

Economic Costs of Excessive Alcohol Consumption in the U.S., 2006

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Background: Excessive alcohol consumption causes premature death (average of 79,000 deaths annually); increased disease and injury; property damage from fire and motor vehicle crashes; alcohol-related crime; and lost productivity. However, its economic cost has not been assessed for the U.S. since 1998.

Purpose: To update prior national estimates of the economic costs of excessive drinking.

Methods: This study (conducted 2009–2010) followed U.S. Public Health Service Guidelines to assess the economic cost of excessive alcohol consumption in 2006. Costs for health care, productivity losses, and other effects (e.g., property damage) in 2006 were obtained from national databases. Alcohol-attributable fractions were obtained from multiple sources and used to assess the proportion of costs that could be attributed to excessive alcohol consumption.

Results: The estimated economic cost of excessive drinking was \$223.5 billion in 2006 (72.2% from lost productivity, 11.0% from healthcare costs, 9.4% from criminal justice costs, and 7.5% from other effects) or approximately \$1.90 per alcoholic drink. Binge drinking resulted in costs of \$170.7 billion (76.4% of the total); underage drinking \$27.0 billion; and drinking during pregnancy \$5.2 billion. The cost of alcohol-attributable crime was \$73.3 billion. The cost to government was \$94.2 billion (42.1% of the total cost), which corresponds to about \$0.80 per alcoholic drink consumed in 2006 (categories are not mutually exclusive and may overlap).

Conclusions: On a per capita basis, the economic impact of excessive alcohol consumption in the U.S. is approximately \$746 per person, most of which is attributable to binge drinking. Evidence-based strategies for reducing excessive drinking should be widely implemented.

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Introduction

Excessive alcohol consumption is responsible for an average of 79,000 deaths and 2.3 million years of potential life lost in the U.S. each year,¹ making it the third-leading preventable cause of death in this country.² Excessive alcohol consumption is associated with multiple adverse health and social consequences, including liver cirrhosis, certain cancers, unintentional injuries, violence, and fetal alcohol spectrum disorder. Excessive

alcohol consumption also causes premature death, increased healthcare costs, property damage from fire and motor vehicle crashes, increased crime and criminal justice system costs, and lost worker productivity in the form of missed work, diminished output, and reduced earnings potential.

A comprehensive analysis³ estimated the 1992 economic cost of alcohol abuse at \$148 billion; a 1998 update⁴ put the figure at \$184.6 billion. Since then, there have been no comprehensive national estimates of the costs of excessive alcohol consumption.⁵ Current estimates are needed to more fully assess the public health impact of excessive drinking. Accordingly, the purpose of the present study (conducted 2009–2010) was to update prior national estimates of the economic costs of excessive drinking.

The 2006 estimates reported here employ updated data, as well as new data sources and take advantage of new scientific findings and measurement tools (e.g., Al-

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cohol-Related Disease Impact [ARDI] software created by the CDC)⁶ that can more effectively assess the relationship between excessive drinking and various health and social outcomes. Addressing the benefits of excessive alcohol consumption was beyond the scope of the current study. Studies such as this one focus solely on identifying and quantifying the societal costs of excessive drinking.

Methods

General Approach

The present study follows the approach in *Guidelines for Cost of Illness Studies in the Public Health Service*.⁷ In brief, this approach estimates the proportion of national costs for health care; crime; mortality- and morbidity-associated productivity; and other expenses that can be reasonably attributed to a particular behavior or health problem. This same approach was used by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) to assess the economic cost of alcohol misuse in 1992 and 1998.^{3,4} This methodology focuses on the direct and indirect costs associated with risk factors and health outcomes and does not consider intangible costs, such as pain and suffering. Thus, such estimates tend to be substantially lower than those that include intangible costs. Estimates were developed for 2006, because this is the most recent year for which cost and outcome data were generally available.

To be as consistent as possible with prior estimates, the same general methods and cost centers as the NIAAA studies^{3,4} were used. The current study did, however, make use of the best currently available science for assessing the economic costs of alcohol-attributable health and social outcomes, and as a result, some of the specific conditions or approaches used to obtain alcohol-attributable fractions (AAFs) (e.g., AAFs for crime) differed somewhat from those that were used previously.

Definition of Excessive Alcohol Consumption

Excessive alcohol consumption was defined as follows: binge drinking (≥ 4 drinks per occasion for a woman, and ≥ 5 drinks per occasion for a man); heavy drinking (> 1 drink per day on average for a woman, and > 2 drinks per day on average for a man); any alcohol consumption by youth aged < 21 years; and any alcohol consumption by pregnant women. Depending on the data source, these drinking patterns were generally ascertained for the past 30 days. This definition is consistent with CDC and NIAAA standards used to identify harmful patterns of alcohol consumption. Because most excessive drinkers are not alcohol dependent and the diagnoses of alcohol dependence/alcohol abuse generally involves a history of excessive drinking over an extended period of time, these diagnoses were considered an outcome of excessive drinking and not the primary basis for assessing economic costs. However, a history of alcohol dependence or abuse was used as a specific indicator of excessive drinking in some analyses (e.g., productivity losses based on lost earnings).

Alcohol-Attributable Fractions

Several analytic components used AAFs to quantify what proportion of costs were attributable to excessive alcohol consumption

(Appendix A, available online at www.ajpmonline.org). The CDC's ARDI system⁶ was used as the basis for selecting the specific alcohol-attributable conditions that were included in the analysis of health-related costs, including deaths and healthcare expenditures related to excessive drinking. The ARDI system produces national and state estimates of alcohol-attributable deaths and Years of Potential Life Lost due to excessive alcohol consumption.

The selection of the alcohol-attributable conditions included in ARDI, as well as the methods used in ARDI to obtain attribution factors for these conditions, was made by a panel of public health experts. For some conditions (e.g., those with an acute onset [such as injuries]), ARDI uses direct AAF estimates based on studies assessing the proportion of deaths from a condition that occurred at a blood alcohol concentration (BAC) of ≥ 0.10 g/dL. For the majority of the chronic conditions in ARDI, AAFs are calculated using pooled estimates of relative risk obtained from meta-analyses and prevalence data on specified alcohol-consumption levels using data from the Behavioral Risk Factor Surveillance System.

The AAFs from ARDI⁶ were used for fatalities and for nonfatal chronic conditions. A meta-analysis assessing alcohol involvement among people treated in emergency departments⁸ provided AAFs for nonfatal violent injuries (0.267) and unintentional injuries other than those related to traffic crashes (0.058). For nonfatal traffic injuries, an AAF of 0.061 was derived from a National Highway Traffic Safety Administration study of injury-producing crashes involving BACs of ≥ 0.10 g/dL.⁹ For fire-related outcomes, an AAF of 0.05 was used based on a National Fire Protection Association study.¹⁰

For crime, the AAF for homicide from ARDI⁶ was used because this AAF considers drinking by the perpetrator and not just drinking by the victim. Alcohol-related crimes such as driving under the influence of alcohol, public drunkenness, and liquor law violations were fully attributed to alcohol.

For other offenses, attribution was estimated as the percentage of offenders intoxicated at the time of their offense based on self-reported alcohol-consumption data from surveys of jail inmates and state and federal prison inmates, respectively^{11,12} (Appendix B, footnote e, available online at www.ajpmonline.org). AAFs for state and federal inmates were used to attribute costs for those incarcerations only. AAFs for jail inmates were used to attribute costs for jail detentions, as well as for arrests and victim costs by offense.

Cost Calculations

Costs were estimated for a variety of impacts and consequences (Appendix B, available online at www.ajpmonline.org). The general approach was to identify a valid and reliable source of national costs for a particular consequence (e.g., hospitalizations), or alternatively, identify the mean cost per individual or event; calculate the number of individuals affected or the number of alcohol-related events; and then estimate the proportion attributable to excessive alcohol consumption.

Healthcare costs. Healthcare costs included the costs of specialty treatment for alcohol dependence and alcohol abuse; treatment costs for the 54 health conditions in ARDI, or their nonfatal equivalent, that were fully or partially attributable to alcohol (Appendix A, available online at www.ajpmonline.org);

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costs associated with fetal alcohol syndrome (FAS); research and prevention costs; health insurance administration costs; and costs of training substance abuse and mental health professionals. For hospitalizations and ambulatory care, the study calculated only those costs associated with the primary (first-listed) diagnosis. With the exception of FAS, prematurity, low birth weight, intrauterine growth retardation, motor vehicle traffic crashes, and child maltreatment, conditions that were less than 100% attributable to alcohol were attributed only to individuals aged ≥ 15 years for acute conditions and ≥ 20 years for chronic conditions. Where research and prevention programs addressed both alcohol and drug abuse, the share attributed to alcohol was based on the share of specialty substance abuse treatment spending for alcohol (48.1%).¹³

Productivity losses. Productivity losses related to excessive drinking included losses associated with premature mortality; impaired productivity (at work, at home, and while institutionalized); work-related absenteeism; crime (lost work days among victims and lost productivity from incarcerations); and fetal alcohol syndrome. When alcohol-related sickness, disability, death, or incarceration prevents an individual from engaging in his or her normal expected productive activities, this represents a loss of potential productivity—work that could and would have been done, but wasn't because of excessive drinking.

Estimation methods were based on human capital theory, and lost productive time was valued at estimated earnings levels (i.e., estimated average earnings and benefits in the U.S.), including employer payroll taxes. This approach to valuing the loss follows the *Guidelines for Cost of Illness Studies in the Public Health Service*⁷; however, it should be noted that alternative methods for valuing productivity loss, such as “willingness to pay,” exist and these would tend to generate much larger losses than those estimated in the present study.

Other effects. Other effects include costs associated with property damage due to crimes, criminal justice system, motor vehicle crashes, fire damage, and FAS-related special education. Criminal justice system costs include costs for police protection, the court system, correctional institutions, private legal costs, and alcohol crimes (e.g., driving under the influence [DUI]; liquor law violations; and public drunkenness).

Treatment costs, productivity losses, and special education costs for fetal alcohol syndrome were taken from a 2004 study.¹⁴ Results from the current study were trended to 2006 based on increases in the U.S. population and price inflation. Treatment costs, productivity losses, and special education costs were trended for price inflation based on the consumer price index (CPI) for Medical Care Services, the employment cost index for U.S. civilian employees, and the CPI for all goods and services, respectively.

Subgroup Analyses

Costs were broken down to provide estimates related to specific types of excessive consumption or adverse consequences (Appendix C, available online at www.ajpmonline.org). These subgroups are not mutually exclusive and may overlap.

Binge drinkers. Binge drinking was defined as a woman consuming ≥ 4 drinks or a man consuming ≥ 5 drinks within a 2-hour period (commonly reported as the amount consumed per occasion). This pattern of rapid alcohol consumption typically results in

legal intoxication (i.e., a blood alcohol level of ≥ 0.08 g/dL). Accordingly, the cost of treating alcohol-attributable acute conditions was fully attributed to binge drinking because the AAFs for those conditions were based on intoxication. Because estimated crime costs were also based on intoxication, they were all attributed to binge drinking, as were motor vehicle and fire costs.

For costs of treatment for alcohol dependence or abuse and for costs of impaired productivity due to lost earnings among people with a history of alcohol dependence, the percentage of individuals with alcohol dependence or alcohol abuse who reported binge drinking in the past 30 days in the National Epidemiologic Survey on Alcohol and Related Conditions (68.5%)¹⁵ was used to estimate the proportion of costs related to these conditions that were due to binge drinking to ensure that these costs related only to the proportion of people with these conditions who also had a recent history of binge drinking. For productivity losses due to premature mortality, costs attributable to acute causes of death and 68.5% of deaths from alcohol abuse or alcohol dependence were attributed to binge drinking.

Underage drinkers. Where data included the age of affected individuals, results were estimated separately for those aged < 21 years. For those cost categories for which it was not possible to directly estimate costs for those aged < 21 years, the share of costs attributed to underage drinking was estimated based on the share of the associated population that was underage as determined in the 2006 National Survey on Drug Use and Health¹⁶ (e.g., the share of FAS costs attributed to underage drinking was estimated based on the share of women of child-bearing age who were excessive drinkers and were aged < 21 years).

Drinking while pregnant. Costs associated with fetal alcohol syndrome, spontaneous abortion, and adverse birth outcomes (prematurity, low birth weight, intrauterine growth retardation) were attributed to drinking during pregnancy.

Crime. Estimates of crime-related costs included victim costs (medical, lost productivity, property damage, and homicide losses); criminal justice system costs (police protection, legal adjudication, corrections, private legal defense, and productivity loss among those incarcerated); and the cost of alcohol-attributable motor vehicle traffic crashes. Victim costs were estimated based on the 2006 National Crime Victimization Survey.

Who Bears the Cost

Costs related to excessive alcohol consumption may be borne by many others than those who excessively drink and their families. Those bearing costs were grouped into three categories based on who directly bore the costs: (1) government; (2) excessive drinkers and their families; and (3) others, which included private health insurers, employers, crime victims, and others.

Results

The estimated total economic cost of excessive drinking was \$223.5 billion in 2006. On a per capita basis, this cost was approximately \$746 for each man, woman, and child in the U.S. in 2006.¹⁷ Of the total cost, \$161.3 billion (72.2%) came from lost productivity; \$24.6 billion (11.0%) came from increased healthcare costs; \$21.0 billion (9.4%)

Table 1. Estimated costs in millions (\$) of excessive drinking, by type of cost and population, U.S., 2006

Cost item	Group-specific cost estimates (\$, in millions)				
	Total cost	Binge drinking ^a	Underage drinking ^a	Drinking while ^a pregnant	Crime-related ^a
Health care	24,555.6	14,028.6	3,706.5	2612.4	—
Specialty care for abuse/dependence	10,668.5	7,303.2	2,056.9	Not estimated	—
Hospitalization	5,115.6	1,726.4	212.2	44.8	479.4
Fetal alcohol syndrome	2,538.0	1,071.0	461.9	2538.0	—
Health insurance administration	1,585.7	909.7	187.1	6.2	60.2
Drugs/services	1,212.4	851.6	156.2	6.5	115.0
Prevention and research	1,207.1	570.7	470.7	9.9	—
Ambulatory care	1,195.9	840.0	154.1	6.5	139.5
Nursing homes	1,002.9	742.1	2.3	0.5	—
Crime victims	—	—	—	—	295.6
Training	29.5	14.0	5.3	Not estimated	—
Lost productivity	161,286.1	119,743.3	16,579.6	2221.83	—
Impaired productivity—work	74,101.8	50,727.0	2,020.8	Not estimated	—
Mortality	65,062.2	50,501.0	6,777.2	165.6	28,672.7 ^b
Incarceration of perpetrators	6,328.9	6,328.9	3,587.0	Not estimated	6,328.9
Impaired productivity—home	5,355.6	3,666.2	211.0	Not estimated	—
Absenteeism	4,237.6	4,237.6	186.5	Not estimated	—
Crime victims	2,092.9	2,092.9	641.8	Not estimated	2,092.9
Fetal alcohol syndrome	2,053.7	866.7	373.8	2053.7	—
Impaired productivity—institution	2,053.3	1,323.0	363.2	2.5	11.9
Other effects	37,636.9	36,928.0	6,703.0	368.8	—
Criminal justice	20,972.7 ^c	20,476.9	4,700.5	Not estimated	20,972.7
Motor vehicle crashes	13,718.4	13,718.4	1,378.6	Not estimated	13,718.4
Fire losses	2,137.3	2,137.3	Not estimated	Not estimated	—
Crime victim property damage	439.8	439.8	169.9	Not estimated	439.8
Fetal alcohol syndrome—special education	368.8	155.6	67.1	368.8	—
Total	223,478.6	170,699.9	26,989.1	5203.0	73,327.0

^aThese categories are not mutually exclusive and may overlap.

^bHomicide = \$11,050.9 million; DUI-associated deaths = \$17,621.8 million

^c\$4408.1 million for police protection, \$3747.8 million for legal and adjudication, \$12,587.4 million for corrections, and \$229.4 million for private legal defense

DUI, driving under the influence

came from criminal justice costs; and \$16.7 billion (7.5%) came from other effects (Table 1). The cost associated with binge drinking was \$170.7 billion, underage drinking \$27.0 billion, drinking during pregnancy \$5.2 billion, and crime \$73.3 billion (note that these subcategories are not mutually exclusive and may overlap; Table 1).

Cost Categories

Healthcare costs. Of the \$24.6 billion in health expenditures attributable to alcohol, 43.4% was from specialty treatment for alcohol abuse and dependence and another 20.8% from hospitalizations for other medical conditions

stemming from excessive drinking (Table 1). There were 360,785 alcohol-attributable hospitalizations (0.9% of all hospitalizations) in community hospitals; 2.785 million physician office visits (0.31% of all such visits); 0.329 million hospital outpatient department visits (0.32% of total); and 1.272 million emergency department visits (1.07% of emergency department visits) for a total of 4.386 million outpatient visits (0.39% of all outpatient visits) attributable to excessive drinking. In addition, there were 11,976 (0.80%) nursing home admissions that were attributable to excessive drinking.

Productivity costs. The two largest productivity losses were from impaired productivity at work (45.9%) and lost productivity (40.3%) resulting from the 83,180 alcohol-attributable deaths (46,825 from acute conditions and 36,355 from chronic conditions) that occurred in 2006 (Table 1). For men with alcohol dependence (a subset of excessive drinkers), there was a reduction in both labor force participation (2.5%) and earnings given labor force participation (5.0%). There was also an estimated 19.269 million days spent institutionalized or hospitalized for care resulting from excessive drinking and, depending on age group, 0.4–0.9 days lost to absenteeism per year for female binge drinkers and 0.5–1.2 days for male binge drinkers.

Costs from other effects. The two largest costs were criminal justice system costs (55.7%) and motor vehicle crashes (36.4%) (Table 1). Of the \$21.0 billion in criminal justice system costs, 76.8% came from crimes that would not be thought of as solely alcohol-attributable (e.g., assault) as opposed to obviously alcohol-attributable crimes like driving under the influence of alcohol.

Cost Allocations by Drinking Pattern, Risk Group, and Outcome

Binge drinking. Overall, \$170.7 billion (76.4%) of the total costs were attributed to binge drinking (Table 1). When assessed by cost category, the share of the total cost of excessive alcohol consumption that was allocated to binge drinking was lower for health system direct costs (57.1%); than for productivity losses (74.2%); and other costs (98.1%).

Underage drinking. Overall, 12.1% of the economic costs of excessive alcohol consumption were related to underage drinking (Table 1). Lost productivity accounted for 61.4% of the costs. The largest share of the productivity losses was related to premature mortality representing 25.1% of all costs associated with underage drinking.

Drinking while pregnant. A total of \$5.2 billion (2.3%) of the total economic cost of excessive drinking was at-

tributable to drinking while pregnant (Table 1). Of this \$5.2 billion, 95.3% was related to FAS.

Costs of crime. Of the total \$73.3 billion cost of alcohol-attributable crime, 43.8% came from crash-related costs from driving under the influence, 17.2% came from corrections costs, and 15.1% came from lost productivity associated with homicide (Table 1).

Who Bears the Cost

Overall, \$94.2 billion (42.1%) of the total economic cost of excessive alcohol use was borne by government, including federal, state, and local government agencies, while almost as much \$92.9 billion (41.5%) was borne by excessive drinkers and their family members (Table 2). By cost category, the excessive drinker and their household bore 10.3% of the \$24.6 billion in total healthcare expenditures related to excessive alcohol consumption. In contrast, government entities bore most (60.9%) of these costs, which is larger than the proportion of total healthcare spending that is covered by government (46.1%).¹⁸ In contrast, slightly more than half (54.6%) of productivity losses were borne by the excessive drinker and their household; 35.1% by government; and the remainder by others in society.

Costs per Alcoholic Drink

According to the NIAAA, 550,761,000 gallons of ethanol in the form of 7,538,026,000 total gallons of beer, wine, and spirits were consumed in the U.S. in 2006,¹⁹ or 117.4 billion standard drinks ([gallons consumed multiplied by the specific gravity of ethanol, the weight of 1 gallon of water, and the number of grams in 1 lb] divided by the grams of ethanol in a standard drink [i.e., 14.0]),²⁰ Thus, the total economic cost of excessive alcohol use in 2006 was about \$1.90 per standard drink. Considering the \$94.196 billion paid by government for excessive alcohol consumption, this government expense equated to about \$0.80 per standard drink consumed in 2006.

Discussion

The estimated \$223.5 billion cost of excessive drinking in 2006 is on a par with the costs of other major health-risk behaviors. For example, smoking currently costs the U.S. about \$193 billion annually—\$97 billion from lost productivity and about \$96 billion in healthcare costs.^{21,22} The total direct and indirect cost of physical inactivity was estimated to be in excess of \$150 billion in 2000.²³

Comparing the 2006 estimates to those from 1992 and 1998^{3,4} is problematic because there were several methodologic differences among the studies (e.g., different attribution factors, data sources, categories of expense [new ones such as absenteeism and old ones that were

Table 2. Payer-specific percentages of costs of excessive drinking, 2006

Cost item	Total cost (\$, in millions)	Government			Heavy drinker and family	Others in society
		Total	Federal	State/local		
Health care	24,555.6	60.9	33.1	27.9	10.3	28.8
Specialty care for abuse/dependence	10,668.5	75.0	24.6	50.4	7.7	17.3
Hospitalization	5,115.6	47.5	41.5	6.0	11.1	41.4
Fetal alcohol syndrome	2,538.0	46.1	33.5	12.6	12.1	41.9
Health insurance administration	1,585.7	52.3	23.7	28.6	0	47.7
Drugs/services	1,212.4	25.0	21.7	3.3	30.5	44.5
Prevention and research	1,207.1	100	94.7	5.3	0	0
Ambulatory care	1,195.9	34.4	26.8	7.6	16.9	48.8
Nursing homes	1,002.9	60.0	41.2	18.7	26.1	13.9
Training	29.5	36.3	20.7	15.6	0	63.7
Lost productivity	161,286.1	35.1	20.0	15.1	54.6	10.4
Impaired productivity—work	74,101.8	36.3	20.7	15.6	63.7	0.0
Mortality	65,062.2	36.3	20.7	15.6	44.2	19.5
Incarceration of perpetrators	6,328.9	36.3	20.7	15.6	63.7	0
Impaired productivity—home	5,355.6	0.0	0.0	0.0	100.0	0.0
Absenteeism	4,237.6	36.3	20.7	15.6	0	63.7
Crime victims	2,092.9	36.3	20.7	15.6	0	63.7
Fetal alcohol syndrome	2,053.7	36.3	20.7	15.6	63.7	0
Impaired productivity—institution	2,053.3	36.3	20.7	15.6	63.7	0
Other effects	37,636.9	60.3	0.8	59.5	6.2	33.6
Criminal justice	20,972.7	98.9	1.4	97.5	1.1	0
Motor vehicle crashes	13,718.4	0	0	0	14.2	85.8
Fire losses	2,137.3	73.5	0	73.5	6.6	19.8
Crime victim property damage	439.8	0	0	0	0	100
Fetal alcohol syndrome—special education	368.8	100	0	100	0	0
Total cost (\$, in millions)	223,478.6	94,195.8	40,692.5	53,503.2	92,854.3	36,428.6
Percentage of total	100.0	42.1	18.2	23.9	41.5	16.3

removed such as social welfare], disease conditions considered, approach to comorbidity, FAS prevalence, valuing of inmate time, and discount rate). In fact, if the 1998 estimate had simply been inflated to 2006 based on population and relevant price increases, the estimated 2006 cost would have been \$265 billion (productivity losses \$192 billion, health losses \$40 billion, and other costs \$34 billion) versus the \$223.5 billion estimated. Nonetheless, comparing the 2006 estimate of \$223.5 billion to those from 1992 and 1998^{3,4} shows an annualized increase of 3.0%. This 3% increase is far below what would be ex-

pected based on population and wage growth and cost index trends and is testament to the conservative approach used in the current study to calculate the 2006 estimate.

Although the \$223.5 billion figure is the best currently available estimate of the cost of excessive drinking for 2006, the authors believe it is a substantial underestimate. First, the econometric models found that there was no reduction in workplace or household productivity for alcohol-dependent women. This zero estimate defies biologic plausibility and is more likely due to imprecise

Table 3. Sources of underestimation of the costs of excessive drinking, 2006

AAFs
Self-reported consumption (used to define some AAFs) is under-reported in surveys ^{26,27} and former drinkers are not included in survey estimates of excessive drinking.
AAF estimates based on Medical Examiner data for deaths from acute conditions may be conservative because of alcohol metabolism and interventions (e.g., fluid replacement) administered prior to death. The BAC cut-point used in this study to define fatal alcohol-attributable acute conditions (i.e., a BAC >0.10 g/dL) was conservative compared to the legal blood alcohol limit (0.08 g/dL) used in all states.
AAF estimates based on ED data may be conservative because of delays in seeking treatment and incomplete or under-reporting of alcohol involvement. ED data may also underestimate alcohol involvement for people hospitalized for injuries because alcohol involvement tends to increase with injury severity.
The AAFs for nonfatal injuries that were used in this study were lower than those reported in other studies. ^{28–30}
Healthcare costs
Alcohol-attributable conditions are generally under-recognized and under-reported in the healthcare system.
As in ARDI, many potentially alcohol-related conditions (e.g., pneumonia, tuberculosis, influenza, hepatitis C, sudden infant death syndrome, and sexually transmitted diseases) were not included.
Using only the primary (first-listed) diagnosis to assess alcohol-attributable healthcare costs likely resulted in the exclusion of many alcohol-attributable encounters (e.g., hospitalizations with a non-alcohol-related primary diagnosis such as bleeding) but with an alcohol-attributable root cause (e.g., alcoholic cirrhosis of the liver).
Long-term care costs did not include the costs of care at home or in institutions other than nursing homes, or the cost of long-term care or sequelae from very expensive alcohol-attributable traumatic injuries (i.e., spinal cord injury and traumatic brain injury). ³¹
Alcohol-related training costs for physicians, nurses, clergy, and law enforcement personnel and transportation costs for treatment of alcohol-attributable conditions were not included in cost estimates.
Productivity
Productivity losses due to lost work time resulting from alcohol-attributable nonfatal injuries or alcohol-attributable diseases (e.g., work time lost for outpatient care or decreased productivity from long-term sequelae), some DUI conviction-associated costs (e.g., loss of driving privileges, difficulty finding or keeping a job, increased insurance costs), and economic costs of having family members care for excessive drinkers recovering from alcohol-attributable conditions were not included in cost estimates.
Costs resulting from reduced presenteeism (i.e., reduced workplace productivity due to excessive drinking) were not included.
The \$4.4 billion cost of absenteeism for excessive drinkers who were alcohol dependent was not included to avoid potential overlap with estimated earnings losses.
Crime
Alcohol involvement in crime was likely to have been under-reported. For example, only 34.8%–63.3% of offenders incarcerated for DUI reported consuming enough alcohol to be intoxicated, and 18% denied drinking at all.
Cost estimates were based on 10 “index” crimes that were included in this study. However, 12%–15% of inmates incarcerated for non-index crimes reported having drunk enough to be intoxicated at the time of the crime.
Alcohol-attributable violence (i.e., intimate partner violence, sexual violence, and child sexual abuse) is likely to have been under-reported in the National Crime Victimization Survey. Victims of such violence incur higher healthcare costs related to more-frequent visits to care providers, including visits for mental health services, and more intensive use of these services (e.g., longer length of stay when hospitalized) than their non-abused counterparts.

AAF, alcohol-attributable fraction; ARDI, alcohol-related disease impact; BAC, blood alcohol content; DUI, driving under the influence; ED, emergency department

estimation resulting from several common problems and data gaps that plague attempts to estimate women’s wages (e.g., breaks in the earnings histories of women because of childbirth). Further, the surveys that were used to assess the impact of alcohol dependence on earnings included a relatively small number of women, which made it difficult to accurately assess the impact of alcohol dependence on earnings history.

Second, mortality and morbidity direct costs and lost productivity cost estimates were based on the primary cause of death or illness only; thus, contributing causes of death or disease that were related to alcohol were not considered. For example, direct costs associated with increased length of hospital stay from comorbid alcohol problems were not included—Harwood³ had estimated this cost at \$881 million (4.8% of healthcare costs) in

1992. Third, using conservative cost estimates where presented with choices likely resulted in underestimation. For example, the distribution of healthcare costs is highly skewed toward large values. In the current study, reported cost distributions were truncated at the 95th percentile to reduce the impact of outliers on costs related to average expenditures for emergency department visits, hospital outpatient department visits, and office visits. Without truncation, the average costs would have increased 13%, 28%, and 44%, respectively.

Fourth, the estimates for absenteeism were based on data from the National Survey on Drug Use and Health, which does not use a gender-specific definition of binge drinking (i.e., it uses five or more drinks on a single occasion to define binge drinking for both genders). Research²⁴ has shown this underestimates binge drinking among women by about 35%. Fifth, for the analysis of lost productivity due to alcohol-associated incarceration, inmates' time was valued at minimum wage rather than at the average worker's wage. Had average wage been used, the loss due to incarceration would have increased to \$20.8 billion from \$6.3 billion (a 330% increase).

Finally, the current study did not estimate intangible costs like pain, suffering, and bereavement. A study²⁵ of the costs of underage drinking included these costs and estimated that 67% of the total economic impact of underage drinking was due to intangible costs. Should a similar relationship apply here, the costs of excessive alcohol consumption estimated in the present study would have been substantially higher. Additional sources of underestimation are described in Table 3.

Subgroup estimates are similarly underestimated. In addition, although many experts would argue that binge drinking is part and parcel of all dependent drinking, only 68.5% of specialty treatment costs for the abuse/dependent population were included in binge drinking estimates. For underage drinking, AAFs for nonfatal injuries are probably higher than those the current study used.³² Also, although early-onset drinking and heavy alcohol consumption at an early age have been associated with increased negative outcomes and long-term costs, these costs were not included. For drinking during pregnancy, FAS costs were based on a prevalence of 1 per 1000 which was lower than estimates used in many other studies.³³ Moreover, many subclinical cases are not recognized and their costs are not estimated.

Despite these limitations, this study shows that the economic impact of excessive alcohol consumption is quite comparable to the economic impact of other leading health-risk behaviors, such as smoking and physical inactivity. The \$5.368 billion in 2006 state and local tax revenues from alcohol³⁴ and \$9.194 billion in federal excise taxes on alcohol in 2006³⁵ do not begin to cover the economic costs. Effective interventions to reduce excessive alcohol consumption—

including increasing alcohol excise taxes, limiting alcohol outlet density, maintaining and enforcing the minimum legal drinking age of 21 years, screening and counseling for alcohol misuse, and specific countermeasures for alcohol-impaired driving such as sobriety checkpoints—are available^{36–39} to reduce the health, social, and economic impacts of excessive drinking.

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Appendix

Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.amepre.2011.06.045.

A pubcast created by the authors of this paper can be viewed at http://www.ajpmonline.org/content/video_pubcasts_collection.