LB 330
Revenue Committee
Testimony of Chris Wagner, Project Extra Mile
March 20, 2025

Good afternoon. My name is Chris Wagner, and I am here representing Project Extra Mile, a statewide coalition working to prevent and reduce alcohol-related harms in our state, here in support of LB 330.

Our state has not increased alcohol taxes since 2003, a time when a stamp cost $0.37, the average price of a dozen eggs was $1.56, and a gallon of gas was $1.59. So why are we still taxing alcohol like it's 2003?

Of course, the current sales tax applies to alcohol, but we have always taxed alcohol differently because it's not an ordinary commodity. When consumed excessively, it causes death, disease, crime, violence, and quality of life issues in our state. Excessive alcohol consumption is a tax on Nebraska businesses and all Nebraskans whether they drink or not – to the tune of $1.2 billion (Sacks et al., 2015).

We have seen an exponential rise in the harms from alcohol because, when accounting for inflation, alcohol is the cheapest it's ever been. And so when you hear that alcohol-specific death rates increased nationwide by 55% from 2000 to 2016 (Spillane et al., 2020) and emergency room visits involving alcohol grew by 62% from 2006 to 2014 (White et al., 2018) and they continued to grow between 2018 and 2020 when emergency room visits for all other causes were decreasing (Esser et al., 2022), it makes perfect sense. In 2009, there were an estimated 582 alcohol-related deaths in Nebraska – that number is now 1,001.

Research has found that doubling alcohol taxes would reduce alcohol-related mortality by an average of 35%, traffic crash deaths by 11%, sexually transmitted diseases by 6%, violence by 2%, and crime by 1.4% (Wagenaar et al., 2010).

A 10% sales tax would equal between 10-20 cents per drink, which would amount to excessive drinkers paying $36.44 more per year while non-excessive drinkers would pay an extra $6.54 per year. And of course, this is a tax that one chooses to pay. Alcohol is a luxury item and over 40% of Nebraska adults would not be affected because they don't drink. The bill would also be expected to create approximately 1,500 jobs because the revenue is being used to fund education, enforcement, prevention, and treatment (CAMY, 2020).

I also saw the fiscal note does not have an estimate on revenue and I can help with that. Nebraska had $1,326,614,000 in sales in 2022. The price elasticity for alcohol is .77 (Task Force on Community Services, 2010), which makes that for every 10% increase in price, you can expect to see a 7.7% decrease in excessive consumption. Subtract that percentage from total sales and you get roughly $1.2 billion and the revenue from 10% of that would be around $122 million per year.

Simply put senators, LB 330 presents this body with a unique opportunity to save lives, make businesses more productive, reduce chronic diseases and cancers in our state, and ensure that the 26% of Nebraskans that drink excessively start making a down payment on the costs they're causing the rest of us – and it really is a down payment. The state only raised $34 million in excise tax revenue last year (NLCC, 2025). If we pass LB 330 without changes this session, that'd add another $122 million – a drop in the bucket when you consider the nearly $1.2 billion in annual economic costs. We're still deep in the hole, but it's a start that will make our state a better place to live and raise a family. Thank you for your consideration. I'm eager to answer your questions.

2010 National and State Costs of Excessive Alcohol Consumption

Jeffrey J. Sacks, MD, MPH,[1] Katherine R. Gonzales, MPH,[2] Ellen E. Bouchery, MS,[3] Laura E. Tomedi, PhD, MPH,[4] Robert D. Brewer, MD, MSPH[5]

Introduction: Excessive alcohol use cost the U.S. $223.5 billion in 2006. Given economic shifts in the U.S. since 2006, more-current estimates are needed to help inform the planning of prevention strategies.

Methods: From March 2012 to March 2014, the 26 cost components used to assess the cost of excessive drinking in 2006 were projected to 2010 based on incidence (e.g., change in number of alcohol-attributable deaths) and price (e.g., inflation rate in cost of medical care). The total cost, cost to government, and costs for binge drinking, underage drinking, and drinking while pregnant were estimated for the U.S. for 2010 and allocated to states.

Results: Excessive drinking cost the U.S. $249.0 billion in 2010, or about $2.05 per drink. Government paid for $100.7 billion (40.4%) of these costs. Binge drinking accounted for $191.1 billion (76.7%) of costs; underage drinking $24.3 billion (9.7%) of costs; and drinking while pregnant $5.5 billion (2.2%) of costs. The median cost per state was $3.5 billion. Binge drinking was responsible for >70% of these costs in all states, and >40% of the binge drinking–related costs were paid by government.

Conclusions: Excessive drinking cost the nation almost $250 billion in 2010. Two of every $5 of the total cost was paid by government, and three quarters of the costs were due to binge drinking. Several evidence-based strategies can help reduce excessive drinking and related costs, including increasing alcohol excise taxes, limiting alcohol outlet density, and commercial host liability.
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Introduction

Excessive alcohol consumption causes about one in ten deaths among working-age adults in the U.S. annually,[1] and cost the U.S. an estimated $223.5 billion in 2006.[2,3] However, these economic costs have not been re-evaluated despite ongoing concerns about the public health impact of excessive drinking, underutilization of prevention strategies,[4] and economic changes in the U.S. since 2006. This study's purpose is to update national and state cost estimates to inform the planning and implementation of prevention strategies.[5]

Methods

Excessive alcohol consumption was defined as binge drinking (four or more drinks per occasion for women; five or more drinks per occasion for men); heavy drinking (more than eight drinks per week for women; and ≥15 drinks per week for men); any alcohol consumption by youth aged <21 years; and any alcohol consumption by pregnant women.

The methodology for the 2006 estimates is described in detail elsewhere.[2,3] Briefly, alcohol-attributable fractions from studies were used to assess the proportion of 26 costs (e.g., lost productivity, health care, criminal justice) that could be attributed to excessive drinking. For each component, a state-level measure was selected as an allocator to distribute a portion of that national total to states. Estimates of the cost to government and costs due to binge drinking, underage drinking, and drinking during pregnancy were calculated nationally and allocated to states.

From March 2012 to March 2014, each of the 2006 cost components was projected to 2010 based on incidence and price (Appendix 1, available online). The incidence trend reflected the

From the [1]Sue Binder Consulting, Inc., Atlanta, Georgia; [2]Bureau of Disease Control, Prevention and Epidemiology, Michigan Department of Community Health, Lansing, Michigan; [3]Mathematica Policy Research, Washington, District of Columbia; [4]Substance Abuse Epidemiology Section, Epidemiology and Response Division, New Mexico Department of Health, Santa Fe, New Mexico; and [5]Alcohol Program, National Center for Chronic Disease Prevention and Health Promotion, CDC, Atlanta, Georgia

Address correspondence to: Jeffrey J. Sacks, MD, MPH, Sue Binder Consulting, Inc., 201 W. Ponce de Leon Ave., Unit 38, Decatur GA 30030-3267. E-mail: sacksj@bellsouth.net.

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2006–2010 change in occurrence of an event (e.g., alcohol-attributable deaths, hospital discharges, patients in alcohol abuse treatment), whereas the price trend adjusted for change in cost per occurrence due to inflation and other factors (e.g., mean hourly wage). The government share of costs was estimated separately for 2010 for each of the 26 components (Appendix 2, available online).

Each state's costs were estimated as a share of the national cost estimate on a line item–specific basis (Appendix 3, available online). State allocators were adjusted to reflect differences in state wages, given the significant contribution of productivity losses to costs.

The number of standard drinks per state was estimated by multiplying the number of gallons of ethanol sold[6] by the specific gravity of ethanol (0.79); weight of 1 gallon of water (8.33 pounds); and number of grams in 1 pound (453.59), and then dividing by the number grams of ethanol in a standard drink (14.0).[7] The state cost was divided by the number of standard drinks. The per capita costs were calculated by dividing the state cost by the 2010 state population.[8]

Results

The estimated cost of excessive drinking in 2010 was $249.0 billion. This equates to $2.05 per drink or $807 per person. Lost productivity comprised 71.9% of costs, health care comprised 11.4%, and other comprised 16.7%. The cost to government was $100.7 billion ($0.83 per drink, $306 per capita) (Tables 1 and 2).

Binge drinking costs ($191.1 billion) represented 76.7% of total costs (Table 1). Binge drinking accounted for $78.7 billion (78.2%) of the $100.7 billion in government costs.

Underage drinking cost $24.3 billion, which was 9.7% of the total cost in 2010. Drinking while pregnant accounted for $5.5 billion in costs, or 2.2% of the total cost of excessive drinking.

The median state cost was $3.5 billion and ranged from $35.0 billion (California) to $488 million (North Dakota). The median state cost per drink was $2.05 and ranged from $2.77 (New Mexico) to $0.92 (New Hampshire). The median state per capita cost was $769 and ranged from $1,526 (District of Columbia) to $592 (Utah) (Table 2).

The median state government cost was $1.4 billion (range, $14.5 billion [California] to $183 million [North Dakota]). The proportion of costs paid by government ranged from 43.5% (Utah) to 36.3% (Mississippi). Government costs per drink ranged from $1.19 (Utah) to $0.36 (New Hampshire); per capita costs ranged from $619 (District of Columbia) to $257 (Utah) (Table 2).

The median state cost of binge drinking was $2.6 billion. Binge drinking was responsible for a median of 76.3% of state costs (range, 83.3% [Louisiana] to 72% [Oregon]) (Table 2). More than 40% of binge drinking–related costs in states were paid by government.

The median state cost of underage drinking was $350 million, a median of 10.0% of total state cost (range, 16.2% [Utah] to 4.6% [District of Columbia]). The median state cost of drinking while pregnant was $60 million, a median of 2.3% of total cost (range, 4.8% [Nebraska] to 0.5% [Tennessee]) (Appendix 4, available online).

Discussion

Despite the severe economic recession in the U.S. from late 2007 to mid-2009, the cost of excessive drinking increased about 2.7% annually from $223.5 billion in 2006 to $249.0 billion in 2010, significantly outpacing the 1.9% annual inflation rate during this four-year time period. Had the recession not occurred, the cost of excessive drinking in 2010 might have been even higher than estimated in this study given the significant reduction in labor force participation that occurred as a result of the recession, and the significant contribution (71.9%) of productivity losses to the total cost of excessive drinking in 2010. Nonetheless, the proportion of the total cost of excessive drinking caused by binge drinking (76.7%) and paid by government (40.4%) were similar to the proportion of total costs in 2006 (76.4% and 42.1%, respectively).

Differences in state costs were probably influenced by factors that are independent of alcohol consumption, including differences in economic conditions (e.g., state budgets, population shifts) and other factors (e.g., access to medical services). However, differences in cost per drink and per capita also reflect differences in per capita sales of alcohol (a proxy for excessive drinking) and the prevalence of excessive alcohol use, which are influenced by social and cultural factors (e.g., demographics and religion) and state alcohol control policies, particularly those related to the price and availability of alcohol.[9–13]

Limitations

This study had limitations. The trending factors for some component costs may have misestimated the 2010 costs because several were based on changes in broader outcomes (e.g., total hospitalizations) that were not specific to alcohol. For most cost components, change in price drove trending more than change in incidence (price factors were always greater than 1.0, but some incidence factors were less than 1.0) (Appendix 1, available online). In addition, some allocators may not have accurately distributed national costs to states. State adjustment factors were unavailable for some items (e.g., medical care, motor vehicle repair) resulting in imprecision. However, the 2010 national and state estimates are likely to substantially underestimate the actual cost of excessive

Table 1. Excessive Alcohol Consumption Costs (in Millions), by Category, U.S., 2010

Category of cost	Total costs ($)	Government costs ($)	Binge drinking ($)	Underage drinking ($)	Drinking while pregnant ($)
Total	249,026.4	100,674.8	191,126.9	24,268.3	5,494.1
Health care	28,379.1	16,915.1	16,273.8	3,795.8	2,830.0
Specialty care for abuse/ dependence	12,044.6	9,031.3	8,245.2	2,120.4	—
Hospitalization	5,948.5	2,828.1	2,007.5	198.9	48.6
Ambulatory care	1,524.5	524.0	1,070.8	144.4	7.0
Nursing home	1,166.8	691.6	863.4	2.1	0.5
Drugs/services	1,545.5	471.6	1,085.5	146.4	7.1
Fetal alcohol syndrome	2,750.0	1,248.5	1,160.5	449.5	2,750.0
Prevention and research	1,048.8	1,048.8	496.1	454.4	10.1
Training	34.8	11.5	16.4	6.3	—
Health insurance administration	2,315.6	1,059.7	1,328.5	273.3	6.7
Lost productivity	179,084.9	57,219.0	134,035.4	13,666.6	2,290.0
Impaired productivity at work	76,858.6	25,440.2	52,614.1	1,924.3	—
Impaired productivity at home	6,218.0	—	4,256.6	205.0	—
Absenteeism	4,619.9	1,529.2	4,619.9	201.5	—
Impaired productivity while in specialty care	1,983.4	656.5	1,358.6	349.1	—
Impaired productivity while in hospital	228.4	75.6	64.1	6.4	2.6
Mortality	75,204.5	24,892.7	58,373.4	6,044.2	170.7
Incarceration of perpetrators	9,150.5	3,028.8	9,150.5	3,855.3	—
Crime victims	2,704.8	895.3	2,704.8	734.7	—
Fetal alcohol syndrome	2,116.8	700.6	893.3	346.0	2,116.8
Other	41,562.5	26,540.7	40,817.7	6,806.0	374.1
Crime victim property damage	559.4	—	559.4	216.1	—
Criminal justice: corrections	15,865.9	15,865.9	15,865.9	1,842.0	—
Criminal justice: alcohol-related crimes	2,160.0	2,160.0	1,631.4	478.6	—
Criminal justice: violent and property crimes	5,998.8	5,998.8	5,998.8	2,117.6	—
Criminal justice: private legal	228.1	—	228.1	72.8	—
Motor vehicle crashes	13,461.9	—	13,461.9	1,490.2	—
Fire losses	2,914.3	2,142.0	2,914.3	527.5	—
Fetal alcohol syndrome (special education)	374.1	374.1	157.9	61.1	374.1

Note: Cost to government and costs for binge, underage, and drinking while pregnant are all subsets of total costs. Binge drinking, underage drinking, and drinking while pregnant are not mutually exclusive and may overlap.

Table 2. Estimated Total, Governmental, and Binge Drinking Costs of Excessive Alcohol Consumption, by State, 2010

	Total cost			Cost to government				Binge drinking	
	2010 cost (millions, $)	Cost per drink, $	Cost per capita, $	2010 cost (millions, $)	Cost per drink, $	Cost per capita, $	% of total cost	2010 cost (millions, $)	% of total cost
U.S.	249,026.4	2.05	807	100,674.8	0.83	326	40.4	191,126.9	76.7
State median	3,520.2	2.05	769	1,386.6	0.79	307	40.3	2,561.2	76.3
Alabama	3,724.3	2.27	779	1,386.6	0.85	290	37.2	3,035.7	81.5
Alaska	827.2	2.25	1,165	347.0	0.95	489	42.0	637.8	77.1
Arizona	5,946.4	2.27	930	2,434.5	0.93	381	40.9	4,539.8	76.3
Arkansas	2,073.3	2.27	711	772.9	0.85	265	37.3	1,692.3	81.6
California	35,010.6	2.44	940	14,468.7	1.01	388	41.3	25,786.9	73.7
Colorado	5,056.5	2.14	1,005	2,193.0	0.93	436	43.4	3,765.7	74.5
Connecticut	3,029.0	2.04	847	1,204.1	0.81	337	39.8	2,297.9	75.9
Delaware	803.8	1.64	895	332.6	0.68	370	41.4	626.4	77.9
District of Columbia	918.4	2.14	1,526	372.3	0.87	619	40.5	715.3	77.9
Florida	15,322.2	1.82	815	6,126.6	0.73	326	40.0	11,854.0	77.4
Georgia	6,930.9	2.12	715	2,805.7	0.86	290	40.5	5,612.4	81.0
Hawaii	937.4	1.58	689	369.2	0.62	271	39.4	702.0	74.9
Idaho	1,137.9	1.62	726	452.6	0.64	289	39.8	865.6	76.1
Illinois	9,715.7	1.86	757	3,795.8	0.73	296	39.1	7,412.1	76.3
Indiana	4,468.2	1.96	689	1,804.4	0.79	278	40.4	3,476.5	77.8
Iowa	1,933.6	1.59	635	766.9	0.63	252	39.7	1,454.4	75.2
Kansas	2,075.8	2.18	728	802.5	0.84	281	38.7	1,636.6	78.8
Kentucky	3,194.5	2.36	736	1,281.2	0.95	295	40.1	2,561.2	80.2
Louisiana	3,801.4	1.91	839	1,521.9	0.77	336	40.0	3,168.4	83.3
Maine	938.7	1.58	707	394.8	0.66	297	42.1	690.3	73.5
Maryland	4,964.7	2.22	860	2,098.6	0.94	363	42.3	3,852.9	77.6
Massachusetts	5,634.6	1.93	861	2,256.4	0.77	345	40.0	4,134.3	73.4

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Table 2. Estimated Total, Governmental, and Binge Drinking Costs of Excessive Alcohol Consumption, by State, 2010 *(continued)*

	Total cost			Cost to government				Binge drinking	
	2010 cost (millions, $)	Cost per drink, $	Cost per capita, $	2010 cost (millions, $)	Cost per drink, $	Cost per capita, $	% of total cost	2010 cost (millions, $)	% of total cost
Michigan	8,161.7	2.10	826	3,326.8	0.86	337	40.8	6,072.3	74.4
Minnesota	3,886.4	1.74	733	1,533.5	0.69	289	39.5	2,898.3	74.6
Mississippi	2,277.4	2.05	768	827.0	0.74	279	36.3	1,901.3	83.5
Missouri	4,603.6	1.83	769	1,790.4	0.71	299	38.9	3,676.0	79.8
Montana	870.8	1.73	880	335.0	0.67	339	38.5	666.8	76.6
Nebraska	1,166.5	1.61	639	491.3	0.68	269	42.1	879.8	75.4
Nevada	2,296.3	1.49	850	935.9	0.61	347	40.8	1,742.1	75.9
New Hampshire	959.9	0.92	729	376.5	0.36	286	39.2	714.7	74.5
New Jersey	6,175.2	1.70	702	2,540.7	0.70	289	41.1	4,632.8	75.0
New Mexico	2,232.9	2.77	1,084	914.2	1.13	444	40.9	1,680.2	75.2
New York	16,330.2	2.28	843	6,937.8	0.97	358	42.5	12,261.9	75.1
North Carolina	7,034.2	2.11	738	2,801.1	0.84	294	39.8	5,568.4	79.2
North Dakota	487.6	1.40	725	182.7	0.52	272	37.5	372.2	76.3
Ohio	8,519.8	2.10	739	3,404.6	0.84	295	40.0	6,447.2	75.7
Oklahoma	3,081.2	2.49	821	1,205.2	0.97	321	39.1	2,443.6	79.3
Oregon	3,520.2	2.08	919	1,486.7	0.88	388	42.2	2,534.6	72.0
Pennsylvania	9,544.2	1.92	751	3,895.5	0.78	307	40.8	7,487.0	78.4
Rhode Island	886.5	1.82	842	358.2	0.73	340	40.4	657.1	74.1
South Carolina	3,982.9	2.13	861	1,458.7	0.78	315	36.6	3,161.7	79.4
South Dakota	598.2	1.59	735	241.0	0.64	296	40.3	446.2	74.6
Tennessee	4,683.8	2.25	738	1,807.3	0.87	285	38.6	3,760.9	80.3
Texas	18,820.6	1.99	748	7,342.0	0.78	292	39.0	14,968.1	79.5
Utah	1,636.1	2.74	592	711.4	1.19	257	43.5	1,291.5	78.9
Vermont	513.0	1.66	820	212.2	0.69	339	41.4	377.6	73.6

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Table 2. Estimated Total, Governmental, and Binge Drinking Costs of Excessive Alcohol Consumption, by State, 2010 *(continued)*

	Total cost			Cost to government				Binge drinking	
	2010 cost (millions, $)	Cost per drink, $	Cost per capita, $	2010 cost (millions, $)	Cost per drink, $	Cost per capita, $	% of total cost	2010 cost (millions, $)	% of total cost
Virginia	6,126.0	2.06	766	2,496.6	0.84	312	40.8	4,782.4	78.1
Washington	5,805.1	2.23	863	2,479.6	0.95	369	42.7	4,286.2	73.8
West Virginia	1,334.9	2.20	720	510.0	0.84	275	38.2	1,051.5	78.8
Wisconsin	4,452.9	1.62	783	1,845.4	0.67	324	41.4	3,387.1	76.1
Wyoming	593.1	2.33	1,052	239.2	0.94	424	40.3	459.2	77.4

drinking for many reasons.[2,3] For example, the mortality, morbidity, and associated lost productivity estimates were based only on the primary cause of death/illness and did not include alcohol-related contributing causes. Intangible costs like pain and suffering were not included. Multiple additional sources of underestimation appear in Table 3 of the national report.[2]

Conclusions

It is clear that excessive alcohol consumption is very expensive, that these costs are largely due to binge drinking, and that a substantial proportion of these costs are borne by taxpayers, including non-drinkers. There are several evidence-based strategies to reduce excessive drinking and the related harms, including increasing alcohol excise taxes, limiting alcohol outlet density, and commercial host liability.[14,15] Screening and brief intervention for excessive alcohol use has also been recommended for adults.[16] Yet, many of these interventions are underused.[4] Unless this changes, the economic cost of excessive drinking is likely to increase, placing an ever-greater burden on the excessive drinker, their family, society, and taxpayers.

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Appendix

Supplementary data

Supplementary data associated with this article can be found at, http://dx.doi.org/10.1016/j.amepre.2015.05.031.

Appendix 1. Incidence and Price Trending Factors by Category, U.S., 2006 - 2010

	Incidence trend [a]				Price trend [a]	
	Total & binge drinking	**Total and binge comment**	**Underage drinking**	**Underage comment**	**All categories**	**Comment**
Health care						
Specialty care for abuse/dependence	0.9801	No. patients in specialty treatment for alcohol[1]	0.8910	No. clients under age 18 in treatment per N-SSATS[2]	1.1554	CPI-All Medical[3]
Hospitalization	1.0065	No. hospital discharges[4]	0.8115	UAADs [b]	1.1554	CPI-All Medical
Ambulatory care	1.1033	No. ambulatory care visits[5]	0.8115	UAADs	1.1554	CPI-All Medical
Nursing home	1.0070	No. patients from census[6]	0.8115	UAADs	1.1554	CPI-All Medical
Drugs/services	1.1033	No. ambulatory care visits	0.8115	UAADs	1.1554	CPI-All Medical
FAS healthcare	0.9378	No. live births[7]	0.8423	No. live births to mothers under 20[8]	1.1554	CPI-All Medical
Prevention and research		Actual expenditures[9]		Decrement 2006 value - 3.4531% as for total		
Training	1.0891	No. employed alcohol-related counselors[10]	1.0891	No. employed alcohol-related counselors	1.0816	CPI – All[11]
Health insurance administration	1.2640	Prog. Admin. cost + net cost of private insurance[12]	1.2640	Prog. administration cost + net cost of private insurance	1.1554	CPI-All Medical
Lost Productivity						
Impaired productivity at work	0.9437	No. employed males 18-64 years old[13]	0.8664	NSDUH-reported alcohol dependents age 12 – 20[14]	1.0990	Mean annual person income + fringe[15]
Impaired productivity at home	1.0352	No. males 18-64 years old[16] [c]	0.8664	NSDUH-reported alcohol dependents age 12 - 20	1.1215	Mean hourly wage child care workers[17]

Absenteeism	0.9920	BRFSS binge episodes[18]	0.9832	No. NSDUH-reported binge drinkers past month age 12-20[19]	1.0990	Mean annual person income + fringe
Impaired productivity in specialty care	0.9801	No. patients in specialty treatment for alcohol	0.8910	No. clients under age 18 in treatment per N-SSATS	1.0990	Mean annual person income + fringe
Impaired productivity while in hospital	1.0065	No. hospital discharges	0.8115	UAADs	1.0990	Mean annual person income + fringe
Mortality	1.0517	AADs[20]	0.8115	UAADs	1.0990	Mean annual person income + fringe
Incarceration of perpetrators	1.0270	No. incarcerated adults[21]	0.7635	No. juveniles in residential placement[22]	1.4078	Federal minimum hourly wage[23]
Crime victims	1.1759	No. crime victims[24]	1.0415	No. juvenile arrests for violent + property crime[25]	1.0990	Mean annual person income + fringe
FAS productivity	0.9378	No. live births	0.8423	No. live births to mothers under 20	1.0990	Mean annual person income + fringe
Other						
Crime victim property damage	1.1759	No. crime victims	1.1759	No. juvenile arrests for violent + property crime	1.0816	CPI- All
CJ: corrections	1.1653	Actual expenditures[26]	0.7635	No. juveniles in residential placement	1.0816	CPI- All
CJ: alcohol related crimes	0.9857	No. alcohol arrests[27]	0.8513	No. juvenile arrests for alcohol crimes[25]	1.0816	CPI- All
CJ: violent and property crimes	0.9048	No. violent + property crime arrests[28]	1.0415	No. juvenile arrests for violent + property crime	1.0816	CPI- All
CJ: private legal	0.9195	No. violent + property + alcohol crime arrests[28]	0.9566	No. juvenile arrests for alcohol+violent+prop. crime[25]	1.0816	CPI- All
Motor vehicle crashes	0.9072	No. of crashes[29]	0.9994	No. licensed drivers under age 21 years[30]	1.0816	CPI- All
Fire losses	1.2606	Fire protection expenditures[26]	1.2606	Fire protection expenditures	1.0816	CPI- All

FAS special education	0.9378	No. live births	0.8423	No. live births to mothers under 20	1.0816	CPI- All

N-SSATS, National Survey on Substance Abuse Treatment Services; CPI, Consumer Price Index; UAAD, underage associated alcohol-attributable deaths; FAS, fetal alcohol syndrome; NSDUH, National Survey on Drug Use and Health; BRFSS, Behavioral Risk Factor Surveillance System; AADs, alcohol-attributable deaths; CJ, criminal justice.

[a] Expressed as ratio of 2010/2006 values. All line items included in drinking while pregnant used the same incidence factor (0.9378) of the ratio of 2010 to 2006 live births. All categories used the same price factors noted for a line item.

[b] UAADs were estimated as the sum of alcohol-attributable deaths to those under age 21 except for motor vehicles and homicides + (all AADs from motor vehicle crashes X proportion of fatal crashes from drivers 15-20 as reported in http://www-fars.nhtsa.dot.gov/States/StatesCrashesAndAllVictims.aspx and http://www-nrd.nhtsa.dot.gov/Pubs/811622.pdf) + (all AADs from homicide X the proportion of homicide arrests by juveniles as reported in http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/10shrtbl03.xls)

[c] Both employed & unemployed can exhibit decreased household productivity so there was no restriction to employed

Appendix 2. Assigning Costs to Government

Healthcare	Methods for government expenditure allocation
Specialty care for abuse/dependence	Based on payer source distribution in 2006 SAMHSA spending estimates. Medicaid payments allocated 67.2% federal and 32.8% state based on proportion of Medicaid spending allocated to federal and state in the 2010 NHEA [a]
Hospitalization	Based on payer source distribution for substance abuse-attributable expenditures in the 2006 HCUP; Medicaid expenditures allocated 67.2% federal and 32.8% state based on division of Medicaid spending in the 2010 NHEA
Ambulatory care	Based on distribution of ambulatory expenditures for substance abuse-attributable expenditures in 2006 as estimated from the 2006 National Ambulatory Medical Care Survey (NAMCS), 2006 National Hospital Ambulatory Medical Care Survey (NHAMCS), and the 2006 Medical Expenditure Panel Survey (MEPS). Medicaid expenditures allocated 67.2% federal and 32.8% state based on division of Medicaid spending in the 2010 NHEA.
Nursing home	Based on the distribution of nursing home expenditures in the 2010 NHEA. Medicaid expenditures allocated 67.2% federal and 32.8% state based on division of Medicaid spending in the 2010 NHEA.
Drugs/services	Based on the distribution of prescribed drug and other expenditures in the 2010 NHEA. Medicaid expenditures allocated 67.2% federal and 32.8% state based on division of Medicaid spending in the 2010 NHEA.
FAS healthcare	Based on the distribution of overall health care expenditures in the 2010 NHEA. Medicaid expenditures allocated 67.2% federal and 32.8% state based on division of Medicaid spending in the 2010 NHEA.
Prevention and research	Based on observed spending estimates for each level of government
Training	Government share based on 16.7% federal and 16.4% state/local share of Net National Product 2010
Health insurance administration	Calculated the federal and state administrative spending based on the estimated health care spending for each level of government multiplied by an administrative percentage (6.6 percent for federal and 7.9 percent for state and local) calculated from the 2010 NHEA.
Lost Productivity	
Impaired productivity - work	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local). [b]
Impaired productivity - home	No costs to government.
Absenteeism	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).
Impaired productivity - institutional specialty care	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).

Impaired productivity-institutional hospital	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).
Mortality	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).
Incarceration of perpetrators	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).
Crime victim	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).
FAS productivity	Government's lost tax revenue estimated based on each level of government's share of the Net National Product 2010 (16.7% federal and 16.4% state/local).
Other	
Crime victim property damage	No costs to government.
Criminal justice - corrections	Police protection and legal and adjudication costs assigned to state and local government; corrections costs assigned to level of government based on estimated costs for each.
Criminal justice - alcohol related crimes	
Criminal justice - violent and property crimes	
Criminal justice - private legal	Private legal defense costs not assigned to government.
Motor vehicle crashes	No costs allocated to government
Fire losses	Fire protection service costs allocated 100% to state/local government (assumed this share 73.5% remained constant between 2006 and 2010); assumed that 75% of remaining loss paid by private insurance and 25% by heavy drinker and household
FAS special education	Allocated to state/local government as it bears public education responsibility

[a] NHEA 1960 -2011downloaded on March 15, 2013 from http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical.html

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Appendix 3. Allocators to Assign Costs to States

	Total, government, and binge drinking	Underage drinking	Drinking while pregnant	Price adjustment
Health care				
Specialty care for abuse/dependence	N-SSATS[31]	State share N-SSATS patients <18 treated for alcohol problems[32]	N/A	None
Hospitalization	AADs [a]	UAADs [a]	Birth-adjusted binge episodes [b]	None
Ambulatory care	AADs	UAADs	Birth-adjusted binge episodes	None
Nursing home	AADs	UAADs	Birth-adjusted binge episodes	None
Drugs/services	AADs	UAADs	Birth-adjusted binge episodes	None
FAS healthcare	Binge episodes females 18 – 44[33]	State share live births to mothers 15-19 years[34]	Birth-adjusted binge episodes	None
Prevention and research	AADs	UAADs	Birth-adjusted binge episodes	None
Training	AADs	UAADs	N/A	None
Health insurance administration	AADs	UAADs	Birth-adjusted binge episodes	None
Lost Productivity				
Impaired prod. at work	NSDUH Table B17[35]	NSDUH Table B17 Age 12-17 + 3/8*(age 18-25)[36]	N/A	Average hourly wage all occupations[37]
Impaired productivity at home	NSDUH Table B17	NSDUH Table B17 Age 12-17 + 3/8*(age 18-25)	N/A	Average hourly wage **child care workers**[37]
Absenteeism	BRFSS binge episodes[33]	State share binge drinkers aged 12-20 from NSDUH[38]	N/A	Average hourly wage all occupations

Impaired productivity while in specialty care	N-SSATs	State share N-SSATS patients <18 treated for alcohol problems[32]	N/A	Average hourly wage all occupations
Impaired prod. while in hospital	AADs	UAADs	Birth-adjusted binge episodes	Average hourly wage all occupations
Mortality	YPLL*	UAADS	Birth-adjusted binge episodes	Average hourly wage all occupations
Incarceration of perpetrators	State share of total inmates[39]	State share of juveniles in residential placement[40]	N/A	Average hourly **minimum** wage[41]
Crime victims	State share of US arrests violent + property crime[42]	State share 2010 juvenile arrests for violent + property crimes[42]	N/A	Average hourly wage all occupations
FAS productivity	Binge episodes females 18 - 44	State share live births to mothers 15-19	Birth-adjusted binge episodes	Average hourly wage all occupations
Other				
Crime victim property damage	State share of US arrests violent + property crime	State share 2010 annual juvenile arrests for violent + property crimes	N/A	None
CJ: corrections	State share of U.S. correctional costs[43]	State share of juveniles in residential placement	N/A	None
CJ: alcohol related crimes	State share arrests for alcohol crimes[42]	State share 2010 juvenile arrests for alcohol crimes including liquor law violations[42]	N/A	None
CJ: violent and property crimes	State share violent + prop. crime arrests	State share 2010 annual juvenile arrests for violent + property crimes	N/A	None
CJ: private legal	State share arrests for alc + viol + prop crime	State share 2010 juvenile arrests for alcohol + violent + property crimes	N/A	None
Motor vehicle crashes	NHTSA alcohol impaired MV deaths[44]	State share licensed drivers under age 21 years[45]	N/A	None

Fire losses	State share national fire protection service costs[44]	State share national fire protection service costs	N/A	None
FAS special education	Binge episodes females 18 - 44	State share live births to mothers 15-19	Birth-adjusted binge episodes	None

N-SSATS, National Survey on Substance Abuse Treatment Services; AADs, alcohol-attributable deaths; UAAD, underage associated alcohol-attributable deaths; FAS, fetal alcohol syndrome; NSDUH, National Survey on Drug Use and Health; BRFSS, Behavioral Risk Factor Surveillance System; YPLL, years of potential life lost; CJ, criminal justice; NHTSA, National Highway Traffic Safety Administration; MV, motor vehicle.

[a] Estimated by Alcohol-Related Disease Impact (ARDI) software. For binge drinking, acute AADS were used which are restricted to acute causes + .685*the number of abuse and dependence deaths.[2,3] UAADs estimated by state as the sum of alcohol-attributable deaths to those under age 21 except for motor vehicles and homicides + (all AADs from motor vehicle crashes X the proportion of fatal crashes in a state from drivers 15-20 as reported in http://www-fars.nhtsa.dot.gov/States/StatesCrashesAndAllVictims.aspx and http://www-nrd.nhtsa.dot.gov/Pubs/811622.pdf) + (all AADs from homicide X the proportion of homicide arrests by juveniles as reported in http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/tables/10shrtbl03.xls)

[b] Birth adjusted binge episodes was calculated by multiplying the ratio of each state's 2010 live births per 1,000[46] to the U.S. rate of 2010 live births per 1,000[46], and then multiplying this product by the estimated total number of binge drinking episodes in the state for women of childbearing age (18-44 years) from the 2010 Behavioral Risk Factor Surveillance System (BRFSS). State costs for drinking while pregnant were allocated by multiplying the proportion of birth-adjusted binge episodes in a state by the national cost of drinking while pregnant.

Appendix 4. Estimated Costs and Percent of Total Cost for Underage Drinking and Drinking While Pregnant, by State, 2010

	Underage drinking		Drinking while pregnant	
State	**Cost (millions)**	**% of total cost**	**Cost (millions)**	**% of total cost**
U.S.	$24,268.3	9.7%	$5,494.1	2.2%
State median	$350.3	10.0%	$60.4	2.3%
Alabama	$374.1	10.0%	$37.7	1.0%
Alaska	$90.4	10.9%	$20.0	2.4%
Arizona	$528.3	8.9%	$47.7	0.8%
Arkansas	$212.9	10.3%	$20.4	1.0%
California	$3,388.1	9.7%	$729.8	2.1%
Colorado	$502.2	9.9%	$114.3	2.3%
Connecticut	$197.1	6.5%	$84.3	2.8%
Delaware	$85.1	10.6%	$19.0	2.4%
District of Columbia	$41.9	4.6%	$14.2	1.5%
Florida	$1,528.9	10.0%	$221.7	1.4%
Georgia	$732.8	10.6%	$166.4	2.4%
Hawaii	$107.4	11.5%	$28.7	3.1%
Idaho	$150.0	13.2%	$26.0	2.3%
Illinois	$917.7	9.4%	$337.9	3.5%
Indiana	$519.4	11.6%	$94.7	2.1%
Iowa	$255.0	13.2%	$61.6	3.2%
Kansas	$250.2	12.1%	$53.7	2.6%
Kentucky	$301.7	9.4%	$76.0	2.4%
Louisiana	$436.8	11.5%	$83.3	2.2%
Maine	$103.8	11.1%	$20.4	2.2%
Maryland	$453.5	9.1%	$137.8	2.8%
Massachusetts	$375.3	6.7%	$149.5	2.7%
Michigan	$775.2	9.5%	$171.2	2.1%
Minnesota	$390.9	10.1%	$117.3	3.0%
Mississippi	$203.3	8.9%	$29.5	1.3%
Missouri	$516.3	11.2%	$105.5	2.3%
Montana	$94.4	10.8%	$16.5	1.9%
Nebraska	$179.8	15.4%	$55.7	4.8%
Nevada	$218.3	9.5%	$60.4	2.6%
New Hampshire	$78.4	8.2%	$22.5	2.3%
New Jersey	$517.2	8.4%	$146.3	2.4%
New Mexico	$238.4	10.7%	$27.7	1.2%
New York	$1,172.0	7.2%	$390.9	2.4%
North Carolina	$627.4	8.9%	$113.4	1.6%
North Dakota	$67.3	13.8%	$12.3	2.5%
Ohio	$850.5	10.0%	$288.3	3.4%
Oklahoma	$323.1	10.5%	$55.8	1.8%

Oregon	$350.5	10.0%	$113.8	3.2%
Pennsylvania	$1,061.5	11.1%	$185.0	1.9%
Rhode Island	$72.4	8.2%	$18.0	2.0%
South Carolina	$377.8	9.5%	$56.1	1.4%
South Dakota	$104.8	17.5%	$21.7	3.6%
Tennessee	$435.3	9.3%	$22.8	0.5%
Texas	$1,952.3	10.4%	$442.3	2.4%
Utah	$265.7	16.2%	$37.9	2.3%
Vermont	$36.4	7.1%	$16.4	3.2%
Virginia	$571.5	9.3%	$113.3	1.8%
Washington	$561.6	9.7%	$134.0	2.3%
West Virginia	$126.0	9.4%	$15.2	1.1%
Wisconsin	$476.0	10.7%	$145.2	3.3%
Wyoming	$71.7	12.1%	$14.5	2.4%

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Effects of Alcohol Tax and Price Policies on Morbidity and Mortality: A Systematic Review

Alexander C. Wagenaar, PhD, Amy L. Tobler, PhD, and Kelli A. Komro, PhD

Objectives. We systematically reviewed the effects of alcohol taxes and prices on alcohol-related morbidity and mortality to assess their public health impact.

Methods. We searched 12 databases, along with articles' reference lists, for studies providing estimates of the relationship between alcohol taxes and prices and measures of risky behavior or morbidity and mortality, then coded for effect sizes and numerous population and study characteristics. We combined independent estimates in random-effects models to obtain aggregate effect estimates.

Results. We identified 50 articles, containing 340 estimates. Meta-estimates were r=–0.347 for alcohol-related disease and injury outcomes, –0.022 for violence, –0.048 for suicide, –0.112 for traffic crash outcomes, –0.055 for sexually transmitted diseases, –0.022 for other drug use, and –0.014 for crime and other misbehavior measures. All except suicide were statistically significant.

Conclusions. Public policies affecting the price of alcoholic beverages have significant effects on alcohol-related disease and injury rates. Our results suggest that doubling the alcohol tax would reduce alcohol-related mortality by an average of 35%, traffic crash deaths by 11%, sexually transmitted disease by 6%, violence by 2%, and crime by 1.4%. (*Am J Public Health.* 2010;100: 2270–2278. doi:10.2105/AJPH.2009.186007)

Alcohol prices and taxes are rising issues on the agenda of state and local health officials and policymakers because of historically low real alcohol tax rates, political opposition to increased income and property taxes, increasing budget shortfalls, and positive experience with tobacco tax increases. Moreover, the knowledge base on alcohol tax effects is much larger than most health officials and policymakers realize. Over the past several decades, 162 papers have been published that evaluate the effects of alcohol tax and price levels on alcohol sales, drinking, and a range of alcohol-related morbidity and mortality outcomes. We recently presented the cumulative evidence from 112 papers containing 1003 estimates of effects of alcohol taxes and prices on alcohol sales and drinking behaviors; we found statistically significant inverse relationships for all 3 major beverages (beer, wine, and spirits).[1] The major conclusion emerging from those 112 studies was that a 10% increase in alcohol prices resulted in an approximately 5% reduction in drinking.

A large epidemiological literature covering many decades shows drinking to be a risk factor for a wide range of injuries, diseases, and social disruption,[2–4] and considerable consensus has emerged on approximate alcohol-attributable fractions for several leading causes of morbidity and mortality.[5,6] Because the link between alcohol tax and price levels and drinking (including heavy drinking) is so well established, along with the association of individual and population drinking levels with several indicators of morbidity and mortality, we hypothesized an effect of alcohol tax and price levels on morbidity and mortality. Therefore, we systematically reviewed the literature and calculated overall estimates of effect between alcohol tax or price changes and the range of alcohol-related morbidity and mortality outcomes reported in the literature.

METHODS

A doctoral student with expertise in econometric methods conducted a comprehensive search of the published literature in 12 databases: AgEcon Search (1960–2009); Blackwell-Synergy (1879–2009); EBSCO Host, which includes EconLit (1969–2009); Academic Search Premier (1922–2009); Business Source Premier (1922–2009); PsychInfo (1967–2009); JSTOR (1838–2009); MEDLINE (1950–2009); Springer (1992–2009); ScienceDirect (1823–2009); Thomson Reuters ISI Web of Knowledge (1900–2009); and Wiley (1961–2009).

Our search terms for each database were as follows, where * was the truncation indicator to include all forms of the root word: [(tax OR taxes OR taxation OR cost OR cost* OR price OR prices) AND (alcohol* OR drinking OR liquor OR drunk* OR beer OR wine OR spirits OR malt beverage*)]. Any record with any search term in the title, keywords, subject heading, descriptors, or abstract fields was identified. In addition, we located additional relevant studies in the reference lists of the selected articles.

We obtained each article and reviewed it for relevance and content. Studies were excluded from analysis if they were (1) duplicate publications of a single study or data set (most recent was retained); (2) empirical studies that did not provide sufficient data for calculating some form of numeric estimate of effect and estimate of its standard error; (3) commentaries, legal reviews, or literature reviews, or articles that for another reason reported no new data; or (4) not written in English.

Data Classification and Coding

Studies eligible for inclusion in the analyses assessed effects of alcohol prices or taxes on a range of morbidity and mortality outcomes. Much of the literature treats various tax or price indices as alternative measures of the same underlying phenomenon, especially because spatial variability and sudden changes in price over time are largely attributable to differing alcohol excise taxes.

Individual studies identified in our search had considerable variation in quality, specific

measures, research designs, and statistical models. However, all studies were conceptually similar and provided results from some sort of regression equation showing estimated coefficients and standard errors or other statistics that indicate the standard error, such as a *t* ratio or confidence interval. We coded the measure of effect, its standard error, the analysis sample size, and the effect's significance level for each separate estimate.

For studies that reported significance cutoff values (e.g., .05) but not exact values, we (conservatively) assigned the value .05, even though the (unknown) exact value was less than .05. We coded all relevant estimates from each article, including results from multiple subgroups, multiple follow-ups, and multiple statistical models for each subgroup.

Statistical Analyses

We used Comprehensive Meta-analysis 2.0 software[7] to estimate a standardized effect size *r* for each separate estimate of the underlying relationship of interest, calculated from the statistics reported in each study and preprogrammed conversion formulas from the meta-analysis statistical literature. The *r* estimates are interpretable as the standardized slope of the relationship between the independent variable and the outcome variable. We examined heterogeneity of effects and conducted sensitivity and robustness analyses to evaluate the consistency of estimates across study characteristics and risks to the meta-estimates attributable to publication bias and potential nonrepresentativeness of the sample studies.

We combined individual effect sizes in 4 steps to produce a single meta-estimate of effect for each outcome. First, we identified sets of statistically independent estimates (e.g., separate youth and adult samples, separate states) and nonindependent estimates (e.g., multiple estimation models derived from the same population or sample). Intrastudy estimates that were not independent were averaged such that only 1 value contributed to the meta-analysis. We then applied inverse variance–weighting methods to each resulting independent effect size.[8]

Second, we examined effect size distributions for outliers, to determine the need for trimming (i.e., deletion of outliers) or winsorizing (i.e., transformations to reduce effects of outliers). Next, we calculated the weighted mean effect sizes for each subgroup as $\overline{ES} = \Sigma(w_i ES_i)/\Sigma w_i$, where ES_i were the values of the effect size statistic used (here *r*), w_i was the inverse variance weight for each effect size *i*, and *i* was equal to $1 - k$, with *k* being the number of effect estimates. Last, we conducted homogeneity tests within and across subgroups with the *Q* statistic,[9] where a statistically significant *Q* indicated a heterogeneous effect size distribution.[10]

As anticipated, we observed statistically significant study-level heterogeneity and therefore adopted a random-effects model to determine the average meta-estimates of effect and their precision.[8] We constructed confidence intervals (CIs) and tested the significance of each mean effect size, where a 95% CI was $\overline{ES} \pm Z_{(.95)}(SE_{\overline{ES}})$ and the significance of the mean effect size was obtained with a *Z* test as $z = |\overline{ES}|/SE_{\overline{ES}}$.

The calculated standardized effect size *r* was not uniformly derived from reported simple bivariate estimates of the underlying relationship of interest (alcohol price/tax→outcome), because such bivariate correlations were rarely reported. We also did not calculate effects via a multiple regression model with identical model forms and covariates across studies. This procedure is inherent to any literature where a single straightforward uniform research design is not typical (by contrast with meta-analyses of a large set of similarly designed randomized clinical trials). As a result, the statistical theory and accompanying assumptions that underlie the calculation and accumulation of standardized effect sizes were not fully met. Therefore, we also reported alternative, simpler summary statistics, such as the proportion of individual estimates in the hypothesized direction and the proportion that was significant, to provide additional information about the underlying estimates.

We grouped the diverse set of outcome measures reported in the literature into 8 conceptually distinct categories: specific measures of alcohol-related disease or injury, other morbidity and mortality indicators, violence, suicide, traffic crashes and alcohol-related driving measures, sexually transmitted diseases (STDs) and risky sexual behavior, other drug use, and crime and misbehavior indicators. However, any grouping of the estimates and outcomes combined somewhat disparate outcomes and contexts. Therefore, we also calculated the effect size and specific outcome from each study separately. Obviously, differences in estimated effect size from study to study may have been attributable to the specific outcome measures used or local differences in samples and contexts of a given study.

RESULTS

We identified 50 papers containing 340 estimates of the effects of alcohol taxes or prices (Table 1).[11–60] Studies were diverse in the units analyzed (state–country aggregate vs individual-level data), outcome measures, settings, time, statistical models, independent variable measure (alcohol prices or taxes), and population (adults or youths or both). The meta-estimate of effect for all of the studies across all outcomes combined was $r = -0.071$ and was statistically significant ($Z = -12.491$; $P < .001$; Table 2). The inverse variance–weighted partial *r* for the aggregate-level studies was –0.119 ($Z = -8.769$; $P < .001$); for the individual-level studies, –0.029 ($Z = -6.244$; $P < .001$); for studies with alcohol price as the independent variable measure, –0.065 ($Z = -4.866$; $P < .001$); for studies with alcohol tax as a surrogate measure for price, –0.073 ($Z = -11.228$; $P < .001$); for studies of adults, –0.079 ($Z = -9.151$; $P < .001$); and for studies of youths, –0.069 ($Z = -7.659$; $P < .001$).

The first section of Table 2 presents the results from studies that specifically examined effects of alcohol prices or taxes on alcohol-related disease or injury. Eleven articles (reporting 13 statistically independent studies) provided 29 estimates of effect, among which 22 (76%) showed a statistically significant inverse association. At the study level, all 13 studies were in the hypothesized direction and only 2 were not significant.[23,50] The inverse variance–weighted overall *r* for the 13 studies was –0.347 and significant ($Z = -5.430$; $P < .001$).

Two articles examined effects on morbidity and mortality outcomes not specifically alcohol-related, such as all-cause mortality[16] and industrial injury,[40] providing 5 estimates of effect. All 5 estimates showed an inverse association, and 4 were statistically significant. At the study level, both were in the hypothesized direction. The inverse variance–weighted *r* for these 2 studies combined was –0.076 ($Z = -1.942$; $P = .052$).

TABLE 1—Studies in Meta-Analysis of Effects of Alcohol Taxes and Prices on Health and Social Indicators

	Outcome Category	Population	Country	Cross-Sectional Unit	No. Repeated Observations	Data Collection Period
Adrian et al. 2001[11]	Traffic	Adults	Canada	State/province	19	1972–1990
Birckmayer and Hemenway 1999[12]	Suicide	Adults and youths	United States	State/province	21	1970–1990
Chaloupka and Laixuthai 1997[13]	Traffic	Youths	United States	Individual	2	1982–1989
	Traffic	Youths	United States	Individual	1	1989–1989
Chaloupka et al. 1993[14]	Traffic	Adults and youths	United States	State/province	7	1982–1988
Chesson et al. 2000[15]	STDs/risky sex	Adults and youths	United States	State/province	15	1981–1995
Cook et al. 2005[16]	Mortality/morbidity	Adults	United States	State/province	32	1970–2001
Cook and Tauchen 1982[17]	Alcohol-related mortality	Adults	United States	State/province	16	1962–1977
Cuellar et al. 2004[18]	Crime	Youths	United States	Individual	1	1994–1997
Dee 1999[19]	Traffic	Youths	United States	State/province	16	1977–1992
Evans et al. 1991[20]	Traffic	Adults	United States	State/province	12	1975–1986
Grossman and Markowitz 1999[21]	Crime/misbehavior	Youths	United States	Individual	3	1989–1991
	Violence	Youths	United States	Individual	3	1989–1991
Grossman and Markowitz 2005[22]	STDs/risky sex	Youths	United States	Individual	1	1991–1999
Heien and Pompelli 1987[23]	Alcohol-related mortality	Adults	United States	State/province	9	1968–1977
Herttua et al. 2008[24]	Alcohol-related mortality	Adults	Finland	Country	2	2001–2005
Herttua et al. 2008[25]	Crime/misbehavior	Adults	Finland	City	2	2002–2005
	Crime/misbehavior	Adults	Finland	City	4	2002–2005
	Violence	Adults	Finland	City	2	2002–2005
	Violence	Adults	Finland	City	4	2002–2005
Jimenez and Labeaga 1994[26]	Drug use	Adults	Spain	Country	1	1980–1981
Koski et al. 2007[27]	Alcohol-related mortality	Adults	Finland	Country	783	1990–2004
Markowitz 2000[28]	Violence	Adults	United States	Individual	1	1985–1987
	Violence	Adults	United States	Individual	2	1985–1987
Markowitz 2000[29]	Crime/misbehavior	Adults	Multiple	Individual	1	1989–1992
	Violence	Adults	Multiple	Individual	1	1989–1992
Markowitz 2000[30]	Violence	Youths	United States	Individual	1	1991–1995
Markowitz 2005[31]	Crime/misbehavior	Adults	United States	Individual	3	1992–1994
	Violence	Adults	United States	Individual	3	1992–1994
Markowitz et al. 2003[32]	Suicide	Adults and youths	United States	State	24	1976–1999
Markowitz and Grossman 1998[33]	Violence	Adults	United States	Individual	1	1976–1976
Markowitz and Grossman 2000[34]	Violence	Adults	United States	Individual	1	1976–1985
	Violence	Adults	United States	Individual	2	1976–1985
Markowitz et al. 2005[35]	STDs/risky sex	Adults and youths	United States	State	21	1981–2001
	STDs/risky sex	Adults and youths	United States	MSA	20	1982–2001
Mast et al. 1999[36]	Traffic	Adults	United States	State	9	1984–1992
Matthews et al. 2006[37]	Violence	Adults	Great Britain	State/province	10	1995–2000
Mullahy and Sindelar 1994[38]	Traffic	Adults	United States	Individual	1	1988–1988
Nelson and Young 2001[39]	Alcohol-related mortality	Adults	Multiple	Country	19	1977–1995
	Traffic	Adults	Multiple	Country	19	1977–1995
Ohsfeldt and Morrisey 1997[40]	Other morbidity	Adults	United States	State	10	1975–1985
Pacula 1998[41]	Other drug use	Youths	United States	Individual	2	1979–1984
Ponicki et al. 2007[42]	Traffic	Youths	United States	State	27	1975–2001
Ruhm 1995[43]	Traffic	Adults	United States	State	14	1975–1988
Ruhm 1996[44]	Traffic	Adults and youths	United States	State	7	1982–1988
Rush et al. 1986[45]	Alcohol-related mortality	Adults	United States, Canada	State/province	28	1955–1982

Continued

TABLE 1—*Continued*

Saffer 1997[46]	Traffic	Adults and youths	United States	City	16	1986–1989
Saffer and Chaloupka 1989[47]	Traffic	Adults and youths	United States	State	6	1980–1985
Saffer and Grossman 1987[48]	Traffic	Adults and youths	United States	State	7	1975–1981
Saffer and Grossman 1987[49]	Traffic	Adults and youths	United States	State	7	1975–1981
Schweitzer et al. 1983[50]	Alcohol-related mortality	Adults	United States	State	1	1975–1975
Sen 2003[51]	STDs/risky sex	Youths	United States	Individual	4	1985–1996
Skog and Melberg 2006[52]	Alcohol-related mortality	Adults	Denmark	Country	21	1911–1931
Sloan et al. 1994[53]	Alcohol-related mortality	Adults	United States	State	7	1982–1988
	Traffic	Adults	United States	State	7	1982–1988
	Suicide	Adults	United States	State	7	1982–1988
Smart and Mann 1998[54]	Alcohol-related mortality	Adults	Canada	Province	19	1975–1993
	Traffic	Adults	Canada	Province	19	1975–1993
Wagenaar et al. 2009[55]	Alcohol-related mortality	Adults and youths	United States	State	116	1976–2004
Whetten-Goldstein et al. 2000[56]	Traffic	Youths	United States	State	12	1984–1995
Wilkinson 1987[57]	Traffic	Adults	United States	State	5	1976–1980
Yamasaki et al. 2005[58]	Suicide	Adults	Switzerland	Country	30	1965–1994
Young and Bielinska-Kwapisz 2006[59]	Traffic	Adults and youths	United States	State	19	1982–2000
Young and Likens 2000[60]	Traffic	Adults and youths	United States	State	9	1982–1990

Note. MSA=metropolitan statistical area; STD = sexually transmitted disease.

Nine articles examined effects of alcohol taxes or prices on various measures of violence. The 9 articles reported 10 statistically independent studies. These studies provided 70 individual estimates of effect, of which 29 (41%) showed a statistically significant inverse association. At the study level, 6 reported a significant inverse association between alcohol taxes or prices and violence. The inverse variance–weighted effect across the 10 studies was significant, however (r=–0.022; Z=–3.579; P<.001).

Four articles examined effects of alcohol prices or taxes on suicide, providing 12 individual estimates of effect. Among these estimates, 5 (42%) showed a statistically significant inverse association. The inverse variance–weighted effect across the 11 independent estimates was marginally significant (r=–0.048; Z=–1.726; P=.084). Removing 1 outlier[58] increased the statistical significance of the meta-estimate (r=–0.060; Z=–2.356; P=.018).

The fifth section of Table 2 presents results from 21 articles examining effects of alcohol prices or taxes on traffic safety outcomes, with 150 individual estimates of effect. Among all estimates, 86 (57%) showed a statistically significant inverse association. All 34 independent estimates showed an inverse association between alcohol prices or taxes and a traffic outcome, with 23 estimates (68%) statistically significant. The inverse variance–weighted overall partial r for the 34 independent estimates was –0.112, which was significant (Z=–8.069; P<.001). There was 1 outlier,[11] whose removal did not affect the results (r=–0.110; Z=–8.010; P<.001).

Four articles examined the effects of alcohol taxes or prices on rates of STDs and risky sexual behavior. Thirty-seven individual estimates of effect were obtained from these 4 articles, all showing an inverse association, with 28 (76%) statistically significant. All of the 12 independent estimates showed an inverse association with rates of STDs or risky sexual behavior, and 10 (83%) were statistically significant. The inverse variance–weighted effect across the 12 independent estimates was –0.055 (Z=–4.845; P<.001).

Two articles, containing 10 estimates, examined effects of alcohol taxes or prices on other drug use (i.e., tobacco and marijuana).[26,41] All of the individual estimates showed an inverse association, and 6 (60%) were statistically significant. At the study level, both estimates were in the hypothesized direction; however, neither was statistically significant when considered alone. However, the inverse variance–weighted r for these 2 studies combined was –0.022 and was significant (Z=–2.003; P=.045).

The last section of Table 2 presents results from 5 articles on the effect of alcohol prices or taxes on various indicators of crime and misbehavior, providing 27 estimates of effect. Of the 27 estimates, 21 showed an inverse association and 18 were statistically significant. At the study level, 4 showed a significant inverse association, and 1 was in the hypothesized direction but not statistically significant.[25] The inverse variance–weighted overall partial r for the 5 studies was –0.014, which was significant (Z=–2.943; P=.003).

DISCUSSION

The aggregated results from this fairly large set of studies showed clearly that beverage alcohol prices and taxes were significantly and inversely related to all outcome categories examined: alcohol-related morbidity and mortality, violence, traffic crash fatalities and drunk driving, rates of STDs and risky sexual behavior, other drug use, and crime, with the sole exception that the estimated inverse relation with suicide was not statistically significant.

Meta-analyses inherently present average effect sizes, which may not reflect the exact effect in each specific setting; some locations experience larger effects, and others, smaller effects. The magnitude of effects in our analysis

TABLE 2—Studies in Effects of Alcohol Taxes and Prices on Health and Social Indicators

	Outcome Measure	*r* (95% CI)	*Z*	*P*
	Alcohol-related morbidity and mortality			
Cook and Tauchen 1982[17]	Cirrhosis death rate	−0.080 (−0.169, 0.009)	−1.761	.078
Heien and Pompelli 1987[23]	Cirrhosis death rate	−0.003 (−0.101, 0.094)	−0.070	.944
Herttua et al. 2008[24]	Alcohol-related acute and chronic deaths	−0.068 (−0.107, −0.028)	−3.357	.001
Koski et al. 2007[27]	No. of alcohol-related injury deaths	−0.086 (−0.155, −0.016)	−2.405	.016
Nelson and Young 2001[39]	Cirrhosis death rate	−0.183 (−0.287, −0.075)	−3.313	.001
Rush et al. 1986[45]	Cirrhosis death rate (Michigan)	−0.610 (−0.801, −0.307)	−3.545	<.001
Rush et al. 1986[45]	Cirrhosis death rate (Ontario)	−0.950 (−0.977, −0.894)	−9.159	<.001
Schweitzer et al. 1983[50]	Alcoholism morbidity and mortality	−0.133 (−0.446, 0.210)	−0.754	.451
Skog and Melberg 2006[52]	Delirium tremens death rate	−0.931 (−0.972, −0.835)	−7.072	<.001
Sloan et al. 1994[53]	Primary cause death rate	−0.539 (−0.742, −0.246)	−3.358	.001
Smart and Mann 1998[54]	Cirrhosis death rate	−0.467 (−0.760, −0.016)	−2.025	.043
Wagenaar et al. 2009[55]	Alcohol-related mortality (1983 tax change)	−0.240 (−0.404, −0.060)	−2.598	.009
Wagenaar et al. 2009[55]	Alcohol-related mortality (2002 tax change)	−0.208 (−0.376, −0.027)	−2.243	.025
Total		−0.347 (−0.457, −0.228)	−5.430	<.001
	Other morbidity and mortality			
Cook et al. 2005[16]	All-cause mortality	−0.047 (−0.095, 0.002)	−1.889	.059
Ohsfeldt and Morrisey1997[40]	Industrial injury	−0.128 (−0.223, −0.031)	−2.578	.01
Total		−0.076 (−0.152, 0.001)	−1.942	.052
	Violence			
Grossman and Markowitz 1999[21]	Sexual assault	−0.013 (−0.019, −0.006)	−3.730	<.001
Herttua et al. 2008[25]	Assault, rape, domestic arrests	−0.083 (−0.189, 0.024)	−1.520	.128
Markowitz and Grossman 1998[33]	Child abuse	−0.086 (−0.158, −0.012)	−2.294	.022
Markowitz and Grossman 2000[34]	Child abuse (adult female)	−0.067 (−0.122, −0.011)	−2.348	.019
Markowitz and Grossman 2000[34]	Child abuse (adult male)	−0.047 (−0.122, 0.028)	−1.227	.22
Markowitz 2000[28]	Spouse abuse	−0.026 (−0.059, 0.007)	−1.540	.123
Markowitz 2000[29]	Probability of victimization	−0.023 (−0.033, −0.012)	−4.234	<.001
Markowitz 2000[30]	Fights	−0.012 (−0.023, −0.002)	−2.270	.023
Markowitz 2005[31]	Alcohol-related assault	−0.002 (−0.005, 0.001)	−1.027	.304
Matthews et al. 2006[37]	Violence injury rate	−0.175 (−0.252, −0.097)	−4.329	<.001
Total		−0.022 (−0.034, −0.010)	−3.579	<.001
	Suicide			
Birckmayer and Hemenway 1999[12]	Suicide (aged 15–17 y)	0.032 (−0.030, 0.093)	0.999	.318
Birckmayer and Hemenway 1999[12]	Suicide (aged 18–20 y)	0.000 (−0.062, 0.062)	0.007	.994
Birckmayer and Hemenway 1999[12]	Suicide (aged 21–23 y)	0.010 (−0.051, 0.072)	0.333	.739
Markowitz et al. 2003[32]	Suicide (females aged 10–14 y)	−0.007 (−0.063, 0.049)	−0.260	.795
Markowitz et al. 2003[32]	Suicide (males aged 10–14 y)	−0.097 (−0.152, −0.041)	−3.393	.001
Markowitz et al. 2003[32]	Suicide (females aged 15–19 y)	−0.035 (−0.091, 0.021)	−1.219	.223
Markowitz et al. 2003[32]	Suicide (males aged 15–19 y)	−0.168 (−0.222, −0.113)	−5.929	<.001
Markowitz et al. 2003[32]	Suicide (females aged 20–24 y)	−0.049 (−0.104, 0.007)	−1.699	.089
Markowitz et al. 2003[32]	Suicide (males aged 20–24 y)	−0.170 (−0.224, −0.115)	−6.008	<.001
Sloan et al. 1994[53]	Suicide	−0.339 (−0.607, −0.001)	−1.964	.05
Yamasaki et al. 2005[58]	Suicide	0.570 (0.264, 0.772)	3.367	.001
Total		−0.048 (−0.102, 0.007)	−1.726	.084
	Traffic			
Adrian et al. 2001[11]	Alcohol-related driver motor vehicle accident; fatality rate	−0.650 (−0.853, −0.278)	−3.102	.002
Chaloupka et al. 1993[14]	Crash fatality rate (adults)	−0.195 (−0.296, −0.090)	−3.602	<.001

Continued

TABLE 2—*Continued*

Chaloupka et al. 1993[14]	Crash fatality rate (youths)	−0.322 (−0.415, −0.223)	−6.093	<.001
Chaloupka and Laixuthai 1997[13]	Driver motor vehicle accident; fatality rate; probability of motor vehicle accident	0.125 (−0.181, −0.069)	−4.326	<.001
Dee 1999[19]	Driver and total motor vehicle fatality rate	−0.102 (−0.172, −0.032)	−2.836	.005
Evans et al. 1991[20]	Alcohol-related and total motor vehicle fatality rate	−0.127 (−0.205, −0.048)	−3.122	.002
Mast et al. 1999[36]	Driver; total motor vehicle fatality rate	−0.009 (−0.104, 0.085)	−0.194	.846
Mullahy and Sindelar 1994[38]	Probability of drunk driving (adult non-White females)	−0.026 (−0.048, −0.004)	−2.287	.022
Mullahy and Sindelar 1994[38]	Probability of drunk driving (adult non-White males)	−0.027 (−0.051, −0.004)	−2.258	.024
Mullahy and Sindelar 1994[38]	Probability of drunk driving (adult White females)	−0.008 (−0.030, 0.014)	−0.731	.465
Mullahy and Sindelar 1994[38]	Probability of drunk driving (adult White males)	−0.013 (−0.037, 0.011)	−1.084	.278
Nelson and Young 2001[39]	Total motor vehicle fatality rate	−0.066 (−0.174, 0.043)	−1.182	.237
Ponicki et al. 2007[42]	Total motor vehicle fatality rate	−0.065 (−0.119, −0.011)	−2.351	.019
Ruhm 1995[43]	Total motor vehicle fatality rate	−0.205 (−0.278, −0.131)	−5.307	<.001
Ruhm 1996[44]	Total miles motor vehicle fatality rate	−0.132 (−0.235, −0.025)	−2.415	.016
Ruhm 1996[44]	Total motor vehicle fatality rate	−0.161 (−0.263, −0.054)	−2.955	.003
Saffer and Grossman 1987[48]	Total motor vehicle fatality rate (aged 21–24 y)	−0.236 (−0.335, −0.133)	−4.399	<.001
Saffer and Grossman 1987[48]	Total motor vehicle fatality rate (aged 15–17 y)	−0.146 (−0.249, −0.039)	−2.677	.007
Saffer and Grossman 1987[48]	Total motor vehicle fatality rate (aged 18–20 y)	−0.250 (−0.347, −0.146)	−4.651	<.001
Saffer and Grossman 1987[49]	Total motor vehicle fatality rate (aged 21–24 y)	−0.169 (−0.271, −0.063)	−3.110	.002
Saffer and Grossman 1987[49]	Total motor vehicle fatality rate (aged 15–17 y)	−0.183 (−0.284, −0.077)	−3.376	.001
Saffer and Grossman 1987[49]	Total motor vehicle fatality rate (aged 18–20 y)	−0.299 (−0.393, −0.198)	−5.626	<.001
Saffer and Chaloupka 1989[47]	Night driver motor vehicle fatality rate (adults)	−0.195 (−0.304, −0.082)	−3.342	.001
Saffer and Chaloupka 1989[47]	Total motor vehicle fatality rate (adults)	−0.215 (−0.322, −0.101)	−3.678	<.001
Saffer 1997[46]	Night driver motor vehicle fatality rate (aged 15–24 y)	−0.050 (−0.107, 0.006)	−1.748	.080
Saffer 1997[46]	Total motor vehicle fatality rate (aged 15–24 y)	−0.016 (−0.073, 0.040)	−0.560	.575
Sloan et al. 1994[53]	Total motor vehicle fatality rate	−0.436 (−0.675, −0.114)	−2.600	.009
Smart and Mann 1998[54]	Alcohol-related driver; motor vehicle fatality rate	−0.373 (−0.707, 0.098)	−1.568	.117
Whetten-Goldstein et al. 2000[56]	Alcohol-related driver; total; total night motor vehicle fatality rate	−0.011 (−0.091, 0.069)	−0.267	.790
Wilkinson 1987[57]	Total motor vehicle fatality rate	−0.082 (−0.212, 0.050)	−1.216	.224
Young and Likens 2000[60]	Alcohol-related driver; total motor vehicle fatality rate (aged ≥20 y)	−0.023 (−0.121, 0.075)	−0.462	.644
Young and Likens 2000[60]	Alcohol-related driver; total motor vehicle fatality rate (aged 18–20 y)	−0.014 (−0.112, 0.085)	−0.268	.788
Young and Bielinska-Kwapisz 2006[59]	Total motor vehicle fatality rate (adults)	−0.097 (−0.162, −0.031)	−2.860	.004
Young and Bielinska-Kwapisz 2006[59]	Total motor vehicle fatality rate (youths)	−0.065 (−0.131, 0.001)	−1.930	.054
Total		−0.112 (−0.139, −0.085)	−8.069	<.001
	STDs and risky sexual behavior			
Chesson et al. 2000[15]	STD rate (females aged ≥24 y)	−0.102 (−0.180, −0.022)	−2.492	.013
Chesson et al. 2000[15]	STD rate (females aged 20–24 y)	−0.061 (−0.131, 0.010)	−1.686	.092
Chesson et al. 2000[15]	STD rate (males aged ≥24 y)	−0.123 (−0.201, −0.043)	−3.024	.002
Chesson et al. 2000[15]	STD rate (males age 20–24 y)	−0.101 (−0.171, −0.030)	−2.798	.005
Chesson et al. 2000[15]	STD rate (females age 15–19 y)	−0.032 (−0.103, 0.039)	−0.882	.378
Chesson et al. 2000[15]	STD rate (males aged 15–19 y)	−0.133 (−0.202, −0.062)	−3.687	<.001
Grossman and Markowitz 2005[22]	Birth control and condom use (females aged 14–18 y)	−0.014 (−0.032, 0.005)	−1.450	.147
Grossman and Markowitz 2005[22]	Birth control and condom use (males aged 14–18y)	−0.022 (−0.041, −0.003)	−2.306	.021
Markowitz et al. 2005[35]	Gonorrhea rate (males aged 15–19 y)	−0.061 (−0.121, 0.000)	−1.960	.05
Markowitz et al. 2005[35]	Gonorrhea rate (males aged 20–24 y)	−0.061 (−0.121, 0.000)	−1.960	.05
Markowitz et al. 2005[35]	AIDS rate	−0.023 (−0.046, 0.000)	−1.960	.05
Sen 2003[51]	Abortion rate	−0.176 (−0.306,−0.039)	−2.513	.012
Total		−0.055 (−0.078, −0.033)	−4.845	<.001

Continued

TABLE 2—*Continued*

	Other drug use			
Jimenez and Labeaga 1994[26]	Tobacco consumption	−0.022 (−0.048, 0.004)	−1.628	.104
Pacula 1998[41]	Marijuana use	−0.023 (−0.061, 0.015)	−1.168	.243
Total		−0.022 (−0.043, 0.000)	−2.003	.045
	Crime/misbehavior			
Cuellar et al. 2004[18]	Probability of detention	−0.033 (−0.058, −0.008)	−2.576	.01
Grossman and Markowitz 1999[21]	Alcohol-related property damage; arguments; police trouble	−0.015 (−0.021, −0.009)	−5.100	<.001
Herttua et al. 2008[25]	Police detainments; multiple crimes/misbehavior	−0.090 (−0.196, 0.017)	−1.650	.099
Markowitz 2000[29]	Probability of being robbery victim	−0.015 (−0.023, −0.006)	−3.320	.001
Markowitz 2005[31]	Robberies	−0.004 (−0.007, −0.001)	−2.683	.007
Total		−0.014 (−0.023,- 0.005)	−2.943	.003
Total effects (all outcomes combined)		−0.071 (−0.082, −0.060)	−12.491	<.001

Note. CI = confidence interval; STD = sexually transmitted disease. Duplicate citations reflect results from multiple independent samples reported in the same article.

varied considerably across outcomes, with the largest effect size for alcohol-related morbidity and mortality. This variation was not surprising, because the measures of alcohol-related morbidity and mortality largely represented deaths where essentially all cases were known to be specifically attributable to ethanol ingestion (e.g., alcoholic cirrhosis, delirium tremens).

By contrast, outcomes examined in studies reported in other categories all had substantial proportions related to alcohol but also included many individual cases with no alcohol involvement (e.g., overall suicide, STDs, and violence). Substantial measurement error (specifically the lack of good measures of alcohol involvement) is inherent in most of the outcome indicators in this literature; therefore, the consistency of the findings of an inverse relationship between alcohol prices or taxes and the wide range of outcomes reported is noteworthy. The natural consequence of high measurement error is underestimating the magnitude of the relationship (attenuation).[61] Results for violence, suicide, STDs, and crime outcomes were particularly likely to represent substantial underestimates attributable to measurement error, because only 2 of the 38 results included indicators of alcohol involvement, and the epidemiological literature suggests that only about a quarter of those outcomes are caused by alcohol.[5]

More generally, the pattern of results across outcomes (Table 2) showed an expected monotonic relationship between the proportion of the outcome attributable to ethanol ingestion and the magnitude of the relationship between alcohol prices or taxes and the outcome (−0.347 for cirrhosis and similar outcomes, −0.112 for traffic crashes, −0.055 for STDs, −0.022 for violence, −0.048 for suicide, and −0.014 for general crime).

Our findings are consistent with a recent meta-analysis of the literature that found substantial effects of alcohol taxes and prices on alcohol sales and drinking behavior.[1] Together with that systematic review, our results indicate that hundreds of studies over the past 4 decades reveal the basic mechanism of effect: sales and excise taxes are a major determinant of variation in retail prices of alcohol across jurisdictions and across time, price of alcoholic beverages affects sales and drinking patterns, and tax policy–induced changes in drinking are in turn reflected in rates of a range of disease, injury, and other harm indicators.

Limitations

Statistical theory for systematic reviews and meta-analyses relies on assumptions regarding comparability of research designs and analytic approaches in the underlying studies. Although such assumptions are rarely met fully in any meta-analysis, in our case the pool of studies was particularly characterized by methodological diversity, including differences in the structure of the equations used to estimate effects of alcohol taxes or prices on the outcomes of interest. Consistent with this diversity, we found considerable residual study-level variance. We therefore used random-effects models to account for the residual variance in study-level effects associated with these differences.

Although we did not exclude available unpublished studies, we did not systematically search for unpublished literature. It is well known that larger studies that detect statistically significant effects are more likely to be published,[8,62–64] published in English,[8,65] and cited by other authors[64,66]—all of which may contribute to biased meta-estimates.

We assessed these potential biases by 2 methods: failsafe N[67] and Duval and Tweedie's trim and fill.[68] The failsafe N is an estimate of the number of studies with null results that would need to be added to an analysis for the estimated effect to no longer be statistically significant. For our analysis, an additional 178 (purportedly unfound or unpublished) studies with null effects would be required to negate the statistical significance of the overall estimated effect we found. For each outcome category, the number of additional studies needed to negate the significance of effects ranged from 57 (for crime) to 1991 (for traffic outcomes).

Trim and fill uses a funnel plot in a nonparametric, iterative technique for estimating the number of missing studies that might exist in a meta-analysis and the potential effect these missing studies might have on conclusions.[68] This procedure suggested that 28 studies might have been missed in our analysis because of publication and other small-study biases; adjusting our overall random-effects partial *r* meta-estimate for these purported missing studies reduced the estimate from −0.071 to −0.038, which nevertheless remained statistically significant (95% CI=−0.050, −0.027). After we adjusted for publication and small-study bias, our

meta-estimates remained statistically significant for alcohol-related morbidity and mortality (r=−0.347; 95% CI=−0.457, −0.228), violence (r=−0.014; 95% CI=−0.027, −0.001), traffic outcomes (r=−0.067; 95% CI=−0.094, −0.039), STDs (r=−0.027; 95% CI=−0.050, −0.003), and crime (r=−0.011; 95% CI=−0.020, −0.002). The bias-adjusted estimate for suicide was r=−0.048 (95% CI=−0.102, 0.007).

Because we had only 2 studies each in the other morbidity and mortality and other drug use categories, we could not calculate failsafe N and trim-and-fill estimates for those 2 categories. Although small-study and publication biases likely were present, such effects would not negate the overall conclusion of a significant inverse relationship between alcohol taxes and prices and population health outcomes, with the sole exception of suicide, for which the evidence remains insufficient.

Despite methodological limitations, the overwhelming consistency of the evidence in this literature is clear. Excluding suicide, every independent estimate except 1[13] showed an inverse relationship between alcohol taxes and prices and harmful outcomes. Of 11 suicide estimates, 7 were negative and 4 were positive, perhaps suggesting that suicide operates differently as an independent estimate.

Public Health Significance

Our results establish beyond any reasonable doubt that alcohol taxes and prices are inversely associated with population health outcomes. But how significant is this apparent effect to public health? Two approaches can be taken to evaluate the substantive significance of these findings.

Effect sizes for individual-level preventive interventions are frequently reported as Cohen's d (standard mean difference), which is comparable to $2r$, and Cohen's rule of thumb is that d=0.20 is a small effect and d=0.80 is a large effect.[69] In the data we analyzed, the effect on alcohol morbidity and mortality indicators was r=−0.347, analogous to d=−0.70, a large effect, and the effect on traffic crash outcomes was r=−0.112, analogous to d=−0.22, a medium effect. Effects on crime, violence, and STDs, although still statistically significant, were smaller. In the context of individual-level interventions, some of these effects might be deemed as medium-sized effects, but in our analysis they were population-level effects. Modest effects on individuals are substantively larger and more significant when the effects apply across the entire population of drinkers in a region or country.

A second way to assess the public health significance of our findings is to estimate the percentage reduction in these important population health outcomes associated with a given change in alcohol tax. In this calculation, r represents the standardized slope, and a 1-SD change in the independent variable is associated with an r times SD reduction in the dependent variable. We assessed several data sets on alcohol taxes and alcohol-related mortality indicators for the United States and found that SDs (estimated longitudinally over many years or cross-sectionally across the 50 states) are approximately equal to the mean. Therefore, an alternative interpretation of r is that it is the proportionate reduction in morbidity or mortality associated with doubling the alcohol tax. According to the data we analyzed, doubling alcohol taxes would be associated with an average reduction of 35% in alcohol-related mortality, an 11% reduction in traffic crash deaths, a 6% reduction in STDs, a 2% reduction in violence, and a 1.2% reduction in crime.

Conclusions

In most developed countries, alcohol is second only to tobacco as a consumer product that causes death (approximately 85 000 alcohol-related deaths per year in the United States alone[70]); the public health significance of our findings is therefore obvious. Moreover, by contrast to many prevention efforts, the mechanisms for taxing alcoholic beverages are already in place, and the large public health benefits not only accrue without requiring additional fiscal resources, but actually generate additional revenues that can be used for other pressing public health infrastructure and prevention needs. ■

About the Authors

The authors are with the Department of Epidemiology and Health Policy Research and the Institute for Child Health Policy, College of Medicine, University of Florida, Gainesville.

Correspondence should be sent to Alexander C. Wagenaar, Professor, University of Florida, College of Medicine, Department of Epidemiology and Health Policy Research, 1329 SW 16th St, Rm 5130, PO Box 100177, Gainesville, FL 32610-0177 (e-mail: wagenaar@gmail.com). Reprints can be ordered at http://www.ajph.org by clicking the "Reprints/Eprints" link.

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Contributors

A. C. Wagenaar originated, designed, and supervised the study and obtained funding; acquired the data and took responsibility for its integrity; conducted the statistical analysis; and drafted the article and revised it for important intellectual content. A. L. Tobler conducted the statistical analysis and drafted the article. K. A. Komro originated and designed the study and revised the article for important intellectual content. All authors analyzed and interpreted the data.

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Human Participant Protection

No protocol approval was required because no human participants were involved.

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Consumer Costs and Job Impacts from Nebraska Alcohol Tax Increases

Overview

Excessive alcohol use is a leading cause of death, resulting in about 88,000 deaths each year. Excessive drinking cost the U.S. economy $1.90 a drink in 2006. In contrast, the average total federal and state taxes on alcoholic beverages across all beverage types were approximately $0.12 per drink.

The Community Preventive Services Task Force recommends increasing alcohol taxes based on strong evidence that this can reduce excessive alcohol consumption and related harms. Public health effects are expected to be proportional to the size of the tax increase.

However, questions have been raised about the potential impact of alcohol tax increases on employment and on the cost of alcohol to individual drinkers. To help address these concerns, the Centers for Disease Control and Prevention (CDC) funded a research collaborative involving the Johns Hopkins Bloomberg School of Public Health, the University of Florida, the University of Illinois at Chicago, and Boston Medical Center to evaluate how increasing alcohol taxes could affect employment and the amount that consumers would pay for alcoholic beverages based on their self-reported patterns of alcohol consumption. This web tool was developed based on these research findings to model the expected impact of various alcohol tax increase scenarios on these outcomes.

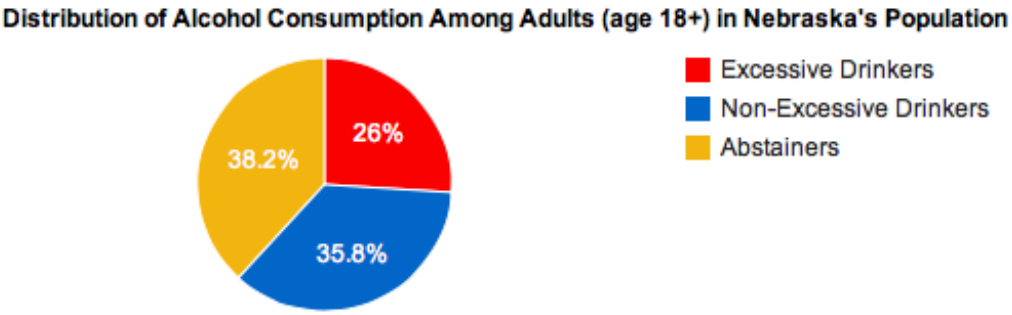
In these web tools, "excessive drinkers" refers to anyone who reported binge drinking (consuming 5 or more drinks on an occasion for men, 4 or more drinks on an occasion for women), heavy drinking (15 or more drinks per week for men, 8 or more drinks per week for women), or underage drinking (any drinking by persons under the age of 21) in the last 30 days. "Non-excessive drinkers" are all drinkers except those who reported binge, heavy or underage drinking.

Alcohol use data come from CDC's 2011 Behavioral Risk Factor Surveillance System survey of adults aged 18 years and older.

This web tool was supported by Contract Number 200-2011-40800 from The Centers for Disease Control and Prevention. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the Centers for Disease Control and Prevention.

Methodology (PDF)

Distribution of Alcohol Consumption Among Adults (age 18+)

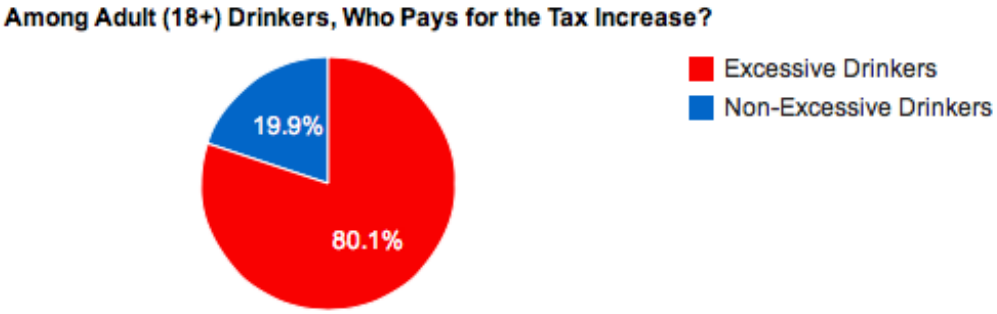


Alcohol Use

Average Additional Cost for Alcohol per Adult (18+) Per Year as a Result of the Tax Increase, by Drinking Category

Tax/Drink	Excessive Drinkers	Non-Excessive Drinkers
$0.05	$12.61	$2.26
$0.10	$23.89	$4.29
$0.25	$49.83	$8.95
Sales Tax		
5%	$18.22	$3.27

Among Adult (18+) Drinkers, Who Pays for the Tax Increase?



Excessive Drinkers	Non-Excessive Drinkers	Abstainers
80.1%	19.9%	0.0%
No matter the tax scenario, these proportions will not change		

- *Excessive drinkers pay most of the tax increase.*
- *Non-drinkers pay nothing.*

Income

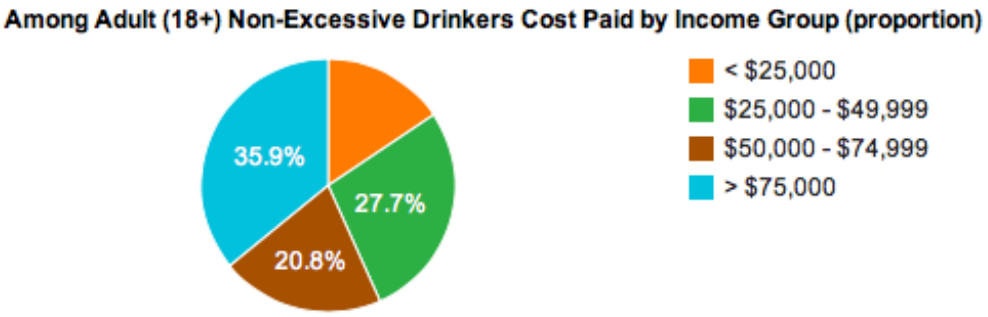
Among Adult (18+) Non-Excessive Drinkers, Average Additional Cost for Alcohol Per Year by Income Group

Tax/Drink	< $25,000	$25,000 - $49,999	$50,000 - $74,999	> $75,000
$0.05	$2.05	$2.23	$2.24	$2.40
$0.10	$3.88	$4.23	$4.25	$4.55
$0.25	$8.10	$8.83	$8.86	$9.48
Sales Tax				
5%	$2.96	$3.23	$3.24	$3.47

Among Adult (18+) Excessive Drinkers, Average Additional Cost for Alcohol Per Adult Per Year by Income Group

Tax/Drink	< $25,000	$25,000 - $49,999	$50,000 - $74,999	> $75,000
$0.05	$12.55	$13.84	$13.10	$11.73
$0.10	$23.78	$26.24	$24.84	$22.24
$0.25	$50.20	$55.36	$52.40	$46.92
Sales Tax				
5%	$18.83	$20.76	$19.65	$17.60

Among Adult (18+) Non-Excessive Drinkers Cost Paid by Income Group (proportion)



< $25,000	$25,000 - $49,999	$50,000 - $74,999	> $75,000
15.6%	27.7%	20.8%	35.9%
No matter the tax scenario, these proportions will not change			

- *Excessive drinkers will pay the majority of any tax increase.*
- *Non-excessive drinkers in the highest household incomes would pay more additional taxes per year on average than non-excessive drinkers in the lowest income groups.*

Employment Status

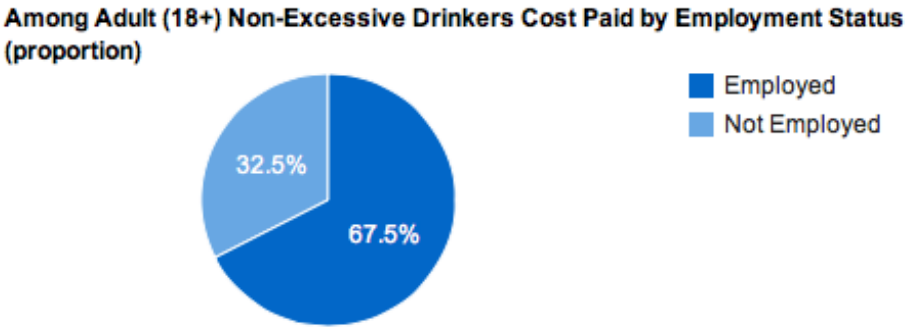
Among Adult (18+) Non-Excessive Drinkers, Average Additional Cost for Alcohol Per Person Per Year by Employment Status

Tax/Drink	Employed	Not Employed
$0.05	$2.22	$2.35
$0.10	$4.21	$4.46
$0.25	$8.78	$9.30
Sales Tax		
5%	$3.21	$3.40

Among Adult (18+) Excessive Drinkers, Average Additional Cost for Alcohol Per Person Per Year by Employment Status

Tax/Drink	Employed	Not Employed
$0.05	$12.65	$12.48
$0.10	$23.99	$23.66
$0.25	$50.60	$49.92
Sales Tax		
5%	$18.98	$18.72

Among Adult (18+) Non-Excessive Drinkers Cost Paid by Employment Status (proportion)



Employed	Not Employed
67.5%	32.5%
No matter the tax scenario, these proportions will not change	

- *Excessive drinkers will pay the majority of any tax increase.*

Effects on Employment

Potential Impact of Alcohol Tax Increases on Jobs

Tax/Drink	General Fund	Healthcare
$0.05	791	257
$0.10	1532	498
$0.25	3523	1149
Sales Tax		
5%	768	214

- *The funds generated by an alcohol tax increase are used to pay for general government services, or specific services, such as healthcare.*
- *The General Fund option above shows the estimated change in the number of jobs if the additional revenue from an alcohol tax increase were used to fund general government services, such as education and law enforcement.*
- *The Healthcare option shows the estimated change in the number of jobs if the additional revenue generated from an alcohol tax increase were used to pay for health care services, including doctors and nurses, prescription drugs, hospital care, and care in nursing homes or other long-term care facilities.*
- *Overall, alcohol tax increases generally result in small increases in employment under either of these options, even after taking into account the potential effect of tax increases on jobs that are specifically related to the production or sale of alcohol.*
- *Larger tax increases will also generally have a greater impact on jobs than smaller tax increases.*