

# Do Beliefs about Alcohol and Cancer Risk Vary by Alcoholic Beverage Type and Heart Disease Risk Beliefs?

Andrew B. Seidenberg<sup>1</sup>, Kara P. Wiseman<sup>2</sup>, and William M.P. Klein<sup>1</sup>



## ABSTRACT

**Background:** Alcohol is a leading risk factor for cancer, yet awareness of the alcohol–cancer link is low. Awareness may be influenced by perceptions of potential health benefits of alcohol consumption or certain alcoholic beverage types. The purpose of this study was to estimate awareness of the alcohol–cancer link by beverage type and to examine the relationship between this awareness and concomitant beliefs about alcohol and heart disease risk.

**Methods:** We analyzed data from the 2020 Health Information National Trends Survey 5 Cycle 4, a nationally representative survey of U.S. adults.

**Results:** Awareness of the alcohol–cancer link was highest for liquor (31.2%), followed by beer (24.9%) and wine (20.3%). More U.S. adults believed wine (10.3%) decreased cancer risk, compared with beer (2.2%) and liquor (1.7%). Most U.S. adults (>50%) reported not

knowing how these beverages affected cancer risk. U.S. adults believing alcoholic beverages increased heart disease risk had higher adjusted predicted probabilities of being aware of the alcohol–cancer link (wine: 58.6%; beer: 52.4%; liquor: 59.4%) compared with those unsure (wine: 6.0%; beer: 8.6%; liquor: 13.2%), or believing alcoholic beverages reduced (wine: 16.2%; beer: 21.6%; liquor: 23.8%) or had no effect on heart disease risk (wine: 10.2%; beer: 12.0%; liquor: 16.9%).

**Conclusions:** Awareness of the alcohol–cancer link was low, varied by beverage type, and was higher among those recognizing that alcohol use increased heart disease risk.

**Impact:** These findings underscore the need to educate U.S. adults about the alcohol–cancer link, including raising awareness that drinking all alcoholic beverage types increases cancer risk.

See related commentary by Hay et al., p. 9

## Introduction

Alcohol consumption is a leading modifiable risk factor for cancer in the United States (1), contributing to an average of more than 75,000 cancer cases and almost 19,000 cancer deaths per year between 2013 and 2016 (2). All beverage types containing ethanol (e.g., wine, beer, liquor) increase cancer risk, and alcohol consumption has been linked to seven cancer types, including cancers of the breast, mouth, and colon (3–5). There is a dose–response relationship between alcohol consumption and cancer risk, such that the more one drinks the greater the risk of developing cancer (4). Even light drinking ( $\leq 12.5$  g ethanol/day) increases risk of some cancers (e.g., esophageal and breast cancers; ref. 6). Multiple carcinogenic pathways linking alcohol and cancer have been identified, which vary by cancer site. For instance, alcohol consumption is associated with increased blood levels of estrogen, which has been implicated in heightened breast cancer risk (7). Furthermore, ethanol is metabolized to acetaldehyde, which damages DNA, increasing risk of head and neck, esophagus, and liver cancers (7).

Despite alcohol's significant contribution to cancer-related morbidity, mortality, and health care costs (1, 8), awareness of the alcohol–cancer link remains low in the United States (9–11). Data from the 2017 Health Information National Trends Survey found that only 38% of U.S. adults were aware of alcohol's carcinogenic risk. Similarly,

analysis of the National Survey of Family Growth (2011–2015) revealed that only 25% of women were aware that alcohol increased the risk of breast cancer (10). In contrast, the same survey found 88% of women were aware that a family history of breast cancer was a risk factor (10). Furthermore, a 2017 survey by the American Institute for Cancer Research found that 93%, 80%, and 39% of U.S. adults were aware that tobacco, asbestos, and alcohol, respectively, increased cancer risk (11). Low awareness of the alcohol–cancer link is not unique to the United States, as recognizing that alcohol is a cancer risk factor has been found to be low in Australia and many European countries (e.g., Greece, Portugal, United Kingdom) as well (12). Moreover, there is some evidence that awareness may be higher for some types of cancer (e.g., liver cancer) and lower for others (e.g., breast cancer; ref. 13).

One factor that may be contributing to low awareness of the alcohol–cancer link is perceptions of potential health benefits of alcohol consumption. Meta-analyses of epidemiologic studies have reported that light to moderate drinkers have a reduced risk of heart disease (14, 15) and ischemic stroke (16), relative to nondrinkers. Despite the fact that these purported protective associations could be due to selection bias and residual confounding (17–19), cardioprotective benefits are not found in studies that control for lifestyle heart disease risk factors (20), and research using mendelian randomization has suggested that alcohol use of all amounts is associated with increased cardiovascular disease risk (21), the “heart health” message is reaching the public. Whitman and colleagues analyzed data from the Health eHeart Study and among participants whom indicated that alcohol was “heart healthy,” 80% reported lay press as a source of this information (22). Furthermore, the same study also reported that two thirds of participants believed that the type of alcohol mattered for heart health, and of these, 92% reported that red wine was exclusively cardioprotective (22).

It is currently not known whether perceptions of potential cardiovascular benefits of alcohol are associated with awareness of the alcohol–cancer link. Moreover, given that wine may be perceived as

<sup>1</sup>Behavioral Research Program, Division of Cancer Control and Population Sciences, National Cancer Institute, Bethesda, Maryland. <sup>2</sup>Department of Public Health Sciences, School of Medicine, University of Virginia, Charlottesville, Virginia.

**Corresponding Author:** William M.P. Klein, 9609 Medical Center Dr, Bethesda, MD 20892. Phone: 240-276-6972; E-mail: kleinwm@mail.nih.gov

Cancer Epidemiol Biomarkers Prev 2023;32:46–53

doi: 10.1158/1055-9965.EPI-22-0420

©2022 American Association for Cancer Research

healthier than other alcoholic beverage types (e.g., beer, liquor; ref. 22), perceptions about the alcohol–cancer link may vary by beverage type. To help advance understanding of U.S. adults' awareness of the alcohol–cancer link and inform future educational campaigns and messaging, we examined awareness of the alcohol–cancer link by beverage type, as well as its association with beliefs about alcohol and heart disease risk using nationally representative survey data.

## Materials and Methods

This study used data from the National Cancer Institute's Health Information National Trends Survey (HINTS) 5 Cycle 4, a nationally representative mailed survey. HINTS used a two-stage sampling design. In stage one, a stratified random sample of addresses was selected, with an oversample of addresses from a stratum containing high minority census tracts. In stage two, a single adult was selected from each chosen household. A detailed description of the HINTS design has been published elsewhere (23, 24). The HINTS 5 Cycle 4 survey was administered February 27 – June 15, 2020 and a total of 3,865 adults participated (response rate = 36.7% using the American Association for Public Opinion Research Response Rate 4 formula; ref. 24).

### Measures

#### Outcome variables

Awareness of the link between alcohol and cancer was measured for three alcoholic beverage types: wine, beer, and liquor. The items asked, "In your opinion, how much does drinking the following types of alcohol affect the risk of getting cancer?" Response options were: decreases risk a lot, decreases risk a little, no effect, increases risk a little, increases risk a lot, and don't know. Responses were coded as increases risk (a little/a lot), no effect, decreases risk (a little/a lot), and don't know.

#### Predictor variables

Awareness of how wine, beer, and liquor affect heart disease risk was measured by asking "In your opinion, how much does drinking the following types of alcohol affect the risk of getting heart disease?" Response options were the same as the cancer items and similarly coded as increases risk (a little, a lot), no effect, decreases risk (a little, a lot), and don't know.

#### Covariates

Other variables included as potential confounders were sociodemographic measures including sex, age, race/ethnicity, education, income perceptions (e.g., "living comfortably" or "finding it difficult" on present income), region, cancer survivorship status, and drinking status. Current drinking status was measured by asking participants three items: (i) "During the past 30 days, how many days per week did you have at least one drink of any alcoholic beverage?"; (ii) "During the past 30 days, on the days when you drank, about how many drinks did you drink on average?"; (iii) "During the past 30 days, how many times did you have [5 or more for males, 4 or more for females] alcoholic drinks on one occasion?" (binge drinking). Nondrinkers were defined as those indicating that they drank on 0 days per week (in past 30 days) and no binge drinking. Participants indicating recent drinking were classified as drinkers or heavier drinkers based on the 2020–2025 Dietary Guidelines for Americans (25). The Guidelines recommend drinking no more than one drink per day (for men and women). Therefore, participants indicating they drank on >0 days per week, drank one drink on average, and did not binge drink were coded as

"drinkers," while those drinking >1 drink on average or binge drinking were coded as "heavier drinkers."

In addition, previous research found that cancer information seeking and cancer fatalism beliefs were associated with awareness of the alcohol–cancer link (9). Therefore, we included a measure of cancer information seeking ("Have you ever looked for information about cancer from any source?"; yes/no) and cancer fatalism ("There's not much you can do to lower your chances of getting cancer"; agree/disagree; ref. 9).

### Analysis

All analyses were performed using Stata v16. Sample weights and 50 jackknife replicate weights were applied to produce weighted estimates and design-adjusted standard errors. In addition, design-corrected Pearson  $\chi^2$  tests with the second-order correction of Rao and Scott were used to assess bivariate relationships of awareness with predictor variables and covariates. Design-corrected Pearson  $\chi^2$  tests with the second-order correction of Rao and Scott were also used to compare the weighted prevalence of awareness by beverage type. For all design-corrected Pearson  $\chi^2$  tests, we dichotomized the responses to the three items measuring awareness of the link between alcohol and cancer (wine, beer, liquor) to "increases risk" versus all other responses.

We estimated three weighted multivariable logistic regression models predicting awareness that wine, beer, and liquor increase cancer risk (vs. all other responses). We then calculated predicted probabilities (and marginal effects) of awareness that each alcoholic beverage increases *cancer* risk by beliefs about how each alcoholic beverage affects heart disease risk. For each of the three models, we included the single item about heart disease risk that matched the beverage type in the dependent variable. For instance, in the model predicting awareness that beer increases cancer risk, we included the item measuring beliefs about how beer affects heart disease risk (and not the items about wine or liquor affecting heart disease risk). All models controlled for the covariates previously mentioned and whether the survey was completed before or during the COVID-19 pandemic (before or after March 11, 2020). Missingness among all variables included in models ranged from 0% to 9.2%, and was highest for Hispanic ethnicity (9.2%), drinking status (8.4%), and race (7.5%). All models used list-wise deletion.

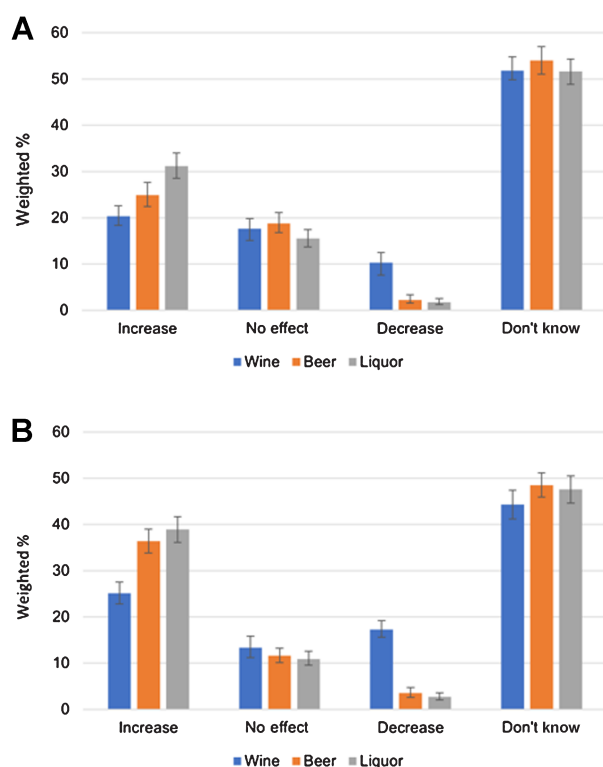
HINTS 5 received an expedited approval from the Westat IRB on March 28, 2016, and was subsequently reviewed by the NIH Office of Human Subjects Research and given a non-human subjects determination via exemption #13204 on April 25, 2016.

### Data availability

The data analyzed from this study are publicly available and can be accessed from the HINTS website: <https://hints.cancer.gov/>. Stata code used for our analyses can be accessed here: <https://osf.io/qshu4/files/osfstorage/635fdbadb233120e8d4313d9>.

## Results

Awareness that alcohol consumption increased cancer risk was low overall and varied by beverage type. Awareness was lowest for wine (20.3%) and highest for liquor (31.2%); about a quarter of U.S. adults were aware that beer (24.9%) increased cancer risk (all differences significant at  $P < 0.001$ ). A greater number of U.S. adults believed that wine (10.3%) decreased cancer risk, compared with beer (2.2%) and liquor (1.7%). The percentages of U.S. adults believing that wine, beer, and liquor had no effect on cancer risk were 17.6%, 18.8%, and 15.5%, respectively. Across all three beverage types, most U.S. adults (>50%)



**Figure 1.** **A**, Weighted proportion of U.S. American adults' beliefs about how wine, beer, and liquor consumption affect cancer risk (error bars = 95% CI). **B**, Weighted proportion of U.S. American adults' beliefs about how wine, beer, and liquor consumption affect heart disease risk (error bars = 95% CI).

indicated they did not know how each beverage affected cancer risk (Fig. 1A).

Beliefs about how alcohol consumption affects heart disease risk followed the same pattern as cancer risk and varied by beverage type (Fig. 1B). Although 38.9% and 36.4% of U.S. adults believed that liquor and beer, respectively, increased heart disease risk, fewer U.S. adults (25.1%) believed that wine increased heart disease risk. In contrast, 17.3% of U.S. adults believed that wine consumption reduced heart disease risk, whereas 3.5% and 2.7% believed that beer and liquor reduced heart disease risk, respectively. A little less than half of U.S. adults did not know how wine (44.3%), beer (48.5%), and liquor (47.6%) affected heart disease risk (Fig. 1B).

Table 1 reports the weighted percentage of U.S. adults aware of the alcohol-cancer link and results from the design-corrected Pearson  $\chi^2$  tests examining bivariate relationships between awareness of the alcohol-cancer link (by beverage type) with socio-demographic characteristics and beliefs about how each beverage affects heart disease risk. Table 2 reports the weighted adjusted odds of awareness of the alcohol-cancer link by beverage type. Across all three beverage types, older adults (ages 40–59 and  $\geq 60$ ) had lower odds of awareness compared to younger adults (ages 18–39). In addition, U.S. adults reporting cancer information seeking from any source had greater odds of awareness of the alcohol-cancer link for beer [aOR = 1.80; 95% confidence interval (CI) = 1.21–2.68] and liquor (aOR = 1.69; 95% CI = 1.12–2.56), but not wine (aOR = 1.43; 95% CI = 0.95, 2.14), compared with U.S. adults reporting no cancer information seeking. Beliefs about how alcohol

affects heart disease risk were also associated with awareness of the alcohol-cancer link (all three beverage types). U.S. adults believing each beverage type had no effect on heart disease risk or decreased heart disease risk, or do not know its effect on heart disease risk, had lower odds of awareness compared with U.S. adults that believed each beverage type increased heart disease risk. Drinking status was not associated with odds of awareness of the alcohol-cancer link ( $P > 0.05$ ) for all beverage types. With one exception, race and ethnicity were not associated with awareness across all three beverage types. While black adults had lower odds (OR = 0.50; 95% CI = 0.25–0.99) of awareness that wine increases cancer risk (relative to white adults), all other relationships between race and ethnicity and awareness across all other products were nonsignificant ( $P > 0.05$ ). In addition, for all three beverage types, awareness of the alcohol link was not associated with ( $P > 0.05$ ) sex, education, census region, cancer fatalism beliefs, cancer survivorship status, or survey return date (before or after the COVID-19 pandemic was declared).

Beliefs about how each beverage type affected heart disease risk were associated with awareness of the alcohol and cancer link, which followed a consistent pattern across all three alcoholic beverages. Awareness was greatest among those believing that each beverage increased heart disease risk (unadjusted range: 53.6%–61.1%). Awareness of the alcohol-cancer link was substantially lower among U.S. adults believing alcohol decreased heart disease risk (unadjusted range: 16.4%–22.2%), had no effect on heart disease risk (unadjusted range: 9.8%–16.0%), or did not know how alcohol affected heart disease risk (unadjusted range: 5.0%–10.7%).

The adjusted predicted probabilities of being aware of the alcohol-cancer link by beliefs about how consuming each beverage type affects heart disease risk is reported in Table 3. Awareness of the alcohol-cancer link was highest among those who believe alcoholic beverages increased heart disease risk (wine: 58.6%; beer: 52.4%; liquor: 59.4%), and were lower among U.S. adults who believed alcoholic beverages decreased heart disease risk (wine: 16.2%; beer: 21.6%; liquor: 23.8%), or had no effect on heart disease risk (wine: 16.9%; or did not know how alcohol affects heart disease risk (wine: 6.0%; beer: 8.6%; liquor: 13.2%).

## Discussion

This is the first study to examine awareness of the alcohol-cancer link by beverage type, as well as the relationship of beliefs about alcohol and heart disease with awareness in a national U.S. sample. We found that awareness of the alcohol-cancer link in the United States was low and varied by beverage type. Awareness was highest for liquor (31.2%) and lowest for wine (20.3%). In addition, we found that beliefs about how alcohol affects heart disease risk were associated with awareness of the alcohol-cancer link, such that U.S. adults believing that alcoholic beverages increased heart disease risk reported higher cancer awareness than U.S. adults who believed alcoholic beverages reduced/had no effect or were unsure of how alcohol affects heart disease risk.

The finding that awareness of the alcohol-cancer link was low is consistent with previous studies. For instance, two previous versions of HINTS found that <40% of U.S. adults were aware that alcohol consumption increased cancer risk (9, 26). In addition, for all three alcoholic beverage types measured in this study, >50% reported that they “don't know” how consuming these beverages affected cancer risk. Interventions are clearly needed to educate the public about the cancer risks associated with alcohol consumption.

**Table 1.** Weighted unadjusted percentage of American adults aware of the alcohol-cancer link by demographic characteristics and beverage type.

Sex	Unweighted n	Aware wine increases cancer risk		Aware beer increases cancer risk		Aware liquor increases cancer risk	
		% (95% CI)	P value <sup>a</sup>	% (95% CI)	P value <sup>a</sup>	% (95% CI)	P value <sup>a</sup>
Male	1,561	20.4 (17.3–24.0)	0.993	25.9 (22.1–30.1)	0.405	33.0 (28.8–37.5)	0.217
Female	2,204	20.4 (17.8–23.3)		24.0 (21.2–27.1)		29.6 (26.3–33.1)	
<b>Age</b>							
18–39	694	26.1 (21.5–31.3)	<0.001	33.1 (27.8–39.0)	<0.001	39.1 (33.2–45.4)	<0.001
40–59	1,192	19.1 (15.9–22.7)		23.2 (19.6–27.2)		30.2 (25.9–34.8)	
≥60	1,852	15.7 (13.4–18.2)		17.8 (15.5–20.4)		23.7 (20.9–26.7)	
<b>Race</b>							
White	2,606	21.5 (19.2–24.0)	0.003	26.2 (23.5–29.1)	0.007	31.4 (28.6–34.5)	0.005
Black	600	12.2 (8.1–17.8)		16.8 (11.9–23.1)		23.5 (18.3–29.8)	
Other	368	27.4 (20.4–35.7)		30.7 (23.7–38.6)		38.8 (31.6–46.5)	
<b>Ethnicity</b>							
Hispanic	596	18.3 (13.3–24.8)	0.313	22.4 (16.6–29.6)	0.280	32.2 (25.0–40.3)	0.968
Non-Hispanic	2,914	21.6 (19.3–24.2)		26.3 (23.5–29.3)		32.0 (29.1–35.2)	
<b>Education</b>							
≤HS/Tech	1,242	15.9 (12.5–20.1)	<0.001	20.0 (16.4–24.2)	0.001	25.7 (21.4–30.5)	0.002
Some college	817	17.8 (14.1–22.3)		23.7 (18.5–29.8)		30.9 (25.4–36.9)	
≥College deg	1,663	29.1 (25.1–33.4)		32.7 (28.3–37.3)		38.8 (34.5–43.2)	
<b>Income feelings</b>							
Living comfortably	1,432	22.2 (18.5–26.4)	0.136	23.6 (19.9–27.7)	0.662	28.3 (24.5–32.4)	0.157
Getting by	1,448	21.7 (18.4–25.4)		25.6 (22.2–29.3)		32.4 (28.4–36.7)	
Finding it difficult <sup>b</sup>	752	16.1 (11.7–21.7)		26.4 (20.3–33.5)		35.0 (28.5–42.0)	
<b>Census region</b>							
Northeast	581	21.3 (16.8–26.6)	0.826	27.4 (22.4–33.2)	0.746	31.0 (24.9–37.8)	0.316
Midwest	645	19.6 (15.3–24.9)		25.0 (19.8–31.2)		28.1 (22.7–34.1)	
South	1,728	19.4 (16.0–23.4)		23.8 (20.0–28.1)		30.2 (26.4–34.2)	
West	911	21.7 (17.5–26.4)		24.7 (20.1–29.9)		35.8 (28.7–43.6)	
<b>Drinking status</b>							
Nondrinker	1,884	19.3 (16.4–22.7)	0.450	25.7 (22.1–29.8)	0.583	31.2 (27.8–34.9)	0.372
Drinker	744	22.1 (17.9–26.9)		27.2 (21.9–33.2)		35.7 (29.7–42.2)	
Heavier drinker	911	21.9 (18.0–26.3)		23.4 (18.9–28.7)		30.4 (25.3–36.0)	
<b>Cancer info seeking</b>							
Yes	1,868	25.1 (21.7–28.8)	<0.001	32.6 (28.4–37.2)	<0.001	38.3 (34.3–42.6)	<0.001
No	1,991	16.4 (13.7–19.5)		18.4 (15.8–21.4)		25.2 (21.8–28.9)	
<b>Cancer fatalism beliefs</b>							
Agree	1,098	13.4 (9.8–18.1)	<0.001	15.8 (12.0–20.6)	<0.001	22.2 (17.2–28.1)	<0.001
Disagree	2,648	23.3 (20.9–25.9)		29.0 (25.8–32.4)		35.3 (32.2–38.6)	
<b>Cancer survivor</b>							
Yes	626	18.9 (14.0–25.0)	0.562	21.5 (17.0–27.0)	0.197	26.3 (21.3–32.1)	0.090
No	3,168	20.6 (18.4–23.0)		25.2 (22.5–28.1)		31.7 (28.8–34.8)	
<b>Survey return date<sup>c</sup></b>							
Before pandemic	1,437	18.3 (14.9–22.4)	0.200	23.0 (19.1–27.4)	0.240	30.9 (26.3–35.9)	0.871
During pandemic	2,428	21.4 (18.9–24.3)		25.9 (22.9–29.2)		31.4 (28.0–34.9)	
<b>Wine and heart disease</b>							
Increases risk	894	56.0 (50.1–61.8)	<0.001				
No effect	502	9.8 (6.5–14.5)					
Decreases risk	597	16.4 (11.3–23.1)					
Don't know	1,703	5.0 (3.3–7.6)					
<b>Beer and heart disease</b>							
Increases risk	1,268			53.6 (48.5–58.6)	<0.001		
No effect	466			9.8 (6.6–14.4)			
Decreases risk	124			21.1 (9.6–40.5)			
Don't know	1,859			7.2 (5.1–10.2)			
<b>Liquor and heart disease</b>							
Increases risk	1,412					61.1 (56.6–65.4)	<0.001
No effect	401					16.0 (10.7–23.2)	
Decreases risk	100					22.2 (9.0–45.1)	
Don't know	1,803					10.7 (7.8–14.6)	

Note: Cancer fatalism was measured by asking participants whether they agree or disagree with the following statement: "There's not much you can do to lower your chances of getting cancer." Drinkers consumed ≤1 drink/day and did not consume ≥4 drinks on a single occasion for women and ≤2 drinks/day and did not consume ≥5 drinks on a single occasion for men. Heavier drinkers consumed >1 drink/day or consumed ≥4 drinks on a single occasion for women and >2 drinks/day or consumed ≥5 drinks on a single occasion for men.

<sup>a</sup>P values from design-corrected Pearson  $\chi^2$  test with 2nd order correction by Rao and Scott.

<sup>b</sup>Finding it difficult or very difficult on present income.

<sup>c</sup>Survey return time stamped before or after the COVID-19 pandemic was declared on March 11, 2020, by the World Health Organization.

Downloaded from <http://aacrjournals.org/cebp/article-pdf/32/1/46/3237508/46.pdf> by guest on 14 April 2024

**Table 2.** Weighted adjusted odds of awareness of the alcohol–cancer link by beverage type.

Sex	Aware wine increases cancer risk		Aware beer increases cancer risk		Aware liquor increases cancer risk	
	aOR (95% CI)	P value	aOR (95% CI)	P value	aOR (95% CI)	P value
Male	1.04 (0.72–1.51)	0.828	1.05 (0.73–1.53)	0.780	0.95 (0.66–1.38)	0.796
Female	Ref	—	Ref	—	Ref	—
<b>Age</b>						
18–39	Ref	—	Ref	—	Ref	—
40–59	0.45 (0.28–0.73)	0.001	0.52 (0.34–0.79)	0.003	0.63 (0.42–0.95)	0.029
≥60	0.41 (0.27–0.63)	<0.001	0.45 (0.31–0.66)	<0.001	0.50 (0.34–0.74)	0.001
<b>Race</b>						
White	Ref	—	Ref	—	Ref	—
Black	0.50 (0.25–0.99)	0.047	0.55 (0.29–1.00)	0.054	0.62 (0.35–1.07)	0.084
Other races	1.46 (0.81–2.60)	0.201	1.04 (0.66–1.63)	0.870	1.45 (0.86–2.45)	0.161
<b>Ethnicity</b>						
Hispanic	0.93 (0.50–1.73)	0.808	0.94 (0.51–1.73)	0.846	1.14 (0.58–2.24)	0.708
Non-Hispanic	Ref	—	Ref	—	Ref	—
<b>Education</b>						
≤HS/Tech	Ref	—	Ref	—	Ref	—
Some college	0.82 (0.48–1.41)	0.474	0.71 (0.41–1.24)	0.220	0.98 (0.54–1.79)	0.949
≥College deg	1.09 (0.63–1.87)	0.763	0.92 (0.58–1.46)	0.708	1.20 (0.77–1.87)	0.422
<b>Income feelings</b>						
Living comfortably	Ref	—	Ref	—	Ref	—
Getting by	0.84 (0.53–1.33)	0.445	1.00 (0.65–1.55)	0.994	1.22 (0.79–1.87)	0.367
Finding it difficult <sup>a</sup>	0.73 (0.42–1.28)	0.263	1.30 (0.76–2.23)	0.328	1.83 (1.10–3.02)	0.020
<b>Census region</b>						
Northeast	Ref	—	Ref	—	Ref	—
Midwest	1.15 (0.72–1.84)	0.563	0.79 (0.55–1.14)	0.195	0.87 (0.55–1.36)	0.527
South	1.18 (0.69–2.02)	0.527	1.00 (0.62–1.62)	1.000	1.16 (0.71–1.90)	0.538
West	1.25 (0.69–2.27)	0.459	0.86 (0.48–1.52)	0.593	1.38 (0.77–2.46)	0.276
<b>Drinking status</b>						
Non-drinker	Ref	—	Ref	—	Ref	—
Drinker	1.36 (0.84–2.22)	0.205	0.95 (0.61–1.48)	0.824	1.27 (0.80–2.02)	0.312
Heavier drinker	0.96 (0.63–1.46)	0.849	0.69 (0.43–1.12)	0.132	0.89 (0.58–1.37)	0.598
<b>Cancer info seeking</b>						
Yes	1.43 (0.95–2.14)	0.086	1.80 (1.21–2.68)	0.004	1.69 (1.12–2.56)	0.014
No	Ref	—	Ref	—	Ref	—
<b>Cancer fatalism beliefs</b>						
Agree	0.85 (0.51–1.41)	0.521	0.74 (0.47–1.18)	0.208	0.75 (0.49–1.17)	0.202
Disagree	Ref	—	Ref	—	Ref	—
<b>Cancer survivor</b>						
Yes	1.29 (0.71–2.34)	0.399	0.97 (0.64–1.47)	0.893	0.89 (0.56–1.42)	0.630
No	Ref	—	Ref	—	Ref	—
<b>Survey return date<sup>b</sup></b>						
Before pandemic	Ref	—	Ref	—	Ref	—
During pandemic	1.41 (0.92–2.16)	0.117	1.35 (0.96–1.91)	0.082	1.16 (0.81–1.66)	0.399
<b>Wine and heart disease</b>						
Increases risk	Ref	—	NI	—	NI	—
No effect	0.07 (0.04–0.11)	<0.001	NI	—	NI	—
Decreases risk	0.12 (0.07–0.21)	<0.001	NI	—	NI	—
Don't know	0.04 (0.02–0.07)	<0.001	NI	—	NI	—
<b>Beer and heart disease</b>						
Increases risk	NI	—	Ref	—	NI	—
No effect	NI	—	0.11 (0.06–0.19)	<0.001	NI	—
Decreases risk	NI	—	0.23 (0.07–0.75)	0.016	NI	—
Don't know	NI	—	0.07 (0.04–0.12)	<0.001	NI	—
<b>Liquor and heart disease</b>						
Increases risk	NI	—	NI	—	Ref	—
No effect	NI	—	NI	—	0.12 (0.07–0.21)	<0.001
Decreases risk	NI	—	NI	—	0.19 (0.04–0.98)	0.048
Don't know	NI	—	NI	—	0.09 (0.06–0.14)	<0.001

Note: NI = Not included in model. Cancer fatalism was measured by asking participants whether they agree or disagree with the following statement: “There’s not much you can do to lower your chances of getting cancer.” Drinkers consumed ≤1 drink/day and did not consume ≥4 drinks on a single occasion for women and ≤2 drinks/day and did not consume ≥5 drinks on a single occasion for men. Heavier drinkers consumed >1 drink/day or consumed ≥4 drinks on a single occasion for women and >2 drinks/day or consumed ≥5 drinks on a single occasion for men.

<sup>a</sup>Finding it difficult or very difficult on present income.

<sup>b</sup>All models adjusted for survey return time stamped before or after the COVID-19 pandemic was declared on March 11, 2020, by the World Health Organization.

**Table 3.** Weighted adjusted predicted probabilities of awareness of the alcohol–cancer link by beverage type.

Wine and heart disease	Adjusted weighted % aware wine increases cancer risk		Beer and heart disease	Adjusted weighted % aware beer increases cancer risk		Liquor and heart disease	Adjusted weighted % aware liquor increases cancer risk	
	Predicted probabilities	P value		Predicted probabilities	P value		Predicted probabilities	P value
Increases risk	58.6 (53.3–63.8)	Ref	Increases risk	52.4 (46.9–57.8)	Ref	Increases risk	59.4 (54.6–64.1)	Ref
No effect	10.2 (6.2–14.2)	<0.001	No effect	12.0 (7.0–17.0)	<0.001	No effect	16.9 (10.3–23.5)	<0.001
Decreases risk	16.2 (9.8–22.6)	<0.001	Decreases risk	21.6 (2.9–40.3)	0.003	Decreases risk	23.8 (0.00–51.6)	0.013
Don't know	6.0 (3.2–8.8)	<0.001	Don't know	8.6 (5.2–11.9)	<0.001	Don't know	13.2 (8.8–17.5)	<0.001

Note: P values from marginal effects examining the difference in predicted probabilities between “increases risk” response with “no effect”, “decreases risk”, and “don't know” responses. All models controlled for sex, age, race/ethnicity, education, income perceptions, region, cancer survivorship status, drinking status, cancer information seeking, cancer fatalism, and survey return time stamped before or after the COVID-19 pandemic was declared on March 11, 2020, by the World Health Organization.

Although all beverage types containing ethanol increase cancer risk, this study found that fewer U.S. adults were aware that wine increases cancer risk (20.3%) compared with beer (24.9%) and liquor (31.2%). In addition, this study found that 10.3% of U.S. adults believed that wine consumption actually reduced cancer risk, compared with only to 2.2% and 1.7% for beer and liquor, respectively. These findings suggest that future educational interventions may need to underscore that all alcoholic beverage types increase cancer risk given that all have ethanol as a common ingredient. Research is also needed to determine whether different messaging strategies are needed to increase awareness among individuals who “don't know” how alcohol affects cancer risk versus those who believe alcohol has no effect or reduces cancer risk.

Despite public media attention to the purported heart health benefits of wine consumption (22), between 44.3% and 48.5% of U.S. adults were not sure how the three beverage types (including wine) affect heart disease risk. Fewer U.S. adults believed that drinking wine (17.3%), beer (3.5%), and liquor (2.7%) reduced heart disease risk. Nonetheless, this study found that beliefs about alcohol and heart disease were associated with awareness that alcohol consumption increased cancer risk. In particular, awareness was highest among those believing alcohol increased heart disease risk relative to those believing alcohol had no effect or decreased heart disease risk, or do not know how alcohol affects heart disease risk. Although the impact of alcohol consumption on heart disease risk is complex and controversial, U.S. adults believing that alcohol reduces/has no effect or are unsure of how alcohol affects heart disease reported very low awareness of the alcohol–cancer link and might be targeted with educational interventions.

In adjusted models, age was associated with awareness of the alcohol–cancer link, with young adults (ages 18–39) having greater odds of awareness than older adults. This finding held across all three alcoholic beverage types. However, awareness among young adults was still low (<40%). Young adults have higher rates of binge drinking than older adults, which could affect cancer risk (27). While educational interventions are needed for all age groups, targeted messaging for different age demographics may be needed given age-related differences in drinking behaviors, norms, and social pressure.

This study found no association between drinking status and awareness of the alcohol–cancer link (for all three beverage types), which is consistent with previous studies. For instance, Buykx and colleagues measured alcohol use using the Alcohol Use Disorders Test short form (AUDIT-C) and found no relationship between AUDIT-C score (<5 vs. 5+) and awareness of the alcohol–cancer link among adults in England (28). Thomsen and colleagues surveyed Danish

adults and reported that odds of being aware that alcohol increased cancer risk were similar across different levels of alcohol consumption (29). Moreover, an earlier version of HINTS (2019) found no association between self-reported alcohol consumption and awareness of the alcohol–cancer link (26). Thus, it appears that current drinking level might not be a good indicator of awareness of alcohol's role in cancer risk. Given that nondrinking behaviors may be temporary, former drinkers (i.e., current nondrinkers) may be at risk for an alcohol-related cancer, and drinking behaviors may be influenced by the attitudes and knowledge of close friends and family, educating nondrinkers (in addition to drinkers) about the alcohol–cancer link may help reduce the burden of alcohol-related cancers.

Mass media campaigns have been used outside the United States to increase awareness of the alcohol–cancer link. For instance, Martin and colleagues evaluated a television campaign in England and found that awareness increased postcampaign (45%) versus precampaign (33%; ref. 30). A separate study found that a television and print media campaign increased odds of awareness among Western Australian women (31). Similar campaigns could be initiated in the United States to help increase awareness of the carcinogenic effects of alcohol. In addition, although clinicians are viewed as the most trustworthy source of health information, a recent analysis of national survey data found that less than half of U.S. adults report a medical provider discussing the harms of alcohol use with them in the past year (32, 33). Clinician discussions could be an effective way to increase awareness, as the same study found clinician discussions about the harms of alcohol were associated with greater odds of being aware of the alcohol–cancer link (33).

In the United States, alcoholic beverages are required to feature warnings about the dangers for pregnant women consuming alcohol and how alcohol consumption “impairs your ability to drive a car or operate machinery, and may cause health problems.” At the present time, no specific “health problems” are stated. Adding cancer warning labels to alcoholic beverages could also be used to increase awareness of the alcohol–cancer link, as recommended by several public health groups in a recent petition (34). Moreover, a separate analysis of the same 2020 HINTS data found that 65% of U.S. adults support adding health warnings to alcohol containers (35). In addition to increasing awareness, adding cancer warning labels may also reduce alcohol use. For instance, using an interrupted time-series design, researchers evaluated the impact of adding cancer risk warnings and drinking guidelines to alcoholic beverages sold in a sample of stores in Yukon, Canada, and found that the labels reduced alcohol sales (36).

Increasing awareness of the link between alcohol and cancer may also increase public support for alcohol control policies. Studies from

Downloaded from <http://aacrjournals.org/cebip/article-pdf/32/1/46/3237508/46.pdf> by guest on 14 April 2024

the United States, Australia, England, Canada, and Denmark have all found awareness of the alcohol–cancer link to be associated with increased support for a variety of alcohol policies, including adding warning labels, restricting advertising, and pricing policies (35, 37–40). Therefore, educating the public about the cancer risks of alcohol may also help expedite alcohol policy adoption and implementation.

Strengths of the current study include the use of a large, diverse, national probability sample, and measurement of awareness of the alcohol–cancer link by beverage type. Measurement of awareness also included a “don’t know” option, which yielded a more nuanced picture of lack of awareness. One limitation was the use of unconditional measures regarding awareness of the alcohol–cancer link and beliefs about how alcohol affects heart disease risk (i.e., quantity of alcohol consumed and length of drinking were not specified). In addition, these measures did not ask about how alcohol consumption affected risk of specific cancer types, which could have created confusion given that alcohol consumption is linked to some but not all cancer types. This study found an association between beliefs about how alcohol affects heart disease risk with awareness of the alcohol–cancer link. However, the cross-sectional design prevents assessment of temporality of this association. Another limitation is that some data collection occurred during the COVID-19 pandemic, which may have affected study participation and survey responses. Notably, adjusted analyses did control for whether the survey was returned before or during the pandemic.

Alcohol use is a leading modifiable risk factor for cancer in the United States, yet awareness that alcohol consumption increases cancer risk remains low (1, 9, 26). This study’s findings underscore the need to develop interventions for educating the public about the

cancer risks of alcohol use, particularly in the prevailing context of national dialog about the purported heart health benefits of wine. Educating the public about how alcohol increases cancer risk will not only empower consumers to make more informed decisions, but may also prevent and reduce excessive alcohol use, as well as cancer morbidity and mortality.

### Authors’ Disclosures

No disclosures were reported.

### Authors’ Contributions

**A.B. Seidenberg:** Conceptualization, formal analysis, writing–original draft. **K.P. Wiseman:** Writing–review and editing. **W.M. Klein:** Writing–review and editing.

### Acknowledgments

K.P. Wiseman is an iTHRIV Scholar. The iTHRIV Scholars Program is supported in part by the National Center for Advancing Translational Sciences of the National Institutes of Health under Award Numbers UL1TR003015 and KL2TR003016. Opinions expressed by the authors are their own and this material should not be interpreted as representing the official viewpoint of the U.S. Department of Health and Human Services, the National Institutes of Health, or the National Cancer Institute.

The publication costs of this article were defrayed in part by the payment of publication fees. Therefore, and solely to indicate this fact, this article is hereby marked “advertisement” in accordance with 18 USC section 1734.

Received April 14, 2022; revised July 18, 2022; accepted September 21, 2022; published first December 1, 2022.

### References

- Islami F, Goding Sauer A, Miller KD, Siegel RL, Fedewa SA, Jacobs EJ, et al. Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States. *CA Cancer J Clin* 2018;68:31–54.
- Goding Sauer A, Fedewa SA, Bandi P, Minihan AK, Stoklosa M, Drope J, et al. Proportion of cancer cases and deaths attributable to alcohol consumption by US state, 2013–2016. *Cancer Epidemiol* 2021;71:101893.
- International Agency for Research on Cancer. World Cancer Report 2014. Accessed December 4, 2021. Available from: <https://publications.iarc.fr/Non-Series-Publications/World-Cancer-Reports/World-Cancer-Report-2014>.
- Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, et al. Alcohol consumption and site-specific cancer risk: a comprehensive dose-response meta-analysis. *Br J Cancer* 2015;112:580–93.
- World Cancer Research Fund/American Institute for Cancer Research. Continuous Update Project. Alcoholic Drinks. Accessed December 4, 2021. Available from: [wcrf.org/dietandcancer/alcoholic-drinks/](http://wcrf.org/dietandcancer/alcoholic-drinks/).
- Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, et al. Light alcohol drinking and cancer: a meta-analysis. *Ann Oncol* 2013;24:301–8.
- Boffetta P, Hashibe M. Alcohol and cancer. *Lancet Oncol* 2006;7:149–56.
- Han M, Tran BT, Cho H, Oh JK. Economic burden of alcohol-related cancers in the Republic of Korea. *Drug Alcohol Depend* 2020;217:108295.
- Wiseman KP, Klein WMP. Evaluating Correlates of Awareness of the Association between drinking too much alcohol and cancer risk in the United States. *Cancer Epidemiol Biomarkers Prev* 2019;28:1195–201.
- Khushalani JS, Qin J, Ekwueme DU, White A. Awareness of breast cancer risk related to a positive family history and alcohol consumption among women aged 15–44 years in United States. *Prev Med Rep* 2020;17:101029.
- American Institute for Cancer Research. 2017 AICR Cancer Risk Awareness Survey Report. Accessed December 4, 2021. Available from: [https://www.aicr.org/assets/docs/pdf/reports/AICR%20Cancer%20Awareness%20Report%202017\\_jan17%202017.pdf](https://www.aicr.org/assets/docs/pdf/reports/AICR%20Cancer%20Awareness%20Report%202017_jan17%202017.pdf).
- Scheidele JK, Klein WMP. Awareness of the link between alcohol consumption and cancer across the world: a review. *Cancer Epidemiol Biomarkers Prev* 2018;27:429–37.
- Calvert CM, Toomey T, Jones-Webb R. Are people aware of the link between alcohol and different types of cancer? *BMC Public Health* 2021;21:734.
- Ronksley PE, Brien SE, Turner BJ, Mukamal KJ, Ghali WA. Association of alcohol consumption with selected cardiovascular disease outcomes: a systematic review and meta-analysis. *BMJ* 2011;342:d671.
- Roerecke M, Rehm J. The cardioprotective association of average alcohol consumption and ischaemic heart disease: a systematic review and meta-analysis. *Addiction* 2012;107:1246–60.
- Larsson SC, Wallin A, Wolk A, Markus HS. Differing association of alcohol consumption with different stroke types: a systematic review and meta-analysis. *BMC Med* 2016;14:178.
- Naimi TS, Stockwell T, Zhao J, Xuan Z, Dangardt F, Saitz R, et al. Selection biases in observational studies affect associations between ‘moderate’ alcohol consumption and mortality. *Addiction* 2017;112:207–14.
- Hansel B, Kontush A, Bruckert E. Is a cardioprotective action of alcohol a myth? *Curr Opin Cardiol* 2012;27:550–5.
- Hansel B, Thomas F, Pannier B, Bean K, Kontush A, Chapman MJ, et al. Relationship between alcohol intake, health and social status and cardiovascular risk factors in the Urban Paris-Ile-de-France Cohort: is the cardioprotective action of alcohol a myth? *Eur J Clin Nutr* 2010;64:561–8.
- Zhao J, Stockwell T, Roemer A, Naimi T, Chikritzhs T. Alcohol consumption and mortality from coronary heart disease: an updated meta-analysis of cohort studies. *J Stud Alcohol Drugs* 2017;78:375–86.
- Biddinger KJ, Emdin CA, Haas ME, Wang M, Hindy G, Ellinor PT, et al. Association of habitual alcohol intake with risk of cardiovascular disease. *JAMA Netw Open* 2022;5:e223849.
- Whitman IR, Pletcher MJ, Vittinghoff E, Imburgia KE, Maguire C, Bettencourt L, et al. Perceptions, information sources, and behavior regarding alcohol and heart health. *Am J Cardiol* 2015;116:642–6.

23. Nelson DE, Kreps GL, Hesse BW, Croyle RT, Willis G, Arora NK, et al. The Health Information National Trends Survey (HINTS): development, design, and dissemination. *J Health Commun* 2004;9:443–60.
24. National Cancer Institute. Health Information National Trends Survey 5 (HINTS 5) Cycle 4 Methodology Report. Accessed December 4, 2021. Available from: [https://hints.cancer.gov/docs/methodologyreports/HINTS5\\_Cycle4\\_MethodologyReport.pdf](https://hints.cancer.gov/docs/methodologyreports/HINTS5_Cycle4_MethodologyReport.pdf).
25. U.S. Department of Agriculture and U.S. Department of Health and Human Services. Dietary Guidelines for Americans, 2020–2025. Updated December 2020. Accessed December 4, 2021. Available from: [https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary\\_Guidelines\\_for\\_Americans\\_2020-2025.pdf](https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf).
26. Kiviniemi MT, Orom H, Hay JL, Waters EA. Limitations in American adults' awareness of and beliefs about alcohol as a risk factor for cancer. *Prev Med Rep* 2021;23:101433.
27. Bohm MK, Liu Y, Esser MB, Mesnick JB, Lu H, Pan Y, et al. Binge drinking among adults, by select characteristics and state - United States, 2018. *MMWR Morb Mortal Wkly Rep* 2021;70:1441–6.
28. Buykx P, Li J, Gavens L, Hooper L, Lovatt M, Gomes de Matos E, et al. Public awareness of the link between alcohol and cancer in England in 2015: a population-based survey. *BMC Public Health* 2016;16:1194.
29. Thomsen KL, Christensen ASP, Meyer MKH. Awareness of alcohol as a risk factor for cancer: a population-based cross-sectional study among 3000 Danish men and women. *Prev Med Rep* 2020;19:101156.
30. Martin N, Buykx P, Shevills C, Sullivan C, Clark L, Newbury-Birch D. Population level effects of a mass media alcohol and breast cancer campaign: a cross-sectional pre-intervention and post-intervention evaluation. *Alcohol Alcohol* 2018;53:31–38.
31. Dixon HG, Pratt IS, Scully ML, Miller JR, Patterson C, Hood R, et al. Using a mass media campaign to raise women's awareness of the link between alcohol and cancer: cross-sectional pre-intervention and post-intervention evaluation surveys. *BMJ open* 2015;5:e006511.
32. Jackson DN, Peterson EB, Blake KD, Coa K, Chou WS. Americans' trust in health information sources: trends and sociodemographic predictors. *Am J Health Promot* 2019;33:1187–93.
33. Wiseman KP, Seidenberg AB, Klein WMP. Clinician role in patient awareness regarding carcinogenic nature of alcohol consumption in the US: a Nationally Representative Survey. *J Gen Intern Med* 2022;37:2116–9.
34. Petition for a Report to Congress Supporting a Label on Alcoholic Beverages Warning the Public that Consumption Can Cause Cancer, Including Breast and Colon Cancers. Accessed December 4, 2021. Available from: <https://consumerfed.org/wp-content/uploads/2020/10/Citizen-petition-re-alcohol-cancer-warning.pdf>.
35. Seidenberg AB, Wiseman KP, Eck RH, Blake KD, Platter HN, Klein WMP. Awareness of alcohol as a carcinogen and support for alcohol control policies. *Am J Prev Med* 2021;62:174–82.
36. Zhao J, Stockwell T, Vallance K, Hobin E. The Effects of alcohol warning labels on population alcohol consumption: An interrupted time series analysis of alcohol sales in Yukon, Canada. *J Stud Alcohol Drugs* 2020;81:225–37.
37. Buykx P, Gilligan C, Ward B, Kippen R, Chapman K. Public support for alcohol policies associated with knowledge of cancer risk. *Int J Drug Policy* 2015;26:371–9.
38. Bates S, Holmes J, Gavens L, de Matos EG, Li J, Ward B, et al. Awareness of alcohol as a risk factor for cancer is associated with public support for alcohol policies. *BMC Public Health* 2018;18:688.
39. Weerasinghe A, Schoueri-Mychasiw N, Vallance K, Stockwell T, Hammond D, McGavock J, et al. Improving knowledge that alcohol can cause cancer is associated with consumer support for alcohol policies: findings from a real-world alcohol labelling study. *Int J Environ Res Public Health* 2020;17:398.
40. Christensen ASP, Meyer MKH, Dalum P, Krarup AF. Can a mass media campaign raise awareness of alcohol as a risk factor for cancer and public support for alcohol related policies? *Prev Med* 2019;126:105722.