

⁷"In your bathroom, do you regularly use an exhaust fan that vents to the outside?"

⁸Responded "hot" to: "Are your sheets and pillowcases washed in cold, warm, or hot water?"

COMORBID CONDITIONS THAT AFFECT ASTHMA

The Minnesota Asthma Callback Survey includes questions on co-existing chronic conditions, specifically chronic obstructive pulmonary disease (COPD) and depression, offering the first opportunity to look at the prevalence of these conditions among adults with asthma in Minnesota.

COPD is a broad term that encompasses both emphysema and chronic bronchitis. Because COPD is a relatively new term and because some individuals may know the condition by different names (COPD, emphysema or chronic bronchitis), the Minnesota Asthma Callback Survey includes separate questions about the respondent's history of COPD, emphysema and chronic bronchitis. Overall, 28% of adults with asthma report that they have also been diagnosed with COPD (i.e., answered "yes" to having been diagnosed with COPD or emphysema or chronic bronchitis).

Nearly one-third of all adults with current asthma report a diagnosis of depression. This finding does not imply that having asthma leads to depression, or vice versa. It is clear that there is an association between the two conditions, but more research is needed to determine exactly how they are related.

Table 10. Comorbid conditions reported by adults with current asthma (N=330), Minnesota, 2005

	n*	Percent	95% CI
Chronic Obstructive Pulmonary Disease ¹	97	27.9	21.1-34.8
Depression ²	111	32.7	25.7-39.6

*unweighted number of respondents

¹Responded "Yes" to any of the following questions: "Have you ever been told by a doctor or other health professional that you have...

...chronic obstructive pulmonary disease also known as COPD?"

...emphysema?"

...chronic bronchitis?"

²Responded "Yes" to "Have you ever been told by a doctor or other health professional that you were depressed?"

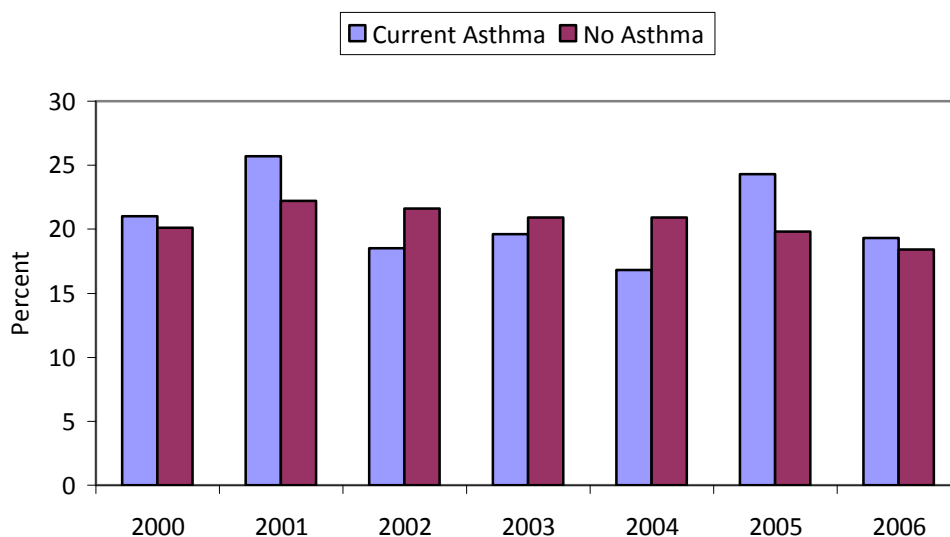
Source: Minnesota Asthma Callback Survey, 2005

RISK FACTORS ASSOCIATED WITH ASTHMA

Smoking

Adults with asthma are just as likely to report that they smoke cigarettes as people without asthma. These findings suggest that people with asthma continue to smoke. Smoking can be a trigger of asthma symptoms, and environmental tobacco smoke (also known as secondhand smoke) is known to exacerbate asthma and cause asthma in young children (Institute of Medicine 2000). In 2006, 19.3% of adults with current asthma reported smoking while 18.4% of adults without asthma reported smoking; these proportions are relatively consistent with reported smoking data since 2000.

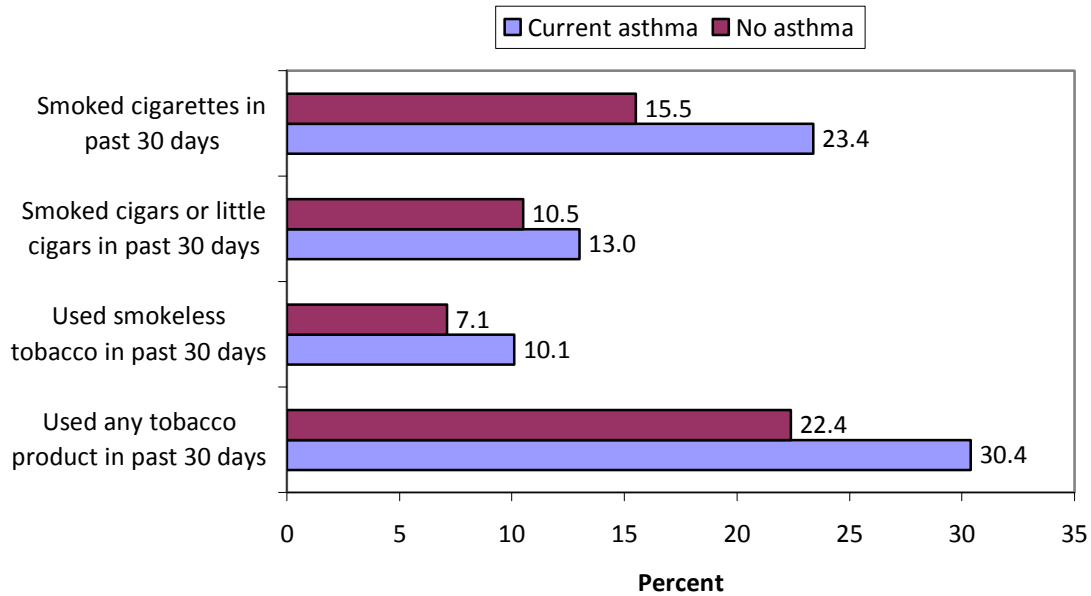
Figure 13. Current smoking by asthma status, Minnesota adults, 2000-2006



Source: Minnesota BRFSS, 2000-2006.

Data from the Minnesota Youth Tobacco and Asthma Survey show that high school students with asthma are more likely than students without asthma to use tobacco. No such associations were observed among middle school students (data not shown).

Figure 14. Tobacco use and current asthma status, Minnesota high school students, 2008



Source: 2008 Minnesota Youth Tobacco and Asthma Survey

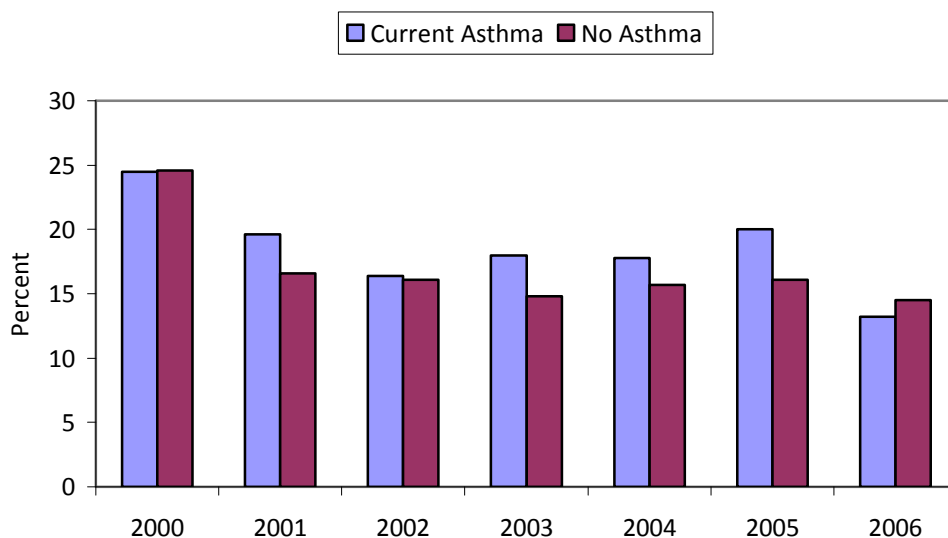
Secondhand Smoke

Results from the Minnesota Youth Tobacco and Asthma Survey also show associations between secondhand smoke and asthma. Students with current asthma are more likely than their peers who do not have asthma to live with someone who smokes. Among high school students, 44.7% of those with asthma live with a smoker versus 37.2% of students without asthma. Among middle school students with asthma, 48.6% reported being exposed to secondhand smoke in the past week compared to 38.3% of students without asthma.

Physical Inactivity

Decreasing numbers of Minnesota adults report that they are physically inactive (i.e., no leisure time physical activity in the past 30 days), with little difference between those with asthma and those who do not have asthma. This is a good sign because when asthma is under control, individuals with asthma should not be limited in their ability to participate in physical activities. During the most recent year of data (2006), 13.2% of adults with current asthma and 14.5% of adults without asthma reported that they had no leisure time physical activity in the past 30 days.

Figure 15. No leisure time physical activity by asthma status, Minnesota adults, 2000-2006



Source: Minnesota BRFSS, 2000-2006.

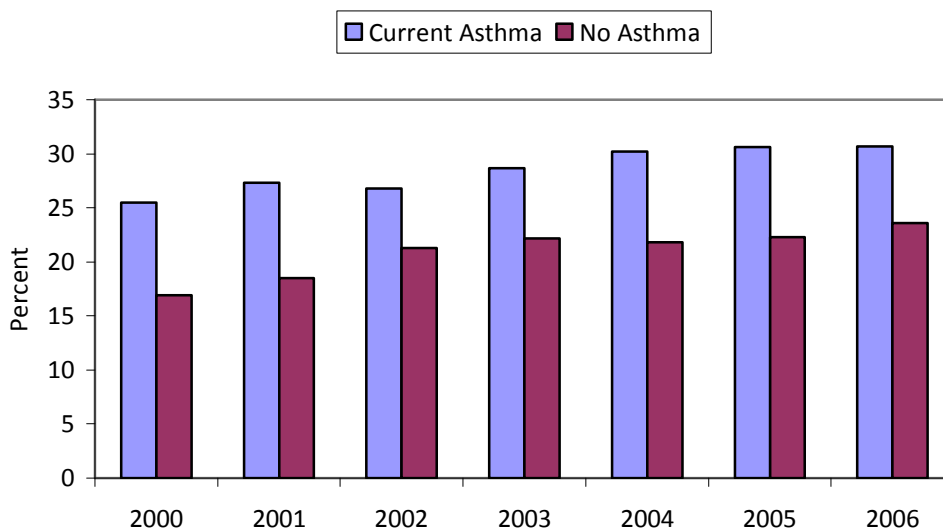
Obesity

Body mass index (BMI) is a measure of body fat based on height and weight. In this case, the BMI is based on the BRFSS respondent's self-reported height and weight. (BMI = weight in kilograms divided by the square of the height in meters.) The CDC defines overweight as a BMI greater than 24 and less than 30, and obese as a BMI greater than or equal to 30.

Since 1991, there has been little difference in the percentage of Minnesota adults who are overweight and have asthma compared to those who are overweight and do not have asthma (data not shown). However, adults with asthma are much more likely than those without asthma to be obese. We cannot say for certain whether people who are obese are more likely to develop asthma or whether people with asthma are more likely to become obese because asthma has caused them to limit their activities (Ford 2005).

In 2006, 30.7% of adults with current asthma reported an obese BMI, while only 23.6% of adults without asthma reported an obese BMI.

Figure 16. Obesity by asthma status, Minnesota adults, 2000-2006



Source: Minnesota BRFSS, 2000-2006

COSTS OF CARE

The total costs of asthma in Minnesota for 2003 have been estimated at \$363.9 million, including \$208.6 million in direct costs of office visits, ED visits, hospitalizations and medication, and \$155.3 in indirect costs of missed school and work days. (Coffey, Ho et al. 2006)

A potential barrier to asthma control is the cost of medical care and medications. Results from the 2005 Minnesota Asthma Callback Survey show that approximately 9% of children and 4% of adults with asthma do not have health insurance coverage, whether through commercial or public plans. Ten percent of adults with asthma and 6% of parents/guardians of children with asthma report not being able to afford asthma medications at some time in the past year.

Table 11. Insurance status and costs among children and adults with current asthma, Minnesota, 2005

	Children % (95% C.I.)	Adults % (95% C.I.)
Currently has health insurance ¹	91.1 (82.6-99.6)	96.1 (93.7-98.4)
Cost not a barrier to seeing primary care doctor for asthma in past 12 months ²	94.2 (88.5-99.9)	96.0 (93.2-98.8)
Cost not a barrier to buying medications for asthma in past 12 months ³	93.9 (87.0-99.6)	89.9 (85.6-94.2)

Source: Minnesota Asthma Callback Survey, 2005

¹“Yes” to: “Do you [Does your child] have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare or Medicaid?”

²“No” to: “Was there a time in the past 12 months when you [your child] needed to see your primary care doctor for your asthma but could not because of the cost?”

³“No” to: “Was there a time in the past 12 months when you needed to buy medication for your [your child’s] asthma, but could not because of the cost?”

MINNESOTA PUBLIC HEALTH CARE PROGRAM ENROLLEES

It is important to characterize the burden of asthma among public health care program enrollees because lower-income populations are generally at higher risk for having asthma and for experiencing asthma exacerbations. The Minnesota Department of Human Services (DHS) oversees the state’s public health care programs. *Medical Assistance* is Minnesota’s Medicaid program, providing medical care and prescription medications for residents with low incomes and residents with disabilities. DHS contracts with managed care organizations to cover the majority of enrollees eligible for Medical Assistance through the *Prepaid Medical Assistance Program (PMAP)*. Persons with disabilities and others who are in transition between programs are covered through a fee-for-service program, *Medical Assistance Fee-For-Service (MA-FFS)*. *MinnesotaCare* is a program that provides health insurance for Minnesotans with low and moderate incomes who do not qualify for other health insurance coverage.

Because DHS does not collect information specifically on asthma diagnoses (i.e., from the medical record), individuals likely to have “persistent asthma” are identified based on claims for emergency department visits, hospitalizations, doctor visits and/or filling of prescriptions for asthma. (See the Data Sources section of this report for more details.) This definition identifies individuals likely to have “persistent asthma”, however, it is not based on an actual measure of asthma severity. For this reason, the term “persistent asthma” is listed in quotes.

Estimates of asthma prevalence using claims data, such as these, are typically lower than estimates of asthma prevalence from surveys, such as BRFSS. Thus, the figures below are not comparable to those for the statewide population presented earlier in this report.

Table 12. Percentage of enrollees with “persistent asthma” by public health care program, Minnesota, 2005-2007.

	2005	2006	2007
	%	%	%
PMAP	5.2	5.2	5.2
MA-FFS	9.1	5.7	5.8
MNCare	4.2	4.6	4.7

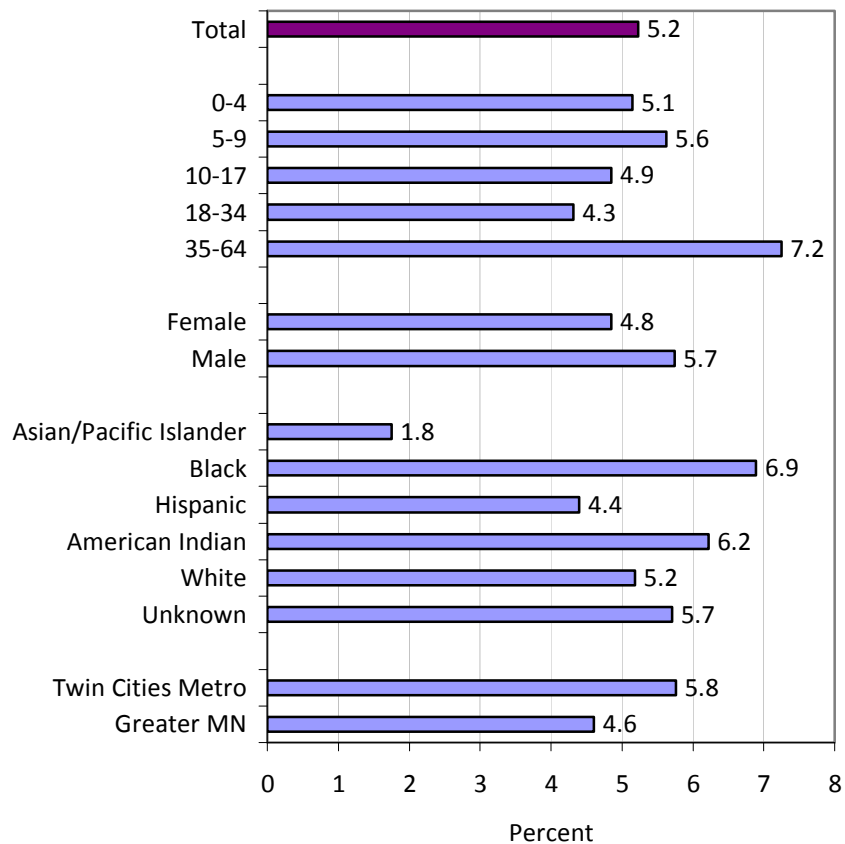
Source: Minnesota Department of Human Services, 2005-2007

The prevalence of persistent asthma was stable over 2005-2007 among PMAP enrollees and increasing among MinnesotaCare enrollees. It is not known why the prevalence of asthma was so high among MA-FFS enrollees in 2005.

Prevalence of “Persistent Asthma” Among Prepaid Medical Assistance Program (PMAP) Enrollees

Among the 139,460 individuals continuously enrolled in PMAP in 2007, 5.2% had “persistent asthma.” Prevalence of “persistent asthma” was highest among 35-64 year olds (7.2%) and Blacks/African Americans (6.9%). Prevalence was higher among residents of the seven-county Twin Cities metro area (5.8%) than among residents of Greater Minnesota (4.6%), and higher among males (5.7%) than females (4.8%).

Figure 17. Percentage of PMAP enrollees with “persistent asthma,” Minnesota, 2007

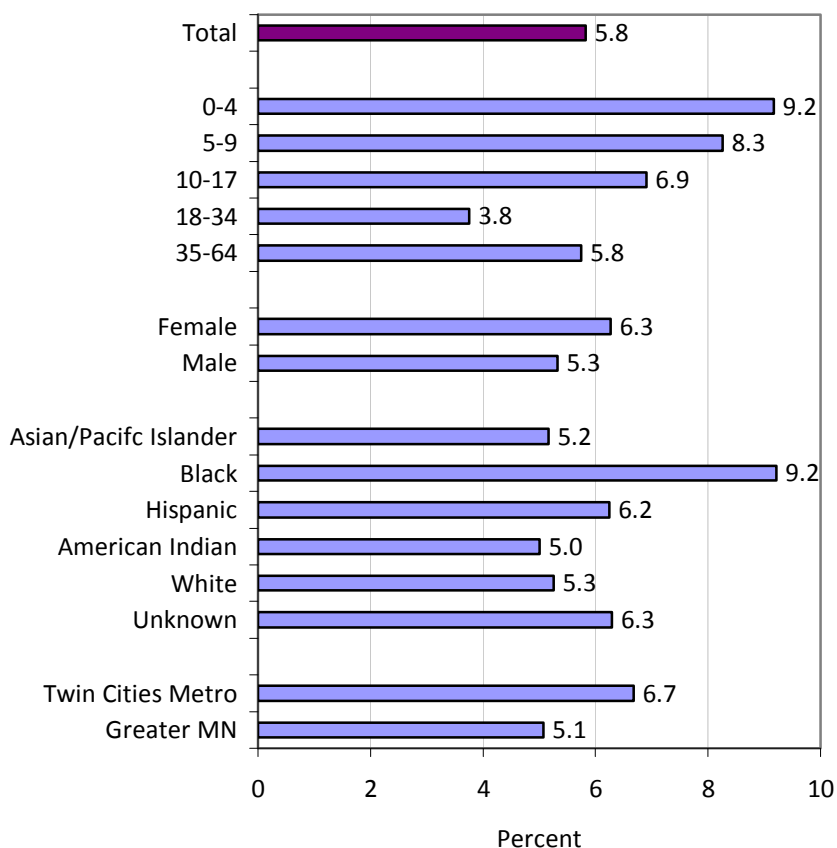


Source: Minnesota Department of Human Services, 2007.

Prevalence of “Persistent Asthma” Among Medical Assistance – Fee-For-Service (MA-FFS) Enrollees

Among the 117,098 individuals continuously enrolled in MA-FSS in 2007, 5.8% had “persistent asthma.” Prevalence of “persistent asthma” was highest among children under 10 years old (17.5%) and Blacks/African Americans (9.2%). Prevalence was higher among Twin Cities metro area residents (6.7%) than residents of Greater Minnesota (5.1%), and higher among females (6.3%) than males (5.3%).

Figure 18. Percentage of MA-FFS enrollees with "persistent asthma," Minnesota, 2007

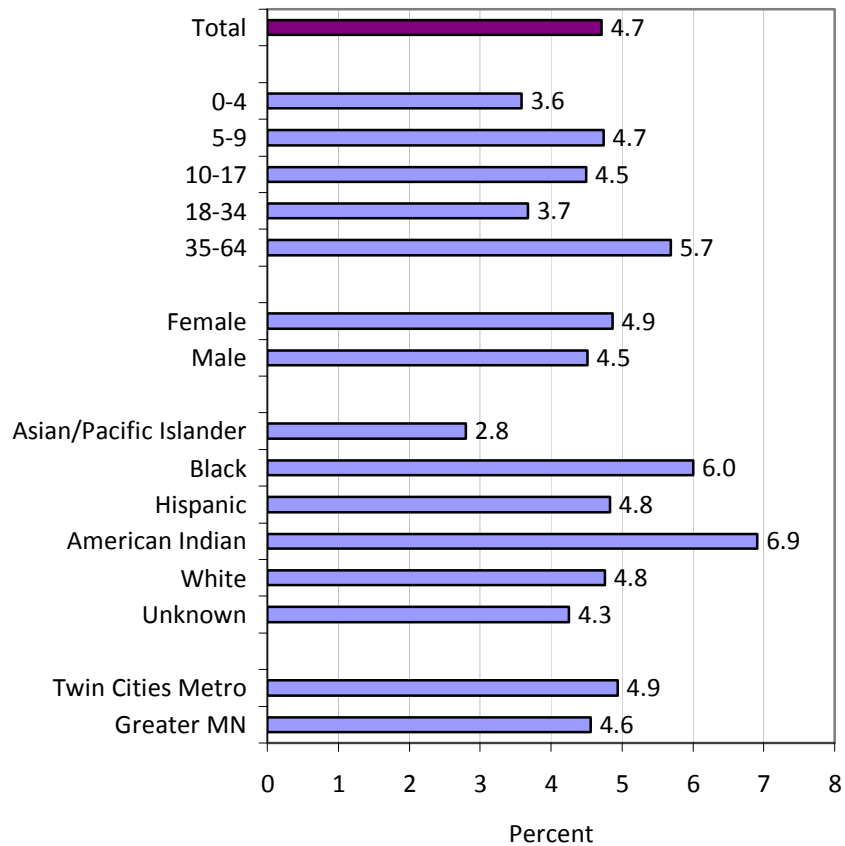


Source: Minnesota Department of Human Services, 2007.

Prevalence of “Persistent Asthma” Among MinnesotaCare Enrollees

Among the 74,430 individuals continuously enrolled in MinnesotaCare in 2007, 4.7% had “persistent asthma.” The prevalence of “persistent asthma” was highest among American Indians (6.9%), Blacks/African Americans (6.0%), and 35-64 year olds (5.7%). As with PMAP and MA-FFS, the prevalence of “persistent asthma” was slightly higher among Twin Cities metro area residents than Greater Minnesota residents. Prevalence was also slightly higher among females (4.9%) than males (4.5%).

Figure 19. Percentage of MinnesotaCare enrollees with "persistent asthma," Minnesota, 2007



Source: Minnesota Department of Human Services, 2007.

Medication Use

Overall, MinnesotaCare enrollees with “persistent asthma” were more likely than those in PMAP and MA-FFS to be using appropriate medication for asthma (i.e., filled at least one prescription for asthma controller medication during the study year) in 2007. (See Data Sources section for more details on this measure.) In each program, children age 5-9 were most likely to have used appropriate medication for asthma.

Table 13. Percentage of enrollees with “persistent asthma” who used appropriate asthma medications by program, Minnesota, 2007.

<i>Age Group</i>	<i>Prepaid Medical Assistance Program</i>	<i>Medical Assistance Fee-For-Service</i>	<i>MinnesotaCare</i>
0-4	74.1	87.3	84.2
5-9	86.9	90.1	91.2
10-17	83.5	83.8	87.5
18-34	70.9	68.5	77.3
35-64	75.4	67.5	82.2
Total	78.8	74.5	83.3

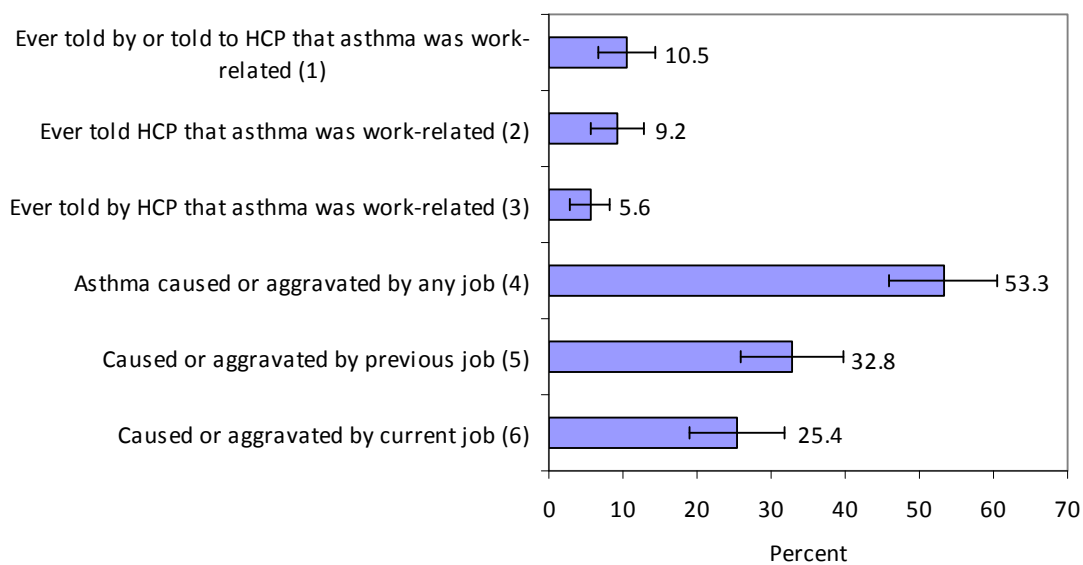
Source: Minnesota Department of Human Services, 2007.

WORK-RELATED ASTHMA

The Minnesota Asthma Callback Survey provides the first statewide estimates of the prevalence of work-related asthma (WRA). Here, the term work-related asthma includes both asthma that has been caused by some aspect of work and existing asthma that is worsened or aggravated by work. The Asthma Callback Survey asked about WRA in two ways: first, asking respondents whether their asthma had been caused or aggravated by their current or previous job; and second, whether or not their healthcare provider had ever told them or they had ever told their healthcare provider that their asthma was work-related.

More than half of all adults with asthma in Minnesota (53.3%) report that their asthma was caused or aggravated by a current or previous job. However, the prevalence of work-related asthma based on reported discussion with a healthcare provider is much lower.

Figure 20. Prevalence of work-related asthma among Minnesota adults with current asthma, 2005



Source: Minnesota Asthma Callback Survey, 2005. HCP=Healthcare provider

Responded “Yes” to:

¹ “[Were you ever told by/Did you ever tell] a doctor or other medical person that your asthma was related to any job you ever had?”

² “Did you ever tell a doctor or other medical person that your asthma was related to any job you ever had?”

³ “Were you ever told by a doctor or other medical person that your asthma was related to any job you ever had?”

⁴ “Was your asthma [caused/made worse] by chemicals, smoke, fumes, or dust in [your current job/any previous job you ever had]?”

⁵ “Was your asthma [caused/made worse] by chemicals, smoke, fumes, or dust in any previous job you ever had?”

⁶ “Was your asthma [caused/made worse] by chemicals, smoke, fumes, or dust in your current job?”

LOCAL DATA PROFILES

More detailed data on the prevalence of asthma in adults and children/youth is available for Hennepin County from the 2006 SHAPE survey, and for Minneapolis (Hennepin County), St. Paul (Ramsey County), Rochester (Olmsted County) and Willmar (Kandiyohi County) from the “STEPS to a Healthier Minnesota” program. (Note: Data on youth for Willmar not available.)

HENNEPIN COUNTY

Adults

In 2006, 12.4% of Hennepin County adults age 18 and older reported that they had been diagnosed with asthma at some point in their lives and 8.2% reported that they currently had asthma. These numbers are higher than the statewide prevalence rates found by BRFSS (10.9% for lifetime asthma and 7.7% for current asthma).

Asthma prevalence within Hennepin County varies by location, with residents of Minneapolis more likely to report that they had a history of asthma than residents in the suburban areas. Current asthma is also higher in Minneapolis, but this difference is not statistically significant.

Table 15. Lifetime and current asthma prevalence among adults, Hennepin County, 2006

Area	N	Lifetime Asthma ¹ % (95% C.I.)	Current Asthma ² % (95% C.I.)
Hennepin County	7573	12.4 (11.1-13.7)	8.2 (7.1-9.3)
Minneapolis	3805	15.0 (12.8-17.2)	9.0 (7.3-10.7)
Suburban Area	3768	11.1 (9.5-12.7)	7.8 (6.4-9.2)

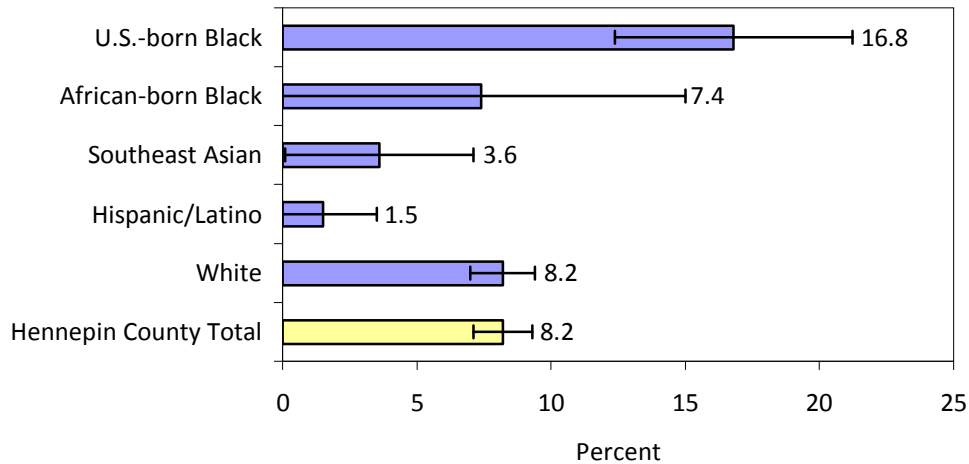
¹Has a doctor or other health professional ever told you that you had asthma?

²Do you still have asthma?

Source: Hennepin County SHAPE, 2006.

The SHAPE survey also tracks asthma prevalence by race/ethnicity. One of the most striking observations is that African-born blacks have a much lower prevalence of self-reported asthma (7.4%) than U.S.-born blacks (16.8%). The prevalence of asthma has increased in both groups since the 2002 survey (African-born blacks: 2.4%, U.S.-born blacks: 12.5%; 2002 SHAPE).

Figure 21. Current asthma rates among adults by racial and ethnic groups, Hennepin County, 2006



Source: Hennepin County SHAPE, 2006.

Adults in suburban Hennepin County are more likely than adults in Minneapolis to have had an asthma attack or ED visit for asthma in the past year. They are also more likely to have received an asthma action plan, however none of these differences are statistically significant.

Table 16. Measures of impairment and asthma management among adults with current asthma, Hennepin County, 2006

Area	N	Asthma attack in past 12 months ¹	1 ED/urgent care visit in past 12 months ²	2 or more ED/urgent care visits in past 12 months ³	Given Asthma Action Plan ⁴
		% (95% C.I.)	% (95% C.I.)	% (95% C.I.)	% (95% C.I.)
Hennepin County	675	52.8 (46.5-59.1)	8.1 (3.3-12.9)	8.8 (4.3-13.3)	36.6 (30.5-42.7)
Minneapolis	356	49.8 (40.6- 59.0)	7.5 (-0.2-15.2)	8.2 (3.6-12.8)	30.9 (23.0-38.8)
Suburban Area	319	54.5 (46.1- 62.9)	8.5 (1.7-15.3)	9.2 (2.1-16.3)	39.9 (31.4-48.4)

¹Have you had an asthma attack or an episode of asthma in the past 12 months?

²How many emergency room or urgent care center visits due to asthma in the past 12 months?

³Were you ever given an asthma action plan (AAP) by a doctor or other health care professional?

Source: Hennepin County SHAPE, 2006.

Children

There are small differences in the prevalence of lifetime and current asthma between children in Minneapolis and suburban Hennepin County, but none of these differences is statistically significant. These figures are much higher than those for the state as a whole (9.5% and 7.0%).

Table 17. Lifetime and current asthma prevalence among children, Hennepin County, 2006.

Area	N	Lifetime Asthma ¹	Current Asthma ²
		% (95% C.I.)	% (95% C.I.)
Hennepin County	4033	13.1 (11.8-14.4)	9.3 (8.1-10.5)
Minneapolis	1892	13.6 (11.2-16.0)	10.0 (7.9-12.1)
Suburban Area	2141	12.8 (11.2-14.4)	9.0 (7.6-10.4)

¹Has a doctor or other health professional ever told you that your child has asthma?

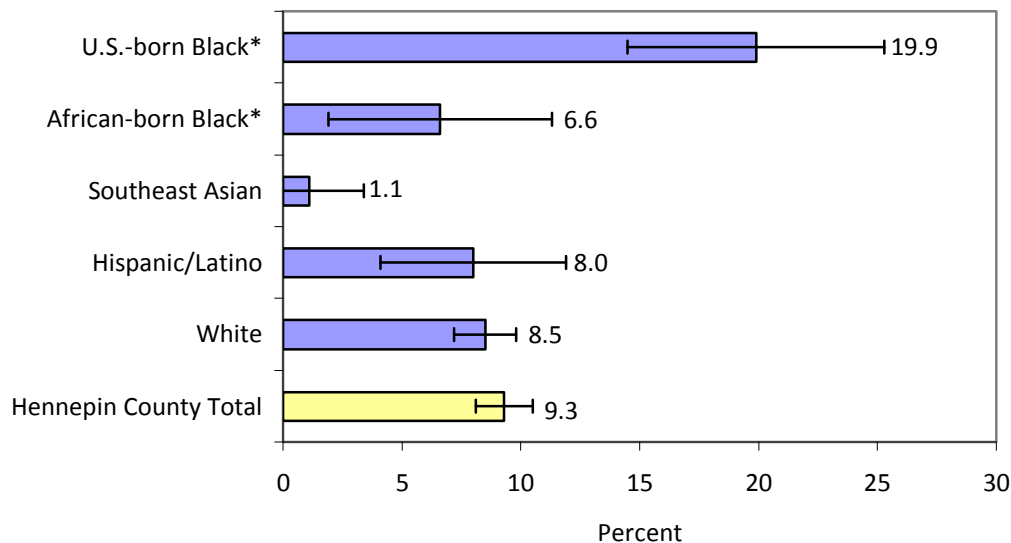
²Does your child still (currently) have asthma?

³In the past 12 months, has your child had an episode of asthma or an asthma attack?

Source: Hennepin County SHAPE, 2006.

Children of parents born in Africa are significantly less likely than black children whose parents were born in the U.S. to have current asthma. This finding is consistent with other studies that have observed lower prevalence of asthma among recent immigrants to the U.S. (Brugge, Woodin et al. 2008).

Figure 22. Current asthma prevalence in children by race and ethnicity, Hennepin County, 2006



*Child's parent place of birth

Source: Minnesota SHAPE, 2006.

Children in Minneapolis are more likely than children in suburban Hennepin County to have had an asthma attack or ED/urgent care visit for asthma in the past year, although these differences are not statistically significant.

There is little difference in rates of reported asthma episodes and ED/urgent care visits for asthma among children in Minneapolis versus suburban Hennepin County.

Table 18. Measures of impairment among children with current asthma, Hennepin County, 2006.

Area	N	Asthma attack in past 12 months ¹ % (95% C.I.)	1 ED/urgent care visit in past 12 months ² % (95% C.I.)	2 or more ED/urgent care visits in past 12 months ² % (95% C.I.)
Hennepin County	201	54.1 (48.0 – 60.0)	8.9 (6.3 – 12.4)	10.7 (7.5 – 15.3)
Minneapolis	81	54.7 (44.4 – 64.6)	10.5 (6.6 – 16.5)	11.3 (6.2 – 19.7)
Suburban Area	120	53.7 (46.2 – 61.1)	8.1 (5.0 – 12.9)	10.5 (6.6 – 16.3)

¹In the past 12 months, has your child had an episode of asthma or an asthma attack?

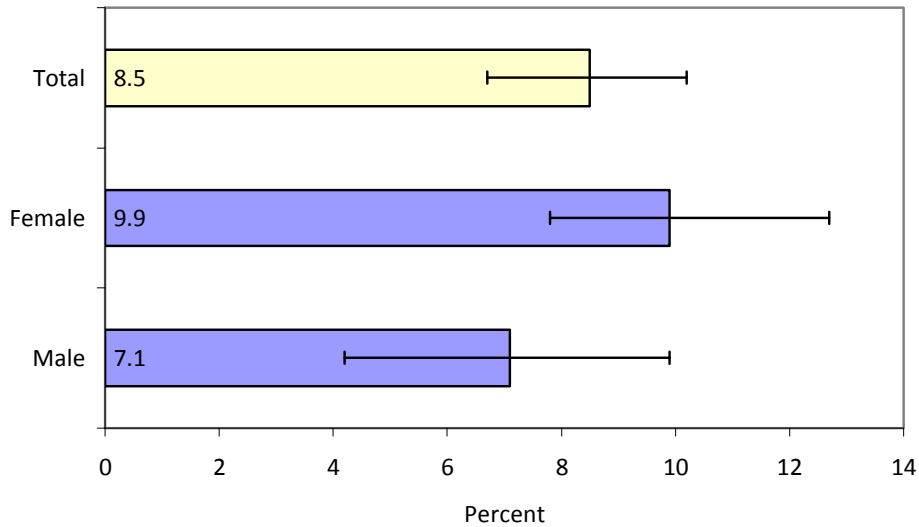
²How many emergency room or urgent care center visits has your child had due to asthma in the past 12 months?

Source: Hennepin County SHAPE, 2006.

MINNEAPOLIS, MN

Adults

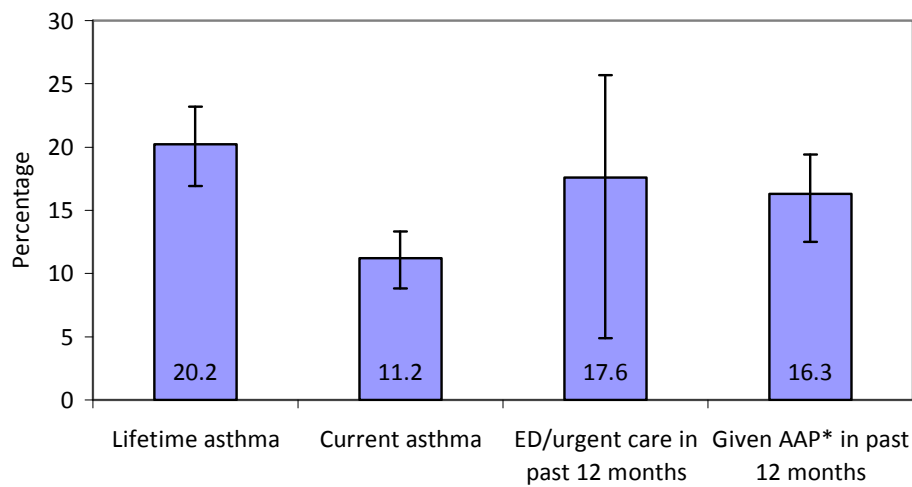
Figure 23. Current asthma prevalence among adults, Minneapolis, 2006.



Source: STEPS to a Healthier Minnesota, 2006.

Youth

Figure 24. Asthma prevalence and management among high school students, Minneapolis, 2007.



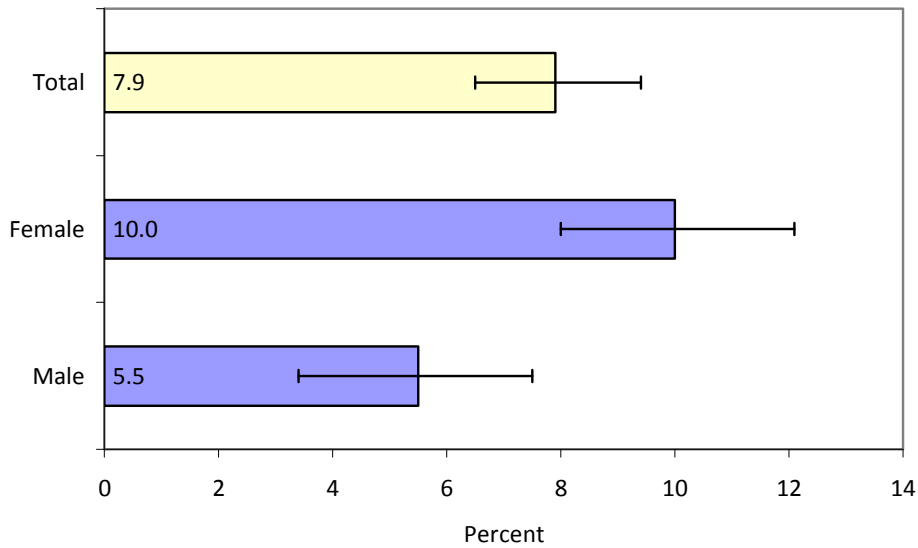
*AAP: Asthma Action Plan (AAP)

Source: STEPS to a Healthier Minnesota, Minnesota High School Survey, 2007.

ST. PAUL, MN

Adults

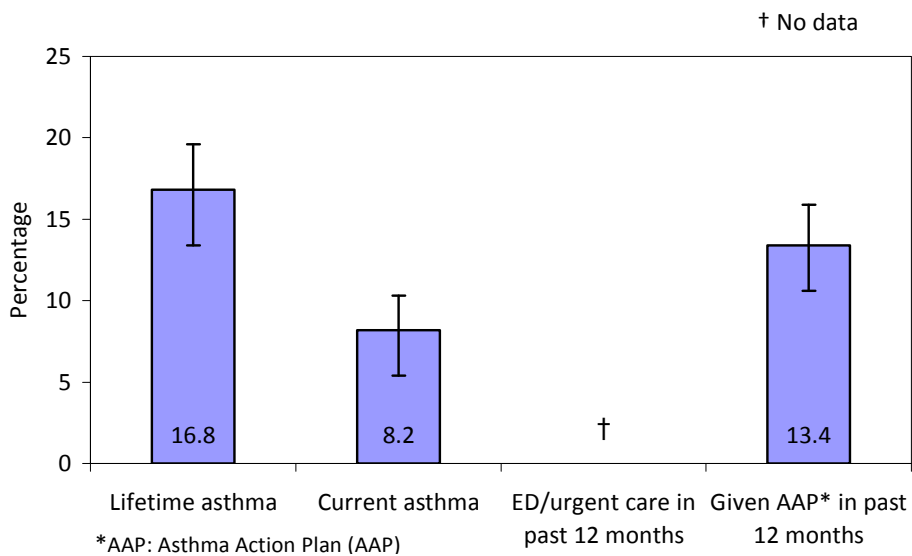
Figure 25. Current asthma prevalence among adults, St. Paul, 2006.



Source: STEPS to a Healthier Minnesota, 2006.

Youth

Figure 26. Asthma prevalence and management, high school students, St. Paul, 2007.

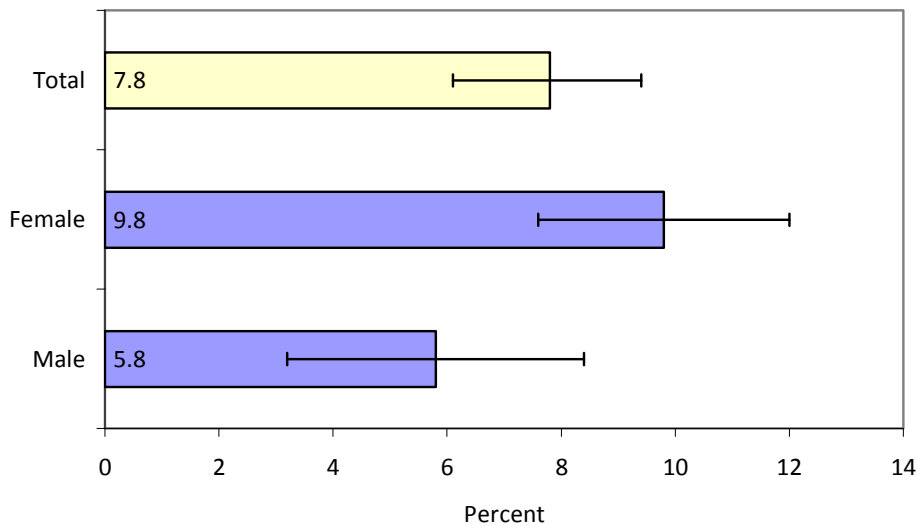


Source: STEPS to a Healthier Minnesota, Minnesota High School Survey, 2007.

ROCHESTER, MN

Adults

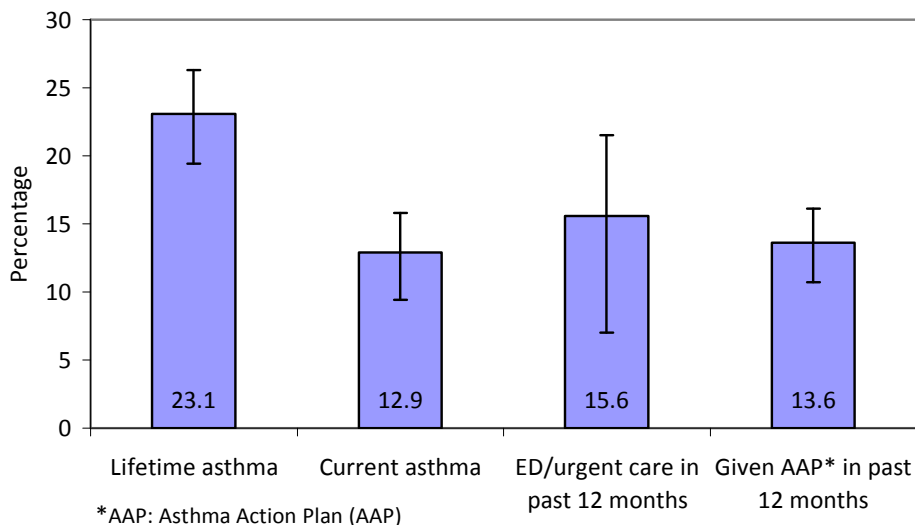
Figure 27. Current asthma prevalence among adults, Rochester, 2006.



Source: STEPS to a Healthier Minnesota, 2006.

Youth

Figure 28. Asthma prevalence and management, high school students, Rochester, 2007.

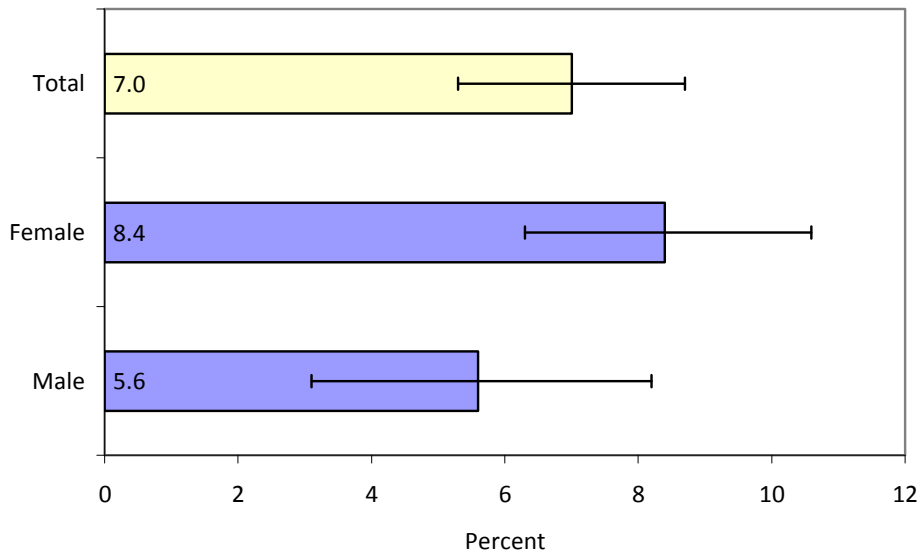


Source: STEPS to a Healthier Minnesota, Minnesota High School Survey, 2007.

WILLMAR, MN

Adults

Figure 29. Current asthma prevalence among adults, Willmar, 2006.



Source: STEPS to a Healthier Minnesota, 2006.

ASTHMA-RELATED EMERGENCY DEPARTMENT VISITS

The goal of asthma management is to decrease the likelihood of asthma exacerbations, which in turn should decrease the need for an emergency department (ED) visit or hospitalization. Thus, factors associated with asthma exacerbations, such as respiratory infections, are also risk factors for ED visits and hospitalizations.

In 2006, there were 15,837 emergency department visits for asthma in Minnesota. Note that the ED data do not include records for those who went to the ED and were subsequently admitted to the hospital (they are counted with the hospitalizations); thus, the visits represented in this section may tend to represent less severe asthma.

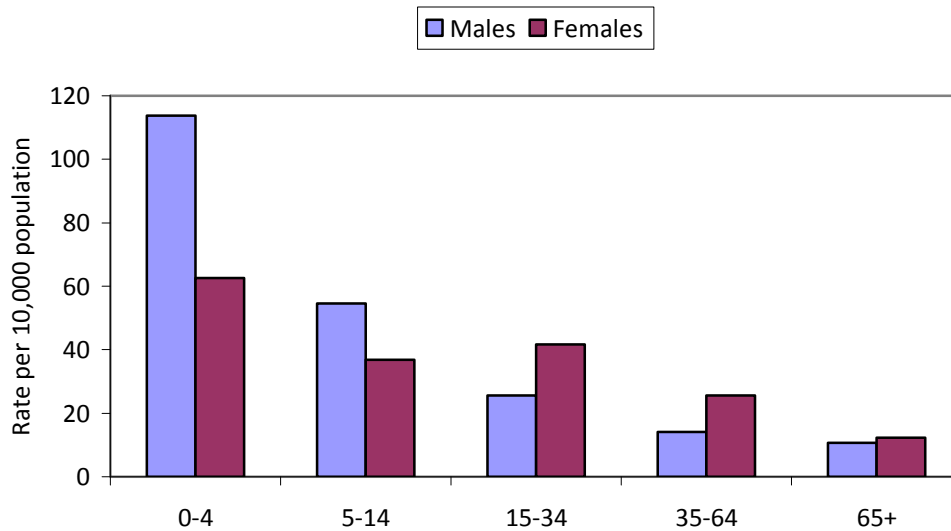
Table 19. Rates of asthma-related ED Visits by age, Minnesota, 2005-2006.
Rate per 10,000 population

Age Group	2005	2006
0-4	90.7	88.7
5-14	46.8	46.0
15-34	34.8	33.5
35-64	20.7	19.8
65+	12.1	11.6
Total	31.6	30.6

Source: Minnesota Hospital Association, 2005-2006

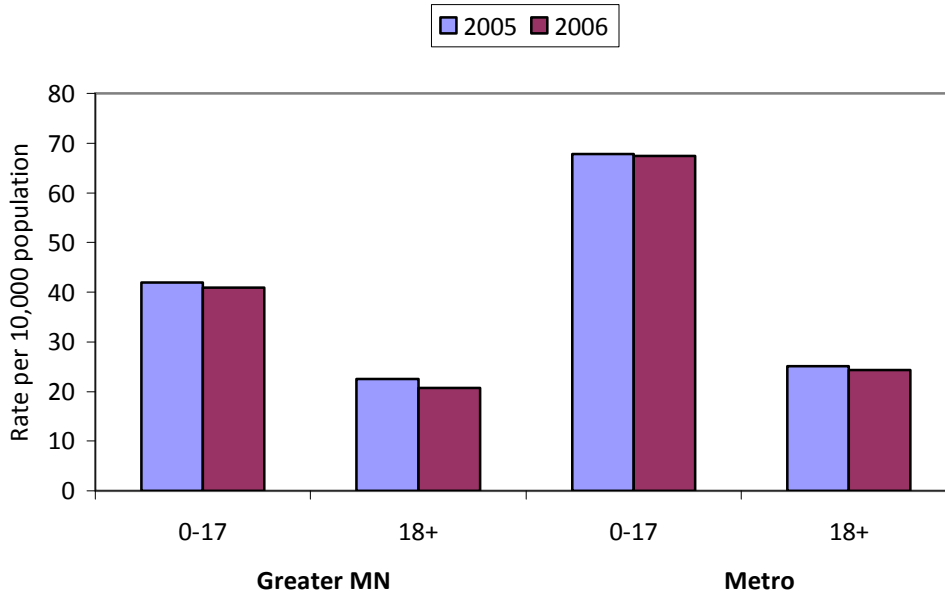
Rates of asthma-related ED visits decrease with increasing age. Males under the age of 5 have the highest rates, nearly double that for females under 5 years.

Figure 30. Asthma ED visits by sex and age group, Minnesota, 2006



Source: Minnesota Hospital Association, 2006.

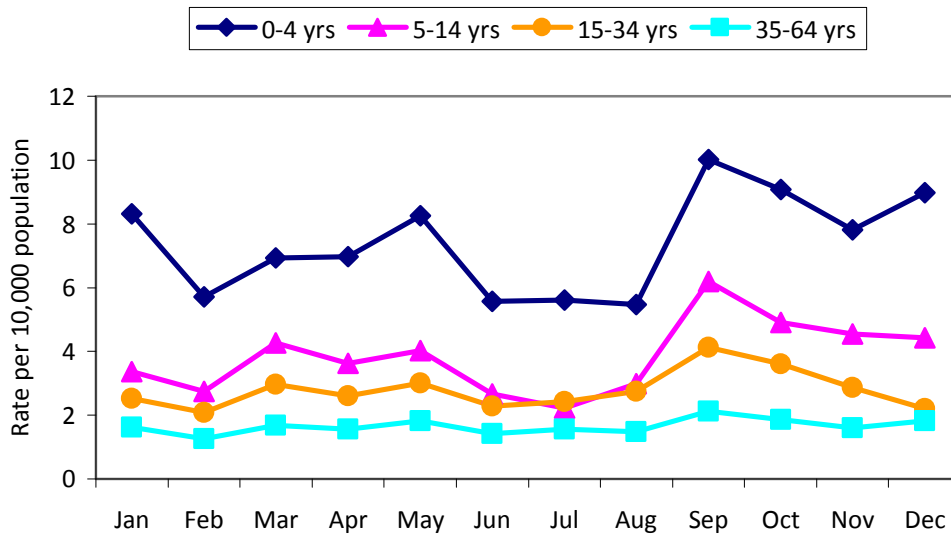
Figure 31. Asthma ED visits for the Twin Cities Metro and Greater Minnesota, 0-17 years and 18+ years, 2005-2006



Source: Minnesota Hospital Association, 2005-2006

Rates of asthma-related ED visits are much higher among children (0-17 years) in the Twin Cities metro area than children in Greater Minnesota. There is, however, little difference in rates between adults in the Twin Cities metro and adults in Greater Minnesota.

Figure 32. Seasonal variation in asthma-related ED visits, age 0-64, Minnesota, 2006



Source: Minnesota Hospital Association, 2006.

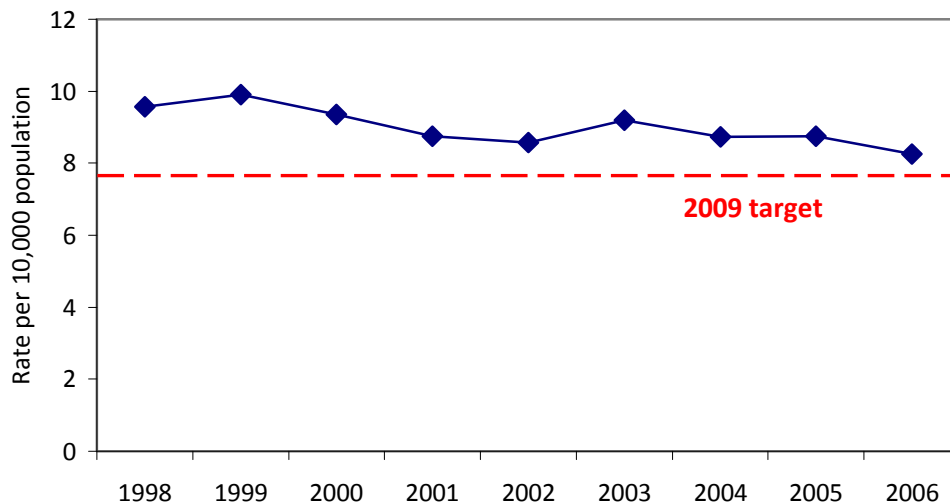
Asthma-related ED visits follow seasonal patterns, as do asthma hospitalizations (figure 38). Seasonal variations in asthma-related ED visits are more pronounced in the younger age groups. (Note that persons aged 65 and older are not included in the graph because of the difficulty of distinguishing asthma from chronic obstructive pulmonary disease (COPD) in this age group.) The highest ED visit rates occur during September and October. There is also a small elevation in ED visit rates in the spring.

ASTHMA HOSPITALIZATIONS

Hospitalizations due to asthma are an indicator both of the severity of the disease and barriers to regular asthma care (e.g., lack of health insurance). Asthma hospitalizations are costly and theoretically preventable when asthma is under control.

In 2006, there were more than 4,200 asthma hospitalizations among Minnesota residents, for an overall rate of 8.3 hospitalizations per 10,000 population. In comparison, the 2004 U.S. rate was nearly double that at 17.0 hospitalizations per 10,000 population (Moorman, Rudd et al. 2007).

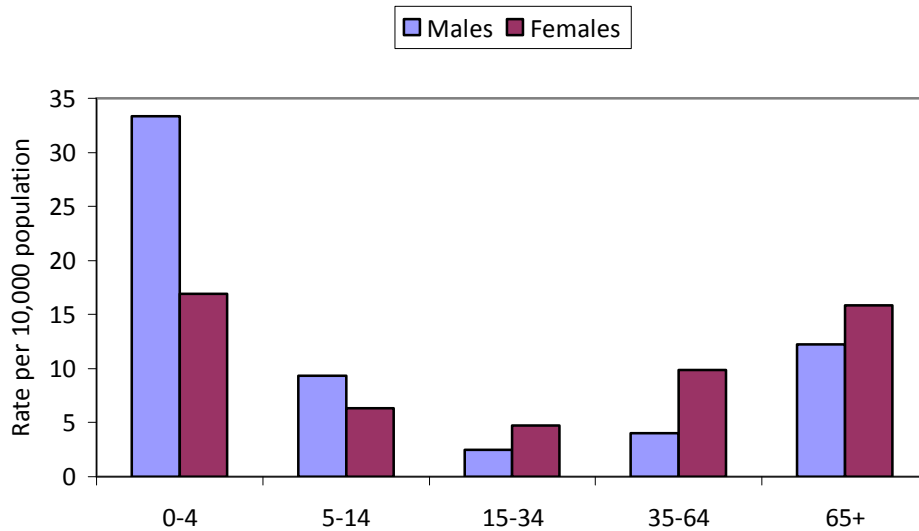
Figure 33. Asthma hospitalization rates, Minnesota, 1998-2006



Source: Minnesota Hospital Association, 1998-2006.

Asthma hospitalization rates in Minnesota have steadily declined since 1998. The CDC has set a target of a 16% drop in asthma hospitalization rates by 2009 from the year 2000 baseline. At the current rate of 8.3 per 10,000 population, we are closing in on the goal of 7.9 per 10,000 population.

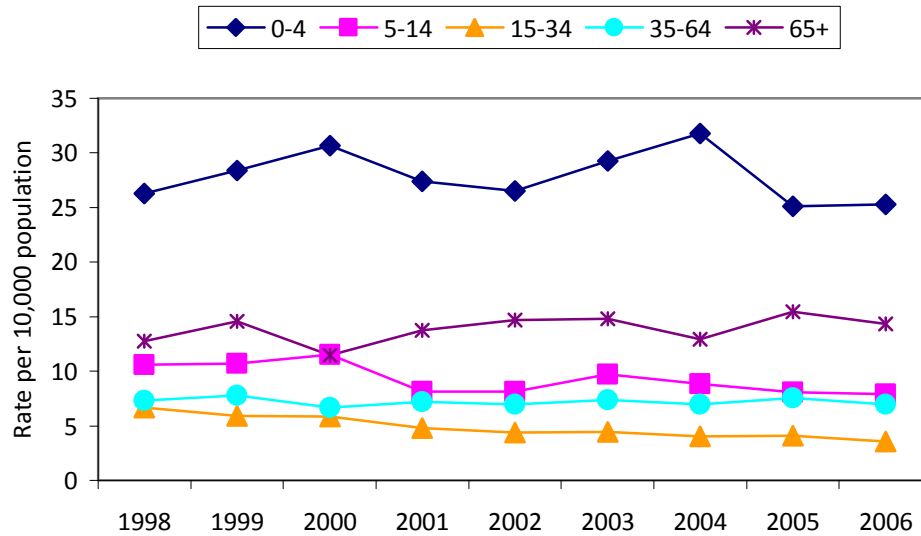
Figure 34. Asthma hospitalization rates by age and sex, Minnesota, 2006



Source: Minnesota Hospital Association, 2006.

Asthma hospitalizations are highest among children under the age of 5 (males and females combined). The rate steadily decreases through middle age, and then starts to increase. Asthma hospitalization rates are higher for boys than girls until the late teenage years at which point rates become higher for females adults than male adults. The highest hospitalization rates in 2006 occurred in males under 5 years, at 33.3 hospitalizations per 10,000 population.

Figure 35. Asthma hospitalization rates by age group, Minnesota, 1998-2006



Source: Minnesota Hospital Association, 1998-2006.

Trends in asthma hospitalization rates over 1998-2006 differ by age group, with some decreasing (ages 5-14 and 15-34), others increasing (ages 65 and older), and the rest relatively stable (ages 0-4 and 35-64). Rates are highest in children aged 0-4, followed by those aged 65 and older.

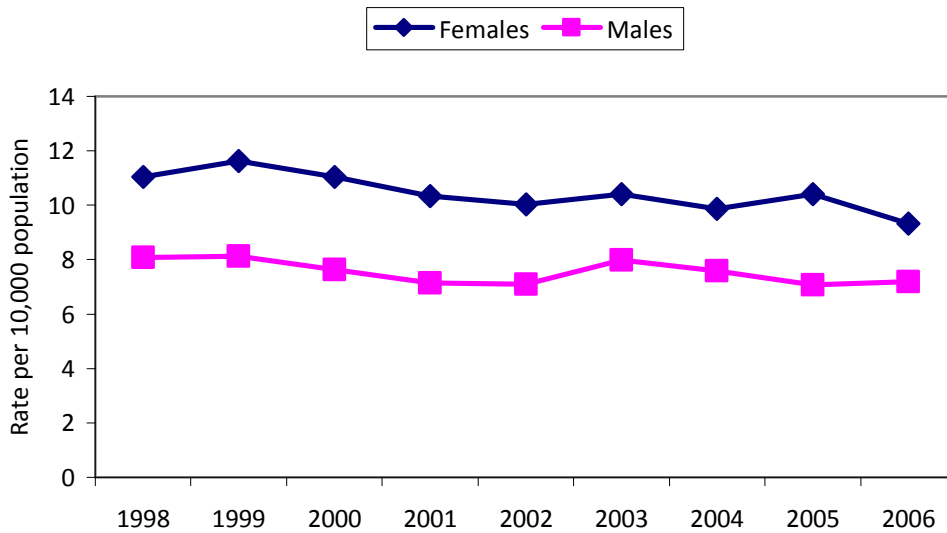
Table 20. Asthma hospitalization rates by age, Minnesota, 1998-2006.

Rate per 10,000 population

Age	1998	1999	2000	2001	2002	2003	2004	2005	2006
0-4	26.3	28.4	30.7	27.4	26.5	29.3	31.8	25.1	25.3
5-14	10.6	10.7	11.5	8.1	8.2	9.7	8.9	8.1	7.9
15-34	6.7	5.9	5.8	4.8	4.4	4.5	4.0	4.1	3.6
35-64	7.3	7.8	6.7	7.2	7.0	7.4	7.0	7.5	6.9
65+	12.8	14.6	11.5	13.7	14.7	14.8	12.9	15.5	14.3
Total	9.6	9.9	9.4	8.8	8.6	9.2	8.7	8.7	8.3

Source: Minnesota Hospital Association, 1998-2006.

Figure 36. Asthma hospitalization rates by sex, Minnesota, 1998-2006



Source: Minnesota Hospital Association, 1998-2006.

Asthma hospitalization rates are decreasing in both sexes, with rates consistently higher in females than males.

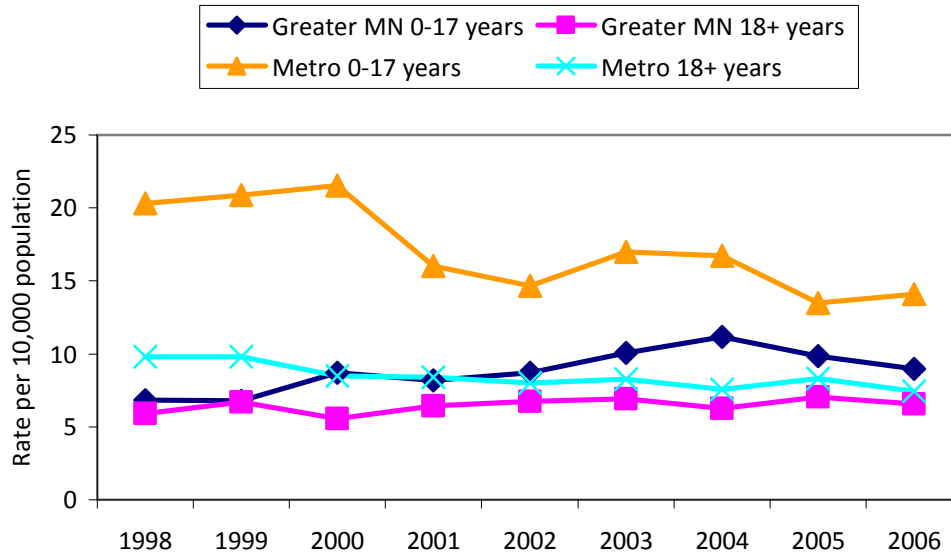
Table 21. Asthma hospitalization rates by sex, Minnesota, 1998-2006

Rate per 10,000 population

	1998	1999	2000	2001	2002	2003	2004	2005	2006
Female	11.1	11.6	11.0	10.3	10.0	10.4	9.9	10.4	9.3
Male	8.1	8.1	7.6	7.1	7.1	8.0	7.6	7.1	7.2

Source: Minnesota Hospital Association, 1998-2006

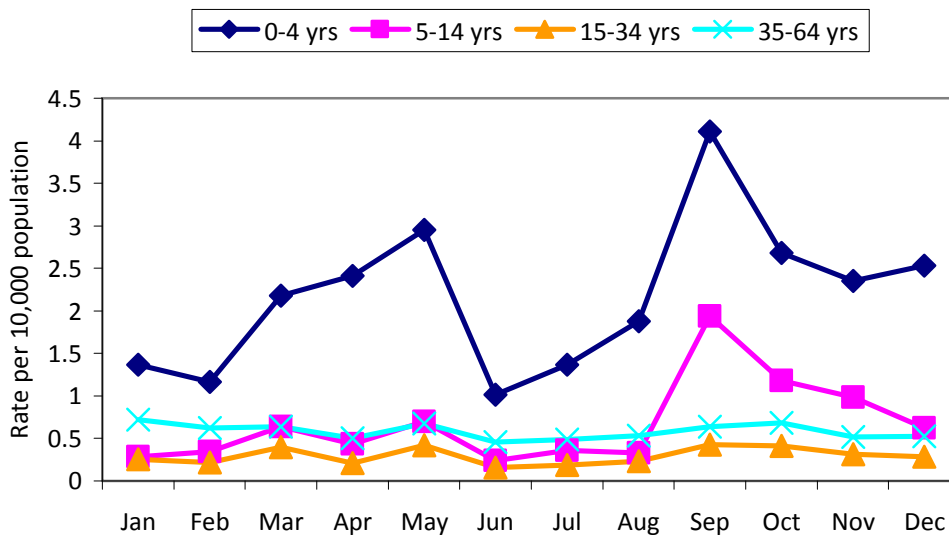
Figure 37. Asthma hospitalization rates for the Twin Cities Metro and Greater Minnesota, 0-17 years and 18+ years, 1998-2006



Source: Minnesota Hospital Association, 2000-2006

Children (0-17 years) in the seven-county Twin Cities metro area have consistently had the highest rates of asthma hospitalizations in the state; however, these rates have declined dramatically since 1998. Hospitalization rates for adults in the Twin Cities metro area are also declining, while rates for adults in Greater Minnesota have remained stable. Asthma hospitalization rates among children in Greater Minnesota have increased since 1998. Some of this increase may be due to increased reporting of hospitalizations in Greater Minnesota during this time period; however, the greatest increases in reporting took place in 2005 and 2006, at a time when hospitalization rates among Greater Minnesota children decreased.

Figure 38. Seasonal variations in asthma-related hospitalization rates, age 0-64, Minnesota, 2006



Source:

Minnesota Hospital Association, 2006

In Minnesota, asthma hospitalization rates follow seasonal patterns. The greatest number of hospitalizations is seen in the fall months. A smaller peak occurred during the spring. The lowest rates are generally seen in June and July. The seasonal patterns are most pronounced in young people.

In 2006, there were 4,267 hospitalizations across all ages in Minnesota, ranging from a low of 214 in June to a high of 526 in September. This pattern has been consistent over the years for which the data are available (1998-2006). Other states including Michigan, Vermont, New Hampshire, and Nebraska have reported similar patterns.

The peaks in hospitalization rates described above are especially pronounced in the youngest age group (0-4 years old). Older age groups exhibit less seasonal variation. (Note that persons aged 65 and older are not included in the graph because of the difficulty of distinguishing asthma from chronic obstructive pulmonary disease (COPD) in this age group.)

A major cause of the fall increase in asthma hospitalizations is thought to be increasing rates of respiratory infections associated with children going back to school.

ASTHMA MORTALITY

Asthma deaths should be preventable with timely and proper diagnosis and appropriate care. Known risk factors for asthma death include: a history of severe exacerbations, 2 or more hospitalizations or more than 3 ED visits in the past year and excessive use of short-acting beta-agonists, low socioeconomic status and inner city residence. Severe exacerbations associated with asthma deaths are not limited to individuals with severe asthma (National Heart, Lung, and Blood Institute 2007).

Asthma deaths among young people in Minnesota are relatively rare. Between 1999 and 2007, there were 26 deaths among Minnesota residents under the age of 20.

The highest rate of asthma mortality in Minnesota occurs among residents age 65 and older. However, distinguishing asthma from other chronic respiratory conditions is difficult in this age group. In addition, the likelihood of errors in reporting the cause of death on death certificates increases with age.

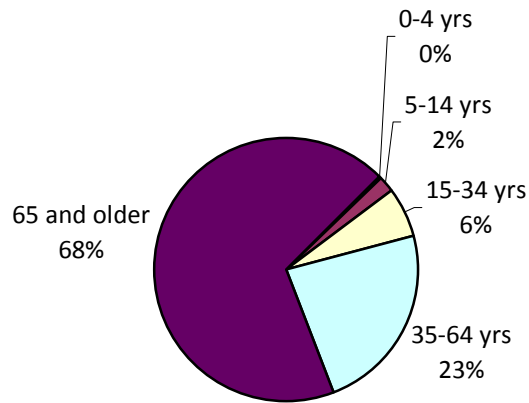
Asthma Deaths in Older Minnesotans

In the 2002 Strategic Plan for Addressing Asthma in Minnesota, the data and surveillance work group recommended that the MDH Asthma Program conduct an asthma mortality review to address the high rates of asthma deaths among seniors. There were concerns that the classification of asthma as the underlying cause of death in many of these deaths was not accurate.

In the “Asthma Deaths in Older Minnesotans” study, an expert panel reviewed records for Minnesota residents age 55 and older whose deaths had been classified as due to asthma. The major finding of this review was that many of the deaths were probably not due to asthma, and that inconsistent reporting on the death certificates had resulted in the underlying cause of death being coded as asthma.

We will continue to present asthma mortality rates among seniors according to the CDC and Healthy People 2010 guidelines, with the caveat that many of these deaths may not in fact have been due to asthma. We will also look into other measures that may more accurately reflect the burden of asthma in this age group.

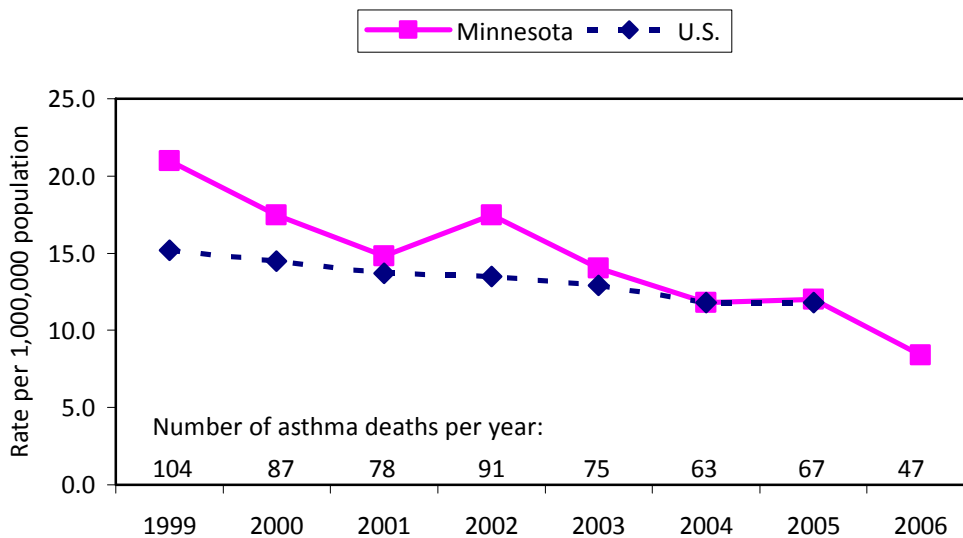
Figure 39. Asthma mortality by age group, Minnesota, 1999-2006



Source: Minnesota Center for Health Statistics, 1999-2006

Age-adjusted asthma mortality rates have declined steadily since 1999, with the greatest declines in the 65 and older age group. The age-adjusted asthma mortality rate for 2006 was 8.4 asthma deaths per 1,000,000 population.

Figure 40. Age-adjusted asthma mortality rates, Minnesota and the U.S., 1999-2006



Source: Minnesota Vital Records, 1999-2006; CDC, 1999-2005.

In 2006, there were 47 deaths for which asthma was classified as the underlying cause of death. Sixty-nine percent of these deaths occurred in persons aged 65 and older; 70% were in women.

Table 22. Asthma deaths by age group and sex among Minnesota residents, 2001-2006.
Rates per 1,000,000

	2001	2002	2003	2004	2005	2006
Age						
0-4	0	0	1	1	0	0
5-14	2	3	1	1	1	1
15-34	1	9	6	3	4	2
35-64	18	19	14	11	18	18
65+	57	60	53	47	44	26
Sex						
Female	51	49	54	44	53	33
Male	27	42	21	19	14	14
Total	78	91	75	63	67	47

Source: Minnesota Center for Health Statistics, 2001-2006

HEALTHY PEOPLE 2010 GOALS

The U.S. Department of Health and Human Services coordinated an effort to create a set of national health goals to be reached by the year 2010. The following are Healthy People 2010 goals relating to asthma, along with Minnesota's status on meeting these goals.

Reduce asthma deaths.

24-01: Deaths from asthma

The ultimate goal should be zero deaths due to asthma. Minnesota has met the Healthy People 2010 target for the 35-64 age group and is very close to meeting the targets for all other age groups. In recent years, asthma mortality rates have been decreasing dramatically in Minnesota and nationwide.

Table 23. Asthma Deaths* for Minnesota and U.S. and Healthy People 2010 Goals

Age Group	Minnesota, 2003-2006		U.S. Baseline	Healthy People
	Number	Rate*	1999	2010 Goal*
0 to 4	2	1.5 [#]	1.7	1.0
5 to 14	4	1.5 [#]	3.1	1.0
15 to 34	15	2.6 [#]	5.6	2.0
35 to 64	61	7.4	15.5	9.0
≥ 65	170	68.7	69.5	60.0

*Rate per 1,000,000 population

[#]Rates based on fewer than 20 deaths per age group and may be unstable; interpret with caution.

Source: Minnesota Center for Health Statistics, 2003-2006; National Vital Statistics System-Mortality (NVSS-M), 1999

Reduce hospitalizations for asthma.

Healthy People 2010 goals: 24-02 Hospitalizations for asthma.

Minnesota has already met, or is very close to meeting, the Healthy People 2010 targets for the 0-4 and 5-64 age groups; however, the 2006 rate for the 65 and older group is still above the federal target. Hospitalization rates among Minnesotans under age 65 have been decreasing since 1998.

Table 24. Asthma Hospitalizations* for Minnesota and U.S. and Healthy People 2010 Goals

Age Group	Minnesota 1999	Minnesota 2006	U.S. baseline 1998	U.S. 2005	Healthy People 2010 Goal
0 to 4	28.0	25.3	45.6	43.3	25.0
5 to 64 [†]	7.5	5.9	12.5	10.8	7.7
≥ 65 [†]	14.3	14.2	17.7	23.7	11.0

*Rate per 10,000 population

[†]Age-adjusted to the year 2000 standard population.

Sources: Minnesota Hospital Association, 1999, 2006; National Hospital Discharge Survey (NHDS), 1998, 2005

Greater Minnesota has met the Healthy People 2010 targets for persons under age 65. The 2006 rate for residents 65 and older is still above the target. In the Twin Cities metro area, asthma hospitalization rates for children under age 5 and adults 65 and older remain above the federal targets.

Table 25. Asthma Hospitalizations* for Greater Minnesota and Twin Cities Metro Area and Healthy People 2010 Goals

Age Group	Greater Minnesota, 2006	Twin Cities Metro Area†, 2006	Healthy People 2010 Goal
0 to 4	21.2	28.0	25.0
5 to 64	5.2	6.6	7.7
≥ 65	14.1	14.6	11.0

*Rate per 10,000 population

†Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington counties

Source: Minnesota Hospital Association, 2006

Reduce hospital emergency department visits for asthma.

Healthy People 2010 goals: 24-03 Hospital emergency department visits for asthma.

Minnesota has already achieved the Healthy People 2010 targets for asthma ED visits for the 5-64 and 65 and older age groups, and is close to meeting the target for children under 5.

Table 26. Asthma Emergency Department Visits* for Minnesota and U.S. and Healthy People 2010 Goals

Age Group	Minnesota 2006	U.S. baseline 1995-1997	U.S. 2004-2006	Healthy People 2010 Goal
0 to 4	88.7	150.0	148.3	80.0
5 to 64	28.7	71.1	57.4	50.0
≥ 65	11.6	29.5	22.8	15.0

*Rate per 10,000 population

Sources: Minnesota Hospital Association, 2006; National Hospital Discharge Survey (NHDS), 1995-1997; NCHS, 2004-2006

Greater Minnesota has met the Healthy People 2010 targets for asthma ED visits in all age groups, while the seven-county Twin Cities metro area is higher than the target for children under 5.

Table 27. Asthma Emergency Department Visits* for Greater Minnesota and Twin Cities Metro area and Healthy People 2010 Goals

Age Group	Greater Minnesota, 2006	Twin Cities Metro Area†, 2006	Healthy People 2010 Goal
0 to 4	59.6	108.8	80.0
5 to 64	26.2	30.8	50.0
≥ 65	14.1	8.5	15.0

*Rate per 10,000 population

†Anoka, Carver, Dakota, Hennepin, Ramsey, Scott and Washington counties

Source: Minnesota Hospital Association

SUMMARY

Overall, the prevalence of asthma in Minnesota appears to be the same or lower than the national average. The percentage of Minnesota adults with current asthma may be increasing, although it is too soon to tell whether the trend is real or due to random variation. The percentage of children with current asthma has remained stable over 2003-2006.

The Minnesota Asthma Callback Survey allows the first look at asthma control and management, asthma self-management education, environmental triggers in the homes of children and adults with asthma. These data indicate that there is room to improve asthma control among Minnesotans with asthma, as exemplified by the 69% of adults and 52% of children experiencing limitations in their usual activities due to their asthma.

The Minnesota Asthma Callback Survey also provides a first look at the prevalence of work-related asthma and comorbid chronic conditions among Minnesota adults who have asthma. More than half of all adults with asthma report that their asthma was caused or made worse by a job that had held. Approximately one-third of adults with asthma also report a diagnosis of COPD and/or depression.

There are encouraging signs in terms of the burden of asthma in Minnesota. Statewide rates of asthma-related ED visits and hospitalizations are lower than the national average and below or close to Healthy People 2010 targets. Rates of asthma hospitalizations among Twin Cities metro area residents have been declining over the past 10 years, with the largest decreases among children. Asthma mortality rates have decreased dramatically, with the greatest declines among residents 65 and older. However, disparities remain. Rates of asthma-related ED visits and hospitalizations for children are significantly higher in the Twin Cities metro area. Over the same time period that rates have been declining in the metro, hospitalization rates among children in Greater Minnesota have increased.

Several new sources of data add much to our knowledge about asthma in Minnesota; although, the picture remains incomplete. A continuing gap is the lack of data on rates of asthma-related hospitalizations and emergency department visits by race/ethnicity that would increase our understanding of disparities in the burden of asthma. Other gaps include the lack of data on asthma rates at the community or neighborhood level.

In conclusion, many of the measures of the burden of asthma in Minnesota have improved since the 2005 *“Asthma in Minnesota”* report. However, there is still much work to be done, both in terms of improving the quality of life for people with asthma and improving the data that is used to track the impact of that work.

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ACRONYMS

BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CI	Confidence interval
COPD	Chronic Obstructive Pulmonary Disease
EPR-3	Expert Panel Report 3
HEDIS	Health Plan Employer Data and Information Set
ICD	International Classification of Disease
MA-FFS	Medical Assistance Fee-For-Service
MDH	Minnesota Department of Health
MHA	Minnesota Hospital Association
MNDHS	Minnesota Department of Human Services
NAEPP	National Asthma Education and Prevention Program
NCHS	National Center for Health Statistics
NHAMCS	National Hospital Ambulatory Medical Care Survey
NHLBI	National Heart, Lung, and Blood Institute
NVSS	National Vital Statistics System
PMAP	Prepaid Medical Assistance Program
SHAPE	Survey of the Health of All the Population, and the Environment
WRA	Work-Related Asthma

GLOSSARY

Age-adjustment – to take the age distribution of a population into account when calculating a rate. Age-adjusted rates are useful when comparing populations that have different age distributions.

Asthma – a chronic disease of the respiratory system characterized by episodes of tightening of the muscles around the airways in the lungs (bronchoconstriction) and swelling of the bronchial airways (inflammation).

95% Confidence Interval (95% CI) –a measure of the reliability of an estimate. In statistical terms, it is the range of values within which the true value would be expected to fall 95 times out of 100. In surveys it is known as a margin of error. The width of a confidence interval is dependent on the number of individuals included in the survey. Because the 2005 Minnesota Asthma Callback Survey included only 85 children with current asthma, the confidence intervals are generally quite wide for the estimates for that group. See also “Statistical Significance”.

Incidence – the number of new cases of a disease in a particular population at a particular time

Mortality Rate – rate of death in a population; the number of deaths (in general or due to a specific cause) in a population, divided by the number of residents in that population for that time period.

Prevalence – the number of existing cases of a disease in a particular population at a particular time, typically expressed as a percent. For example, a 10% prevalence of asthma in a particular county with a population of 10,000 would mean that 1,000 people in the county had asthma.

Current asthma prevalence – refers to people who currently have asthma

Lifetime asthma prevalence – refers to people who have been diagnosed with asthma at some point in their lives

Rate – a measure of how often an event occurs; in epidemiology, the number of events (e.g., childhood asthma hospitalizations) in a population divided by the number of people in a population at risk for that event (e.g., 0-17 year old population) at a particular time.

Relative Standard Error – a statistical measure of the variability in an estimate; specifically, the estimate divided by its standard error. In this report, if the RSE is greater than or equal to 30, the estimate is considered unreliable and not shown.

Statistical significance – use of statistics to determine whether a difference in values (e.g., rates or percentages) is likely to exist. If a difference between two values is statistically significant, it means that it is unlikely that the difference between the two

is due to chance. For example, the prevalence of asthma among African American adults in Hennepin County is statistically significantly higher than that for African-born black adults in Hennepin County; thus, the difference between the two percentages is not likely due to chance.

APPENDIX A: DATA SOURCES

Behavioral Risk Factor Surveillance System (BRFSS)

The Behavioral Risk Factor Surveillance System is a joint CDC/state survey which asks adults age 18 years and older about risk factors for chronic disease. This telephone survey is completed yearly among approximately 4,000 randomly-selected non-institutionalized adults age 18 years and older residing in Minnesota. The BRFSS estimates are designed to be representative of all Minnesota adults. The annual cooperation rate in Minnesota is greater than 80%, which is among the highest in the country (2003 Minnesota cooperation rate=83.6%; median for states=74.8%) (Centers for Disease Control and Prevention (CDC) 2003). Although self-report of any disease has limitations, various studies, including one done by MDH, demonstrated that there is a good correlation between a positive answer and the presence of an asthma diagnosis in the medical record (Minnesota Department of Health 1991).

The biggest limitation of the BRFSS is that it only provides data on adults 18 years of age and older who have telephones, speak English, and are not institutionalized. Thus some of the groups at highest risk for asthma may be under-represented. Another limitation is that the sample, while large on a statewide basis, is too small to permit analysis on small groups (for example, by race/ethnicity or by geographic location other than the Twin Cities metropolitan area versus the non-metro area). In addition, small changes in wording or a change in the order of the questions from year to year may cause changes in the estimates. Finally, the BRFSS only tracks diagnosed asthma. People who have symptoms of asthma, but have not yet been diagnosed by a health care provider, would answer “no” when asked if a doctor, nurse, or other health professional had ever told them that they had asthma.

Asthma prevalence can vary significantly depending on how it is measured. For example, telephone surveys asking about asthma generally show a higher prevalence than studies in which hospital and clinic billing records are used to determine how many people have asthma. This may partially explain the difference between the prevalence of asthma found in adults enrolled in Minnesota’s public health insurance plans versus the statewide adult asthma prevalence found by a telephone survey.

BRFSS data included in this report have been accessed directly from the Minnesota BRFSS program (data through 2006) and from the CDC BRFSS website (data through 2007).

For more information on BRFSS: <http://www.cdc.gov/brfss>

Minnesota Asthma Callback Survey

The Minnesota Asthma Callback Survey is run in conjunction with the BRFSS. Minnesota participated in the 2005 pilot of the callback survey along with Michigan and Oregon. Adults (age 18 and older) and children (parent/guardian respondents) who are identified in the BRFSS as having lifetime asthma are invited to participate in a detailed asthma survey approximately two weeks after the BRFSS interview. Topics covered by the callback survey

include asthma symptoms, medication use, activity limitations, environmental exposures and work-related asthma.

A total of 469 adults (age 18 and older) and 116 parents/guardians of children with asthma (age 0-17) participated in the callback. Among them, 330 adults and 85 children were classified as having current asthma. Because of the relatively small number of children included in this survey, the 95% confidence intervals for the reported percentages are wide (i.e., the estimates are not as precise as those for the adults). Data from the callback were analyzed using the SAS procedure SURVEYMEANS which takes the complex survey design into account, producing weighted percentages that are designed to be representative of all Minnesotan adults and children with asthma, respectively.

Survey of the Health of All the Population and the Environment (SHAPE)

Every 4 years, Hennepin County conducts a survey of the health of its residents, called the Survey of the Health of All the Population, and the Environment (SHAPE). The SHAPE survey was conducted in 1998, 2002 and 2006. The first two surveys included only adults, while the 2006 survey included both adults and children. For more information about SHAPE: <http://www.co.hennepin.mn.us/SHAPE>.

Minnesota Student Survey

The Minnesota Student Survey is conducted every 3 years by the Minnesota Departments of Education, Health, Human Services and Public Safety among students in public schools (including charter schools and tribal schools), alternative schools and Area Learning Centers, and juvenile correction facilities. The survey includes students in grades 6, 9 and 12. For more information about the Minnesota Student Survey: <http://www.health.state.mn.us/divs/chs/mss/>.

Minnesota Youth Tobacco and Asthma Survey

The Minnesota Youth Tobacco and Asthma Survey is a school-based survey of tobacco use, second-hand smoke exposure and other factors. It is conducted by MDH every three years among a representative sample of students in grades 6-12. For more information, see *“Teens and Tobacco in Minnesota, the View from 2008: Results from the Minnesota Youth Tobacco and Asthma Survey”* at: <http://www.health.state.mn.us/divs/chs/tobacco/>.

Minnesota Health Care Programs

The Minnesota Department of Human Services (DHS) oversees the state’s public health care programs and kindly ran queries of the Minnesota Health Care Program data for use in this report. The analysis was limited to individuals under the age of 65 continuously enrolled in PMAP, MA-FFS or MinnesotaCare for 11 or more months in the year being studied.

To be classified as having “persistent asthma”, an enrollee needed to meet at least one of the following criteria:

- One or more emergency department visits with a principal diagnosis of asthma (ICD-9 code 493)
- One or more hospitalizations with a principal diagnosis of asthma (ICD-9 code 493)

- Four or more doctor visits for asthma and at least two asthma prescriptions* filled
 - Four or more asthma prescriptions* filled.
- *based on 2008 National Committee for Quality Assurance (NCQA) asthma medications

The above definition is a modification of the HEDIS (Health Plan Employer Data and Information Set) criteria for persistent asthma. The HEDIS criteria requires that individuals be continuously enrolled for the study year plus the previous year; in this analysis, individuals only needed to be continuously enrolled for the study year. This definition is likely to miss some individuals with mild asthma (less likely to go to the ED, be hospitalized or regularly take asthma meds), but is less likely to pick up individuals for whom asthma was ruled out at an office visit. Because some medications used by people with asthma are also indicated for COPD, this definition may incorrectly include some people with COPD (more likely in older age groups).

Appropriate medication use is defined as the number of enrollees with “persistent asthma” who filled at least one prescription for asthma controller medication (i.e., inhaled corticosteroids, cromolyn sodium, leukotriene modifiers or methylxanthines) during the study year. This measure is a modification of the HEDIS measure for asthma care, which has slightly different criteria for identifying persons with “persistent asthma” as noted above.

For details on the analysis of asthma data from DHS, see “*Asthma Among Minnesota Health Care Program Enrollees, 2007*” at <http://www.health.state.mn.us/asthma/Research.html>.

Asthma Hospitalizations and ED Visits

Minnesota hospitals report hospital discharge data to the Minnesota Hospital Association (MHA), an association representing Minnesota’s hospitals and health systems. Currently 95% of all hospitalizations in the state are reported, representing 97% of all licensed beds in the state. The information is submitted using the standardized billing form (UB-02). Asthma hospitalizations and ED visits are defined as those for which asthma is listed as the principal diagnosis (ICD-9 code 493.0-493.9). In 2005, MDH began receiving data on the hospitalizations of Minnesota residents in non-Minnesota hospitals, including North Dakota, South Dakota and Iowa hospitals. Data on ED visits to North Dakota hospitals are available for 2005 and 2006.

To protect patient privacy, the hospital discharge data do not contain identifying information, such as name or address. As a result, it is not possible to identify repeat hospitalizations or ED visits. Thus, these data reflect the overall number of asthma hospitalizations/ED visits, not the number of individuals who were hospitalized/went to the ED. Rates presented in this report are the number of asthma hospitalizations/ED visits per 10,000 population, with population estimates from the U.S. Census Bureau (www.census.gov).

Some of the limitations of the hospital discharge data include the fact that federal and sovereign hospitals (e.g., Veteran’s Administration, Indian Health Service) do not submit data to MHA. Another crucial limitation of the hospital discharge data is the lack of information on the patient’s race/ethnicity.

For more information on the Minnesota Hospital Association: <http://www.mnhospitals.org> .

Asthma Mortality

Death records for Minnesota residents who died of asthma are obtained from the Minnesota Center for Health Statistics at MDH. Asthma deaths are identified as those for which asthma is coded as the underlying cause of death. In 1999, the codes used to indicate the underlying cause of death on death certificates changed from the International Classification of Disease (ICD) revision 9 (493.0-493.9) to revision 10 (J45-J46). For this reason, rates before and after 1999 cannot be directly compared.

APPENDIX B: TECHNICAL NOTES

Age-adjusted rates were calculated using the direct method with the U.S. 2000 population as the standard.

95% confidence intervals for age-adjusted rates were calculated using the following equations from the National Center for Health Statistics (Anderson and Rosenberg 1998):

When there were 100 or more events:

$$\text{Lower limit} = R - (1.96 * \sqrt{X})$$

$$\text{Upper limit} = R + (1.96 * \sqrt{X})$$

When there were less than 100 events:

$$\text{Lower limit} = R * L$$

$$\text{Upper limit} = R * U$$

R = rate

X = number of events, e.g. number of hospitalizations or emergency department visits

L and U = values derived from the Poisson distribution

APPENDIX C: DATA TABLES

Table 28. Lifetime and current asthma prevalence by sex, age, residence and education, Minnesota adults, 2006.

	Lifetime Asthma %	Current Asthma %
All Adults	11.1	7.8
Sex		
Female	12.1	9.7
Male	10.0	5.8
Age		
18-44	12.5	8.3
45-64	9.8	7.6
65+	9.2	6.5
Residence		
Metro	12.6	9.3
Non-Metro	9.5	6.2
Education		
<High School	14.7	12.8
High School	9.9	7.0
Some College	11.3	8.6
College Graduate	11.1	6.8

Source: Minnesota BRFSS, 2006.

Table 29. Lifetime and current asthma prevalence by health status and selected health behaviors, Minnesota adults, 2006.

	Lifetime Asthma %	Current Asthma %	Never Diagnosed %
Fair/Poor Health Status	18.3	21.3	9.9
Limitation of Activity	37.7	43.8	20.8
Current Smoker	17.7	19.3	18.4
Overweight	69.0	69.4	61.5
Obese	32.1	30.7	23.6
No leisure time physical activity	11.9	13.2	14.5
Flu shot past 12 months	44.6	49.5	37.2
Ever had pneumonia vaccine	35.0	39.4	21.2

Source: Minnesota BRFSS, 2006.

Table 30. Percentage of students with lifetime asthma by grade and county, Minnesota, 2007.

	Grade 6	Grade 9	Grade 12
Aitkin	10.1	16.7	13.9
Anoka	14.0	18.0	21.0
Becker	13.7	13.2	15.1
Beltrami	12.0	17.4	16.8
Benton	19.3	19.7	17.7
Blue Earth	11.7	15.4	14.2
Brown	16.3	14.7	14.3
Carlton	14.8	20.0	17.6
Carver	14.6	18.7	20.0
Cass	15.0	20.1	16.7
Chippewa	16.3	18.6	20.6
Chisago	14.3	21.1	22.1
Clay	14.4	17.6	15.6
Clearwater	14.7	11.5	18.3
Cottonwood	13.3	14.0	9.6
Crow Wing	12.2	17.4	17.9
Dakota	13.4	18.0	18.0
Dodge	12.9	21.2	15.9
Douglas	10.4	15.2	7.4
Faribault	11.2	17.1	12.4
Fillmore	6.8	17.1	10.6
Freeborn	11.7	17.0	17.8
Goodhue	11.3	15.6	18.9
Grant	7.1	7.4	24.6
Hennepin	15.9	19.7	21.3
Houston	14.9	10.2	12.9
Hubbard	12.4	19.4	17.8
Isanti	15.1	17.4	20.4
Itasca	17.6	17.7	20.0
Jackson	19.3	16.8	9.0
Kanabec	16.8	14.0	18.2
Kandiyohi	16.0	19.6	14.6
Kittson	9.3	4.1	15.8
Lac Qui Parle	12.3	23.4	14.7
Le Sueur	9.1	12.5	19.2
Lincoln	13.6	14.6	14.7
Lyon	10.0	12.9	17.7
McLeod	10.5	19.0	15.6
Mahnomen	17.0	12.3	24.0
Marshall	13.3	15.1	15.2
Martin	13.3	13.5	14.8
Meeker	10.3	11.3	12.2
Mille Lacs	10.9	15.8	20.1
Morrison	16.2	18.0	15.8

Data Tables

	Grade 6	Grade 9	Grade 12
Mower	14.4	13.6	20.1
Nicollet	17.9	14.5	14.2
Nobles	8.7	15.1	18.8
Norman	12.7	10.4	11.1
Olmsted	15.4	23.0	20.9
Otter Tail	9.1	13.6	16.0
Pennington	14.0	16.4	24.2
Pine	15.2	19.4	21.7
Pipestone	6.4	7.7	17.6
Polk	10.9	19.0	14.2
Ramsey	14.7	18.1	18.5
Red Lake	8.2	9.4	21.4
Redwood	10.9	18.1	12.9
Renville	9.2	14.6	14.1
Rice	12.3	16.9	15.2
Roseau	11.8	14.2	17.5
St. Louis	14.3	18.8	20.0
Scott	14.1	17.6	21.2
Sherburne	14.3	16.6	19.9
Sibley	15.9	18.1	16.3
Stearns	13.1	18.1	17.1
Steele	14.0	14.5	12.1
Stevens	9.3	21.5	16.1
Swift	10.8	13.2	13.2
Todd	8.1	16.3	16.7
Wabasha	16.3	18.6	17.8
Wadena	11.2	21.4	14.2
Waseca	13.8	16.0	13.0
Washington	14.4	17.4	18.1
Watsonwan	10.5	10.3	13.9
Wilkin	13.6	10.1	10.9
Winona	18.6	18.2	21.5
Wright	14.2	18.2	20.8
Yellow Medicine	13.3	8.4	15.3
No County Report	10.8	15.6	16.8

Source: Minnesota Student Survey, 2007

Table 31. Age-adjusted rates of asthma ED visits by county of patient residence, Minnesota, 2005-2006. Rate per 10,000 population

County	Number of ED Visits		Age-adjusted rates	95% Confidence Interval
	2005-2006			
Aitkin	116		38.4	(30.9-46.0)
Anoka	1803		27.3	(26.0-28.6)
Becker	168		26.4	(22.3-30.4)
Beltrami	188		21.5	(18.4-24.7)
Benton	190		24.0	(20.5-27.5)
Big Stone	22		21.7	(13.2-33.6)
Blue Earth	198		16.9	(14.4-19.4)
Brown	182		35.8	(30.4-41.2)
Carlton	252		37.9	(33.1-42.7)
Carver	345		19.5	(17.4-21.6)
Cass	151		29.7	(24.8-34.5)
Chippewa	48		21.4	(15.7-28.5)
Chisago	527		52.6	(48.1-57.1)
Clay	213		20.3	(17.5-23.2)
Clearwater	21		14.0	(8.6-21.5)
Cook	26		27.9	(17.8-41.7)
Cottonwood	29		11.8	(7.8-17.3)
Crow Wing	419		36.0	(32.5-39.5)
Dakota	2003		25.6	(24.5-26.7)
Dodge	91		23.2	(18.6-28.5)
Douglas	102		14.5	(11.7-17.8)
Faribault	45		17.3	(12.4-23.3)
Fillmore	78		19.7	(15.5-24.8)
Freeborn	113		18.5	(15.0-22.0)
Goodhue	332		38.7	(34.4-42.9)
Grant	≤20		13.3*	(6.9-23.4)
Hennepin	9355		42.3	(41.5-43.2)
Houston	≤20		1.3*	(0.4-3.0)
Hubbard	113		31.1	(25.2-37.0)
Isanti	212		27.6	(23.8-31.4)
Itasca	263		32.5	(28.4-36.5)
Jackson	31		15.0	(10.0-21.6)
Kanabec	135		42.0	(34.7-49.3)
Kandiyohi	108		13.3	(10.8-15.8)
Kittson	≤20		13.0*	(5.5-26.0)
Koochiching	157		56.6	(47.2-66.0)
Lac qui Parle	30		24.8	(16.3-36.3)
Lake	53		27.2	(20.1-36.1)
Lake of the Woods	≤20		21.2*	(11.4-35.9)
Le Sueur	96		17.7	(14.3-21.7)
Lincoln	≤20		15.1*	(8.7-24.4)
Lyon	107		23.1	(18.7-27.6)
Mahnomen	221		7.5	(2.9-15.7)
Marshall	≤20		16.6*	(10.9-24.1)
Martin	28		29.4	(23.5-35.2)
McLeod	102		29.9	(25.9-33.9)
Meeker	88		19.6	(15.6-24.3)
Mille Lacs	314		63.9	(56.7-71.1)

Data Tables

County	Number of ED Visits		95% Confidence Interval
	2005-2006	Age-adjusted rates	
Morrison	183	28.6	(24.4-32.8)
Mower	264	36.2	(31.7-40.6)
Murray	37	24.4	(17.0-33.9)
Nicollet	130	21.0	(17.3-24.7)
Nobles	60	14.6	(11.1-18.9)
Norman	25	21.5	(13.7-32.0)
Olmsted	863	31.4	(29.3-33.5)
Otter Tail	219	21.1	(18.2-24.0)
Pennington	75	27.3	(21.3-34.5)
Pine	173	30.1	(25.5-34.8)
Pipestone	28	14.2	(9.2-20.9)
Polk	174	29.9	(25.3-34.4)
Pope	32	15.0	(9.9-21.9)
Ramsey	4333	44.2	(42.9-45.5)
Red Lake	≤20	20.1*	(11.3-32.9)
Redwood	56	18.7	(14.0-24.5)
Renville	67	21.8	(16.8-27.9)
Rice	359	30.3	(27.1-33.5)
Rock	23	12.3	(7.7-18.8)
Roseau	107	34.0	(27.6-40.5)
Scott	1207	27.2	(25.1-29.2)
Sherburne	716	22.0	(19.8-24.3)
Sibley	385	27.2	(21.5-33.9)
St. Louis	81	33.4	(31.4-35.4)
Stearns	554	19.1	(17.4-20.7)
Steele	193	27.3	(23.4-31.1)
Stevens	≤20	5.3*	(2.1-11.0)
Swift	38	17.8	(12.2-25.2)
Todd	60	13.2	(10.0-17.2)
Traverse	≤20	25.1*	(13.2-43.4)
Wabasha	100	23.4	(18.7-28.0)
Wadena	112	44.4	(35.9-52.9)
Waseca	98	25.8	(20.9-31.5)
Washington	1007	22.6	(21.2-24.0)
Watonwan	59	25.4	(19.1-33.1)
Wilkin	25	19.9	(12.7-29.7)
Winona	375	39.5	(35.3-43.7)
Wright	614	26.1	(24.0-28.2)
Yellow Medicine	31	15.9	(10.5-23.0)
Minnesota	32044	31.6	(31.3-32.0)

Source: Minnesota Hospital Association, 2004-2006

*Because the number of ED visits is less than or equal to 20, the rate may be unstable and should be interpreted with caution.

Note: ED visit rates for counties in which residents are likely to go to Wisconsin for care may be significantly underestimated (Wisconsin data is not available though the current data sharing agreement). Rates for counties in which residents are likely to visit hospitals that do not submit data to the Minnesota Hospital Association may also be artificially low.

Table 32. Age-adjusted asthma hospitalization rates by county of patient residence, Minnesota, 2004-2006. Rate per 10,000 population

County	Number of Hospitalizations		Age-adjusted rates	95% Confidence Interval
	2004-2006			
Aitkin	51		8.9	(6.4-12.0)
Anoka	758		8.3	(7.7-9.0)
Becker	47		4.7	(3.4-6.3)
Beltrami	88		7.0	(5.6-8.7)
Benton	125		11.2	(9.2-13.2)
Big Stone	≤20		4.2*	(1.5-9.5)
Blue Earth	64		4.3	(3.3-5.5)
Brown	60		7.1	(5.3-9.2)
Carlton	90		8.6	(6.9-10.6)
Carver	188		7.9	(6.7-9.0)
Cass	81		9.7	(7.6-12.1)
Chippewa	≤20		4.6*	(2.6-7.5)
Chisago	143		10.2	(8.5-11.8)
Clay	29		1.9	(1.3-2.8)
Clearwater	≤20		5.7*	(3.3-9.2)
Cook	≤20		5.8*	(2.7-10.9)
Cottonwood	32		7.9	(5.3-11.5)
Crow Wing	164		8.7	(7.3-10.0)
Dakota	854		7.8	(7.3-8.3)
Dodge	41		7.1	(5.1-9.6)
Douglas	69		5.9	(4.5-7.5)
Faribault	≤20		3.0*	(1.6-5.1)
Fillmore	30		4.4	(2.9-6.4)
Freeborn	26		2.5	(1.6-3.7)
Goodhue	92		6.6	(5.3-8.1)
Grant	≤20		6.1*	(3.3-10.3)
Hennepin	3803		11.3	(10.9-11.7)
Houston	≤20		0.7*	(0.2-1.8)
Hubbard	21		3.0	(1.8-4.6)
Isanti	85		8.0	(6.4-9.9)
Itasca	125		9.0	(7.3-10.6)
Jackson	24		8.6	(5.4-13.0)
Kanabec	68		13.7	(10.6-17.4)
Kandiyohi	61		4.9	(3.7-6.3)
Kittson	0		0	-
Koochiching	65		13.1	(9.9-16.9)
Lac qui Parle	32		16.5	(10.9-24.0)
Lake	≤20		4.3*	(2.3-7.3)
Lake of the Woods	≤20		8.5*	(4.1-15.8)
Le Sueur	45		5.3	(3.9-7.1)
Lincoln	23		11.1	(6.7-17.2)
Lyon	58		7.9	(6.0-10.3)
Mahnomen	≤20		3.4*	(1.2-7.3)
Marshall	≤20		2.3*	(1.0-4.5)
Martin	59		10.4	(7.8-13.6)
McLeod	78		6.8	(5.4-8.5)
Meeker	50		7.0	(5.1-9.2)
Mille Lacs	79		10.2	(8.0-12.7)

Data Tables

County	Number of Hospitalizations		95% Confidence Interval
	2004-2006	Age-adjusted rates	
Morrison	71	7.1	(5.6-9.0)
Mower	98	8.5	(6.8-10.4)
Murray	43	17.0	(12.0-23.2)
Nicollet	44	5.0	(3.6-6.7)
Nobles	58	8.4	(6.4-11.0)
Norman	≤20	6.9*	(3.7-11.7)
Olmsted	342	8.3	(7.4-9.2)
Otter Tail	133	6.8	(5.6-8.0)
Pennington	≤20	3.1*	(1.7-5.2)
Pine	61	6.8	(5.2-8.7)
Pipestone	25	7.0	(4.5-10.5)
Polk	55	5.9	(4.4-7.7)
Pope	43	10.8	(7.6-14.9)
Ramsey	1585	10.6	(10.1-11.1)
Red Lake	≤20	3.5*	(0.9-9.0)
Redwood	31	5.9	(3.9-8.5)
Renville	26	5.1	(3.2-7.5)
Rice	140	8.1	(6.8-9.5)
Rock	≤20	3.4*	(1.6-6.3)
Roseau	≤20	3.4*	(2.0-5.5)
Scott	261	7.7	(6.7-8.7)
Sherburne	161	7.2	(6.1-8.4)
Sibley	28	5.9	(3.9-8.6)
St. Louis	592	10.2	(9.3-11.0)
Stearns	435	10.7	(9.7-11.7)
Steele	69	6.5	(5.0-8.2)
Stevens	30	9.3	(6.0-13.8)
Swift	30	8.4	(5.5-12.3)
Todd	42	6.0	(4.3-8.1)
Traverse	≤20	7.6*	(2.7-16.8)
Wabasha	45	6.4	(4.6-8.6)
Wadena	62	14.8	(11.2-19.1)
Waseca	41	6.9	(5.0-9.4)
Washington	429	7.0	(6.3-7.7)
Watsonwan	22	5.4	(3.3-8.3)
Wilkin	≤20	4.0*	(1.8-7.6)
Winona	66	4.5	(3.5-5.8)
Wright	196	6.4	(5.5-7.3)
Yellow Medicine	36	10.8	(7.4-15.1)
Minnesota	13212	8.6	(8.5-8.8)

Source: Minnesota Hospital Association, 2004-2006

*Because the number of hospitalizations is less than or equal to 20, the rate may be unstable and should be interpreted with caution.

Note: Hospitalization rates for counties in which residents are likely to go to Wisconsin for care may be significantly underestimated (Wisconsin data is not available through the current data sharing agreement). Rates for counties in which residents are likely to visit hospitals that do not submit data to the Minnesota Hospital Association may also be artificially low.



December 2008

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