
Decreases in asthma mortality in the United States

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Background: Rates of death from asthma in the United States increased from 1978 until 1988 and have tended to stabilize since then.

Objective: To identify and evaluate recent trends in asthma mortality in the United States.

Methods: Graphing and tabulation of data from the National Center for Health Statistics identifying asthma (ICD 493) as the underlying cause of death in the 50 United States and the District of Columbia with rates of death from asthma by age, race, and sex and age-adjusted rates of death by race.

Results: Rates of death from asthma in the United States increased from 0.8 per 100,000 general population in 1977 and 1978 to 2.0 in 1989 and 2.1 in 1994 through 1996 but decreased to 2.0 in 1997. Rates decreased for black females and males and for white females in 1997. Age-adjusted rates of death from asthma decreased in 1997 for both blacks and whites. Deaths from asthma in children less than 15 years of age decreased from 191 in 1996 to 154 in 1997, the greatest decrease in any single year since 1971.

Conclusion: Decreases in deaths from asthma in the United States in 1997 have followed stabilization of asthma mortality rates since 1988, although changes in a single year cannot establish a trend. Improved management is the most likely explanation of reversal of previous increases in asthma mortality.

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INTRODUCTION

In the United States rates of death from asthma reached a peak of 4.5 per 100,000 general population in 1951 and 1952 with 6943 deaths in 1952.¹ Rates subsequently fell rapidly to 2.8 per 100,000 by 1959 and 0.8 in 1977 and 1978.^{1,2} During the following decade there were progressive increases in asthma mortality rates until stabilization in 1988 for most of the population.³

The increase in mortality from asthma in 1979 might have been due to implementation of the Ninth Revision of the International Classification of

Diseases, which discontinued a previous linkage of bronchitis and emphysema with asthma.⁴ Whereas deaths had been assigned previously as due to bronchitis when both bronchitis and asthma were mentioned on the death certificate, after 1978 they were assigned to asthma. Although that change in coding could have accounted for the increase in mortality rate in 1979 as compared with 1978, it should not have accounted for subsequent increases.

This report describes decreases in deaths from asthma in 1997, the most recent year for which complete data are available.

METHODS

The National Center for Health Statistics supplied data from all death certificates that identified asthma (ICD 493) as the underlying cause of death in the 50 United States and the District of Columbia, rates of death from asthma by race, age, and sex, and age-adjusted rates of death from asthma.

RESULTS

Deaths from asthma in the United States increased from a low of 1674 in 1977 to 5667 in 1996 but decreased to 5434 in 1997 (Fig 1). Rates of death from asthma increased from 0.8 per 100,000 general population in 1977 and 1978 to 1.2 in 1979 with implementation of the Ninth Revision of the International Classification of Diseases and thereafter to 2.1 in 1994 through 1996, but decreased to 2.0 in 1997. Rates also were 2.0 in 1989, 1991, and 1993 (Fig 2).

Rates of death from asthma have been slightly higher for black females than black males, but both decreased in 1997 (Fig 3). Rates have been much higher for white females than white males (Fig 4). The rate for white females decreased slightly in 1997 for the second year in succession, while that for white males was unchanged from 1996, having decreased slightly that year.

Overall rates of death from asthma remain low as compared with the leading causes of death in the United States (Table 1). Asthma contributes only a very small proportion to the total of 40.7 per 100,000 general population for chronic obstructive pulmonary diseases, the fourth leading cause of death.⁵

Age-adjusted rates of death from asthma increased from 0.6 in 1977 and 0.9 in 1979, the year of implementation of the Ninth Revision, to 1.5 in 1991 but decreased slightly to 1.4 in 1997 (Fig 5). The rate also was 1.4 in 1992 and 1993. Age-adjusted rates of death correct for effects of changes in the age distribution of the population by calculating the rate that would have prevailed in a population with the same age distribution as that of the United States in 1940.⁶ Age-adjusted rates of death

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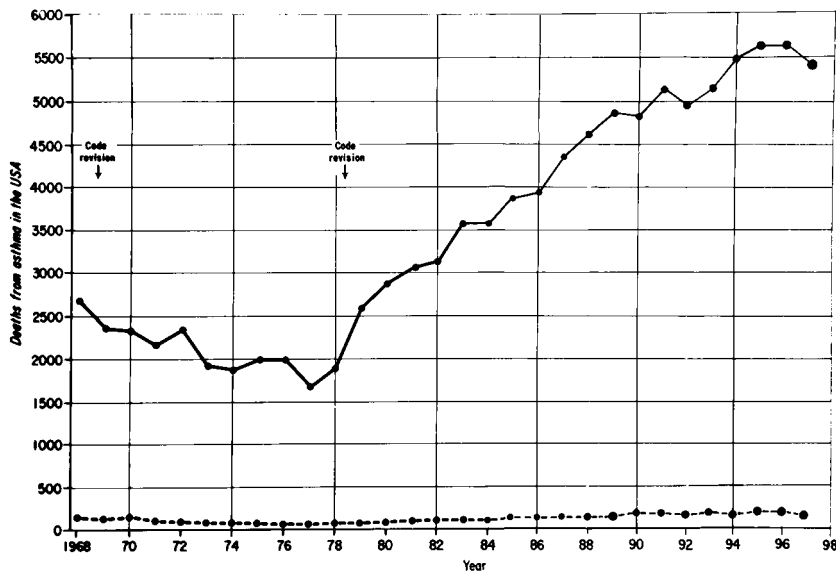


Figure 1. Deaths from asthma in the United States by year. Deaths in children less than 15 years of age have contributed only a very small proportion to the total. (Modified from Sly RM, *Ann Allergy* 1984;53:20–25, used with permission). (— all ages and ---- <15 years).

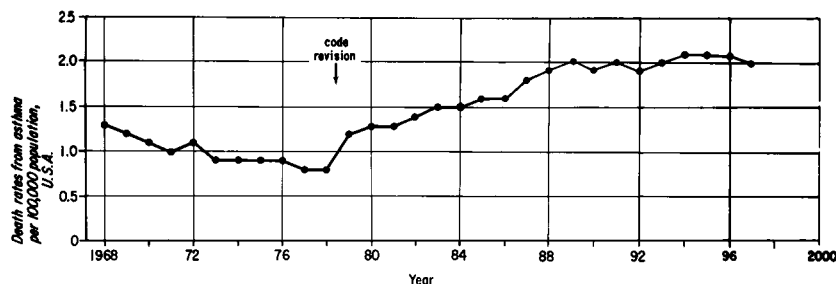


Figure 2. Rates of death from asthma in the United States. (Modified from Sly RM, *Ann Allergy* 1986;56:207–12, used with permission).

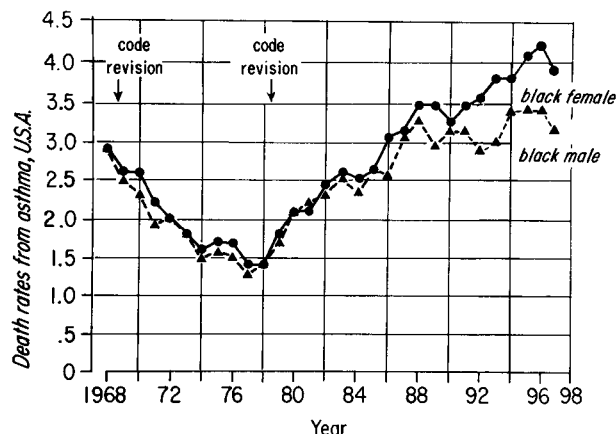


Figure 3. Rates of death from asthma per 100,000 general population in the United States by year and sex for blacks. (Modified from Sly RM, *Ann Allergy* 1984;53:20–25, used with permission).

from asthma have remained much higher for blacks than whites and have increased more rapidly for blacks than whites (Fig 6). These rates for both blacks and whites decreased in 1997.

Deaths from asthma in children less than 15 years of age reached a nadir of 54 in 1977 and subsequently increased to 191 in 1996 before decreasing to 154 in 1997 (Fig 7). This was the greatest decrease in any single year since 1971. Most of these deaths have occurred in children 5 through 14 years of age. In 1997 there were decreases in numbers of deaths in both this age group and in children less than 5 years of age.

Chronic obstructive pulmonary disease was the eighth leading cause of death at 5 through 14 years of age in 1997⁵ (Table 2). Asthma accounts for almost all of the deaths in this category in this age group.

DISCUSSION

These data indicate a tendency for stabilization of asthma mortality in the United States since 1988 and decreases in mortality in most segments of the population in 1997. One exception has been Chicago, where asthma mortality has continued to increase for most age groups, although it has decreased for children less than 15 years of age since 1993.⁷ Mortality decreases in a single year cannot establish a trend, but they are encouraging. The reasons for these decreases are speculative, and the reasons for the increases in asthma mortality during the decade before 1988 are unknown.

Established risk factors for fatal asthma include underestimation of the severity of asthma, psychosocial dysfunction that may contribute to poor perception or inadequate treatment of worsening airway obstruction, underuse of bronchodilators and corticosteroids, poor adherence to recommendations for management, excessive exposure to allergen, infection, inadequacies of medical management, and use of sedatives, tranquilizers, β -adrenergic blockers, or illicit drugs.^{8–17} Air pollution and exposure to cigarette smoke have been implicated.^{18,19} Anal-

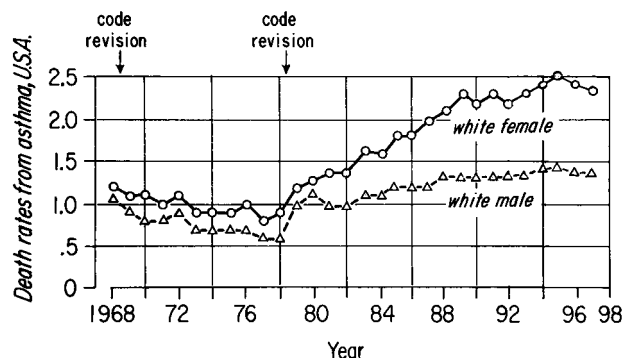


Figure 4. Rates of death from asthma per 100,000 general population in the United States by year and sex for whites. (Modified from Sly RM, Ann Allergy 1994;73:259–268, used with permission).

Table 1. Leading Causes of Death, US, 1997, with Death Rates per 100,000 General Population (from reference #5).

Rank	Cause	Rate
1	Heart disease	271.6
2	Malignant neoplasms	201.6
3	Cerebrovascular diseases	59.7
4	Chronic obstructive pulmonary diseases	40.7
5	Accidents	35.7
6	Pneumonia and influenza	32.3
7	Diabetes mellitus	23.4
8	Suicide	11.4
9	Nephritis, nephrosis	9.5
10	Chronic liver disease and cirrhosis	9.4

ysis of asthma mortality by neighborhood from 1982 through 1987 in New York²⁰ and from 1985 through 1991 in Philadelphia²¹ identified race (black or Hispanic) and poverty as independent risk factors. Most deaths from asthma have occurred in patients with severe or unstable asthma, often indicated by recent emergency care or admission to a hospital for treatment, previous respiratory failure, need for three or more types of antiasthmatic drugs, and need for an inhaled corticosteroid.^{8,9} It is likely most deaths from asthma have been avoidable.^{15,22–24}

Changes in prevalence can affect mortality rates. Annual Health Interview Surveys have indicated increases in prevalence of asthma in the United States that have been associated with increases in mortality with some moderation of the increases in prevalence

at more than 64 years of age since 1987 and at 15 to 34 years of age in 1987 through 1992.²⁵ These increases in prevalence might have accounted for as much as 77% of the increased mortality at least in those less than 45 years of age.²⁶

Risk factors for development of asthma include genetic predisposition,

allergy, poverty, maternal smoking, relatively large family size (6 or more), relatively small home size (fewer than 8 rooms), birth weight less than 2500 g, maternal age less than 20 years at the time of birth of the child, exposure to high concentrations of house dust mite allergen in infancy, black race, and central city residence.^{27–32} There is no reason to believe there have been substantial changes in these risk factors for asthma or fatal asthma in the past 23 years.

Changes in exposure to environmental tobacco smoke may have had some favorable impact on prevalence of asthma in children, however. The Third National Health and Nutrition Examination Survey (NHANES III) of 1988 to 1994 indicated 38% of children less than 6 years of age were exposed to environmental tobacco smoke in the home.³³ This was a decrease from the 42% indicated by the

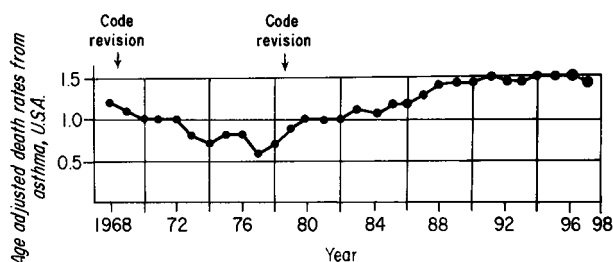


Figure 5. Age-adjusted rates of death from asthma per 100,000 general population in the United States by year. (Modified from Sly RM, N Engl Reg Allergy Proc 1986;7:425–434, used with permission).

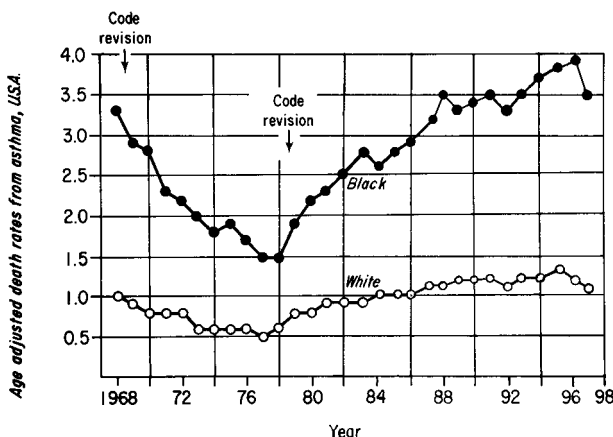


Figure 6. Age-adjusted rates of death from asthma per 100,000 general population in the United States by year and race. (Modified from Sly RM, N Engl Reg Allergy Proc 1986;7:425–434, used with permission).

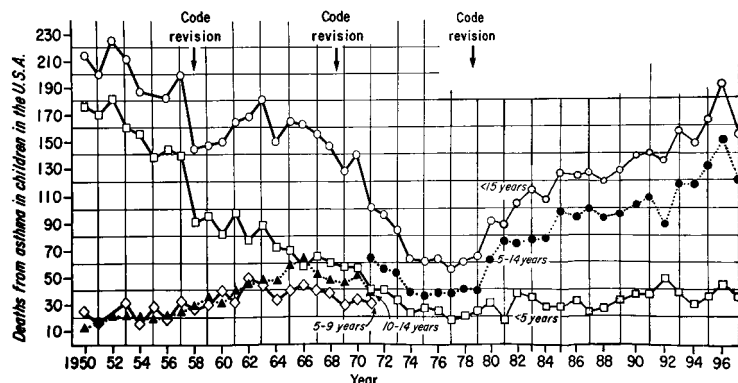


Figure 7. Deaths from asthma in children in the United States, 1950 through 1997, by age group. Revisions of the code for the International Classification of Diseases that took effect in 1958 and 1969 decreased the number of deaths assigned to asthma. The revision of 1979 increased deaths assigned to asthma. (Modified from Sly RM, *Textbook of Pediatric Allergy*, New Hyde Park, NY, Medical Examination Publishing Co, 1985, used with permission).

1988 Child Health Supplement to the National Health Interview Survey.³⁴ Analysis of NHANES III data indicated that 40% to 60% of cases of asthma, chronic bronchitis, and three or more episodes of wheezing in children 2 months to 2 years of age were attributable to such exposure to tobacco smoke after adjustment for other confounding variables.³³ There was a significant association between diagnosed asthma and the smoking of at least 20 cigarettes per day in the home both for children 2 months through 2 years of age and those 3 to 5 years of age. Others have reported exposure to environmental tobacco smoke can double the prevalence of asthma in children.^{35,36}

Six-year follow-up of 404 children 3 to 4 years of age at initial diagnosis of

asthma in 1988 to 1990 in Montreal disclosed no significant difference in prevalence of maternal smoking before their diagnosis between the 293 who continued to have episodes of wheezing (41.9%) and the 108 who had only transient wheezing (40.7%).³⁷ After adjustment for potentially confounding factors, however, the risk for persistent asthma associated with heavy maternal smoking (more than 20 cigarettes per day) was significant (odds ratio 3.84, 95% CI 1.68, 8.76) as compared with controls matched for age and census tract of residence at time of initial diagnosis. There was no significant interaction between heavy maternal smoking and "asthma" in those children who did not have recurrent wheezing after the initial diagnosis.

Table 2. Leading Causes of Death, US, 1997, at 5 through 14 Years of Age with Rates (from reference #5).

Rank	Cause	Rate
1	Accidents	8.7
2	Malignant neoplasms	2.7
3	Homicide and legal intervention	1.2
4	Congenital anomalies	1.2
5	Heart disease	0.8
6	Suicide	0.8
7	Pneumonia and influenza	0.4
8	Chronic obstructive pulmonary diseases	0.3
9	Human immunodeficiency virus infection	0.3
10	Cerebrovascular diseases	0.2
10	Benign neoplasms	0.2

Thus, small decreases in prevalence of maternal smoking could have had a favorable impact on prevalence of asthma in children recently.

The most likely explanation for stabilization and subsequent decreases in asthma mortality has been better treatment. There were some changes in treatment after wide circulation of the first National Asthma Education Program Guidelines in 1991.³⁸

These guidelines were published during collection of data for NHANES III (1988 to 1994). NHANES III consisted of home interviews followed by physical examinations of a representative sample of the civilian noninstitutionalized US population at least 2 months of age selected by a stratified, multistage clustered probability design. Analysis of data for children 2 months to 16 years of age indicated 1025 (9.4%) had been told by physicians they had asthma.³⁹ Only 26% of those with moderate or severe asthma had received maintenance medication (inhaled corticosteroid, cromolyn, nedocromil, or theophylline) within the previous month, when moderate to severe asthma was defined by any hospitalization, at least 2 acute visits, or at least 3 episodes of wheezing within the previous 12 months.

Because NHANES III overlapped publication of the National Asthma Education Guidelines it was possible to compare treatment from 1988 to 1991 with 1991 to 1994, the latter period mostly following publication of the guidelines. Although there was no significant change in frequency of "maintenance medication" usage in children with "moderate to severe asthma" between these two periods (24.4% compared with 27.1%), use of cromolyn and nedocromil nearly doubled (5.0% vs 9.0%) and use of inhaled corticosteroids increased from 3.7% to 10.4% with a decrease in theophylline usage from 19.1% to 12.1%.³⁹

The consensus guidelines released in 1991 encouraged treatment with cromolyn, nedocromil, or an inhaled corticosteroid for frequently recurrent symptoms, relegating theophylline to an alternative, secondary role.³⁸

Analysis of the NHANES III data indicated inadequacy of therapy was significantly more frequent in children less than 5 years of age than older children, and more frequent in children below the poverty level, in children with Medicaid insurance, and in children whose preferred language was Spanish.³⁹ More than 90% of children with "moderate to severe asthma" who were both Spanish-speaking and Medicaid-Insured were receiving no maintenance therapy. These observations might be relevant to the association of asthma mortality with race and poverty.^{2,3,20}

Substantial decreases in rates of death from asthma have been associated with increases in sales of inhaled corticosteroids in New Zealand^{40,41} and introduction in 1989 of consensus guidelines for management of asthma in Australia and New Zealand.^{3,42,43} Even before introduction of the National Asthma Education Program guidelines there were increases in sales of cromolyn and inhaled corticosteroids in the United States.^{44,45} It is not surprising that improved treatment preceded publication of the guidelines, because the consensus guidelines were based largely on published evidence supporting their recommendations.

Surveys of emergency room physicians in 1993 and 1994 have indicated their treatment of acute asthma largely agreed with that recommended in the National Asthma Education Program guidelines,^{46,47} although one survey disclosed only 47% measured pulmonary function more than half the time before treatment and only 38% determined pulmonary function before disposition.⁴⁷ The 1994 survey of Directors of Pediatric Emergency Medicine in Pediatric Residency Training Programs disclosed more frequent routine use of pulmonary function testing (73% versus 47%), use of inhaled beta-adrenergic agonists as the initial choice of drug (98% versus 17%), and early corticosteroid administration (82% versus 21%) as compared with a similar survey in 1988.⁴⁶ Fifty percent of the survey participants indicated the National Asthma Education Program

guidelines had changed their emergency management of asthma.

Relatively high rates of morbidity and mortality from asthma have continued, however, despite some demonstrable benefit from implementation of the NAEP guidelines.^{48,49}

Barriers to implementation of clinical practice guidelines include lack of awareness of the existence of the guidelines, lack of familiarity with their provisions, lack of agreement with their recommendations, lack of expectancy of a favorable outcome from their implementation, and limitations of time.⁵⁰ Controversial and vague or nonspecific recommendations are less likely to be followed than others.⁵¹ Physicians are more likely to follow evidence-based recommendations than those based only on opinion.⁵¹ There is more confidence in guidelines issued by a physician's own specialty or subspecialty organization than those issued by a governmental agency (including the National Institutes of Health) and least confidence in those issued by a health insurance plan.⁵²⁻⁵⁴ Endorsements by respected colleagues and by more than one major organization have important impacts on favorable perceptions of guidelines.^{53,54} Clinicians prefer concise recommendations (pocket cards, concise pamphlets) to lengthy guidelines.^{53,54}

Have these barriers been relevant to implementation of the NAEP guidelines? The initial NAEP guidelines, a report of a consensus of representatives from multiple respected organizations and societies, were distributed widely to primary care physicians and specialists who care for patients with asthma.^{38,55} The second Expert Panel Report has been distributed less widely, and many clinicians may be unaware of it.^{55,56} Most of the recommendations of both sets of guidelines are evidence-based and referenced extensively. Most of the recommendations for treatment are specific, but the result of the extensive detail and documentation has been lengthy publications that many clinicians may not find user-friendly. Brief summaries of recommendations on pocket cards might

facilitate wider implementation. Indexing would facilitate access rapidly to specific topics although detailed tables of contents were published.^{38,56}

The purpose of clinical practice guidelines is to improve practice. Surveys and interviews have not suggested such guidelines have major impacts on clinical practice. Although 38% to 60% of physicians indicate guidelines have had some impact on their decisions, only 16% to 44% have indicated major impacts and only 18% to 32% have indicated even single changes in practice the previous year due to guidelines.^{52,54} Discussions with colleagues or consultants, review articles, continuing medical education courses, and medical textbooks all have had greater impacts on clinical practice.^{52,54,57} Substantial agreement among all these sources of information and evidence-based guidelines is likely, however. Guidelines can have indirect effects beyond their immediate impact.

Stabilization of asthma mortality rates in the United States since 1988 and decreases in 1997 are encouraging. These changes most likely are due to better treatment consistent with National Asthma Education Program guidelines.

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