

The Effectiveness of Tax Policy Interventions for Reducing Excessive Alcohol Consumption and Related Harms

Randy W. Elder, PhD, Briana Lawrence, MPH, Aneeqah Ferguson, MPA, Timothy S. Naimi, MD, MPH, Robert D. Brewer, MD, PhD, Sajal K. Chattopadhyay, PhD, Traci L. Toomey, PhD, Jonathan E. Fielding, MD, MPH, MBA, the Task Force on Community Preventive Services

Abstract: A systematic review of the literature to assess the effectiveness of alcohol tax policy interventions for reducing excessive alcohol consumption and related harms was conducted for the *Guide to Community Preventive Services (Community Guide)*. Seventy-two papers or technical reports, which were published prior to July 2005, met specified quality criteria, and included evaluation outcomes relevant to public health (e.g., binge drinking, alcohol-related crash fatalities), were included in the final review. Nearly all studies, including those with different study designs, found that there was an inverse relationship between the tax or price of alcohol and indices of excessive drinking or alcohol-related health outcomes. Among studies restricted to underage populations, most found that increased taxes were also significantly associated with reduced consumption and alcohol-related harms. According to *Community Guide* rules of evidence, these results constitute strong evidence that raising alcohol excise taxes is an effective strategy for reducing excessive alcohol consumption and related harms. The impact of a potential tax increase is expected to be proportional to its magnitude and to be modified by such factors as disposable income and the demand elasticity for alcohol among various population groups.

(Am J Prev Med 2010;38(2):217–229) Published by Elsevier Inc. on behalf of American Journal of Preventive Medicine

Introduction

Excessive alcohol consumption is the third-leading actual cause of death in the U.S.,¹ and each year it accounts for approximately 79,000 deaths and 2.3 million years of potential life lost (about 29 years of life lost per death; apps.nccd.cdc.gov/ardi/Homepage.aspx). Excessive alcohol consumption contributes to a variety of health and social problems, including unintentional injuries (e.g., injuries due to motor vehicle crashes); suicide; homicide; liver cirrhosis; gastrointestinal cancers; vandalism; and lost productivity.² Alcohol consumption by

underage drinkers also contributes to the three leading causes of death among adolescents (unintentional injuries, suicide, and homicide),³ and any underage drinking is considered excessive.

One of the fundamental laws of economics is that quantity demanded of a product is inversely related to its price (Law of Demand).⁴ Based on economic theory, therefore, increasing the price of alcohol would be expected to lower alcohol consumption. Alcohol taxes are promulgated primarily by federal and state governments, but can be instituted at the local or county level. Currently in the U.S., alcohol taxes are beverage-specific (i.e., they differ for beer, wine, and distilled spirits) and are usually “nominal” taxes, meaning they are based on a set rate per unit volume and are not adjusted for inflation (i.e., they generally remain stable as the cost of living increases). At the state and federal levels, inflation-adjusted alcohol taxes have declined considerably since the 1950s.⁵ Concordant with this decrease in the real value of these taxes from substantially higher levels, the inflation-adjusted price of alcohol decreased dramatically,⁶ reflecting the

From the National Center for Health Marketing (Elder, Lawrence, Ferguson, Chattopadhyay), and National Center for Chronic Disease Prevention and Health Promotion (Naimi, Brewer), CDC, Atlanta, Georgia; University of Minnesota School of Public Health (Toomey), Minneapolis, Minnesota; and Los Angeles County Department of Public Health (Fielding), Los Angeles, California

Address correspondence and reprint requests to: Randy W. Elder, PhD, Guide to Community Preventive Services, 1600 Clifton Road, Mailstop E-69, Atlanta GA 30333. E-mail: rfe3@cdc.gov.

0749-3797/00/\$17.00

doi: 10.1016/j.amepre.2009.11.005

fact that changes in taxes are efficiently passed on through changes in prices.⁷ The goal of this systematic review is to assess the relationship between alcohol taxes or prices and public health outcomes related to excessive alcohol consumption to better inform decision makers about the potential utility of using tax policy as a means of improving those outcomes.

Healthy People 2010 Goals and Objectives

The intervention reviewed here is relevant to several objectives specified in *Healthy People 2010*, the disease prevention and health promotion agenda for the U.S. (Table 1).⁸ The objectives most directly relevant to this review are those that aim to reduce excessive alcohol consumption (26-11); reduce average annual alcohol consumption (26-12); and reduce key adverse consequences of excessive alcohol consumption (26-1, 26-2, and 26-5 through 26-8). In addition to these specific objectives, *Healthy People 2010* notes that excessive alcohol consumption is also related to several other public health priorities such as cancer, educational achievement, injuries, risky sexual activity, and mental health; thus, a reduction in excessive alcohol consumption should help to meet some of the national goals in these areas as well.

Table 1. Selected *Healthy People 2010*⁸ objectives related to excessive alcohol consumption

Adverse consequences of substance use and abuse
26-1 Reduce alcohol-related motor-vehicle fatalities ^a
26-2 Reduce cirrhosis deaths
26-5 Reduce alcohol-related hospital emergency department visits
26-6 Reduce the proportion of adolescents who ride with drinking drivers
26-7 Reduce intentional injuries resulting from alcohol-related violence ^a
26-8 Reduce cost of lost productivity due to alcohol use ^a
Substance use and abuse
26-10a Increase proportion of adolescents not using alcohol in past 30 days ^a
26-11 Reduce proportion of people ^b engaging in binge drinking
26-12 Reduce average annual alcohol consumption
26-13 Reduce proportion of adults who exceed guidelines for low-risk drinking

^aObjective also relates to illicit drug use

^bAged ≥12 years

Recommendations from Other Advisory Groups

Several authors⁹⁻¹² have suggested that increasing alcohol prices by raising alcohol excise taxes is among the most effective means of reducing excessive drinking and alcohol-related harms. Increasing alcohol excise taxes has been specifically recommended as a public health intervention by the IOM, Partnership for Prevention, the WHO, and the expert panel convened for the Surgeon General's Workshop on Drunk Driving.¹³⁻¹⁶ These recommendations are based on studies^{14,17,18} showing that increased alcohol taxes are associated with decreased overall consumption, decreased youth consumption, decreased youth binge drinking, reduced alcohol-related motor-vehicle crashes, reduced mortality from liver cirrhosis, and reduced violence.

The Guide to Community Preventive Services

The current systematic review of the effects of alcohol taxes and prices on excessive alcohol consumption and related harms applies the stringent inclusion and assessment criteria of the *Guide to Community Preventive Services (Community Guide)*.¹⁹ It was conducted under the oversight of the independent, nonfederal Task Force on Community Preventive Services (Task Force), with the support of USDHHS in collaboration with public and private partners. The CDC provides staff support to the Task Force for development of the *Community Guide*.

To support efforts to address important public health priorities, such as reducing excessive alcohol consumption and its related harms, the Task Force makes recommendations for practice and policies based on the results of *Community Guide* reviews such as this one. These recommendations are based primarily on the effectiveness of an intervention in improving important outcomes as determined by the systematic literature review process. In making its recommendations, the Task Force balances information about effectiveness with information about other potential benefits and harms of the intervention itself. The Task Force also considers the applicability of the intervention to various settings and populations in determining the scope of the recommendation. Finally, the Task Force reviews economic analyses of effective interventions, where available. Economic information is provided to assist with decision making, but it generally does not affect Task Force recommendations. See the Task Force-authored paper in this issue for recommendations regarding the effects of alcohol taxes and prices on excessive alcohol consumption and related harms.²⁰

Evidence Acquisition

Community Guide methods for conducting systematic reviews and linking evidence to effectiveness are described elsewhere¹⁹ and on the *Community Guide* website (www.thecommunityguide.org/methods). In brief, for each *Community Guide* review topic, a systematic review development team representing diverse disciplines, backgrounds, and work settings conducts a review by (1) developing a conceptual approach to identify, organize, group, and select interventions for review; (2) developing a conceptual model depicting interrelationships among interventions, populations, and outcomes; (3) systematically searching for and retrieving evidence; (4) assessing and summarizing the quality and strength of the body of evidence of effectiveness; (5) translating evidence of effectiveness into recommendations; (6) summarizing data about applicability (i.e., the extent to which available effectiveness data might apply to diverse population segments and settings), economic impact, and barriers to implementation; and (7) identifying and summarizing research gaps.

Conceptual Model

The conceptual causal pathway by which increased alcohol taxes are expected to reduce excessive alcohol consumption and its related harms is depicted in Figure 1. The first step in this pathway posits that tax increases will be passed on to the

consumer in the form of higher alcohol prices, as has been documented previously.⁷ According to the Law of Demand,⁴ an increased price would be expected to lead to a decrease in the quantity of alcoholic beverages demanded, resulting in decreases in excessive alcohol consumption and its harmful consequences. Details of the specific independent variables and outcome measures that reflect the concepts in this conceptual causal pathway are provided below.

One complicating factor in this conceptual model arises from the fact that different types of alcoholic beverages (e.g., beer, wine, and spirits) are taxed at different rates in the U.S. and several other countries. When tax increases affect one type of beverage only (designated as the “targeted” alcoholic beverage in Figure 1), one must consider the possibility of substitution effects, whereby alcoholic beverages that have not been affected by the tax increase may be consumed in greater quantities. To the extent that such substitution occurs, the overall rate of excessive drinking would not decrease as much as would otherwise be expected based on the decrease in quantity demanded for the beverage targeted by the tax increase. However, binge drinkers are known to prefer certain types of alcoholic beverages (e.g., most adult binge drinkers in the U.S. consume beer)²¹ for reasons that may not be entirely related to price (e.g., availability, convenience, taste); thus, it is not clear whether and how large an effect beverage substitution would likely have on overall alcohol consumption, even when tax increases affect one beverage type only.

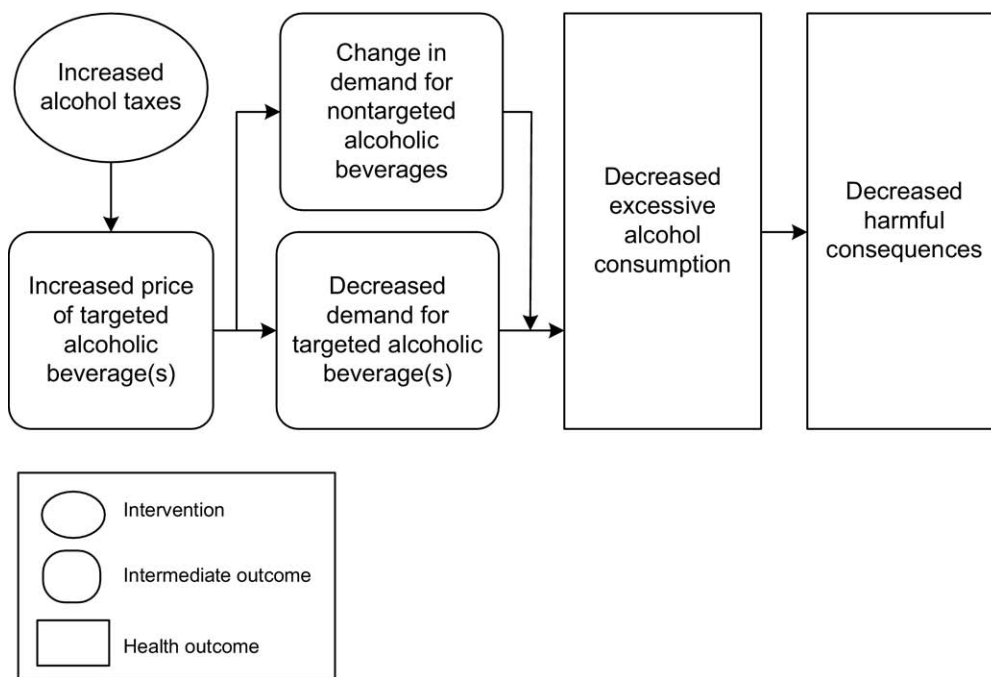


Figure 1. Conceptual model for the causal relationship between increased alcohol taxes and decreased excessive alcohol consumption and related harms (oval indicates intervention; rectangles with rounded corners indicate mediators or intermediate outcomes; and rectangles indicate outcomes directly related to improved health)

Review Inclusion Criteria

To be considered for inclusion in this review, candidate studies had to (1) meet minimum *Community Guide* standards for study design and quality¹⁹; (2) be published in an English-language journal, book chapter, or technical report; (3) be conducted in a high-income economy; and (4) evaluate independent variables and outcome measures of interest.

Independent variables of interest. In addition to the other criteria noted above, to be included in this review, a study had to evaluate either the effects of a

change in alcohol tax policy or the relationship between alcohol taxes or prices and outcomes of interest. Studies of the effects of alcoholic beverage prices were considered relevant to an evaluation of alcohol taxes because there is evidence that changes in alcohol taxes are passed on to the consumer in the form of higher or lower prices, with little or no lag time.⁷ In fact, there is some evidence that tax increases may be magnified as they are passed on to the consumer. For example, when the federal excise tax on beer increased by \$9 per barrel in 1991, it was estimated to have increased retail prices by \$15 to \$17.⁷

Outcome measures of interest. The outcome measures of interest in this review are direct measures or proxies relating to the two final boxes in Figure 1—that is, excessive alcohol consumption and the harmful consequences of such consumption. When excessive alcohol consumption is assessed directly, it is typically done through surveys assessing either the prevalence or frequency of binge drinking (four or more drinks per occasion for women, or five or more drinks per occasion for men); heavy drinking (more than seven drinks per week for women, or more than 14 drinks per week for men); or underage drinking (defined by state or national laws). Measures of societal levels of alcohol sales or consumption were also considered an acceptable proxy for excessive consumption for two primary reasons. First, there is an extremely strong relationship between per capita alcohol consumption and various measures of excessive drinking.^{22,23} Furthermore, because people consuming greater quantities of alcohol may be more sensitive to price increases, reductions in societal levels of alcohol consumption subsequent to price increases may result in even larger declines in excessive consumption.²²

In addition to studies directly or indirectly assessing excessive alcohol consumption, studies assessing health-related outcomes associated with excessive alcohol consumption (e.g., alcohol-related motor-vehicle crashes) were also included in this review. In some cases, a single paper reported multiple measures of a single general outcome (e.g., both single-vehicle nighttime crashes and total crashes reported as measures of alcohol-related crashes). In these instances, the measure that was most strongly associated with excessive alcohol consumption based on estimated alcohol-attributable fractions was chosen as the primary result reported for that outcome.

Search for Evidence

Conducting a thorough search for studies of the effects of alcohol taxes or alcohol prices is challenging because the effects of alcohol taxes or prices are often studied in conjunction with many other variables. As a result, a search that targets “tax” or “price” may fail to identify many relevant studies. To address this issue, a search was conducted for relevant studies as part of a broad database search for terms related to several alcohol policy interventions of interest to

the current review group, covering the period from database inception through July 2005. Using MeSH terms and text words, the following databases were searched: MEDLINE, EMBASE, PsycINFO, the ETOH database of the National Institute on Alcohol Abuse and Alcoholism, Web of Science, Sociological Abstracts, and EconLit. Search strategies are available at www.thecommunityguide.org/alcohol/supportingmaterials/SSincreasingtaxes.html. The reference lists of prior literature reviews, as well as reference lists from studies included in this review, were used to identify additional relevant articles. The search produced 5320 potentially relevant papers, of which 78 met the inclusion criteria.

Data Extraction and Quality Assessment

For each candidate study, study characteristics and results were recorded, and the quality of study execution was assessed. The degree to which a study’s basic design protected against threats to internal validity was rated using a three-level classification system ranging from least suitable (for designs with a cross-sectional analysis or a single observation before and after an intervention) to greatest suitability (for designs with concurrent comparison conditions).¹⁹ Ratings of the quality of each study’s execution provided further information on their utility for the purposes of the review. Quality of study execution was assessed using a standard 9-point scale, reflecting the total number of identified limitations to internal or external validity (viz. study population and intervention descriptions, sampling, exposure and outcome measurement, data analysis, interpretation of results, and other biases). Studies with zero or one limitation were categorized as having good execution, those with two to four limitations had fair execution, and those with five or more limitations were categorized as having limited execution.¹⁹ Studies with limited execution were excluded from further analysis.

Effect Measurement and Synthesis of Results

The most common method for studying the effects of alcohol taxes on alcohol-related outcomes is to assess how they (or the prices they influence) relate to those outcomes over time, while controlling for potential confounding factors. For most of the studies in this review, the reported results were either directly reported as elasticities or were transformed into elasticities. These were then directly compared with elasticities calculated from other studies. An elasticity represents the percentage change in a dependent variable associated with a 1% increase in an independent variable (e.g., price or tax rate). For example, a price elasticity of -0.5 means that a 10% increase in price would be expected to result in a 5% decrease in the outcome of interest. Tax elasticities have a similar interpretation, but cannot be directly compared with price elasticities because taxes represent only a fraction of the total purchase price (resulting in smaller values for tax elasticities). In most cases for which

elasticities were not reported in the original studies, only the direction and significance of the reported effects could be evaluated in this review.

Because elasticities are measures of relative change, they provide a common metric for comparing and aggregating related, but not identical, outcomes (e.g., different measures of alcohol consumption; different types of motor-vehicle crashes). In general, measures of alcohol consumption fell into two broad categories: those that evaluate indices of consumption at the societal level (e.g., total alcohol sales) and those that evaluate consumption at the individual level (e.g., self-reported binge drinking). Measures of alcohol-related harms were grouped into broad categories of related outcomes, such as motor-vehicle crashes, liver cirrhosis, violence, alcohol dependence, and all-cause mortality.

For most of the outcomes of interest in this review, results were synthesized descriptively, without the use of any summary effect measures, due to a substantial amount of variation in the specific outcomes assessed and in the units used to measure the effects of changes in taxes or prices. The only outcome for which both enough studies and sufficiently similar results were found to allow a quantitative synthesis of the results was societal-level alcohol consumption. Data from these studies were summarized graphically and by using descriptive statistics, specifically medians and interquartile intervals. These results were also stratified on several variables considered by the review team to be potentially important effect modifiers (e.g., study design), allowing for an assessment of the robustness and generalizability of the results. This approach to synthesis was primarily chosen for the following two reasons. First, because many of the included studies had some overlap with respect to the locations and time periods covered in their analyses, their results were not completely independent. Second, many of these studies did not report results in a way that allowed for the calculation of CIs for their elasticities.

For studies that reported stratified results (e.g., separate price elasticities for beer, wine, and spirits), the median value across the relevant strata reported in that study was used for the calculation of summary statistics. This approach prevented studies that reported multiple outcomes from having undue influence on the summary statistics.

Evidence Synthesis

Description of Included Studies

A total of 78 papers^{24–101} reported on studies that met the review inclusion criteria. Only some of the outcomes from one study⁸³ were included because not all of its analyses met quality of execution criteria. Five other studies^{70,88–91} were excluded from the review because they failed to meet quality of execution criteria. Detailed descriptions of the included studies are available at www.thecommunityguide.org/alcohol/supportingmaterials/SETincreasingtaxes.html.

[thecommunityguide.org/alcohol/supportingmaterials/SETincreasingtaxes.html](http://www.thecommunityguide.org/alcohol/supportingmaterials/SETincreasingtaxes.html).

Most studies assessed total alcohol consumption at the societal level (i.e., per capita alcohol consumption). The design of these studies varied across countries. Most studies conducted outside the U.S. used interrupted time-series designs, because alcohol taxes in other countries tend to be set at the national level, and as such, it is generally not possible to do intra-country comparisons. In contrast, most of the U.S. studies used a panel study design, in which multiple states were assessed over time, allowing each to serve as a comparison for the others. These studies included both those that accounted for between-state differences using a fixed-effects approach (whereby stable between-state differences are controlled for by dummy coding) and those that used a random-effects approach (whereby between-state differences in variables other than tax or price are controlled for by including important predictors of alcohol consumption in the model). The remaining studies assessed measures related to excessive drinking (e.g., the prevalence of underage or binge drinking) or alcohol-related harms, the most common being outcomes related to motor-vehicle crashes.

Intervention Effectiveness

Alcohol price and overall consumption. Of the studies in the review, 50 assessed overall alcohol consumption; 38 (76%) of these reported price elasticities^{25,27,33–38,40,43,45,47,48,52,53,57,63,65,67,71,73,74,77,78,80–82,84,92–95,97} (six of these studies came from one paper⁸⁰ that calculated elasticities for multiple countries). Almost all of these 38 studies (95%) reported negative price elasticities, indicating that higher prices were associated with lower consumption. These results were quite consistent across beverage type, with median elasticities ranging from -0.50 for beer to -0.79 for spirits (Figure 2). Similarly, interquartile intervals for beer, wine, and spirits were also consistent across beverage type, with the 25th percentile elasticity ranging from -0.91 to -1.03 , and the 75th percentile ranging from -0.24 to -0.38 . Results for studies of overall ethanol consumption across beverage types were somewhat more variable because of the presence of several outliers with very large elasticities; for this outcome, the 75th percentile was comparable to that for the other outcomes (-0.50), but the 25th percentile had a substantially larger absolute value (-2.00).

As indicated in Table 2, the price elasticities reported in the reviewed studies were also quite consistent when evaluated by study characteristics (i.e., design suitability, model type, time period, and location). Across all of the nine strata examined, median elasticities ranged from -0.51 to -0.90 , the 25th percentile elasticities ranged

from -0.78 to -1.10 , and the 75th percentile elasticities ranged from -0.32 to -0.50 . The most notable differences in elasticities across strata were among panel studies that used fixed- versus random-effects regression models. In general, fixed-effects models tended to produce elasticities of slightly smaller magnitude than did random-effects models. This might be expected because the elasticities from fixed-effects models do not account for between-state differences in taxes that are stable over time (although these models have several other desirable qualities).

Of the 50 studies that assessed overall alcohol consumption, 12 studies^{29,31,32,39,41,49,54,75,76,83,98,99} assessed the relationship between price and overall consumption, but these studies did not provide sufficient information to calculate them. Many of these studies reported

the results of multiple analyses that produced separate results for different subpopulations, beverage types, or analytic models with different parameters. In eight of these studies,^{29,31,32,39,41,54,76,83} all of the reported results indicated that higher prices were associated with lower alcohol consumption; in seven,^{29,31,32,39,41,54,83} results were significant across all analyses, and one⁷⁶ had results of mixed significance across analyses. The other four studies^{49,75,98,99} had mixed results across beverage types or analytic models, with some results in the expected direction and some in the opposite direction.

Alcohol price or taxes and individual consumption patterns. Sixteen studies^{24,46,53-56,58-62,64,68,72,96,102} in the review used survey data to evaluate the effects of alcohol prices or taxes on individual alcohol consump-

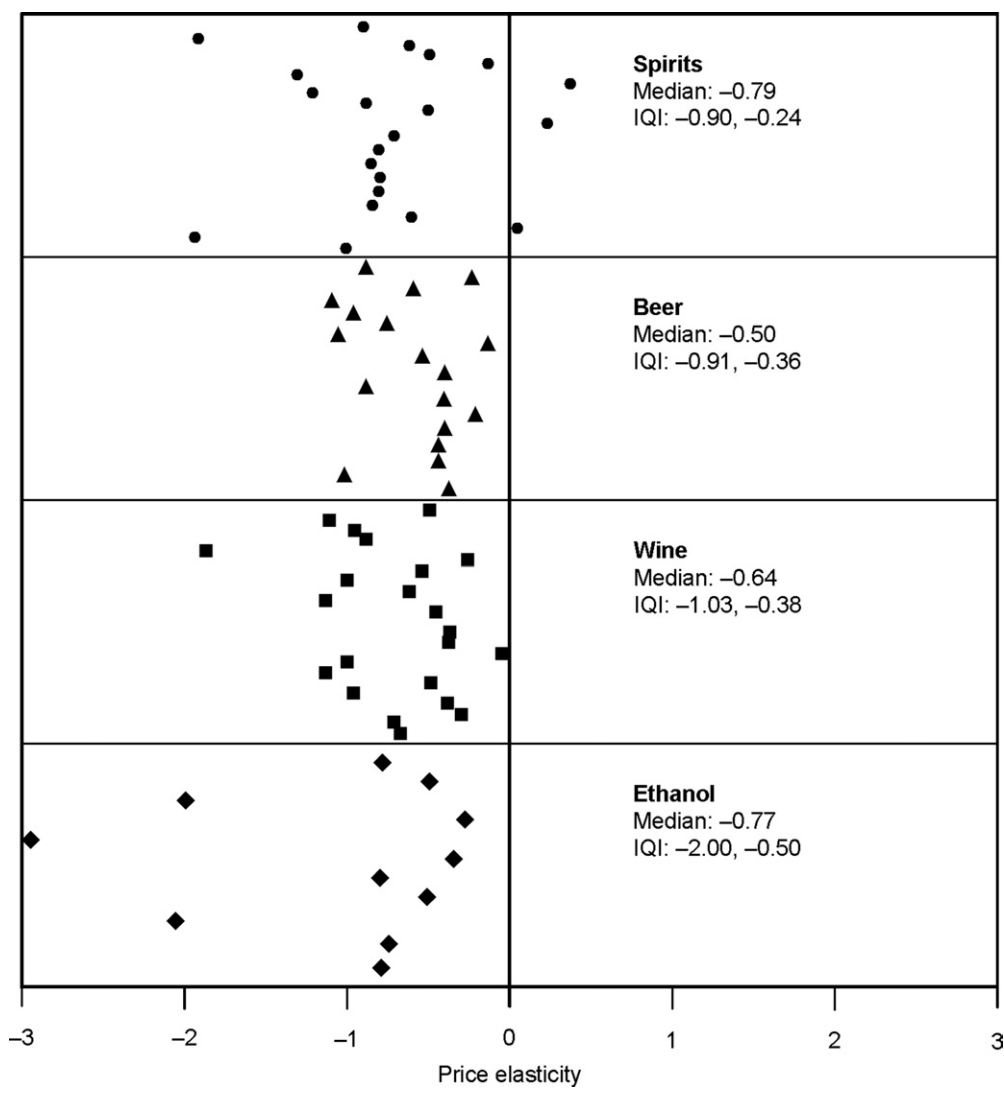


Figure 2. Scatterplot showing the association between alcohol price elasticities and excess consumption as measured by societal alcohol consumption. Each data point represents a single study's elasticity estimate for the given beverage type. IQR, interquartile interval

tion patterns. Most of these studies assessed the prevalence of alcohol consumption among youth aged <25 years, primarily underage youth. Respondent groups included high school students, college students, young people in the general population, and adults in the general population. All but two of these studies^{54,59} were conducted in the U.S.

Of the nine studies^{24,46,56,58,60-62,64,68} that assessed the relationship between alcohol price or taxes and drinking prevalence among young people, six^{46,56,58,60,61,68} consistently indicated that higher prices or taxes were associated with a lower prevalence of youth drinking (four with one or more significant findings). Three of these studies reported price elasticities: -0.29 for drinking among high school students,⁴⁶ -0.53 for heavy drinking among

Three studies evaluated the relationship between alcohol prices^{44,61} or taxes⁶⁶ and self-reported alcohol-impaired driving. These studies consistently found that alcohol-impaired driving was inversely related to the price of alcoholic beverages. The estimated price elasticities were similar for samples of Canadian⁴⁴ and U.S.⁶¹ adults (range of -0.50 to -0.81 ; all $p < 0.05$). The U.S. study stratified their sample by age in addition to gender, and reported price elasticities of -1.26 to -2.11 (both with $p < 0.05$) for men and women aged 18–21 years, respectively.⁶¹ The estimated tax elasticities from the remaining study were substantially larger for women than men (-0.29 vs -0.06), but neither estimate was significant.⁶⁶

Non-motor-vehicle

mortality outcomes. Six studies evaluated the effects of alcohol price^{25,28,72,83,93} or taxes³¹ on nontraffic deaths. Despite substantial variability in their individual effect estimates, all six studies found that higher alcohol prices were associated with decreased mortality.

Five studies evaluated the relationship between alcohol prices and deaths from liver cirrhosis.^{25,28,72,83,93} The two studies that reported results as elasticities produced substantially different elasticity estimates for this outcome, -0.90 ($p < 0.05$)⁹³ and -0.01 ($p > 0.05$).²⁸ Results of another study indicated that a \$1 increase in the spirits tax would lead to a 5.4% decrease in cirrhosis ($p < 0.05$).²⁵ Another found a nonsignificant effect in the expected direction.⁷² The final study found a strong correlation of -0.87 between alcohol prices and cirrhosis deaths.⁸³ Although all of these studies indicate a consistent relationship between higher prices and lower cirrhosis mortality, there are substantial differences in the estimated strength of this relationship, which may be due to methodologic differences among studies.

One of the studies that evaluated cirrhosis mortality also assessed the relationship between alcohol price and several other causes of death.⁷² The researchers found

Table 3. Results of studies evaluating the relationship between alcohol prices or taxes and motor-vehicle crashes

Study	Independent variable	Dependent variable	Elasticity (p -value)
Price elasticity studies			
Cook (1981) ⁹³	Ethanol price ^a	Fatalities	-0.70 (NR)
Adrian (2001) ⁴⁴	Ethanol price ^a	Alcohol-related crashes	-1.20 (<0.05)
Sloan (1994) ⁷²	Ethanol price ^a	Fatalities	<0 (>0.05)
Whetten-Goldstein (2000) ¹⁰⁰	Ethanol price ^a	Alcohol-related fatalities	<0 (>0.05)
Tax elasticity studies			
Chaloupka (1993) ²⁶	Beer tax	Alcohol-related fatalities, all ages	-0.097 (<0.05)
	Beer tax	Alcohol-related fatalities, youth aged 18–20 years	-0.156 (<0.05)
Evans (1991) ⁸⁶	Beer tax	Single-vehicle nighttime fatalities	-0.12 (<0.05)
Ruhm (1996) ³⁰	Beer tax	Nighttime fatalities, youth aged 15–24 years (by age)	-0.18 (<0.05)
Saffer (1987) ⁴²	Beer tax	Fatalities, youth aged 15–24 years (by age)	-0.18 to -0.27 (all <0.05)
Ruhm (1995) ²⁹	Beer tax	Fatalities	<0 (<0.05)
Mast (1999) ⁹⁸	Beer tax	Fatalities	<0 (>0.05)
Dee (1999) ²⁴	Beer tax	Nighttime fatalities, youth aged 18–20 years	>0 (>0.05)

^aAverage price per ounce of ethanol across beer, wine, and spirits

that there was a significant ($p < 0.05$) inverse relationship between the price of alcoholic beverages and deaths from alcohol-related cancers (e.g., breast cancer) and suicide, and a nonsignificant ($p > 0.05$) relationship between alcohol prices and deaths from homicides, falls, fires/ burns, and other injuries. Although these findings are surprising given the stronger relationship between alcohol consumption and intentional and unintentional injuries, the findings were robust across several regression models.

One study assessed all-cause mortality using a two-stage process.³¹ In the first stage, the authors assessed the relationship between alcohol taxes and sales, and found that a one-cent increase in taxes per ounce of ethanol (a tax increase of approximately 10%) would be expected to result in a 2.1% decrease in sales. In the second stage, they found that a 1% decrease in alcohol sales was associated with a 0.23% decrease in all-cause mortality rates ($p < 0.05$).

Violence outcomes. Three additional studies found that higher alcohol taxes are associated with decreased violence.^{69,85,101} When the differences among tax and price elasticities are taken into account, the strength of the relationships reported in these studies were comparable to those found for alcohol consumption outcomes. The first

study estimated that beer tax elasticities on violent crime rates in the U.S. were -0.03 ($p > 0.05$) for homicide; -0.03 ($p > 0.05$) for assault; -0.13 ($p < 0.05$) for rape; and -0.09 ($p < 0.05$) for robbery.¹⁰¹ The other two studies assessed the relationship between beer taxes and violence toward children, with different methods using overlapping samples. In the first analysis,⁶⁹ tax elasticities were -0.12 ($p < 0.05$) for any violence toward children and -0.16 ($p < 0.10$) for severe violence toward children. The subsequent analysis found that these results appeared to be due to an influence of taxes on violence by women but not by men.⁸⁵

Other outcomes. Two studies evaluated the association between alcohol prices and two other health-related outcomes: alcohol dependence and sexually transmitted diseases. The first estimated an alcohol price elasticity for alcohol dependence of -1.49 ($p < 0.05$).⁵¹ The second used multiple methods of evaluating the effect of tax changes on sexually transmitted diseases, and found robust effects on rates of both gonorrhea and syphilis.⁸⁷

Applicability

The Law of Demand⁴ states that the inverse relationship between the price of a commodity and the quantity demanded is almost universal, and that only the strength of this relationship will vary across commodities or population groups. Consistent with these expectations, estimates of price elasticity for societal levels of alcohol consumption were robust across the various high-income economies in North America, Europe, and the Western Pacific Region evaluated in the studies in this review. Although results for harms related to excessive consumption came primarily from the U.S. and Canada, these findings are likely to be broadly applicable across high-income countries.

One important factor hypothesized to affect the strength of price elasticities for alcohol across different population groups is disposable income. Specifically, groups with less disposable income, such as underage drinkers, may be expected to be more sensitive to changes in alcohol prices than those with more disposable income.¹⁰⁴ Unfortunately, based on the studies in this review, it was not possible to determine whether alcohol price elasticities differ significantly on the basis of age or income. Furthermore, although the reviewed studies provided evidence that changes in alcohol prices affect excessive consumption (e.g., the prevalence and frequency of binge drinking), the available data were not adequate to assess potential differences in price elasticities based on drinking pattern (i.e., between excessive and nonexcessive drinkers).

Economic Efficiency

Our systematic economic review identified two studies that estimated the cost effectiveness of alcohol tax intervention based on modeling.^{10,105} The first study¹⁰⁵ assessed the costs and outcomes of 84 injury prevention interventions for the U.S. and found that an alcohol tax of 20% of the pretax retail price offered net cost savings (i.e., the savings outweigh the costs) even after taking into account the adverse economic impact of reduced alcohol sales. The second study¹⁰ analyzed the comparative cost effectiveness of alternative policies to reduce the burden of hazardous alcohol use for 12 WHO subregions and found that taxation was the most effective and cost-effective intervention in populations with a 5% or greater prevalence of heavy drinkers. The costs associated with this intervention included the cost of passing the legislation itself, and the cost of administering and enforcing the laws once they are passed. Effectiveness was assessed using disability-adjusted life-years (DALYs), a standard measure of global health impact that considers the impact of an intervention on healthy years of life lost as a result of either death or disability. For the Americas A region, consisting of the U.S., Canada, and Cuba, which is the region most relevant to this review, the intervention costs for current taxation were \$482,956 (converted to 2007 dollars using the Consumer Price Index) per 1 million population per year, based on a 10-year implementation period and discounted at 3% per year to reflect the time value of money. The cost was assumed to stay the same when the tax was increased by 25% or 50%. Current taxes were estimated to prevent 1224 DALYs per 1 million population per year, yielding an average cost-effectiveness ratio for this intervention of approximately \$395 per DALY averted. This is much less than the average annual income per capita in these three countries, a threshold for an intervention to be considered very cost effective that was proposed by the Commission on Macroeconomics and Health.¹⁰⁶ The DALYs averted increased to 1366 and 1489 per 1 million population per year when taxes were increased by 25% and 50%, respectively. Because these incremental DALYs averted could be achieved without any increase in costs, these increases in taxes improve cost-effectiveness estimates relative to the current tax scenario. To obtain country-specific estimates of the DALYs saved per country as a result of this intervention, the regional analysis needs to be adjusted using country-specific data. Such estimates are limited by the assumptions made and the data available.

Barriers to Implementation

The level of taxation of alcoholic beverages has economic effects on several groups, including federal,

state, and local governments; affected industry groups; and the general population of alcohol consumers. Whereas raising alcohol taxes may provide an important source of revenue for governments, such tax increases may be resisted by some industry groups and consumers. However, public support for increased alcohol taxes increases substantially when tax revenues are specifically directed to fund prevention and treatment programs instead of being used as an unrestricted source of general revenue.¹⁰⁷

Other Benefits or Harms

In addition to the direct public health outcomes evaluated in this review, the primary benefit of increased alcohol excise taxes is that they can provide a source of revenue to support programs to prevent and treat alcohol problems. They also can provide some compensation for the societal costs associated with excessive alcohol consumption that are not borne by the drinker (i.e., “external” costs). Economic analyses suggest that alcohol taxes would need to be increased substantially to address adequately such external costs as crime, alcohol-related crashes, domestic violence, and productivity losses.^{18,108}

A potential concern is that increases in alcohol taxes may have a greater proportional economic impact on people with lower incomes (i.e., alcohol taxes may be regressive). However, alcohol taxes constitute a minor proportion (i.e., <1%) of the tax burden of Americans, including those with low incomes. As such, concerns about the regressive nature of such taxes could be readily addressed by compensatory changes in other elements of the tax system. In addition, the amount of tax paid is directly related to the amount of alcohol consumed, and thus increases in alcohol excise taxes will be disproportionately paid by excessive drinkers, who also experience most of the alcohol-related harms and thus generate most alcohol-attributable economic costs. Furthermore, the beneficial economic results of reducing excessive alcohol consumption and related harms may also be disproportionately greater for people with low incomes. Lower-income people may be particularly vulnerable to the harmful consequences of excessive alcohol consumption—consumed by themselves or others—because of factors such as lower rates of health insurance coverage, which may result in lack of or incomplete treatment for alcohol-related illness or injuries. Increasing alcohol excise taxes could also directly benefit low-income populations if the revenue generated from these taxes is used to help improve the availability of healthcare services for uninsured and other vulnerable populations.

Summary

The reviewed studies provide consistent evidence that higher alcohol prices and alcohol taxes are associated with reductions in both excessive alcohol consumption and related, subsequent harms. Results were robust across different countries, time periods, study designs and analytic approaches, and outcomes. According to *Community Guide* rules of evidence,¹⁹ these studies provide strong evidence that raising alcohol taxes is an effective strategy for reducing excessive alcohol consumption and related harms.

Most of the studies that were included in this review assessed the relationship between alcohol prices and the outcomes of interest using price elasticities. Alcohol-related harms that were well represented in the literature reviewed included alcohol-impaired driving, motor-vehicle crashes, various measures of violence, and liver cirrhosis. For the largest body of evidence in this review—that is, societal levels of alcohol consumption—the majority of estimates of price elasticity fell within the range of approximately -0.30 to -1.00 , indicating that a 10% increase in alcohol prices would be expected to result in a 3% to 10% decrease in alcohol consumption. These results indicate that alcohol consumption is responsive to price, and suggest that the impact of a potential tax increase is likely to be proportional to its size. It would also be reasonable to expect that alcohol price elasticities may vary across population groups by age and disposable income, among other factors, but assessment of such group differences was not possible using results from the studies in this review.

Research Gaps

The volume and consistency of the evidence reviewed here suggests little need for additional research on the basic questions of whether changes in alcohol taxes and price affect excessive alcohol consumption and related harms. Nonetheless, studies published subsequent to the 2005 cutoff date for this review continue to indicate the public health benefits that accrue from increasing alcohol taxes. For example, a recent meta-analysis found very similar mean price elasticities for alcohol consumption as were found in this review.¹⁰⁹ Similarly, a recent study of alcohol-related disease mortality found that substantial alcohol tax increases in Alaska in 1983 and 2002 resulted in estimated reductions of 29% and 11%, respectively.¹¹⁰

However, additional research is needed to assess:

1. Whether changes in alcohol prices differentially affect drinking behavior and health outcomes for important subgroups of the population, such as underage young people.

2. The relative benefits of increasing taxes on all alcoholic beverages simultaneously, versus selectively increasing taxes on specific beverage types. This evaluation should be considered in light of known differences in the beverage preferences of binge drinkers, historic changes in tax rates across beverage types, and the effect of inflation on real tax rates by beverage type.
3. The impact of different approaches to taxing alcoholic beverages on excessive alcohol consumption and related harms. Specific emphasis should be placed on the impact of alcohol sales taxes, where taxes are calculated as a proportion of the total beverage price; the potential impact of standardizing alcohol taxes across beverage types based on alcohol content; and the potential impact of alcohol taxes levied by local governments on a per-drink basis in on-premise, retail alcohol outlets (i.e., tippler taxes).

Author affiliations are shown at the time the research was conducted. The names and affiliations of the Task Force members are listed at www.thecommunityguide.org.

The work of Briana Lawrence and Aneeqah Ferguson was supported with funds from the Oak Ridge Institute for Scientific Education (ORISE).

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

No financial disclosures were reported by the authors of this paper.

References

1. Mokdad AH, Stroup D, Marks J, Gerberding J. Actual causes of death in the U.S., 2000. *JAMA* 2004;291:1238–45.
2. NIAAA. Tenth Special Report to the U.S. Congress on alcohol and health. Bethesda MD: NIH, 2000.
3. CDC. Web-based Injury Statistics Query and Reporting System (WISQARS). 2008. www.cdc.gov/ncipc/wisqars.
4. Marshall A. Principles of economics. 8th ed. London: Macmillan, 1920.
5. Alcohol Epidemiology Program. Alcohol policies in the U.S.: highlights from the 50 States. Minneapolis: University of Minnesota, 2000.
6. Olson S, Gerstein DR. Alcohol in America: taking action to prevent abuse. Washington DC: National Academies Press, 1985.
7. Young DJ, Bielinska-Kwapisz A. Alcohol taxes and beverage prices. *Natl Tax J* 2002;55(1):57–73.
8. USDHHS. Healthy People 2010. 2nd ed. Washington DC: U.S. Government Printing Office, 2000.
9. Babor TF, Caetano R. Evidence-based alcohol policy in the Americas: strengths, weaknesses, and future challenges. *Pan Am J Public Health* 2005;18:327–37.
10. Chisolm D, Rehm J, Van Omeren M, et al. Reducing the global burden of hazardous alcohol use: a comparative cost-effectiveness analysis. *J Stud Alcohol* 2004;65:782–93.
11. Holder HD, Treno AJ. Moving toward a common evidence base for alcohol and other drug prevention policy. In: Stockwell T, Gruenwald PJ, Toumbourou JW, Loxley W, eds. Preventing harmful substance use: the evidence base for policy and practice. New York: John Wiley and Sons, 2005:351–66.
12. Toomey TL, Wagenaar AC. Policy options for prevention: the case of alcohol. *J Public Health Policy* 1999;20(2):192–213.
13. Babor TF, Caetano R, Casswell S, et al. Alcohol: no ordinary commodity: research and public policy. New York: Oxford University Press, 2003.
14. Chaloupka FJ, Grossman M, Saffer H. The effects of price on alcohol consumption and alcohol-related problems. *Alcohol Res Health* 2002;26:22–34.
15. IOM. Reducing underage drinking: a collective responsibility. Washington DC: National Academies Press, 2004.
16. Surgeon General's workshop on drunk driving: proceedings. Rockville MD: USDHHS, 1989.
17. Cook PJ, Moore MJ. The economics of alcohol abuse and alcohol-control policies. *Health Aff (Millwood)* 2002;21(2):120–33.
18. Cook PJ. Paying the tab: the costs and benefits of alcohol control. Princeton NJ: Princeton University Press, 2007.
19. Briss PA, Zaza S, Pappaioanou M, et al. Developing an evidence-based Guide to Community Preventive Services—methods. The Task Force on Community Preventive Services. *Am J Prev Med* 2000;18(1S):35–43.
20. Task Force on Community Preventive Services. Increasing alcoholic beverage taxes is recommended to reduce excessive alcohol consumption and related harms. *Am J Prev Med* 2010;38(2):230–2.
21. Naimi TS, Brewer RD, Miller JW, Okoro C, Mehrotra C. What do binge drinkers drink? Implications for alcohol control policy. *Am J Prev Med* 2007;33:188–93.
22. Cook PJ, Skog O-J. [Discussion of] "Alcohol, alcoholism, alcoholisation" by S. Ledermann. *Alcohol Health Res World* 1995;19:30–2.
23. Skog O-J. The collectivity of drinking cultures: a theory of the distribution of alcohol consumption. *Br J Addict* 1985;80:83–99.
24. Dee TS. State alcohol policies, teen drinking and traffic fatalities. *J Public Econ* 1999;72(2):289–315.
25. Cook PJ, Tauchen G. The effect of liquor taxes on heavy drinking. *Bell J Econ* 1982;13(2):379–90.
26. Chaloupka FJ, Saffer H, Grossman M. Alcohol-control policies and motor-vehicle fatalities. *J Legal Stud* 1993;22:161–86.
27. Blake D, Nied A. The demand for alcohol in the United Kingdom. *Appl Econ* 1997;29:1655–72.
28. Heien D, Pompelli G. Stress, ethnic, and distribution factors in a dichotomous response model of alcohol abuse. *J Stud Alcohol* 1987;48(5):450–5.
29. Ruhm CJ. Economic conditions and alcohol problems. *J Health Econ* 1995;14:583–603.
30. Ruhm CJ. Alcohol policies and highway vehicle fatalities. *J Health Econ* 1996;15:435–54.
31. Cook PJ, Ostermann J, Sloan FA. Are alcohol excise taxes good for us? Short- and long-term effects on mortality rates.

- Working Paper No. 11138. Cambridge MA: National Bureau of Economic Research, 2005.
32. Beard TR, Gant PA, Saba RP. Border-crossing sales, tax avoidance, and state tax policies: an application to alcohol. *South Econ J* 1997;64(1):293-306.
 33. Baltagi BH, Goel RK. Quasi-experimental price elasticity of liquor demand in the U.S.: 1960-83. *Am J Agric Econ* 1990;72(2):451-4.
 34. Simon JL. Price elasticity of liquor in the US and a simple method of determination. *Econometrica* 1966;34(1):193-205.
 35. Decker SL, Schwartz AE. Cigarettes and alcohol: substitutes or complements. Working Paper No. 7535. Cambridge MA: National Bureau of Economic Research, 2000.
 36. Levy D, Shefflin N. New evidence on controlling alcohol use through price. *J Stud Alcohol* 1983;44(6):929-37.
 37. Johnson JA, Oksanen EH. Socioeconomic determinants of the consumption of alcoholic beverages. *Appl Econ* 1974;6(4):293-301.
 38. Goel RK, Morey MJ. The interdependence of cigarette and liquor demand. *South Econ J* 1995;62(2):451-9.
 39. Hoadley JF, Fuchs BC, Holder HD. The effect of alcohol beverage restriction on consumption: a 25-year longitudinal analysis. *Am J Drug Alcohol Abuse* 1984;10(3):375-401.
 40. Lee B, Tremblay VJ. Advertising and the US market demand for beer. *Appl Econ* 1992;24(1):69-76.
 41. Ornstein SI, Hanssens DM. Alcohol control laws and the consumption of distilled spirits and beer. *J Consum Res* 1985;12(2):200-13.
 42. Saffer H, Grossman M. Drinking age laws and highway mortality rates: cause and effect. *Econ Inq* 1987;25(3):403-17.
 43. Wilkinson JT. Reducing drunken driving: which policies are most effective? *South Econ J* 1987;54:322-34.
 44. Adrian M, Ferguson BS, Her M. Can alcohol price policies be used to reduce drunk driving? Evidence from Canada. *Subst Use Misuse* 2001;36(13):1923-57.
 45. Wette HC, Zhang JF, Berg RJ, Casswell S. Effect of prices on alcohol consumption in New Zealand 1983-1991. *Drug Alcohol Rev* 1993;12(2):151-8.
 46. Grossman M, Chaloupka FJ, Sirtalan I. An empirical analysis of alcohol addiction: results from the monitoring the future panels. *Econ Inq* 1998;36(1):39-48.
 47. Hogarty TF, Elzinga KG. The demand for beer. *Rev Econ Stat* 1972;54(2):195-8.
 48. Mayo JR. An estimate of U.S. demand for alcoholic beverages, 1986-92. *Penn Econ Rev* 2000;9(1):1-4.
 49. Bourgeois JC, Barnes JG. Does advertising increase alcohol consumption? *J Advert Res* 1979;19(4):19-29.
 50. Speer PW, Gorman DM, Labouvie EW, Ontkush MJ. Violent crime and alcohol availability: relationships in an urban community. *J Public Health Policy* 1998;19(3):303-18.
 51. Farrell S, Manning WG, Finch MD. Alcohol dependence and the price of alcoholic beverages. *J Health Econ* 2003;22(1):117-47.
 52. Gruenewald PJ, Madden P, Janes K. Alcohol availability and the formal power and resources of state alcohol beverage control agencies. *Alcohol Clin Exp Res* 1992;16(3):591-7.
 53. Manning WG, Blumberg L, Moulton LH. The demand for alcohol: the differential response to price. *J Health Econ* 1995;14(2):123-48.
 54. Kuo M, Heeb JL, Gmel G, Rehm J. Does price matter? The effect of decreased price on spirits consumption in Switzerland. *Alcohol Clin Exp Res* 2003;27(4):720-5.
 55. Gius MP. The effect of taxes on alcoholic consumption: an individual level of analysis with a correction for aggregate public policy variables. *Penn Econ Rev* 2002;11(1):76-93.
 56. Laixuthai A, Chaloupka FJ. Youth alcohol use and public policy. *Contemp Policy Issues* 1993;11(4):70-81.
 57. Heien DM, Pompelli G. The demand for alcoholic beverages: economic and demographic effects. *South Econ J* 1989;55(3):759-70.
 58. Coate D, Grossman M. Effects of alcoholic beverage prices and legal drinking ages on youth alcohol use. *J Law Econ* 1988;31(1):145-71.
 59. Heeb J-L, Gmel G, Zurbrugg C, Kuo M, Rehm J. Changes in alcohol consumption following a reduction in the price of spirits: a natural experiment in Switzerland. *Addiction* 2003;98(10):1433-46.
 60. Pacula RL. Does increasing the beer tax reduce marijuana consumption? *J Health Econ* 1998;17:557-85.
 61. Kenkel DS. Drinking, driving, and deterrence: the effectiveness and social costs of alternative policies. *J Law Econ* 1993;36:877-911.
 62. Grossman M, Coate D, Arluck GM. Price sensitivity of alcoholic beverages in the U.S.: youth alcohol consumption. In: Holder H, ed. *Control issues in alcohol abuse prevention: strategies for states and communities*. Greenwich CT: JAI Press, 1987;169-98.
 63. Nelson J. State monopolies and alcoholic beverage consumption. *J Regul Econ* 1990;2:83-98.
 64. Chaloupka FJ, Wechsler H. Binge drinking in college: the impact of price, availability, and alcohol control policies. *Contemp Econ Policy* 1996;14(4):112-24.
 65. Yen ST. Cross-section estimation of US demand for alcoholic beverage. *Appl Econ* 1994;26(4):381-92.
 66. Mullahy J, Sindelar JL. Do drinkers know when to say when? An empirical analysis of drunk driving. *Econ Inq* 1994;32(3):383-94.
 67. Uri ND. The demand for beverages and interbeverage substitution in the U.S. *Bull Econ Res* 1986;38(1):77-85.
 68. Cook PJ, Moore MJ. This tax's for you: the case for higher beer taxes. *Nat Tax J* 1994;47(3):559-73.
 69. Markowitz S, Grossman M. Alcohol regulation and domestic violence towards children. *Contemp Econ Policy* 1998;16(3):309-20.
 70. Sutton M, Godfrey C. A grouped data regression approach to estimating economic and social influences on individual drinking behaviour. *Health Econ* 1995;4(3):237-47.
 71. Duffy M. Influence of prices, consumer incomes, and advertising upon the demand for alcoholic drink in the United Kingdom: an econometric study. *Alcohol Alcohol* 1981;16(4):200-8.
 72. Sloan FA, Reilly BA, Schenzler C. Effects of prices, civil and criminal sanctions, and law enforcement on alcohol-related mortality. *J Stud Alcohol* 1994;55:454-65.
 73. Johnson JA, Oksanen EH, Veall MR, Fretz D. Short-run and long-run elasticities for Canadian consumption of alcoholic beverages: an error-correction mechanism/cointegration approach. *Rev Econ Stat* 1992;74(1):64-74.

74. Nelson J, Moran J. Advertising and US alcohol beverage system demand: system-wide estimates. *Appl Econ* 1995; 12:1225–36.
75. Treno AJ, Parker RN, Holder HD. Understanding U.S. alcohol consumption with social and economic factors: a multivariate time series analysis, 1950–1986. *J Stud Alcohol* 1993;54:146–56.
76. Gray D, Chikritzhs T, Stockwell T. The Northern Territory's cask wine levy: health and taxation policy implications. *Aust N Z J Public Health* 1999;23(6):651–3.
77. Zhang JF, Casswell S. The effects of real price and a change in the distribution system on alcohol consumption. *Drug Alcohol Rev* 1999;18:371–8.
78. Clements KW, Selvanathan S. The economic determinants of alcohol consumption. *Aust J Agric Resour Econ* 1991; 35(2):209–31.
79. Duffy M. The demand for alcoholic drink in the United Kingdom. *Appl Econ* 1983;15(1):125–40.
80. Labys W. An international comparison of price and income elasticities for wine consumption. *Aust J Agric Resour Econ* 1976;20(1):33–6.
81. Nelson J. Economic and demographic factors in U.S. alcohol demand: a growth-accounting analysis. *Empir Econ* 1997; 22:83–102.
82. Selvanathan EA. Alcohol consumption in the UK, 1955–85: a system-wide analysis. *Appl Econ* 1988;20(2):1071–86.
83. Rush B, Steinberg M, Brook R. Relationships among alcohol availability, alcohol consumption and alcohol-related damage in the province of Ontario and the State of Michigan. *Adv Alcohol Subst Abuse* 1986;5(4):33–45.
84. Young C, Bielinska-Kwapisz A. Alcohol consumption, beverage prices and measurement error. *J Stud Alcohol* 2003; 64:235–8.
85. Markowitz S, Grossman M. The effects of beer taxes on physical child abuse. *J Health Econ* 2000;19:271–82.
86. Evans WN, Neville D, Graham JD. General deterrence of drunk driving: evaluation of recent American policies. *Risk Anal* 1991;11:279–89.
87. Chesson H, Harrison P, Kassler WJ. Sex under the influence: the effect of alcohol policy on sexually transmitted disease rates in the U.S. *J Law Econ* 2000;43:215–37.
88. Brinkley G. The causal relationship between socioeconomic factors and alcohol consumption: a Granger-causality time series analysis, 1950–1993. *J Stud Alcohol* 1999;60(6): 759–68.
89. Niskanen WA. Taxation and the demand for alcoholic beverages. Santa Monica CA: Rand Corp, 1960.
90. Sloan FA, Reilly BA, Schenzler C. Effects of tort liability and insurance on heavy drinking and drinking and driving. *J Law Econ* 1995;38(1):49–77.
91. Kendell RE, Ritson B. Effect of economic changes on Scottish drinking habits 1978–82. *Br J Addict* 1983;78:365–79.
92. Adrian M, Ferguson BS. Demand for domestic and imported alcohol in Canada. *Appl Econ* 1987;19(4):531–40.
93. Cook PJ. The effect of liquor taxes on drinking, cirrhosis, and auto accidents. In: Moore MH, Gerstein D, eds. *Alcohol and public policy: beyond the shadow of prohibition*. Washington DC: National Academies Press, 1981:255–85.
94. Duffy M. Advertising and the inter-product distribution of demand. *Eur Econ Rev* 1987;31:1051–70.
95. Jones AM. A systems approach to the demand for alcohol and tobacco. *Bull Econ Res* 1989;41(2):85–101.
96. Kenkel DS. New estimates of the optimal tax on alcohol. *Econ Inq* 1996;34(2):296–319.
97. Leskinen E, Terasvirta T. Forecasting the consumption of alcoholic beverages in Finland. *Eur Econ Rev* 1976;8:349–69.
98. Mast BD, Benson BL, Rasmussen DW. Beer taxation and alcohol-related traffic fatalities. *South Econ J* 1999;66(2): 214–49.
99. Ponicki W, Holder HD, Gruenewald PRA. Altering alcohol price by ethanol content: results from a Swedish tax policy in 1992. *Addiction* 1997;92(7):859–70.
100. Whetten-Goldstein K, Sloan FA, Stout E, Liang L. Civil liability, criminal law, and other policies and alcohol-related motor vehicle fatalities in the U.S.: 1984–1995. *Accid Anal Prev* 2000;32:723–33.
101. Cook PJ, Moore MJ. Economic perspectives on reducing alcohol-related violence. *Alcohol and interpersonal violence: fostering multidisciplinary perspectives*. NIAAA Research Monograph 24. Rockville MD: NIAAA, 1993:193–212.
102. Stout EM, Sloan FA, Liang L, Davies HH. Reducing harmful alcohol-related behaviors: effective regulatory methods. *J Stud Alcohol* 2000;61(3):402–12.
103. Saffer H, Grossman M. Beer taxes, the legal drinking age, and youth motor vehicle fatalities. *J Legal Stud* 1987;16(June): 351–73.
104. Chaloupka FJ. Effects of price on alcohol-related problems. *Alcohol Health Res World* 1993;17(1):46–53.
105. Miller TR, Levy, DT. Cost-outcome analysis in injury prevention and control: eighty-four recent estimates for the U.S. *Med Care* 2000;38(6):562–82.
106. WHO. *Macroeconomics and health: investing in health for economic development*. Final report of the Commission on Macroeconomics and Health. Geneva, Switzerland: WHO, 2001.
107. Wagenaar AC, Harwood EH, Toomey TL, Denk CE, Zander KM. Public opinion on alcohol policies in the U.S.: results from a national survey. *J Public Health Policy* 2000;21: 303–27.
108. Richardson J, Crowley S. Optimum alcohol taxation: balancing consumption and external costs. *Health Econ* 1994; 3(2):73–87.
109. Wagenaar AC, Salois MJ, Komro KA. Effects of beverage alcohol price and tax levels on drinking: a meta-analysis of 1003 estimates from 112 studies. *Addiction* 2009;104:179–90.
110. Wagenaar AC, Maldonado-Molina MM, Wagenaar BH. Effects of alcohol tax increases on alcohol-related disease mortality in Alaska: time-series analyses from 1976 to 2004. *Am J Public Health* 2009;99:1464–70.