Prevention of Deaths From Harmful Drinking in the United States: The Potential Effects of Tax Increases and Advertising Bans on Young Drinkers*

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ABSTRACT. Objective: Harmful alcohol consumption is a leading cause of death in the United States. The majority of people who die from alcohol use begin drinking in their youth. In this study, we estimate the impact of interventions to reduce the prevalence of drinking among youth on subsequent drinking patterns and alcohol-attributable mortality. **Method:** We first estimated the effect of public health interventions to decrease harmful drinking among youth from literature reviews and used life table methods to estimate alcohol-attributable years of life lost by age 80 years among the cohort of approximately 4 million U.S. residents aged 20 in the year 2000. Then, from national survey data on transitions in drinking habits by age, we modeled the impact of interventions on alcohol-attributable mortality. **Results:** A tax increase and an advertising ban were the most effective interventions identified. In the absence of intervention, there would be 55,259 alcohol-attributable deaths over the lifetime of the cohort. A tax-based 17% increase in the price of alcohol of $1 per six pack of beer could reduce deaths from harmful drinking by 1,490, equivalent to 31,130 discounted years of potential life saved or 3.3% of current alcohol-attributable mortality. A complete ban on alcohol advertising would reduce deaths from harmful drinking by 7,609 and result in a 16.4% decrease in alcohol-related life-years lost. A partial advertising ban would result in a 4% reduction in alcohol-related life-years lost. **Conclusions:** Interventions to prevent harmful drinking by youth can result in reductions in adult mortality. Among interventions shown to be successful in reducing youthful drinking prevalence, advertising bans appear to have the greatest potential for premature mortality reduction. (*J. Stud. Alcohol* **67:** 000-000, 2006)

AN ESTIMATED 63,718 PEOPLE died of causes attributable to alcohol in 2000, making harmful drinking one of the leading causes of death in the United States (Rivara et al., 2004b). These deaths are related to heavy episodic drinking as well as medium and high levels of habitual alcohol consumption. Prior studies indicate that harmful drinking generally begins during adolescence and often persists into adulthood. It is estimated that the odds of future alcohol abuse or dependence are 7% greater for each year of age, below age 21, that alcohol consumption begins (Grant et al., 2001). The risk of adult alcohol dependence is two- to three-fold greater for individuals who began drinking by age 12 compared with those who began at age 19 (DeWit et al., 2000). These findings have been confirmed in several other studies (Guo et al., 2000; Hill et al., 2000; Schulenberg and Maggs, 2002).

Given this longitudinal pattern of drinking behavior and the consequences of harmful drinking, primary prevention of harmful drinking through interventions directed at youth may represent an important method of reducing adult mortality. Previous work evaluating smoking-related deaths has suggested that primary prevention among children and adolescents could reduce lifetime smoking-attributable mortality by as much as 41% (Rivara et al., 2004a). It is unclear whether similar interventions focused on harmful alcohol consumption would achieve such a large impact. We therefore undertook a study to determine the reduction in harmful drinking-related deaths and years of potential life lost (YPLL) from interventions focused on young adults.

Method

This study examined the impact of interventions on the prevalence of heavy episodic drinking and on medium and high levels of habitual drinking in the cohort of 4,049,448 young adults aged 20 in the year 2000 (Bureau of the Census, 2002). We estimated the degree to which different

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interventions might be expected to reduce alcohol consumption at age 20, the lifetime trajectory of alcohol consumption, and alcohol-attributable mortality in subsequent years.

Determination of prevalence of harmful drinking

The methods for determining the prevalence of harmful drinking have been outlined previously (Rivara et al., 2004b). Briefly, heavy episodic drinking was defined as five or more drinks per occasion in the last month for both men and women. This cut-off value was chosen as it corresponds to the value used in the Behavioral Risk Factor Surveillance System (BRFSS) 2004 survey questions on alcohol consumption (Centers for Disease Control and Prevention, 2004). Habitual drinking was categorized into abstinent, low, medium or high levels (Table 1); the cut points for each category are those used by the World Health Organization (2000), and by others (English et al., 1995; Ridolfo and Stevenson, 2001). The prevalence of harmful drinking among young adults was determined from the BRFSS 2004 data (Centers for Disease Control and Prevention, 2004). We classified individuals into six alcohol-intake categories based on level of habitual drinking and the presence or absence of heavy episodic drinking: (1) abstinent/very low habitual drinking, no heavy episodic drinking; (2) abstinent/very low habitual drinking, heavy episodic drinking; (3) low habitual drinking, no heavy episodic drinking; (4) low habitual drinking, heavy episodic drinking; (5) medium habitual drinking, heavy episodic drinking; and (6) heavy habitual drinking, heavy episodic drinking.

Projected course of drinking between ages 20 and 30

As previously described (McCarty et al., 2004), we used panel data from the National Longitudinal Survey of Youth 1979 (NLSY79; Center for Human Resource Research, 2004) cohort to determine the probability of transition to medium and high levels of habitual drinking and heavy episodic drinking as adults ages 29-32, based on patterns of drinking at ages 17-20.

The NLSY79 is a nationally representative sample of almost 12,700 individuals who were ages 14-22 years in 1979 and who have been interviewed annually or biennially since (Center for Human Resource Research, 2004). Population weights are provided to generalize NLSY79 results to the U.S. population. Data from the NLSY79 were accessed using the Center for Human Resource Research Database Investigator Software (Ohio State University, Columbus, OH). Our analysis focuses on the subgroup of 5,111 NLSY79 respondents who were between 17 and 20 years of age when detailed alcohol use questions were first introduced to the survey between 1982 and 1985 and who were between 29 and 32 years of age when similar alcohol questions were repeated in 1994. As a result of loss to follow up, data on alcohol intake in 1994 are not available for 1,132 (22%) subjects. In our primary analysis, we used imputation (Raghunathan, 2004) to infer drinking status for respondents with missing data. The imputation model comprised age, gender, NLSY79 cohort, work status, total family income, parents' education and, when available, drinking status in the survey years immediately before and after 1994. To test the robustness of our results to the missing data, we also performed sensitivity analyses using only respondents with complete data.

We assumed that the patterns of drinking beyond age 30 would conform to the gradual decline in habitual and heavy episodic drinking observed in the cross-sectional BRFSS surveys. There are no large-scale longitudinal panel studies in the United States that have examined drinking trajectories beyond the age of 30.

TABLE 1. Alcohol intake levels

	Standard drinks per day (1 standard drink = 10 g of alcohol)	
Intake level	Men	Women
Abstinence[a]	0.00-0.25	0.00-0.25
Low	0.26-4.00	0.26-2.00
Medium	4.01-6.00	2.01-4.00
High	≥6.01	≥4.01

[a]In line with previous studies, we have categorized respondents who report very low drinking levels (i.e., one drink a week or less) as abstinent for the purposes of this analysis.

Determination of alcohol-attributable mortality

We used the etiologic-fraction method to calculate alcohol-attributable mortality, using U.S. mortality data for 2000, as previously described (Rivara et al., 2004b). Briefly, we identified mortality categories which were potentially related to heavy episodic drinking (e.g., injuries, homicides, alcohol poisoning) or habitual medium and high levels of drinking (e.g., cirrhosis, alcohol dependence syndrome, hemorrhagic stroke) and then determined for each diagnosis the relative risk of death related to these drinking patterns compared with no heavy episodic drinking or low levels of habitual drinking. The attributable fractions were calculated for each diagnosis by age and gender and applied to year 2000 mortality data (Rothman and Greenland, 1998). These were summed across diagnoses to estimate the number of deaths attributable to heavy episodic drinking and to harmful habitual drinking. We excluded all mortality related to heavy episodic alcohol consumption in individuals aged less than 20 although a proportion of these might have been instigated by drinking in adults aged 20 or over. We also conservatively assumed that mortality related to habitual alcohol consumption would not become apparent before age 30.

Multiple studies (e.g., Gronbaek et al., 2004) have shown an association between low levels of habitual drinking and decreased total mortality compared with individuals who

are abstainers. Because the goal of the modeled interventions was not abstention from drinking in adults but rather prevention of harmful drinking, we did not model any increased mortality that might result from an increase in the number of abstainers.

Interventions among young adults to decrease the prevalence of harmful drinking

We undertook systematic reviews of the literature and contacted experts in the field of alcohol misuse to determine effective interventions to decrease the prevalence of harmful drinking by youth. We examined the evidence for the following categories of interventions: increased alcohol excise taxes, restriction of alcohol advertising, counter advertising, school-, community-, and college-based programs, family-based interventions, and interventions to prevent driving while intoxicated. All searches were performed prior to June of 2005, and databases searched include Medline, the Cochrane Library, PsycInfo, ERIC, EconLit, CINAHL, and the National Institute on Alcohol Abuse and Alcoholism Alcohol and Alcohol Problems Science Database. Each database was searched for randomized controlled trials, meta-analyses, and reviews of alcohol use among youthful and college-age young adults. The bibliographies of these articles and review articles were also searched for additional material, and we also contacted experts in the field to ensure that all relevant studies were identified and that no important interventions were missed.

Not included in the model are two highly effective public health interventions to prevent alcohol-related motor vehicle crashes among youth: institution of the minimum legal drinking age of 21 and zero tolerance laws for youthful drinking. These interventions have been implemented in all 50 states (Voas et al., 2003).

One of the most studied types of interventions is an increase in the price of alcohol (Chaloupka et al., 2002). Economic theory predicts that the consumption of a good is typically negatively correlated with its monetary price, although this relationship may be attenuated for addictive substances such as alcohol. Policy makers have some indirect control over price via state and federal excise taxes. The federal excise tax on beer, which is the most popular type of alcohol consumed by young adults, was set at $9.00 per 31-gallon barrel (16 cents per six pack) in 1951. Despite being raised to $18.00 per barrel (32 cents per six pack) in 1991, the increase in excise tax has not kept pace with inflation (Chaloupka, 2004), resulting in a 70% erosion in real tax dollars. By 2005, an additional excise tax of $0.88 per six pack would be needed to return to the 1951 level of taxation.

With rare exceptions (Dee, 1999), studies show that teen and youthful drinking, including heavy episodic and harmful habitual drinking, is price sensitive. A review conducted by Chaloupka (2004) identified several studies showing that teen and youthful drinking is negatively associated with monetary price (Coate and Grossman, 1988; Cook and Moore, 2001; Grossman et al., 1987; Laixuthai and Chaloupka, 1993). Pooling of these data is difficult as there is little uniformity in measures of alcohol consumption. Recent work by Saffer and Dave (2003), with two independent data sources, validates the magnitude of price sensitivity of alcohol use and heavy episodic drinking participation in the last month among adolescents. Their estimates of the price elasticity (elasticity = % change in participation rate / % change in price) of alcohol participation were relatively stable ranging from -0.12 to -0.28 in their preferred empirical models. The price elasticity of heavy episodic drinking participation was more heterogeneous, ranging from -0.04 to -0.51. For each parameter, we used the point estimate recommended by the authors and conducted a sensitivity analysis to test the robustness of our findings to the range of price elasticities estimated in their study (shown in Table 2). We assumed that there was a linear negative relationship between price and consumption across the limited price range evaluated in this study.

The effect of alcohol advertising on alcohol consumption, as opposed to brand selection, is less clear cut. Saffer and Dave (2002) argued that the effect is particularly hard to quantify, because small increases or decreases in national advertising expenditures over time in markets at, or close to, advertising saturation are unlikely to have a large impact on total demand. To counter this problem, Saffer and Dave (2003) focused on types of advertising where wide local variations exist, such as spot television, spot radio, outdoor billboards, local newspapers, and magazines. Using two independent data sources, they estimated that a ban on advertising in all forms of media would reduce adolescent alcohol participation in the last month by 28% (range: 6%-32%) and heavy episodic drinking by 42% (range: 3%-55%). We used these point estimates and ranges in our analysis. A partial media ban, focusing on youth-oriented media, may be more realistic. Therefore, in secondary analyses, we used Saffer and Dave's estimates of changes in alcohol consumption based on a one-third reduction in total advertising expenditures (shown in Table 2).

Other interventions were not included in the model for one or more reasons: lack of long-term effectiveness on problem drinking as youth mature into adulthood, lack of evidence for such effectiveness, or limited data from small studies in research settings without evidence for a similar effect in large-scale intervention trials.

Analysis

We used life table methods to calculate the YPLL resulting from alcohol-related mortality (Miller and Hurley, 2003). Survival of men and women within each of the drink-

ing categories was quantified into 10-year age bands between the ages of 20 and 80. The survival probability for each age band was based on national vital statistics reports (Arias, 2004) and calculated by dividing the number of the population alive at the end of each age band by the number alive at the start of the age band. We categorized deaths in each age band as (1) heavy episodic drinking-attributable deaths, (2) harmful habitual drinking-attributable deaths (both calculated from our previous work [Rivara et al., 2004b]), and (3) other deaths (calculated as the difference between total mortality and alcohol-attributable mortality). An average hazard rate (number of deaths / population alive at the start of the age band) was then calculated for each age- and gender-stratified drinking category. We assumed that all heavy episodic drinkers within a given age and gender group were at equal risk of acute death from their episodic drinking.

A similar assumption was made for harmful habitual drinking. Individuals who changed from one drinking category to another during the 10-year age band were estimated to do so, on average, after 5 years and therefore their morality risk was an average of the hazard rates in the two drinking categories. We also assumed that individuals who gave up harmful drinking immediately reduced their risk of alcohol-attributable death and were not at increased risk of death from other causes. YPLL was calculated by multiplying the number of alcohol-attributable deaths within each age band by the gender-specific remaining expectation of life at the midpoint of that age band (Arias, 2004; Gardner and Sanborn, 1990). We then used the effect sizes reported in the literature (shown in Table 2) to estimate the reduced prevalence of harmful drinking after the implementation of the selected interventions. We calculated post-intervention mortality and YPLL to measure the net effect of tax increases and media bans.

We used a 3% discount rate for future life-years saved, in accordance with the recommendations made by the Panel on Cost-Effectiveness in Health and Medicine (Gold et al., 1996). The values for the different input variables are summarized in Table 2. We assumed that the full impact of a tax increase would be passed along to consumers without compensatory price reduction by alcohol manufacturers. We

TABLE 2. Determination of variables in the model

Variable	Base case value	Range used in sensitivity analysis	Source
Drinking prevalence, %		–	(Centers for Disease Control and Prevention, 2004)
Males			
Abstinent/very low, no heavy episodic	66.8		
Abstinent/very low, heavy episodic	2.3		
Low, no heavy episodic	6.6		
Low, heavy episodic	20.6		
Medium, heavy episodic	2.0		
High, heavy episodic	1.8		
Females			
Abstinent/very low, no heavy episodic	78.3		
Abstinent/very low, heavy episodic	1.8		
Low, no heavy episodic	7.3		
Low, heavy episodic	9.8		
Medium, heavy episodic	2.2		
High, heavy episodic	0.6		
Price elasticity of alcohol participation	–0.284	–0.119-–0.284	(Saffer and Dave, 2003)
Price elasticity of heavy episodic drinking	–0.508	–0.036-–0.508	(Saffer and Dave, 2003)
Effect on alcohol participation of a partial media ban on alcohol advertising	–0.059	–0.030-–0.108	(Saffer and Dave, 2003)
Effect on alcohol participation of a complete media ban on alcohol advertising	–0.280	–0.060-–0.324	(Saffer and Dave, 2003)
Effect on past-month heavy episodic drinking of a partial media ban on alcohol advertising	–0.107	–0.038-–0.182	(Saffer and Dave, 2003)
Effect on past-month heavy episodic drinking of a complete media ban on alcohol advertising	–0.420	–0.033-–0.546	(Saffer and Dave, 2003)
Price of a standard six pack of beer	$5.87	–	(Beer Institute, 2001)
No. of alcohol attributable deaths in the U.S. by age 80 in the population of people who were age 20 in 2000	55,259	–	(Rivara et al., 2004b)
Federal excise tax increase on beer per barrel	$1	$0-$2	
No. of YPLL attributable to alcohol in the U.S. by age 80	1,878,841	–	Arias, 2004; Rivara et al., (2004b)
Dis count rate	3%	0%-5%	(Gold et al., 1996)
No. of 20 year olds in 2000			
Men	2,071,220		
Women	1,978,228	NA	(Bureau of the Census, 2000)

Note: YPLL = years of potential life lost.

TABLE 3. Transition probabilities

Drinking category at 17-20 years	Drinking category at 29-32 years					
	Abstinent/very low, no heavy episodic	Abstinent/very low, heavy episodic	Low, no heavy episodic	Low, heavy episodic	Medium, heavy episodic	High, heavy episodic
Abstinent/very low, no heavy episodic	.730	.042	.117	.099	.007	.004
Abstinent/very low, heavy episodic	.527	.070	.140	.247	.012	.004
Low, no heavy episodic	.485	.039	.237	.213	.014	.012
Low, heavy episodic	.356	.060	.151	.391	.027	.015
Medium, heavy episodic	.256	.014	.170	.485	.060	.014
High, heavy episodic	.202	.034	.070	.588	.064	.041

did not stratify by race or ethnicity, because intervention effectiveness was generally not available at this level and because we were modeling at the population level.

Results

According to the BRFSS, 3.8% of 18- to 20-year-old males and 2.8% of females reported medium to heavy levels of habitual drinking in 2004 (Table 2). Approximately one in four males (26.7%) and one in seven females (14.3%) reported medium or heavy habitual and/or heavy episodic drinking. The probability of transition from one drinking category to another, based on the NLSY79 dataset, is described in Table 3. The intra-individual correlation between total alcohol consumption reported at ages 17-20 and at ages 29-32 was .203, whereas the correlation in heavy episodic drinking status was .310. The total alcohol-related mortality for this cohort of 20-year-olds as they aged was estimated as 55,259, accounting for 953,459 discounted YPLL (Table 4).

Based on price elasticities of -0.28 and -0.51 for alcohol participation and heavy episodic drinking, respectively, and an excise tax increase equivalent to $1 per six pack of beer, we project that the proportion of 20-year-olds engaged in medium and high habitual drinking or heavy episodic drinking would decrease to 24.4% in men and 13.1% in women. The reduction in mortality and YPLL throughout the life span of the cohort is shown in the last three columns of Table 4. We estimate that 1,490 alcohol-attributable deaths would be prevented in the cohort and that discounted YPLL would be reduced by 31,130, equivalent to 3.3% of all premature alcohol-attributable mortality. The distribution of the benefit by age group is bimodal, peaking in the youngest age group because of heavy episodic drinking and in the 40-49 age group when habitual drinking problems become more prevalent.

The YPLL saved varies with the amount of tax increase, as shown in Figure 1. If the federal tax rate on beer had been indexed to keep pace with inflation since 1951, it would be $67.29 per barrel in 2005 rather than $18 per

TABLE 4. Baseline and after-tax estimates of habitual and episodic drinking, alcohol-related mortality, and YPLL

Age group, in years	Population at start of age band, no.	Moderate or heavy drinkers,[a] %	Heavy episodic drinkers,[a] %	Alcohol-related mortality (no tax), no.	Discounted alcohol-related YPLL (no tax), no.	Alcohol-related mortality ($1 tax), no.	Discounted alcohol -related YPLL ($1 tax), no.	Difference in mortality, no.	Difference in discounted YPLL, no.
Males									
20-29	2,071,220	3.8	26.7	6,227	273,930	5,916	260,247	311	13,684
30-39	2,042,919	3.2	29.6	7,066	188,674	6,920	184,775	146	3,899
40-49	2,006,939	2.6	28.9	9,985	155,462	9,770	152,125	214	3,337
50-59	1,931,779	2.5	22.0	7,708	66,017	7,538	64,565	170	1,452
60-69	1,780,871	2.2	15.7	5,144	22,578	5,029	22,074	115	504
70-79	1,474,721	1.9	10.7	4,687	9,498	4,582	9,286	105	212
Females									
20-29	1,978,228	2.8	14.3	1,361	65,529	1,288	62,008	73	3,521
30-39	1,968,269	2.1	14.8	2,282	67,527	2,225	65,842	57	1,685
40-49	1,949,791	1.5	13.8	3,480	61,007	3,388	59,382	93	1,624
50-59	1,907,076	1.4	10.6	2,644	26,024	2,570	25,303	73	721
60-69	1,816,325	1.3	6.8	2,137	11,018	2,076	10,705	61	314
70-79	1,610,947	1.2	4.1	2,539	6,194	2,466	6,016	73	178
Total	–	–	–	55,259	953,459	53,768	922,329	1,490 (2.7%)	31,130 (3.3%)

Notes: YPLL = years of potential lofe lost. [a]At start of age band.

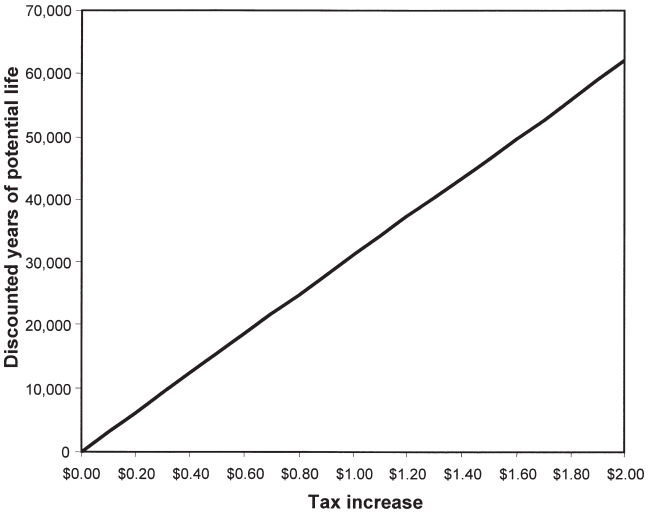

FIGURE 1. Sensitivity analysis of changes in federal excise taxes per six pack and discounted life-years saved from reduced alcohol-related mortality

barrel; this 274% increase in tax would be the equivalent of an additional excise tax of $0.88 per six pack and would have resulted in 27,352 discounted life-years saved over the lifetime of the cohort of 20 year olds.

A complete media-advertising ban would be more effective in reducing preventable alcohol-related mortality (Table 5). Such a ban would prevent 7,610 alcohol-related deaths, 60% of which would be in adults less than 50 years old. Almost three quarters of this preventable mortality occurs in men, who have higher rates of alcohol-related mortality in all age groups. In total, a complete media ban would result in 156,413 fewer YPLL related to alcohol. This equates to 16.4% of the total effect of harmful drinking on survival. A partial media ban had a similar effect size to the tax increase. We estimate that a one-third reduction in total advertising expenditures would lead to 38,393 fewer life-years lost, equivalent to 4% of all alcohol-related mortality.

The results of our model are most susceptible to estimates of the mutability of heavy episodic drinking (Figure 2). First, heavy episodic drinking is influential, because it is prevalent in young adults. By contrast, more than 95% percent of young men and women report abstinent or low habitual drinking before any public health intervention. Second, heavy episodic drinking leads to deaths in young adults who have the most years of potential life to lose. Third, there is a wider degree of uncertainty surrounding the point estimates for the sensitivity of heavy episodic drinking to price and media bans (Table 2). If the price sensitivity of heavy episodic drinking were as low as -0.04 (i.e., a 100% rise in price would result in a 4% decrease in heavy episodic drinking), then a $1 per six pack tax increase would only result in a reduction of approximately 7,500 discounted YPLL.

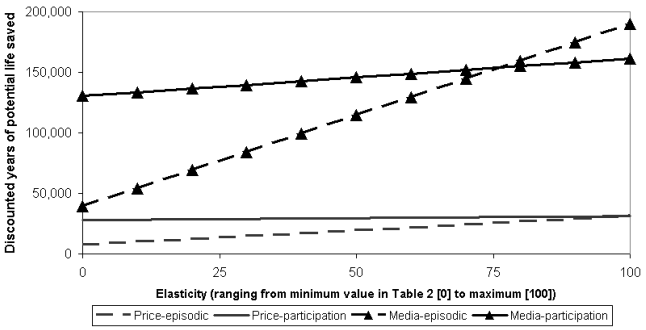

FIGURE 2. Sensitivity analysis of changes in the price elasticity and impact of media bans of drinking behavior on discounted life-years saved from reduced alcohol-related mortality

TABLE 5. Baseline and after-media-ban estimates of habitual and episodic drinking, alcohol-related mortality, and YPLL

Age group, in years	Alcohol-related mortality (no ban), no.	Discounted alcohol-related YPLL (no ban), no.	Alcohol-related mortality (media ban) no.	Alcohol-related mortality (partial ban), no.	Discounted alcohol-related YPLL (media ban), no.	Discounted alcohol-related YPLL (partial ban), no.	Difference in mortality (media ban), no.	Difference in mortality (partial ban), no.	Difference in discounted YPLL (media ban), no.	Difference in discounted YPLL (partial ban), no.
Men										
20-29	6,227	273,930	4,699	5,842	206,712	257,027	1,528	384	67,219	16,904
30-39	7,066	188,674	6,312	6,886	168,527	183,876	755	180	20,147	4,798
40-49	9,985	155,462	8,869	9,721	138,095	151,358	1,115	264	17,368	4,105
50-59	7,708	66,017	6,822	7,500	58,426	64,232	886	208	7,591	1,786
60-69	5,144	22,578	4,542	5,002	19,937	21,959	602	141	2,642	620
70-79	4,687	9,498	4,137	4,558	8,384	9,237	550	129	1,114	261
Women										
20-29	1,361	65,529	1,002	1,271	48,234	61,180	359	90	17,295	4,349
30-39	2,282	67,527	1,991	2,212	58,925	65,452	291	70	8,602	2,075
40-49	3,480	61,007	3,009	3,366	52,734	59,005	472	114	8,273	2,001
50-59	2,644	26,024	2,271	2,553	22,358	25,136	373	90	3,667	888
60-69	2,137	11,018	1,828	2,062	9,425	10,632	309	75	1,594	386
70-79	2,539	6,194	2,168	2,449	5,290	5,975	370	90	904	219
Total	55,259	953,459	47,649	53,423	797,046	915,066	7,610 (13.8%)	1,836 (3.3%)	156,413 (16.4%)	38,393 (16.4%)

Note: YPLL = years of potential life lost.

Our results were not greatly sensitive to the imputation used to calculate transition probabilities. Using data only from NLSY79 respondents with complete information resulted in a 20% decrease in the estimated effect of a tax increase on YPLL.

Discussion

The impact of heavy episodic and habitual alcohol use is a sizeable and potentially preventable cause of U.S. mortality and morbidity (Mokdad et al., 2004; Rivara et al., 2004b). Problem drinking and heavy episodic drinking behaviors begin in adolescence, and early initiation of drinking correlates with higher risks of problem drinking in adulthood. In this study we examined the potential impact of two interventions by using literature reports of drinking prevalence and intervention effect size to model outcomes in a cohort of hypothetical youths. We estimate that 1.4% of this cohort will succumb to an alcohol-attributable mortality. The net reduction in YPLL lost following an alcohol tax increase of $1 per six pack (31,130 years; 3.3%) and a ban of alcohol advertising (156,413 years; 16.4%) appear quite modest. The absolute and relative reductions in mortality are substantially smaller than previous work by our group examining the impact of tax increases and media bans on smoking-related mortality (Rivara et al., 2004a). The more modest result for primary prevention of harmful alcohol consumption stems from the considerable crossover between drinking categories among individuals who were surveyed at 17-20 and 29-32 years of age. We found that drinking habits prior to age 21 are positive predictors of drinking later in life. However, this relationship is relatively weak, indicating that the drinking habits of many individuals change between the ages of 20 and 30, consistent with findings reported by Fillmore et al. (1991). Therefore, reducing consumption at age 20 will prevent only some harmful drinking later in life.

This study has a number of limitations. First, we have studied interventions designed to prevent harmful drinking and not abstention from all drinking, and therefore we did not model any increased mortality that could result from an increase in the number of abstainers. It is possible that the estimated life-years saved could be somewhat counterbalanced by the potential beneficial effects of alcohol. However, most (54%) of the deaths prevented by tax increases occur before the age of 50, whereas most of the deaths prevented by low levels of alcohol consumption occur later in life. The use of a discount factor more heavily weights the immediate reductions in YPLL. Furthermore, such a counterbalancing effect would only be seen if the proposed interventions induced low-level habitual drinkers to abstain from drinking in adulthood, and there is no evidence that this would be the case.

Second, we assumed that tax increases and advertising bans only directly affect consumption at ages 17-20 and will not suppress the uptake of harmful drinking habits later in life. This is a conservative assumption, as a sharp rise in the price of alcohol will deter some adults from increasing alcohol consumption. However, our study focused on the effect in young adults who are still forming drinking habits and might be expected to be most price and media sensitive.

Third, we did not use our model to explore the relationship between youthful alcohol use and other potentially detrimental substances such as marijuana. If, as has been reported (Williams et al., 2004), alcohol is a complement, rather than a substitute for these substances, then our model would underestimate the benefit of public health interventions.

We used the World Health Organization (2000) definition of alcohol consumption levels, which is consistent with previous work, but categorizes many individuals as “low” habitual drinkers who are consuming considerable quantities of alcohol. It is possible that some of these individuals might benefit from reducing their alcohol consumption. Any changes in the definition of harmful habitual drinking would alter the distribution of the estimated reduction in YPLL between individuals but would not necessarily increase or reduce our estimate of the total effect of primary prevention.

We used the NLSY79 data to reconstruct the trajectory of alcohol consumption between the ages of 20 and 30 but used current BRFSS data to determine the prevalence of drinking among youths and to model drinking after age 30. It is possible that the life history of alcohol consumption has altered since the 1980s, but this limitation will be true of any currently available cohort data following youths into adulthood. Our drinking prevalence data are based on self-report of drinking in the prior 30 days, which may not accurately reflect true drinking patterns (Miller et al., 2004). However, our model is less sensitive to the absolute number of youths participating in harmful drinking and more sensitive to estimates of the absolute number of alcohol-attributable deaths and the relative impact on drinking of price increases and media bans.

We have conservatively excluded acute alcohol deaths in persons less than 20 years of age, and all alcohol deaths in persons over age 80. The relationship between cumulative alcohol consumption and the onset of chronic morbidity is poorly understood; therefore, we also chose to exclude chronic alcohol-attributable deaths for persons less than 30 years of age.

Overall, this study suggests that increases in the federal excise tax on alcohol could potentially have a modest effect on alcohol-related mortality and YPLL, and that a media ban on alcohol advertisements would be slightly more effective. However, in the short run, tax increases may be a more feasible intervention to implement at both the state and federal level. Unlike tobacco, the relatively low risk of low-level alcohol consumption would make a complete media ban harder to justify. Partial media interventions through

taxation of advertising expenditures, eliminating tax deductibility of advertising, or focusing specifically on limiting advertising exposure in high-risk age groups seem more practical. But it is difficult to model the likely impact of these partial interventions as new advertising channels might substitute for prohibited advertising and therefore reduce the impact of the partial intervention.

Tax increases and reduced advertising cannot alone combat the adverse effects of harmful drinking in the population. Other strategies such as drinking and driving media campaigns (Elder et al., 2004), random alcohol screening (Peek-Asa, 1999), brief interventions delivered in the primary care (Bertholet et al., 2005), school districts (Perry et al., 2002), college (Barnett and Read 2005), or inpatient (Gentilello et al., 2005) setting can reduce harmful drinking and the resources expended may be cost effective. Problem drinking is more complex than tobacco use and wide-scale effective interventions will need to extend beyond tax increases and media bans.

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