asthma

Epidemic Increase

Cause Unknown

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2175 K Street, NW • Suite 700 • Washington, DC 20037
(202) 775-1110 • (202) 775-1767 (fax) • www.phpab.org

Preface

The Public Health Policy Advisory Board is an independent, not for profit public health advocacy group founded and chaired by Louis W. Sullivan, M.D., former Secretary of the U.S. Department of Health and Human Services. Its goal is effective public health policy through a process of sound, science-based policymaking.

The Board would like to thank A. John Oguntomilade, B.D.S., M.P.H., John J. Cohrssen, M.Sc., J.D., and J. Donald Millar, M.D., D.T.PH, (Lond.) for preparation of this report.

Executive Summary

This report on asthma summarizes changes in trends since our 1999 report, *Health and the American Child*, using the latest data through 1998. It highlights marked limitations of available data and urges improved systems for monitoring trends. We call upon public health officials to take effective action to understand and control the asthma epidemic.

Asthma data reveal an epidemic increase in asthma mortality and morbidity. Yet, the reasons for the epidemic remain unknown.

The following are from the most recent statistics:

- 17.3 million Americans have asthma.
- 34 Americans die every day from asthma-related causes.
- More than 12,000 asthma-related deaths occur annually.
- Blacks die from asthma at a rate twice that of whites and three times that of Hispanics.
- Children, low income, and non-Hispanic minority populations have higher rates of asthma.
- Each year there are about 14 million asthma-related visits to private physicians' offices and hospital outpatient clinics, and 2 million asthma-related visits to hospital emergency rooms.
- The estimated cost of asthma exceeds $12.7 billion per year.

Asthma trends are getting worse:

- The occurrence of asthma is epidemic and doubled from 6.8 million cases in 1980 to 14.6 million cases in 1996 according to the National Center for Health Statistics and to 17.3 million cases in 1999 according to the Centers for Disease Control and Prevention.
- Asthma deaths tripled from 1,674 in 1977 to 5,438 in 1998.
- Costs of asthma doubled from $6.2 billion in 1990 to $12.7 billion in 2000.

Federal data on asthma have serious flaws including the following:

- The implementation of a changed definition of asthma for the federal government's major health survey in 1997 without calibration to the previous system makes it difficult to accurately compare trends in prevalence of asthma before 1997 with those since.
- Federal definitions for important descriptors such as children's age categories and racial and ethnic groupings are inconsistent.

Public Health Implications

Asthma is an increasingly serious health concern, with rapidly rising mortality and morbidity. While outdoor air pollution would seem to be an obvious suspect cause, the available evidence suggests that the ambient outdoor air is cleaner today than it was 20 years ago.

The public health community has not yet adequately focused on gaining an understanding of the asthma epidemic. Without this, prevention is not possible.

The Public Health Policy Advisory Board calls for:

- Standardization of methodology and data describing asthma in order to generate effective public health policy for asthma.
- A careful examination of the evidence underlying the epidemic increase in prevalence and mortality of asthma to gain an understanding of the causes of the epidemic and apparent inconsistencies, such as variations in minorities.

Asthma: The Disease

Asthma is a chronic inflammatory disease of the lungs in which the airways are constricted causing wheezing, shortness of breath, chest tightness and coughing. Recurrent episodes, called *exacerbations*, range in severity from inconvenient to life threatening. The multiple factors causing asthma are not well understood, but involve at least an inherited proclivity to develop the disease combined with exposures to a variety of factors that can *trigger* exacerbations including: respiratory infections (upper and lower), exposures to inhaled environmental allergens (e.g., dust mites, cockroaches, animal dander, mold, pollen, etc.), non-specific environmental irritants (e.g., cold air, exercise, tobacco smoke, indoor and outdoor air pollutants, and certain indoor environments), and psychological factors (e.g., stress).

Our 1999 report *Health and the American Child Part 1: A Focus on Mortality among Children* (PHPAB, 1999) noted that from 1980 to 1994 the annual incidence of asthma doubled from 6.8 million cases to 14.6 million cases and the annual mortality nearly doubled from 2,891 deaths to 5,487 deaths. While many blame the increase in asthma incidence on unspecified outdoor air pollutants, the indicators of air pollution were generally improving. However, it is possible that the influence of some indoor air contaminants may be enhanced by tightly sealed living spaces and the increased time spent indoors by children.

Since our 1999 report, the Institute of Medicine (IOM) completed a scientific review of environmental exposures and asthma, *Clearing the Air: Asthma and Indoor Air*

Exposures, (IOM 2000). This report summarizes the evidence for 27 environmental "exposures" (including biologic, infectious, and chemical agents, as well as generic exposures such as non-residential environments), although the report does not address individual constitutional characteristics. The report draws a useful distinction between causation of the *development* of asthma and causation of *exacerbations* of asthma in asthmatics. The IOM expert panel, in evaluating the role of a particular exposure in causing or exacerbating asthma, deemed the available scientific evidence *sufficient, suggestive ("limited")*, or *insufficient*.

- For the development of asthma, the IOM found *sufficient evidence* for only two listed exposures: house dust mites and environmental tobacco smoke. It found *suggestive evidence* for four others: cockroaches, infections with respiratory syncytial virus, indoor home dampness, and certain non-residential environments.
- For the *exacerbation* of asthma IOM found *sufficient evidence* for the following environmental agents: cats, rodents, cockroaches, house dust mites, fungi, rhinovirus infections (especially in young children), certain higher levels of ozone, and environmental tobacco smoke. It found *suggestive evidence* for additional agents which include: dogs, birds, respiratory syncytial virus infections, chlamydia infections, mycoplasma infections, formaldehyde, fragrances, particulate matter, indoor home dampness, and certain non-residential environments.

Despite its great utility in formulating a research agenda for asthma and environmental exposures, the IOM report has limitations. The IOM did not opine about the causes of the *epidemic* of asthma as contrasted with the *disease* asthma. The two are not the same. *Epidemics* may be "true," i.e., actual increases in incidence, or "apparent" due to factors other than disease incidence, such as changed case definitions affecting the range of reportable cases, or changes (intended or not) due to financial or other incentives for choosing and reporting particular diagnoses. The IOM report does *not* suggest that the observed increase in incidence of asthma was caused by such changes. Moreover, none of the exposures on IOM's list of agents for which there is *sufficient* or *suggestive* evidence of causation have dramatically increased in the last twenty years. Indeed, for most of the chemical agents listed, ambient exposures have decreased during the last two decades.

One observation made by IOM may also be relevant. In discussing trends, the IOM report noted a doubling from 1974 to 1997 of the proportion of children in institutional child daycare. Later, discussing "non-residential indoor environments," IOM noted several studies indicating that daycare attendance early in life *increases* the risk of respiratory tract illnesses including asthma. It also reported a contrary finding from southern Australia that children attending day care had *less* reported asthma than those who did not. This finding appears to run "against the grain" of biological knowledge about asthma, respiratory infections, allergies and daycare centers.

Attempting to further explore the role of institutional child daycare in asthma among children <5 years, Millar and Helms, in an August 2001 unpublished study, found that from 1977 – 1994 attendance by children <5 years at organized child daycare facilities in the United States increased 126%. Asthma among children <5 years increased 160% during the same period. They concluded that their correlational analysis was too limited to provide evidence of cause, but was sufficiently suggestive to warrant epidemiologic investigation of the potential relationship.

Various other hypotheses have been offered to explain the increase in asthma based on observed correlational relationships. For example, in February 2001, the CDC released a report in which the authors explored the hypothesis that decreased citywide use of automobiles in Atlanta during the 1996 Summer Olympics resulted in improved air quality and a large decrease in emergency room visits and hospitalizations of children for asthma. There was a 42% decrease in asthma-related emergency room visits by inner city children on Medicaid, although no significant reduction was seen in other health indicators. The authors also cited studies that have shown a link between "high air pollution days" and worsened asthma symptoms–which might cause emergency room visits, but the impact of citywide transportation changes on air quality had not been previously studied. On the other hand, an article in the July/August 2001 issue of Asthma magazine quotes professor Dr. Laurence Kalkstein, Associate Director of the Center for Climate Research at the University of Delaware, as saying, "summer shows a rather flat and low number of asthmatic hospital visits – the lowest all year. The weather in summer is least variable." (Kalstein 2000) This may offer a different explanation for the findings in Atlanta.

It is important to note that the long running increase in asthma prevalence has occurred during an era when, paradoxically, outdoor air has become cleaner. A question is whether or not the levels of specific unknown substances in the environment (which may be increasing) are associated with the increase in asthma despite the generally cleaner ambient air. Another question is whether or not the investigative focus should shift from the outdoor to the indoor environment.

Morbidity Of Asthma

With some 17.3 million Americans suffering from asthma today, asthma is a profound public health problem. (CDC, Asthma at A Glance 1999) Asthma is one of the most prevalent chronic diseases in the U.S. Moreover, from 1980 to 1996 it doubled in magnitude from 6.8 million reported cases to 14.6 million reported cases. (DHHS, 2000) By any reasonable standard, the steady rise in the prevalence of asthma constitutes an epidemic. If the previous rate of increase continues in the future, cases could total 22

million by the end of this decade and 29 million by year 2020. (Pew, 2000) However, it should also be noted that the most recent data from the National Center for Health Statistics showed a decrease in prevalence from 1995 to 1996, using the old NCHS case definition for asthma, and a further decrease from 1997 to 1998 using the new NCHS case definition. Moreover, mortality also fell slightly from 1997 to 1998 (see below).

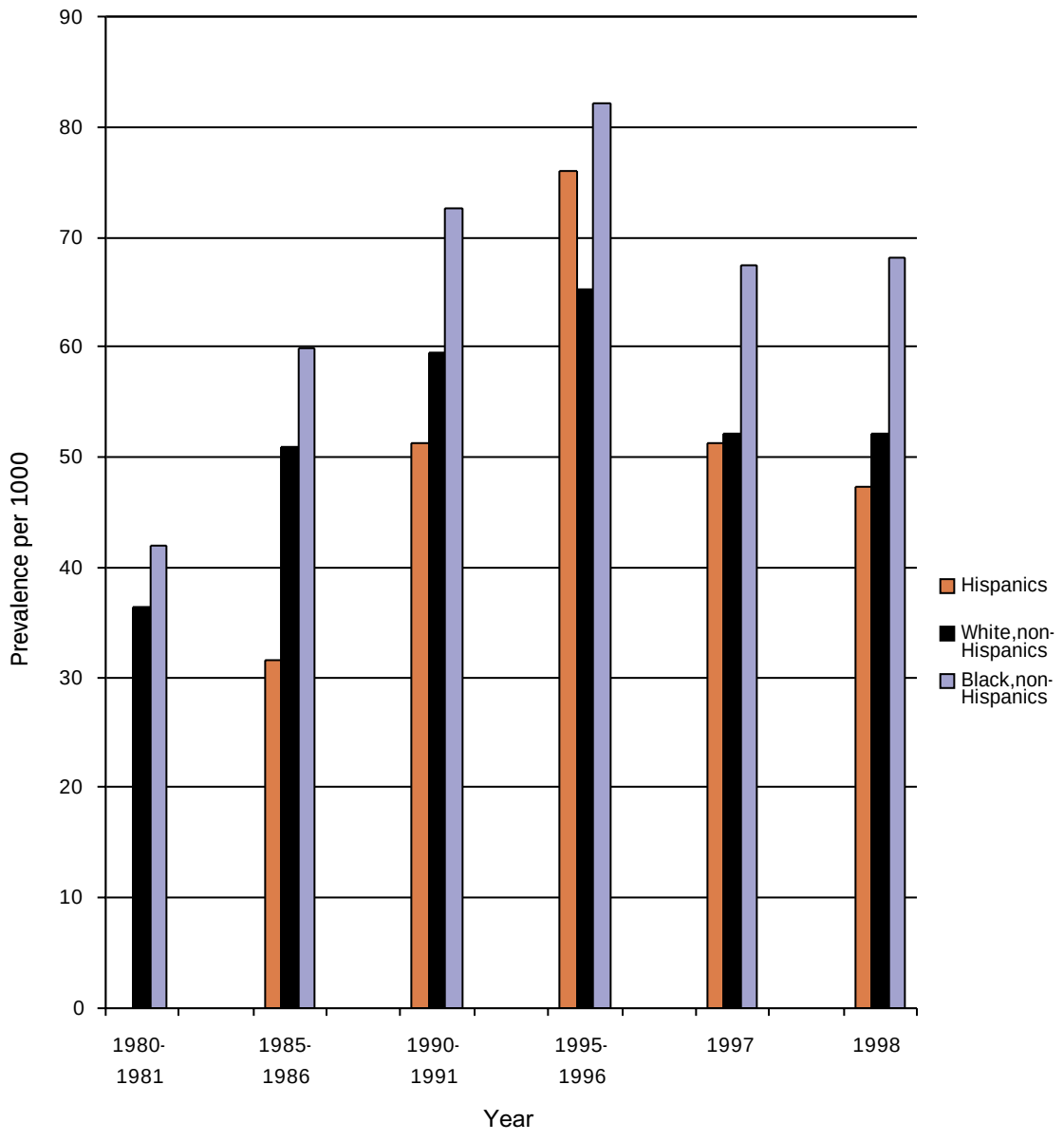
In May 2001 the National Heart, Lung, and Blood Institute (NHLBI) reported that the worldwide prevalence of asthma doubled in the previous 15 years. In the US the rates of death from asthma as well as hospitalizations and emergency room visits have been increasing for more than two decades, especially among African Americans and children. (NIH News Release. May 3, 2001)

Prevalence Of Asthma Attacks

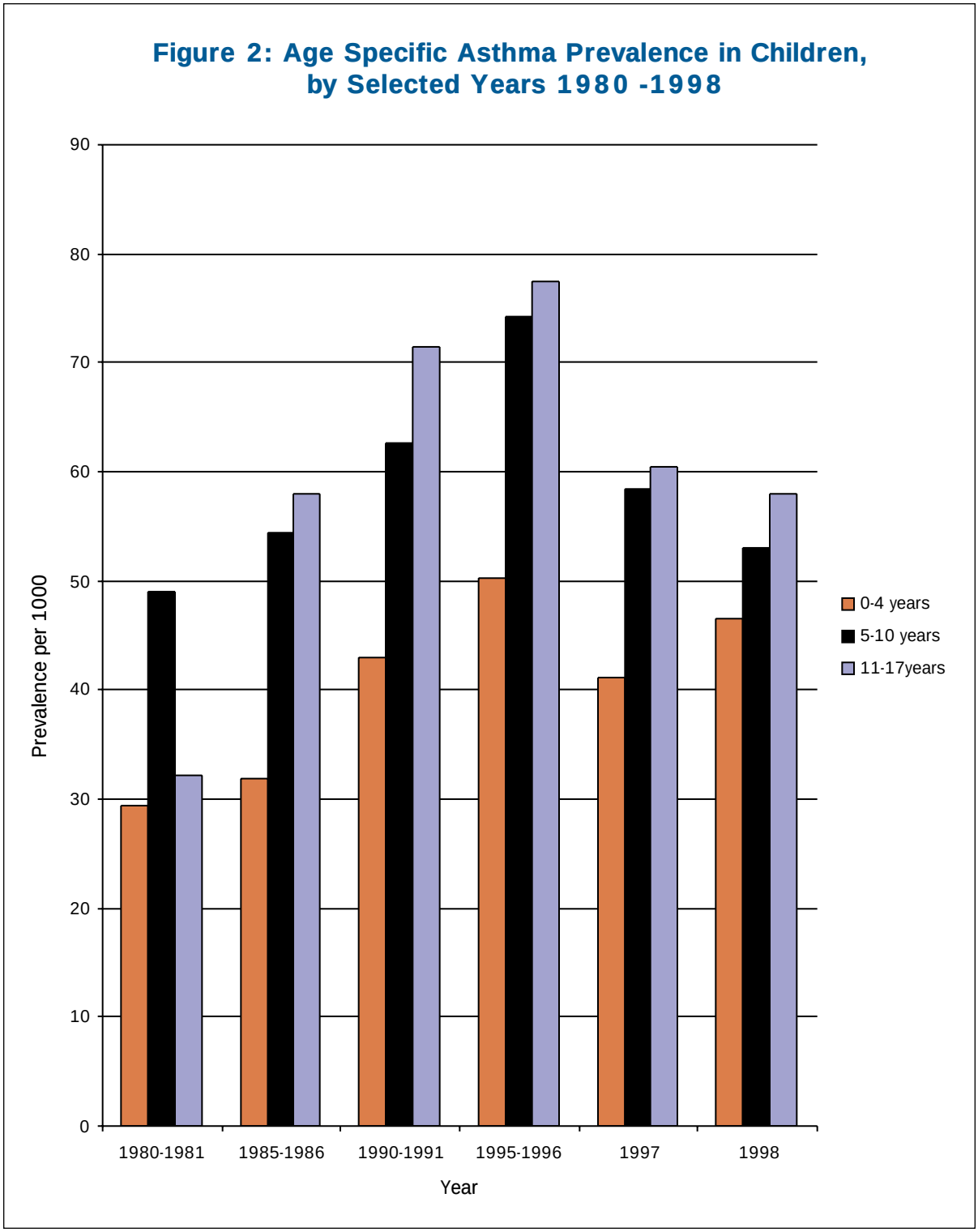
While the CDC estimated that 17.3 million Americans had asthma in 1998 (Asthma at a Glance, 1999), the National Center for Health Statistics (NCHS) estimated that 10.6 million Americans experienced an asthma attack within the previous year, based on the results of its National Health Information Survey (NHIS). (NCHS, Oct 2001) The new NCHS case definition for asthma includes only persons who had an asthma attack confirmed by a health professional within the past 12 months. Thus, asthma attack prevalence measures asthma based on an attack within the past year. This approach, limiting "cases" to those with recent attacks confirmed by a health professional, contrasts with the typical description of asthma as a chronic disease, usually of lifetime duration, even though the asthmatic may be temporarily asymptomatic.

According to NCHS, in 1998, 35 adults per 1,000 ages 18 years and over (6.8 million adults) and 53 children per 1,000 ages 0-17 years (3.8 million children) experienced an asthma attack within the previous year. The asthma attack prevalence for non-Hispanic blacks was 50 per 1,000 population, among non-Hispanic whites, 39 per 1,000, and among Hispanics, 36 per 1,000. Females had a prevalence of asthma attacks of 44 per 1,000 and males 35 per 1,000. However, among children 0-17 years of age, males were more likely to have had an asthma attack. The rates are 59 per 1,000 for males versus 41 per 1,000 for females, a finding that appears to be at odds with the observed difference by gender in mortality. (NCHS, Asthma, 2001) (See Figures 1 and 2.)

Figure 1: Asthma Prevalence* in Children Ages <18 Years, 1980-1998



Source: MMWR, October 13, 2001
NOTE: definition of asthma changed for 1997 and afterwards
* White and black estimates for 1980-1981 include Hispanic ethnicity



Source: NCHS, Asthma, Oct. 2001
NOTE: definition of asthma changed for 1997 and afterwards

Between 1992 and 1998, visits to hospital emergency rooms for asthma increased, with the greatest rate of *increase* occurring in children ages 10-17. Children under 5 years of age accounted for the highest rate of visits to emergency rooms. Although the increased burden of asthma affects Americans of all ages, race and ethnic groups, recent data indicate that children, the poor, and minorities have been most severely affected. (DHHS, 2000) Researchers at Yale University report that black and Hispanic children lack information on asthma, which is believed to contribute to more severe and less well-controlled asthma; the authors concluded this was due to a lack of "culturally sensitive pediatricians." (Current Opinion in Pediatrics, December 2000) Researchers at Johns Hopkins University suggested that a possible explanation for racial disparities is that fewer blacks see asthma specialists. (Journal Archives of Internal Medicine, July 2001)

Mortality From Asthma

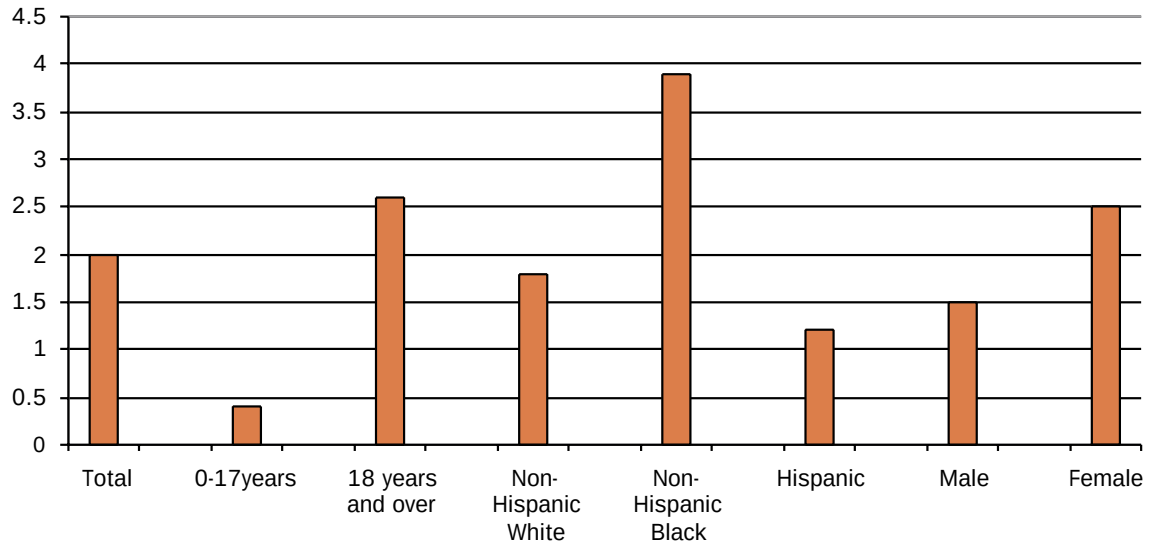
In 1998, the year of the most recent federal statistics, an average of about 15 Americans died each day from asthma as the *primary* cause of death and 34 died each day from asthma-related causes. From 1977-1995, annual deaths from asthma as the primary cause of death more than tripled from 1,674 to 5,637. In 1998, the number of these deaths fell slightly to 5,438. In addition to those who died from asthma as the primary cause of death, an additional 6,850 had asthma mentioned on the death certificate as a *contributing* cause of death. (NCHS, Asthma, Oct, 2001) In 1998 all asthma-related deaths totaled 12,288.

Age, race-ethnicity, and gender affect mortality from asthma. The mortality rate is higher for adults than children. Among children ages 0-17, 4 per million died from asthma compared to 20.6 deaths per million in adults ages 18 and over. According to federal data (NCHS, Asthma, Oct 2001) for 1998, blacks died from asthma at a rate twice that of whites and three times that of Hispanics. Among non-Hispanic white persons, the asthma death rate was 1.8 per 100,000. Among non-Hispanic blacks it was 3.9 deaths per 100,000 and for Hispanics it was 1.2 deaths per 100,000. (Figure 3, Table 1) There is no ready explanation for the observation that asthma deaths appear to be less frequent in Hispanics. As we noted in our 1999 report (PHPAB, 1999), poverty among Hispanics is no less severe than among blacks, and it is counter-intuitive to expect that Hispanics would see asthma specialists more frequently than either blacks or whites; yet, their reported mortality rates from asthma are strikingly different. The cause of these differences could be, for example, some unknown protective factors, or, more likely, problems with the data.

The asthma death rate for all females was nearly twice as high as that for males, 2.5 per 100,000 versus 1.5 per 100,000. (NCHS, Asthma, Oct 2001) Figure 3 from NCHS

data shows deaths per 100,000 by gender and ethnicity for 1998. Table 1 from the CDC compares crude death rates for whites and blacks for the years 1980-1998.

Figure 3: Asthma Deaths per 100,000 Population, 1998



Source: NCHS, Asthma, Oct. 2001

Table 1: Crude Death Rate (CDR), by Race Showing the Percentage Difference in CDR in the Black and White Populations, 1980-1998

Year	CDR (White) Cw Deaths per 100,000	CDR (Black) Cb Deaths per 100,000	Percentage difference (Cb-Cw / Cw) x 100
1980	1.18	2.09	+77%
1985	1.50	2.72	+81%
1990	1.77	3.23	+83%
1995	1.93	3.76	+95%
1998	1.77	3.74	+111%

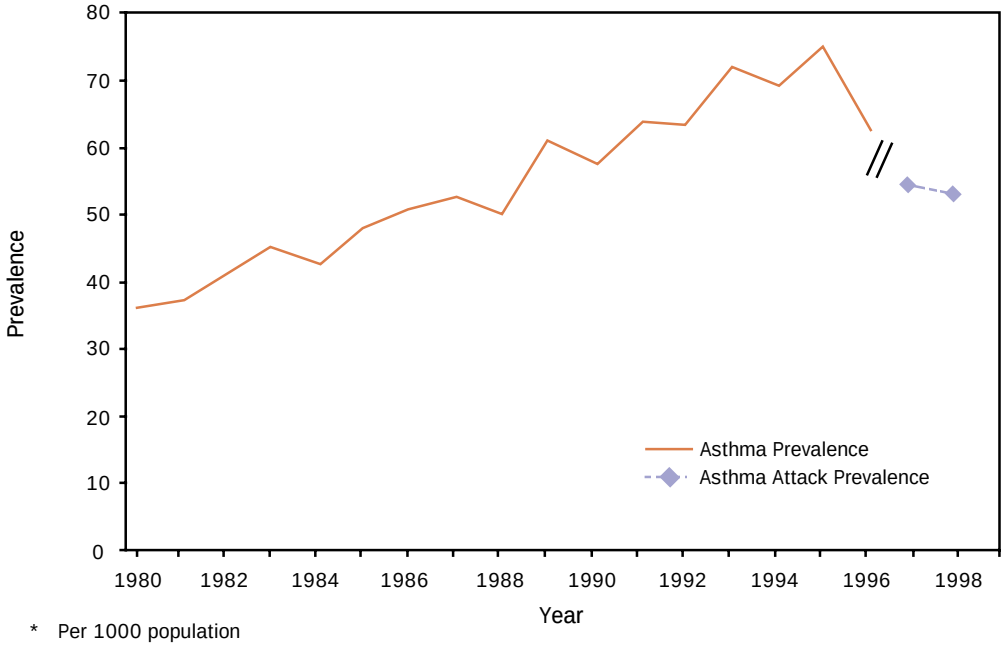
Source: CDC Wonder Mortality Statistics; Centers for Disease Control and Prevention; 2001

Problems With Data On Asthma

The principal source of data on the mortality of asthma in the United States is the Wonder Mortality statistical system of the CDC. These data are available on CDC's website and were summarized in CDC's 1998 surveillance report. (CDC Surveillance for Asthma, 1960-1995) The National Health Interview Survey is a principal source of survey data on the prevalence of asthma. These data are available on the NCHS website.

In 1997 the NCHS revised its NHIS methodology and redefined a case of asthma to include only individuals who been diagnosed by a health professional to have asthma *and* who experienced an asthma attack within the previous 12 months. The adoption of this new case definition for the NHIS had profound consequences for understanding the nature of the epidemic. The impact of the change is visibly seen in Figure 4, which NCHS published.

Figure 4. Prevalence* of Childhood Asthma among Persons Ages 0-17 Years, by Year National Health Interview Survey (NHIS), United States, 1980-1998**



* Per 1000 population
** NHIS was redesigned in 1997, resulting in a discontinuation of the trend

Source: MMWR Oct 13, 2000

The use of the new case definition produced an immediate and wholly artificial reduction by some 20% in the prevalence of asthma in children in 1997. Second, by basing its revised definition of asthma on an attack of asthma during the previous year, the NCHS essentially altered the picture of asthma from a *chronic disease*, often

lifelong, to a *sub-acute disease* measured by experience only of the previous 12 months. This new case definition eliminates from statistical view those individuals with asthma whose asthma is well controlled by continuing therapy. Third, the implementation of the changed case definition without validation against the old case definition has obliterated the opportunity to accurately interpret the trend. The change has made it impossible, at least for several years, to compare trends before 1996 with those afterwards. While both pre-1996 mortality and morbidity data show an unexplained epidemic of asthma for approximately 20 years, the change in case definition has obscured whether or not this epidemic has continued. It is intriguing that the steady increase in mortality rates up to 1995 seems to have flattened and perhaps even declined thereafter. Does this represent a real change in the epidemic, or simply a secondary effect of the changed case definition?

In addition to epidemiologic effects of the change in NCHS case definition, there were already entrenched problems in the old system, which have not been solved. The handling of race and ethnicity is not standardized. Some systems report data by categories "white," "black," and "other." Others report use categories "white," "black," and "Hispanic." Because these categories include fundamentally different forms of distinction–"white" and "black" are racial groupings distinguished by genetically determined physical characteristics, while "Hispanic" is a grouping defined by cultural heritage – they are not comparable. In its recently released report *Health, United States, 2001*, NCHS writes in Appendix II, "Hispanic origin includes persons of Mexican, Puerto Rican, Cuban, Central and South American, and other or unknown Latin American or Spanish origins. Persons of Hispanic origin *may be of any race*" (emphasis added). Given that a Hispanic asthmatic may "count" as a case in any or in none of the racial groupings with which comparisons are made, what does one do with the NCHS finding that mortality varies by ethnicity, and that Hispanics have substantially better mortality rates from asthma than either "Non-Hispanic White" and "Non-Hispanic Black?" If it were true, this would be a promising and important clue. But, in light of non-standardized categorization, non-comparability of the compared groups, and the possibility of counting in more than one category, the observation is unclear and that measures to improve data should be adopted or utilized in order to clarify this apparent paradox. For minorities, a group with considerably less access to, and utilization of, health professional services, the new case definition may significantly underestimate the prevalence and morbidity of asthma.

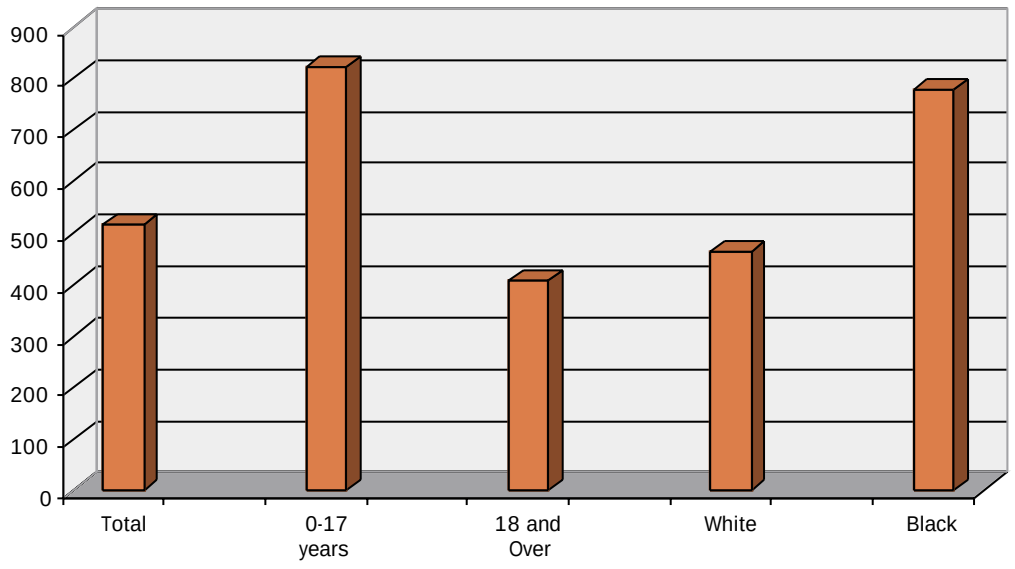
Categorization by age also has its problems. The CDC Surveillance Summary on asthma reported its findings in age categories, 0-4 years, 5-14 years, 15-34 years, 35-65 years and >65 years. In contrast, the NHIS data reported age as simply less than or more than 18 years; and NCHS data are shown as groups, 0-4 years, 5-10 years, and 10-17 years. This lack of standardization can lead to frustration and conflicting interpretations. For example, the data in the CDC Surveillance Summary show that prior to 1995, the age group experiencing the most rapid increase of self reported incidence of asthma (based

on the old case definition) were children 0-4 years. In contrast, the NHIS data on visits to hospital emergency rooms for asthma, collected in a different time frame (1992-1998) (during part of which the transition to the new case definition occurred) and in different age categories, indicates that the group with the greatest increase in incidence were those ages 10-17 years. The lack of standardization in presentation of data on asthma increases the difficulty of finding an epidemiologic explanation for the cause of the epidemic and a predictably successful strategy for its control.

Health Care Utilization And Cost

Health care utilization related to asthma includes visits to doctors' offices and hospital outpatient departments, visits to hospital emergency rooms, and hospitalizations. Our 1999 report showed that hospital discharge rates for asthma increased from 3.5 per 1,000 in 1985, to 4.5 per 1,000 in 1995. (PHPAB, 1999) In 1998, there were 13.9 million outpatient visits for asthma to private physician offices and hospital clinics, 515 per 10,000 population. Children ages 0-17 years had 5.8 million visits and an outpatient rate of 823 per 10,000 and adults 18 years and over had a rate of 407 per 10,000. Blacks had a rate of 778 visits per 10,000, and whites 463 per 10,000. (NCHS, Oct. 2001) (See Figure 5.)

Figure 5: Asthma Outpatient Visits per 10,000 Population, 1998



Source: NCHS, Asthma, Oct. 2001

In 1990, the cost of asthma to the U.S. economy was estimated to be $6.2 billion, with the majority attributed to direct medical expenses, such as hospitalization, physician

and nursing care, and medication. The National Heart, Blood and Lung Institute estimated the cost of asthma in the year 2000 as $12.7 billion. (NIH news release. May 3, 2001) This estimate includes $8.1 billion in direct medical expenses and $4.6 billion in indirect expenses, such as lost workdays for adults with asthma and lifetime earnings lost due to mortality from asthma. Estimating from the trends, the cost of asthma could rise to $18 billion by 2020. (Pew, 2000)

Conclusions And Recommendations

The Asthma Epidemic

- Based on the mortality and morbidity data up to 1995, the nation has experienced a major epidemic of asthma during the past twenty years.
- There are no convincing explanations for this epidemic.
- Because of the change by NHIS of the case definition of asthma, and the failure to calibrate the new definition against the old, morbidity data from 1997 and later can not be compared with those for 1996 and before; as yet, the new data do not aid us in determining whether the epidemic is increasing, continuing, or abating.
- Mortality data show a more or less stable rate of death from asthma after 1995; whether this plateau represents real slowing of the epidemic or secondary effects of the changed case definition is not clear.

Inadequate Data on Asthma

- The state of available data on asthma is a major barrier to understanding the epidemic.
- Thus, any prevention strategy will be based on incomplete, if not wholly erroneous conceptions of the dynamics of the epidemic.
- The likelihood of success with prevention strategies are further handicapped by the relative lack of required data.

Recommendations

- Using sound epidemiological principles, standardize the methodology for acquiring the data (including collection, analysis and presentation) to describe asthma in order to generate effective public health policy for asthma.
- Carefully examine the available epidemiologic evidence relevant to the increase in prevalence and mortality of asthma so as to begin to understand the causes of the epidemic.
- Conduct further research to examine host-environmental interactions.
- Better delineate the role of healthcare system access, availability, and utilization in relation to disparities in morbidity and mortality.

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Public Health Policy Advisory Board
2175 K Street, NW • Suite 700 • Washington, DC 20037
(202) 775-1110 • (202) 775-1767 (fax) • www.phpab.org