Actual Causes of Death in the United States, 2000

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In a seminal 1993 article, McGinnis and Foege described the major external (nongenetic) modifiable factors that contributed to death in the United States and labeled them the “actual causes of death.” During the 1990s, substantial lifestyle pattern changes may have led to variations in actual causes of death. Mortality rates from heart disease, stroke, and cancer have declined. At the same time, behavioral changes have led to an increased prevalence of obesity and diabetes.

Most diseases and injuries have multiple potential causes and several factors and conditions may contribute to a single death. Therefore, it is a challenge to estimate the contribution of each factor to mortality. In this article, we used published causes of death reported to the Centers for Disease Control and Prevention (CDC) for 2000, relative risks (RRs), and prevalence estimates from published literature and governmental reports to update actual causes of death in the United States—a method similar to that used by McGinnis and Foege.

METHODS

Our literature review used a MEDLINE database search of English-language articles that identified epidemiological, clinical, and laboratory studies linking risk behaviors and mortality. Our search criteria were to include all articles including the following key words: mortality, smoking, physical activity, diet, obesity, alcohol, microbial agents, toxic agents, motor vehicle, firearms, sexual behavior, illicit drug use. Our search allowed for words with similar meaning to be included (ie, exercise as well as physical activity). The search was initially restricted to articles published during or after 1990, but we later included relevant articles published in 1980 to December 31, 2002 (search strategies are available from the authors on request). For each risk factor, we used the prevalence and RR identified by the literature search. To identify the causes and number of deaths, we used mortality data reported in 2000 to the CDC. We used no unpublished information or data.

We used the following formula to calculate attributable fractions for each disease: \[ \left[ P_0 + \sum P_i(RR_i) \right] - 1 \right] / \left[ P_0 + \sum P_i(RR_i) \right], \] in which \( P_0 \) is the percentage of individuals in the United States not engaging in the risk behavior, \( P_i \) is the percentage of individuals in the United States engaging in each risk behavior, and \( RR_i \) is the relative risk of death due to the risk factor.

RESULTS

The leading causes of death in 2000 were tobacco (435,000 deaths; 18.1% of total US deaths), poor diet and physical inactivity (400,000 deaths; 16.6%), and alcohol consumption (85,000 deaths; 3.5%). Other actual causes of death were microbial agents (75,000), toxic agents (55,000), motor vehicle crashes (43,000), incidents involving firearms (29,000), sexual behaviors (20,000), and illicit use of drugs (17,000).

CONCLUSIONS

These analyses show that smoking remains the leading cause of mortality. However, poor diet and physical inactivity may soon overtake tobacco as the leading cause of death. These findings, along with escalating health care costs and aging population, argue persuasively that the need to establish a more preventive orientation in the US health care and public health systems has become more urgent.

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Context Modifiable behavioral risk factors are leading causes of mortality in the United States. Quantifying these will provide insight into the effects of recent trends and the implications of missed prevention opportunities.

Objectives To identify and quantify the leading causes of mortality in the United States.

Design Comprehensive MEDLINE search of English-language articles that identified epidemiological, clinical, and laboratory studies linking risk behaviors and mortality. The search was initially restricted to articles published during or after 1990, but we later included relevant articles published in 1980 to December 31, 2002. Prevalence and relative risk were identified during the literature search. We used 2000 mortality data reported to the Centers for Disease Control and Prevention to identify the causes and number of deaths. The estimates of cause of death were computed by multiplying estimates of the cause-attributable fraction of preventable deaths with the total mortality data.

Main Outcome Measures Actual causes of death.

RESULTS The leading causes of death in 2000 were tobacco (435,000 deaths; 18.1% of total US deaths), poor diet and physical inactivity (400,000 deaths; 16.6%), and alcohol consumption (85,000 deaths; 3.5%). Other actual causes of death were microbial agents (75,000), toxic agents (55,000), motor vehicle crashes (43,000), incidents involving firearms (29,000), sexual behaviors (20,000), and illicit use of drugs (17,000).

Conclusions These analyses show that smoking remains the leading cause of mortality. However, poor diet and physical inactivity may soon overtake tobacco as the leading cause of death. These findings, along with escalating health care costs and aging population, argue persuasively that the need to establish a more preventive orientation in the US health care and public health systems has become more urgent.

JAMA. 2004;291:1238-1245

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percentage engaging in separate categories of the risk behavior, and RR is the RR of death for each separate category relative to none. For instance, in the case of smoking, \( P_3 \) is the percentage of persons who never smoked, \( P_1 \) is the percentage of former smokers, \( P_2 \) is the percentage of current smokers, \( RR_1 \) is the RR of a certain type of death for former smokers compared with those who never smoked, and \( RR_2 \) is the RR of death for current smokers compared with those who never smoked. We then multiplied estimates of the cause-attributable fraction of preventable deaths by total mortality data. Whenever possible, we used RRIs of death and mortality data by other variables such as age, sex, and race.

We estimated ranges for our estimated number of deaths by using the smallest and highest RRIs and their boundaries when available. When data were available, we used specific underlying causes of death in deriving some of our estimates (ie, firearms, motor vehicles, and illicit drug use). Further details of these methods may vary due to availability of data and are presented in each section below. We used SAS (version 8.2, SAS Institute Inc, Cary, NC) and SUDAAN (version 8.0, Research Triangle Institute, Research Triangle Park, NC) statistical software.

RESULTS

The number of deaths in the United States in 2000 was 2.4 million, which is an increase of more than 250,000 deaths in comparison with the 1990 total, due largely to population growth and increasing age. Leading causes of death were diseases of the heart (710,760), malignant neoplasms (553,091), and cerebrovascular diseases (167,661) (TABLE 1).

Tobacco

We used methods and software used in previous CDC reports to compute the annual smoking-attributable mortality for 2000. As in previous reports, we used RRIs for each cause of death from the American Cancer Society’s Cancer Prevention Study II and included deaths due to secondhand smoking.

We used data from the Behavioral Risk Factor Surveillance System (BRFSS), a cross-sectional telephone survey conducted by state health departments with the CDC’s assistance, to determine changes in US smoking prevalence from 1995-1999 to 2000. A detailed description of survey methods is available elsewhere. A slight decline in smoking was observed from 1995-1999 to 2000. The prevalence of smoking in 1995-1999 was 22.8% for current smokers (males: 25.1%; females: 20.6%), 24.1% for former smokers (males: 28.3%; females: 20.3%), and 53.1% for never-smokers (males: 46.5%; females: 59.2%). In 2000, these estimates were 22.2% for current smokers (males: 24.1%; females: 20.5%), 24.4% for former smokers (males: 28.3%; females: 20.7%), and 53.4% for never-smokers (males: 47.6%; females: 58.8%).

We estimate that approximately 435,000 deaths were attributable to smoking in 2000, which is an increase of 350,000 deaths from 1990 (TABLE 2). This increase is due to the inclusion of 350,000 deaths due to secondhand smoking and 1000 infant deaths due to maternal smoking, which were not included in the article by McGinnis and Foege.

Poor Diet and Physical Inactivity

To assess the impact of poor diet and physical inactivity on mortality, we computed annual deaths due to overweight. Recent articles have reported that overweight increased in all segments of the US population. To derive the attributable number of deaths due to overweight, we used estimates from the CDC’s 1999 and 2000 National Health and Nutrition Examination Surveys. We used the same procedure reported by Allison et al to estimate annual overweight-attributable deaths. We used the body mass index (BMI) range of 23 to 25 as our reference category to match the method used by Allison et al. Body mass index is calculated as weight in kilograms divided by the square of the height in meters. Using data from the 1999 and 2000 National Health and Nutrition Examination Surveys, the percentages for BMI cut points were less than 23 (22.2%), 23 to less than 25 (15.0%), 25 to less than 27 (7.4%), 26 to less than 27 (7.36%), 27 to less than 28 (6.2%), 28 to less than 29 (6.3%), 29 to less than 30 (5.94%), 30 to 35 (16.95%), and more than 35 (12.6%).

We used hazard ratios reported previously to recompute annual deaths for 6 major population-based studies. The mean estimate of the total number of overweight-attributable deaths in 2000 was 494,921. For the Alameda County Health Study, the estimated number of overweight-attributable deaths in 2000 was 536,763; Framingham Heart Study, 543,981; Tecumseh Community Health Study, 462,005; American Cancer Society Cancer Pre-

**Table 1. Leading Causes of Death in the United States in 2000**

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>No. of Deaths</th>
<th>Death Rate per 100,000 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>710,760</td>
<td>258.2</td>
</tr>
<tr>
<td>Malignant neoplasm</td>
<td>553,091</td>
<td>200.9</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>167,661</td>
<td>60.9</td>
</tr>
<tr>
<td>Chronic lower respiratory tract disease</td>
<td>122,009</td>
<td>44.3</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>97,900</td>
<td>35.6</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>69,301</td>
<td>25.2</td>
</tr>
<tr>
<td>Influenza and pneumonia</td>
<td>65,313</td>
<td>23.7</td>
</tr>
<tr>
<td>Alzheimer disease</td>
<td>49,558</td>
<td>18</td>
</tr>
<tr>
<td>Nephritis, nephrotic syndrome, and nephrosis</td>
<td>37,251</td>
<td>13.5</td>
</tr>
<tr>
<td>Septicemia</td>
<td>31,224</td>
<td>11.3</td>
</tr>
<tr>
<td>Other</td>
<td>499,283</td>
<td>181.4</td>
</tr>
<tr>
<td>Total</td>
<td>2,403,351</td>
<td>873.1</td>
</tr>
</tbody>
</table>

*Data are from Minino et al.*
**CAUSES OF DEATH**

<table>
<thead>
<tr>
<th>Actual Causes of Death in the United States in 1990 and 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Actual Cause</strong></td>
</tr>
<tr>
<td>Tobacco</td>
</tr>
<tr>
<td>Poor diet and physical inactivity</td>
</tr>
<tr>
<td>Alcohol consumption</td>
</tr>
<tr>
<td>Microbial agents</td>
</tr>
<tr>
<td>Toxic agents</td>
</tr>
<tr>
<td>Motor vehicle</td>
</tr>
<tr>
<td>Firearms</td>
</tr>
<tr>
<td>Sexual behavior</td>
</tr>
<tr>
<td>Illicit drug use</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

*Data are from McGinnis and Foege. The percentages are for all deaths.*

As in the study by Allison et al, the estimate for the attributable number of deaths for nonsmokers or never-smokers was higher than the estimate for the total because smoking is associated with both lower body weight and higher mortality. Also in 2000, the mean estimate of the total number of overweight-attributable deaths among nonsmokers or never-smokers was 543,797. For the Alameda County Health Study, the estimate of overweight-attributable deaths among nonsmokers or never-smokers was 639,026; Framingham Heart Study, 583,913; Tecumseh Community Health Study, 457,460; American Cancer Society Cancer Prevention Study I, 466,729; Nurses Health Study, 570,855; and the National Health and Nutrition Examination Survey I Epidemiologic Follow-up Study, 439,548.

We used BRFSS data to compute the number of alcohol-attributable deaths for the US population aged 18 years or older. The BRFSS also asked questions about binge drinking (ie, ≥5 drinks per occasion). To account for the effect that respondents appeared not to include binge drinking in their reported regular drinking, we reran our analyses, adding 5 drinks per binge occasion to average drinks per day. The total number of deaths attributable to alcohol was 103,350.

We also used 3 other recent studies to estimate alcohol-attributable mortality. Two studies were based on the National Health Interview Survey and the National Alcohol Survey. Using all-cause mortality and RRs from these studies, we estimated approximately 60,000 deaths per year. This difference in number of deaths is mainly due to the fact that BRFSS respondents report a higher percentage of heavy drinking than do respondents in a household survey such as the National Health Interview Survey.

In another approach, we aggregated alcohol-related deaths from specified ICD codes that were summed to provide an overall estimate of deaths. In 2000, 18,539 deaths were reported as alcohol-induced (ICD-10 codes F10, G31.2, G62.1, H42.6, K29.2, K70, R78.0, X45, X65). In addition, 16,653 persons were killed in alcohol-related crashes.**
We estimate another 34,797 deaths in 2000 using BRFSS alcohol consumption data and disease-specific RRs from the Australian study for oropharyngeal, esophageal, liver, laryngeal, and female breast cancers; stroke: hypertension; heart disease; and other chronic liver disease and cirrhosis (ICD-10 code K73-74). This totals to 69,989 deaths in 2000 from these factors alone. In the Australian study, all-cause mortality was also higher than the summation of cause-specific mortality.

Total alcohol-attributable deaths would reach about 140,000 if mortality among previous alcohol drinkers were included. It is unclear whether excess mortality among former alcohol drinkers is due to damage or illness from past alcohol consumption.

Taking these various numbers into account, our best estimate for total alcohol-attributable deaths in 2000 is approximately 85,000, based on the conservative estimate from cause-specific deaths and the high estimate using all-cause mortality. This is a reduction of 15,000 deaths from the 1990 estimates.

**Microbial Agents**

We excluded human immunodeficiency virus (HIV) from this category and included it with sexual behaviors to be consistent with the analysis by McGinnis and Foege. In the past, infectious agents were the leading cause of mortality. These agents still present a major threat to the nation’s health and are associated with high morbidity. Several improvements in the health system have led to a decline in mortality from infectious diseases. The increase in US immunization rates led to a decline in mortality from many vaccine-preventable diseases. Several laws ensure this high immunization rate for children by requiring vaccination for school and day-care enrollment. There also have been substantial improvements in sanitation and hygiene, antibiotics and other antimicrobial medicines, and hospital-infection control.

In 2000, influenza and pneumonia accounted for 65,313 deaths, sepsisemia for 31,224, and tuberculosis for 776. In general, mortality from infectious and parasitic diseases has declined since 1990. Because pneumonia and sepsisemia occur at higher rates among patients with cancer, heart disease, lung disease, or liver disease, some of these deaths really are attributable to smoking, poor diet, and alcohol consumption. We estimate that approximately 75,000 deaths were attributable to microbial agents in 2000 from all ICD-10 codes for infectious and parasitic mortality. The major cause of the decline was a decrease in deaths from influenza and pneumonia probably reflecting at least in part an increase in immunization in older adults against vaccine-preventable diseases. This contrasts with 90,000 deaths attributed to microbial agents in 1990 estimates.

**Toxic Agents**

Estimating the number of deaths due to toxic agents is more challenging than any of the other risk factors due to limited published research and the challenges of measuring exposure and outcome. In the 1990s, many improvements were made in controlling and monitoring pollutants. There is more systematic monitoring of pollutants at state and county levels, and exposure to asbestos, benzene, and lead have declined. In fact, the US Environmental Protection Agency reported a decline of 25% from 1970 to 2001 in 6 principal air pollutants: carbon monoxide, lead, ozone, nitrogen dioxide, sulfur dioxide, and particulate matter.

Toxic agents are associated with increased mortality from cancer, respiratory, and cardiovascular diseases. We used the National Morbidity, Mortality, and Air Pollution Study to estimate mortality due to air pollution. The study assessed the association between air pollution and mortality and morbidity in 90 cities in the United States. Only particulate matter (PM) was associated with a significant increase in mortality—an approximate 0.5% increase in total mortality for each 10 µg/m³ increase in PM₁₀. Previous studies reported a range of 0.4% to 1% for that association. We used 23.8 µg/m³ as the daily average of PM₁₀ concentration in 2000, which results in an estimate of 24,000 deaths per year (range, 22,000-25,000 deaths) from air pollution alone.

The National Institute for Occupational Safety and Health (NIOSH) estimates that about 113,000 deaths are due to occupational exposure from 1968 to 1996. The number of deaths caused by occupational exposure has declined during that period. In 1996, NIOSH estimated 31,191 deaths from pneumoconiosis and 1176 from asbestosis. Although, particulate air pollution accounts for the majority (about 60%) of mortality related to toxic agents, indoor air pollution, environmental tobacco smoke, radon, lead in drinking water, and food contamination are associated with increased mortality. We estimate that toxic agents (excluding environmental tobacco exposure) were associated with 2% to 3.5% of total mortality in 2000. We estimate approximately 55,000 deaths attributable to toxic agents in 2000. This estimate is our least certain of the various causes.

**Motor Vehicles**

Motor-vehicle crashes involving passengers and pedestrians resulted in 43,354 deaths in 2000. This decline from 47,000 deaths in 1990 represents successful public health efforts in motor-vehicle safety. Deaths from alcohol-related crashes declined from 22,084 in 1990 to 16,653 in 2000. Major contributing factors include the use of child safety seats and safety belts, decreases in alcohol-impaired driving, changes in vehicle and highway design, and national goals to reduce motor-vehicle–related mortality and injury. We estimate that approximately 26,500 deaths in 2000 were attributable to motor-vehicle crashes in which alcohol was not a factor. This is an increase of 1500 from the 1990 report because both estimates were not adjusted for the number of registered vehicles, number of crashes, nor miles of travel. We included alcohol-related deaths to stress that efforts to educate the public and enforce laws against driving while intoxicated have accounted for most of the

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(Reprinted) JAMA, March 10, 2004—Vol 291, No. 10 1241
the decline in deaths related to motor-vehicle crashes.

**Firearms**

Firearm-related incidents resulted in 28663 deaths among individuals in the United States in 2000.4 This is a decline from approximately 36000 deaths in 1990. The largest declines were in deaths from homicides and unintentional discharge of firearms. In 2000, 16586 deaths were due to intentional self-harm (suicide) by discharge of firearms (ICD-10 codes X72-X74). Assault (homicide) by discharge of firearms (ICD-10 codes X93-X95) resulted in 10801 deaths. Unintentional discharge of firearms (ICD-10 codes W32-W34) resulted in 776 deaths, while discharge of firearms, undetermined intent (ICD-10 codes Y22-Y24), resulted in 230 deaths. The remaining 270 deaths were due to legal intervention (ICD-10 code Y35). These numbers were ascertained from death certificate reports.

**Sexual Behavior**

Sexual behavior is associated with an increased risk of preventable disease and disability.63 An estimated 20 million persons are newly infected with sexually transmitted diseases each year in the United States.64,65 Mortality from sexually transmitted diseases is declining due to the availability of earlier and better treatment, especially for HIV.66,67 In 2000, HIV disease (ICD-10 codes B20-B24) resulted in 14578 deaths. In 1990, HIV was the cause of 27695 deaths for persons older than 13 years, indicating about a 48% decline in HIV mortality during the decade. Based on the sexual behavior-attributable fraction from the literature,68,69 we estimate that 20000 deaths (range, 18000-25000 deaths) in 2000 were due to sexual behavior—mainly HIV; other contributors were hepatitis B and C viruses and cervical cancer. The decline of 10000 deaths from the 1990 estimates was due to the decline in HIV mortality.

**Illicit Use of Drugs**

Illicit drug use is associated with suicide, homicide, motor-vehicle injury, HIV infection, pneumonia, violence, mental illness, and hepatitis.72,73 An estimated 3 million individuals in the United States have serious drug problems.74,75 Several studies have reported an undercount of the number of deaths attributed to drugs by vital statistics;76 however, improved medical treatments have reduced mortality from many diseases associated with illicit drug use. In keeping with the report by McGinnis and Foege,7 we included deaths caused indirectly by illicit drug use in this category. We used attributable fractions to compute the number of deaths due to illicit drug use.77,78

Overall, we estimate that illicit drug use resulted in approximately 17000 deaths in 2000, a reduction of 3000 deaths from the 1990 report.

**Other Factors**

Several other factors contribute to an increased rate of death. There are factors that we do not know of such as unknown pollutants or perhaps exposures that may cause a considerable number of deaths. Poverty and low education levels are associated with increased mortality from many causes,82,83 partly due to differential exposure to the risks described above. However, controlling for differential exposure to risk factors is unlikely to explain the entire impact on mortality. Lack of access to proper medical care or preventive services is associated with increased mortality.84 Biological characteristics and genetic factors also greatly affect risk of death.85 In most studies we reviewed, low education levels and income were associated with increased risk of cardiovascular disease, cancer, diabetes, and injury. The Healthy People 2010 initiative has made the elimination of health disparities, especially racial and ethnic disparities, a primary goal.86

**COMMENT**

We found that about half of all deaths that occurred in the United States in 2000 could be attributed to a limited number of largely preventable behaviors and exposures. Overall, we found relatively minor changes from 1990 to 2000 in the estimated number of deaths due to actual causes. Our findings indicate that interventions to prevent and increase cessation of smoking, improve diet, and increase physical activity must become much higher priorities in the public health and health care systems.

The most striking finding was the substantial increase in the number of estimated deaths attributable to poor diet and physical inactivity. We estimate that roughly 400000 deaths now occur annually due to poor diet and physical inactivity. The gap between deaths due to poor diet and physical inactivity and those due to smoking has narrowed substantially. Because rates of overweight increased rapidly during the 1990s, we used a conservative approach to make our estimates, accounting for the delayed effects of overweight on mortality. In addition, overweight lessens life expectancy.87,88 However, it is clear that if the increasing trend of overweight is not reversed over the next few years, poor diet and physical inactivity will likely overtake tobacco as the leading preventable cause of mortality.

The most disappointing finding may be the slow progress in reducing tobacco-related mortality. A few states, notably California, have had major success in programs that led to reducing deaths from heart disease and cancer.89 However, efforts in most other states are too recent or short-term to have a similar effect. In response to the increase in tobacco use among youth in the early 1990s, state and national tobacco-control efforts increased their focus on prevention of initiation and recognized the importance of cessation on reducing smoking-related deaths. Thus, most national and state efforts now address comprehensive program strategies.90 Current tobacco-control efforts will also need strong cessation components to show a decline in tobacco deaths in a future assessment. Recent reports on the effects of telephone quit lines for smokers are encouraging.91 On the other hand, large...
state budget shortfalls are leading to large cuts in public health, with a corresponding diversion of resources from tobacco taxes and settlement dollars to cover deficits instead of tobacco-control programs.

Despite the call to action on these risk factors a decade ago, there has been little progress in reducing the total number of deaths from these causes. The progress that has occurred primarily involves actual causes of death that are less prominent. With the shift in the age distribution of the population, more adults now are in the age group at highest risk because of the cumulative effects of their behavior. The net effect is that both total deaths and total burden due to the actual causes have increased.

Our analyses have several limitations. Our study reported actual causes of mortality in the United States. However, these causes are also associated with a large morbidity burden. In addition to premature death, years of lost life, diminished productivity, and high rates of disability, decreased quality of life is also strongly associated with these actual causes. A recent World Health Organization report finds these actual causes of death to be the leading causes of total disease burden, not just mortality, in the developed world.92 Because we used self-reported estimates for some risk behaviors, (ie, prevalence of alcohol intake) they may have been underestimated. Finally, using all-cause mortality may result in overestimates of the number of deaths from specific causes. In addition, if the effect of the risk factor is age-dependent, then age- and sex-specific estimates are preferable.

Our analyses did not assess the effect of genetics. Genetic factors have been associated with several diseases discussed herein.85 Much of the impact of genetics is likely mediated through increased physical susceptibility to these behavioral and other modifiable risks. However, increases in obesity and diabetes cannot be due to widespread changes in the human genome over the last 10 years. Nevertheless, genetics offers great potential for treating and ameliorating risk. Identifying individuals at higher risk for a disease through genetic testing may promote lifestyle changes that can help prevent the onset of that disease.93

In this study we also did not examine the effects of high blood pressure and cholesterol or lipid profile on mortality, although some of the effects of these factors are mediated through poor diet and physical inactivity. These risk factors are common among adults in the United States. More than 30% of US adults have high blood pressure or high cholesterol.94,95 Monitoring and controlling blood pressure and cholesterol is crucial to preventing premature mortality and morbidity.

One of the most difficult aspects of this analysis is that the attribution of the actual cause that led to death varies depending on perspective. We used similar methods to those used by McGinnis and Foege1 to allow comparisons. We tried when possible to use RRs that are fully adjusted for other risk factors in our analyses, but possibly not eliminating duplicate attribution of causes. We also explicitly included some deaths in more than 1 category (eg, alcohol and motor vehicle crashes) when choosing another category seemed as though it might artificially constrain interpretation for future prevention programs.

In summary, smoking and the deaths attributed to the constellation of poor diet and physical inactivity currently account for about one third of all deaths in the United States. The rapid increase in the prevalence of overweight means that this proportion is likely to increase substantially in the next few years. The burden of chronic diseases is compounded by the aging effects of the baby boomer generation and the concomitant increased cost of illness at a time when health care spending continues to outstrip growth in the gross domestic product of the United States. In ancient times, Hippocrates stated that “the function of protecting and developing health must rank even above that of restoring it when it is impaired.” The findings in this study argue persuasively for the need to establish a more preventive orientation in health care and public health systems in the United States.

Author Contributions: Dr Mokdad had full access to the data in this study and takes full responsibility for the scientific integrity of the data and the accuracy of the analysis and content of the manuscript.

Study concept and design: Mokdad, Marks, Stroup, Gerberding.

Acquisition of data: Mokdad, Stroup, Gerberding.

Analysis and interpretation of data: Mokdad, Marks, Stroup, Gerberding.

Drafting of the manuscript: Mokdad, Marks, Stroup, Gerberding.

Critical revision of the manuscript for important intellectual content: Mokdad, Marks, Stroup, Gerberding.

Statistical expertise: Mokdad, Stroup.

Obtained funding: Marks, Gerberding.

Administrative, technical, or material support: Mokdad, Marks, Stroup, Gerberding.

Study supervision: Marks, Gerberding.

Role of the Sponsor: There was no external funding for this work.

Acknowledgment: We acknowledge the valuable contributions of Barbara A. Bowman, PhD, Robert D. Brewer, MD, MSPH, Earl S. Ford, MD, MPH, Wayne H. Giles, MD, James M. Mendlein, PhD, Cheryl Pelletier, Susan Y. Chu, PhD, and Eduardo J. Simoes, MD, MPH.

Funding/Support: There was no external funding for this work.

Role of the Sponsor: The Centers for Disease Control and Prevention reviewed and approved this report before submission.
Institute of Health, National Heart, Lung, and Blood Institute; 1998.

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that it may not be correct to assume that methadone is a much safer and less abusable alternative to other opiate analgesics.

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Financial Disclosure: The authors received consultant fees from Purdue Pharma LLC during the time these studies were carried out.

Access to Data: Dr Cicero had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analyses.

Funding/Support: This research was supported in part by grants from Purdue Pharma LLC as a general study of prescription drug abuse. Purdue Pharma has extensive interests in opiate analgesics, the most important of which is oxycodone, and other long-acting analgesic preparations.

Role of Sponsors: Purdue Pharma LLC had no role in the design and conduct of the study; the collection, analysis, and interpretation of the data; or the preparation, review, or approval of the manuscript.