

# Evaluating Correlates of Awareness of the Association between Drinking Too Much Alcohol and Cancer Risk in the United States

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## Abstract

**Background:** Awareness that alcohol consumption is associated with cancer is low in the United States, and predictors of awareness are not well understood.

**Methods:** Data from the 2017 Health Information National Trends Survey (HINTS 5 Cycle 1) were used to describe knowledge of the association between drinking too much alcohol and cancer ("Yes," aware of the association; "No"; or "Don't know") among 3,009 adults. Weighted multinomial multivariable logistic regression determined personal characteristics (e.g., demographic characteristics, health-related self-efficacy, cancer beliefs, and information seeking) associated with reporting "Yes" or "Don't know" compared with "No."

**Results:** Thirty-eight percent of the U.S. population believed there was an association (38.36%), 36.17% were uncertain, and 25.47% believed there was no association. People believing that everything causes cancer and people who had ever

looked up information about cancer had 1.61 and 1.80 higher odds of reporting "Yes" [95% confidence intervals (CI), 1.08–2.42 and 1.27–2.57, respectively]. Compared with people who were completely confident in their ability to take care of their health, people only somewhat confident had 2.32 higher odds of reporting "Don't know" (95% CI, 1.30–4.14). Younger age was negatively associated with reporting "Don't know."

**Conclusions:** Awareness of the association between alcohol and cancer is low in the United States. Personal characteristics associated with awareness differed between reporting "Yes" and "Don't know," and there were few associations between demographic characteristics and awareness.

**Impact:** A significant knowledge gap exists in the population. Broad reaching public health media campaigns, particularly those that increase information seeking, are needed to increase awareness.

## Introduction

Alcohol consumption is an important precursor of illness, accounting for 4.6% of injury and disease globally (1). Further, the prevalence of alcohol use, including high-risk drinking, has increased significantly in the United States since 2002, with particularly sharp increases among women, racial/ethnic minorities, and people with lower income or educational attainment (2).

For example, the prevalence of alcohol use increased 15.8% for women compared with 6.8% for men between 2001 to 2002 and 2012 to 2013. Similarly, compared with an 8.3% increase in alcohol use for non-Hispanic white adults, use has increased 24.2% for black adults, 29.1% for Asian adults, and 17.2% for Hispanic adults (2). Consumption also varies by employment status, with unemployed adults showing an increase in the amount of alcohol consumed daily (3).

Alcohol has been shown to increase the risk of seven types of cancer, including liver, colorectal, and breast cancer (4–7). Oral and esophageal cancers have the strongest association with alcohol use, and some associations vary by sex (6). Although there is

evidence of a dose–response relationship between alcohol intake and cancer risk (6), for some cancers, the risk is increased even with low (up to one drink per day) levels of consumption (8). Knowledge of this association is not new, as alcohol has been listed as a Group 1 carcinogen by the International Agency for Research on Cancer since 1988 (9).

Nevertheless, public awareness that alcohol consumption is associated with cancer is inadequately understood. A recent systematic review identified only 31 studies worldwide published between 1991 and 2017 that investigated people's awareness of this association, many in small or convenience samples rather than national samples (10). The majority of the research on awareness has occurred internationally, particularly in Europe and Australia (10). There has been considerably less research on this topic in the United States, and the limited data suggest that awareness of alcohol as a risk factor for cancer is low and has had little improvement over time (11–19). The earliest assessment of alcohol as a risk factor for cancer in a U.S. representative sample occurred in 2003, using an open-ended question in the first administration of the Health Information National Trends Survey (HINTS 1). At that time, 11.3% of the population listed avoiding or reducing alcohol as a strategy to prevent cancer (12). Population-based assessments of alcohol as a risk factor for cancer using a prompted question have occurred periodically starting in 2001 by the American Institute for Cancer Research (AICR). Data from these surveys (spanning 2001–2017) have shown large variation in awareness, ranging from 33% (2005) to 46% (2009) of Americans reporting that alcohol has a significant effect on whether or not the average person develops cancer (20).

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Previous research has identified age, sex, education, personal and family cancer history, smoking status, and alcohol consumption as personal characteristics associated with awareness of the risk of cancer from drinking alcohol (16, 17, 21–26). In the United States specifically, previous research has considered smoking status (16) and personal or family history of cancer (22). It is necessary to investigate if awareness differs by population characteristics, particularly as some of the largest increases in consumption in the United States has been among specific groups, such as women and people with lower education and income.

More pertinent to this study, other important personal characteristics remain understudied. For example, cognitive and attitudinal constructs such as health self-efficacy and beliefs about cancer have been used to explain health behaviors and are associated with health awareness in other settings (27, 28). For example, previous research has shown that awareness of colorectal cancer screening is less likely among people with higher levels of worry about cancer, cancer fatalism (e.g., believing there is little you can do to prevent cancer), and cause ambiguity (e.g., believing everything causes cancer; ref. 27), but these factors have not been investigated for awareness of alcohol as a risk factor for cancer. It is also possible that endorsement of cancer fatalism and cause ambiguity could lead someone to endorse any potential risk factor as one for cancer.

Awareness of cancer risk factors can be increased through education; thus, it could be that people who engage in information seeking about cancer have greater awareness of cancer risk factors (29). Alternatively, previous research suggests that people who believe a health risk is unavoidable or unchangeable and people with low self-efficacy in addressing health topics might avoid cancer information (30–32), which could in turn reduce awareness of cancer risk factors. Importantly, health behavior and communication theories posit that attitudes and beliefs can be altered by information seeking (29); therefore, the independent association of information seeking and beliefs with awareness of alcohol as a risk factor for cancer needs to be considered. For example, fatalistic beliefs about cancer could lead someone to endorse potential risk factors for cancer but could also reduce information-seeking related to cancer, which might reduce awareness of cancer risk factors (30, 33).

Awareness of cancer prevention behaviors and intention to change behavior can be increased successfully using mass-media campaigns (34, 35). To consider implementation of a mass-media campaign, it is necessary that we identify potential communication strategies driven by beliefs and information seeking among groups most in need of educational intervention. Therefore, the objectives of this study were to (i) describe level of awareness of the association between alcohol and cancer in a U.S. representative sample and (ii) identify personal characteristics (demographic characteristics, cancer beliefs, and information seeking) associated with awareness.

## Materials and Methods

### Data and study population

Data came from the NCI's HINTS 5, Cycle 1. Details on the sample can be found elsewhere (36). HINTS 5 Cycle 1 was a mailed household survey conducted in 2017, which used probability-based sampling of addresses with stratification by the concentration of minority residents at the census tract level to result in a nationally representative sample. The overall response

rate was 32.4%. Of the 3,285 adults completing the survey, data from 3,009 adults are reported here from analyses conducted in 2017 to 2018 (276 omitted due to missing data on the key question about alcohol and cancer).

### Measures

The outcome of interest was awareness of the association between alcohol and cancer (hereafter referred to as "awareness"). Participants were asked, "Which of the following health conditions do you think can result from drinking too much alcohol?" and were provided a list of health conditions: cancer, heart disease, diabetes, high cholesterol, liver disease, and being overweight or obese. For each condition, response options were, "Yes," "No," or "Don't know." Only responses to the cancer item are reported here. Responses of "Yes" were coded as believing that there is an association between alcohol and cancer and "No" responses were coded as not believing that there is an association between drinking too much alcohol and cancer. Based on previous literature that has identified differences between "No" and "Don't know" survey responses (37), "Don't know" responses were kept as a separate categorization of awareness.

Personal characteristics previously identified as associated with awareness (17, 21–26, 38) were included as characteristics of interest. Specifically, these were: personal or family cancer history (yes, no), sex (female, male), smoking status (current smoker, not a current smoker, including former smokers), age (18–39 years, 40–59 years,  $\geq 60$  years), and education ( $\leq$  high school degree, some college,  $\geq$  college degree). Although previously considered in the literature, actual alcohol use was not included in HINTS 5 Cycle 1. Given that alcohol use varies by employment status (employed, or unemployed, homemaker, student, retired, or disabled), race (black, white, other), and ethnicity (Hispanic or not Hispanic; refs. 2, 3), these characteristics were also included to provide contextual information related to alcohol use in the United States. Finally, to further explore the associations among health-related beliefs, health-information seeking, and awareness seen in other settings (27, 28), health self-efficacy (confidence in ability to take care of own health, coded as completely confident, very confident, or somewhat/not at all confident), cancer worry (worry about getting cancer, coded as not at all/slightly worried, somewhat worried, or moderately/extremely worried), cause ambiguity (believing that everything causes cancer, coded as strongly agree/agree, or strongly disagree/disagree), cancer fatalism (believing that there is "little you can do to decrease cancer risk," coded as strongly agree/agree, or strongly disagree/disagree), and information seeking for cancer (has ever looked up information about cancer, coded as yes or no) were also included.

### Statistical analysis

SAS 9.3 was used for all analyses, and analyses were weighted using jack-knife replicate weights to provide U.S. representative estimates with appropriate standard errors (36). After calculating descriptive statistics, two multinomial multivariable logistic regression models were created to assess the association between personal characteristics and reporting "Yes" or "Don't know" compared to "No." Model 1 included only demographic personal characteristics (education, personal or family cancer history, smoking status, sex, age, and education), which included the previously considered moderators of awareness, as well as employment status, race, and ethnicity. Model 2 included all variables from Model 1 as well as the health-related belief and

cancer information seeking variables (health self-efficacy, cancer worry, cancer fatalism, cause ambiguity, and cancer information seeking).

## Results

Thirty-eight percent of the U.S. population indicated that there was an association between drinking too much alcohol and cancer, 36.17% were uncertain, and 25.47% believed there was

no association (Table 1). Awareness was higher among those with more education and higher health self-efficacy. People with a personal history of cancer and those  $\geq 60$  years of age had a higher prevalence of reporting "Don't know."

Cause ambiguity and cancer information seeking were positively associated with awareness (Table 2). Specifically, people who believed everything causes cancer and those who had ever looked up information about cancer had 1.61 and 1.80 higher odds of awareness, respectively (95% CIs, 1.08–2.42; 1.27–2.57).

**Table 1.** Descriptive frequencies, HINTS 5 Cycle 1 ( $n = 3,009$ )

Characteristic	Awareness of alcohol as a risk factor for cancer			P value <sup>a</sup>
	Yes ( $n = 1,120$ , 38.36%) <i>n</i> (weighted %)	No ( $n = 687$ , 25.47%) <i>n</i> (weighted %)	Don't know ( $n = 1,202$ , 36.17%) <i>n</i> (weighted %)	
Ever had cancer <sup>b</sup>				
No	952 (38.73)	592 (26.01)	987 (35.26)	<b>0.012</b>
Yes	166 (35.20)	91 (19.31)	210 (45.49)	
Family history of cancer <sup>b</sup>				
No	272 (34.61)	187 (28.42)	368 (36.97)	0.237
Yes	821 (40.15)	480 (24.17)	806 (35.68)	
Smoking status <sup>b</sup>				
Current smoker	127 (33.23)	87 (29.56)	170 (37.21)	0.401
Not a current smoker	989 (39.34)	600 (24.81)	1024 (35.85)	
Sex <sup>b</sup>				
Female	656 (38.50)	379 (23.52)	710 (37.98)	0.330
Male	449 (38.32)	299 (27.88)	468 (33.80)	
Age <sup>b</sup>				
18–39 years	256 (43.87)	149 (29.77)	143 (26.36)	< <b>0.001</b>
40–59 years	394 (37.76)	273 (27.43)	378 (34.81)	
$\geq 60$ years	436 (33.13)	245 (18.41)	636 (48.46)	
Education <sup>b</sup>				
$\leq$ High school degree	218 (34.15)	166 (27.63)	338 (38.22)	<b>0.033</b>
Some college	316 (35.71)	187 (24.44)	366 (39.85)	
$\geq$ College degree	560 (44.72)	318 (24.94)	465 (30.34)	
Employment status <sup>b</sup>				
Employed	592 (40.69)	380 (26.80)	522 (32.51)	<b>0.024</b>
Unemployed <sup>c</sup>	470 (35.66)	271 (22.37)	626 (41.97)	
Race <sup>b</sup>				
Black	150 (33.35)	91 (27.04)	185 (39.61)	0.185
Other	121 (47.80)	72 (20.01)	109 (32.19)	
White	794 (38.41)	476 (25.52)	826 (36.07)	
Ethnicity <sup>b</sup>				
Hispanic	136 (37.43)	104 (26.87)	146 (35.70)	0.935
not Hispanic	906 (38.64)	539 (25.38)	946 (35.98)	
Confidence in ability to take care of own health <sup>b</sup>				
Completely confident	309 (46.60)	171 (29.74)	213 (23.66)	< <b>0.001</b>
Very confident	496 (36.98)	325 (25.08)	585 (37.94)	
Somewhat or not at all confident	306 (34.46)	190 (23.23)	396 (42.31)	
Worry about getting cancer <sup>b</sup>				
Not at all or slightly	528 (35.38)	367 (28.36)	585 (36.26)	0.291
Somewhat	358 (43.16)	188 (21.18)	372 (35.66)	
Moderately and extremely likely	222 (38.26)	119 (25.36)	225 (36.38)	
Believes that everything causes cancer <sup>b</sup>				
Agree <sup>d</sup>	763 (40.81)	413 (24.06)	786 (35.13)	0.065
Disagree <sup>e</sup>	347 (33.56)	261 (28.77)	387 (37.67)	
Believes that there is little you can do to decrease cancer risk <sup>b</sup>				
Agree <sup>d</sup>	231 (32.17)	189 (25.61)	352 (42.22)	<b>0.010</b>
Disagree <sup>e</sup>	875 (40.82)	481 (25.88)	814 (33.60)	
Has ever looked for information about cancer <sup>b</sup>				
No	352 (29.48)	314 (27.77)	584 (42.75)	< <b>0.001</b>
Yes	764 (45.16)	370 (23.77)	613 (31.07)	

NOTE: Bold indicates statistical significance ( $P < 0.05$ ).

<sup>a</sup>P value from Chi-square test.

<sup>b</sup>Sum does not add to total due to missing.

<sup>c</sup>Unemployed, homemaker, retired, student, or disabled.

<sup>d</sup>Somewhat or strongly agree.

<sup>e</sup>Somewhat or strongly disagree.

**Table 2.** Multivariable multinomial logistic regression examining associations between personal characteristics and awareness

Characteristic	Multivariable model 1 (n = 2,514)		Multivariable model 2 (n = 2,440)	
	Yes OR (95% CI)	Don't know OR (95% CI)	Yes OR (95% CI)	Don't know OR (95% CI)
Has ever had cancer	1.09 (0.71-1.69)	1.22 (0.80-1.88)	0.96 (0.60-1.53)	1.23 (0.82-1.86)
Family history of cancer	1.44 (0.91-2.26)	1.12 (0.70-1.80)	1.26 (0.78-2.06)	1.12 (0.69-1.81)
Current smoker	0.78 (0.41-1.46)	0.90 (0.42-1.90)	0.83 (0.44-1.57)	0.83 (0.40-1.72)
Female	1.16 (0.79-1.71)	1.25 (0.80-1.93)	1.12 (0.76-1.64)	1.32 (0.83-2.08)
Age				
18-39 years old	1.01 (0.59-1.70)	<b>0.46 (0.22-0.96)</b>	0.87 (0.51-1.48)	<b>0.47 (0.23-0.95)</b>
40-59 years old	0.89 (0.55-1.45)	<b>0.65 (0.43-0.98)</b>	0.80 (0.48-1.32)	<b>0.63 (0.40-0.97)</b>
60+ years old	Reference	Reference	Reference	Reference
Unemployed	1.21 (0.77-1.90)	1.36 (0.79-2.33)	1.24 (0.79-1.95)	1.34 (0.77-2.32)
Education				
≤ High school degree	0.71 (0.44-1.13)	1.02 (0.64-1.61)	0.81 (0.51-1.31)	0.89 (0.57-1.38)
Some college	0.91 (0.61-1.36)	1.36 (0.96-1.92)	0.94 (0.61-1.45)	1.28 (0.88-1.84)
≥ College degree	Reference	Reference	Reference	Reference
Race				
Black	1.20 (0.69-2.07)	1.69 (0.98-2.91)	1.17 (0.68-1.99)	1.59 (0.91-2.76)
Other	1.52 (0.84-2.75)	1.40 (0.82-2.39)	1.63 (0.87-3.05)	1.32 (0.76-2.32)
White	Reference	Reference	Reference	Reference
Hispanic	1.16 (0.63-2.13)	1.44 (0.82-2.53)	1.20 (0.64-2.25)	1.34 (0.74-2.43)
Health self-efficacy				
Somewhat or not at all confident			0.80 (0.48-1.32)	<b>2.32 (1.30-4.14)</b>
Very confident			0.87 (0.60-1.28)	<b>2.07 (1.37-3.14)</b>
Completely confident			Reference	Reference
Cancer worry				
Very			1.12 (0.65-1.92)	1.16 (0.58-2.32)
Somewhat			1.54 (1.00-2.38)	1.27 (0.84-1.92)
Not at all			Reference	Reference
Believes everything causes cancer			<b>1.61 (1.08-2.42)</b>	1.23 (0.85-1.77)
Believes there is little you can do to decrease cancer risk			0.73 (0.50-1.07)	1.09 (0.70-1.69)
Has ever looked up information about cancer			<b>1.80 (1.27-2.57)</b>	0.86 (0.59-1.27)

NOTE: Outcome group referent for Model 1 and Model 2 is "No." Statistical significance indicated in bold ( $P < 0.05$ ).

Adults less than 60 years of age were less likely to report "Don't know"; people with lower health self-efficacy were more likely to report "Don't know."

## Discussion

In a nationally representative survey, 38% of the U.S. population believed that drinking too much alcohol can increase risk of cancer. This level of awareness is consistent with recent assessments in other nationally representative surveys of the United States, which have ranged from 30% to 46% (18, 19, 39). In comparison, recent estimates of awareness of tobacco and sun exposure as risk factors for cancer in the United States were 78% and 66%, respectively (39). These data combined with existing United States estimates have shown little improvement in awareness as estimates of awareness have consistently fluctuated between surveys over time. This pattern is particularly concerning given that awareness of other risk factors for cancer such as obesity have shown a steady increase over the same time period (20). The low level of awareness for alcohol as a risk factor for cancer compared with other important risk factors may not be surprising given that issues related to alcohol have been more focused on heavy drinkers or people with alcohol abuse disorders (40). The focus on "problem" drinkers has led to a reduced perceived severity of harms caused by alcohol to the "moderate" drinker (40), which could account for some of the low level of awareness in the population. Low awareness of alcohol as a risk factor for cancer compared with tobacco could be a result of several factors. Policies used for tobacco control have contributed directly to the decline in smoking, have changed social norms

around tobacco use, and have increased awareness about the harms of these products. To date, relatively little has been attempted in the United States to effect similar change for alcohol. One potential reason for the difference in policy action could be that the epidemiologic evidence is thought to be more complicated for alcohol than for tobacco. For example, although alcohol has been shown to increase the risk of several cancers (4-7), other evidence has suggested a potentially beneficial association between light to moderate alcohol consumption and one type of cardiovascular disease (41). This complexity makes public health messages about alcohol more challenging and could have dampened enthusiasm for policies similar to ones implemented for tobacco control.

Awareness in the United States continues to be lower than awareness reported in other countries (42%-47% in Ireland, Australia, and the United Kingdom; refs. 23, 38, 42). The item included in HINTS 5 Cycle 1 to assess awareness is identical to an item that has been used in Australia and the United Kingdom (23, 38), where 47% of both populations reported awareness of the association between alcohol and cancer. One potential reason for lower awareness in the United States compared with the United Kingdom and Australia could be a result of differences in the alcohol policy context between these countries. For example, the legal drinking age in the United Kingdom and in Australia is 18 whereas in the United States it is 21 (<https://www.niaaa.nih.gov/alcohol-health/alcohol-policy>; <https://www.gov.uk/alcohol-young-people-law>; ref. 43). This difference in drinking ages means that youth are exposed to alcohol at earlier ages and might therefore be exposed earlier on to the health risks of alcohol consumption. Further, current alcohol consumption guidelines

differ across all three, as do regulations related to labeling, pricing, and availability (<http://www.ias.org.uk/Alcohol-knowledge-centre/Consumption/Factsheets/A-good-measure-Units-and-drinking-guidelines.aspx>; <https://health.gov/dietaryguidelines/2015/guidelines/>; <https://www.nhmrc.gov.au/guidelines-publications/ds10>; <http://www.ias.org.uk/Alcohol-knowledge-centre/Price/Factsheets/What-determines-the-price-of-a-drink.aspx>; <https://www.cdc.gov/policy/hst/hi5/alcoholpricing/index.html>; <http://fare.org.au/policy/pricing-taxation/>; ref. 44). This policy variability and differences in the culture of alcohol consumption (e.g., social norms regarding frequency of alcohol consumption at social events and general favorability of alcohol) could result in adults in the United States having reduced awareness of the harms of alcohol. Cross country comparisons linking awareness to current alcohol policies could help quantify and explain low awareness in the United States compared with other similar countries.

In Australia and in the United Kingdom, awareness of the association between alcohol and cancer was associated with increased support for several alcohol reduction policies (38, 45). Specifically, in both countries, awareness was associated with increased support for policies related to price, availability, marketing, and labeling. Thus, capturing awareness in the United States could help estimate potential levels of openness to alcohol reduction policies. Given the association between awareness and support for policies, it is possible that increasing awareness could increase receptivity to alcohol reduction policies. Specifically, in the United Kingdom, a recent mass-media campaign was implemented to increase awareness of alcohol as a risk factor for cancer (34). In addition to successfully increasing awareness, receptivity to alcohol reduction policies was also increased.

In addition to assessing awareness, this study was the first in the United States to examine a comprehensive set of personal characteristics associated with awareness to help identify groups potentially most in need of intervention. The characteristics associated with awareness differed between those who were aware of the association and those who reported "Don't know." Specifically, younger age was associated with a decreased odds and lower health self-efficacy was associated with increased odds of reporting "Don't know," whereas cause ambiguity (e.g., believing that everything causes cancer) and cancer information-seeking were associated with increased odds of awareness. Age was the only personal characteristic previously identified in the literature that was also associated with awareness in this study. Specifically, West and colleagues found that younger age was associated with increased awareness of alcohol as a potential risk factor for mouth cancer (25). In this study, younger aged participants were less likely to report, "Don't know" compared to "No," however there was no association between age and believing alcohol is a risk factor for cancer. Thus, although younger respondents were more likely to provide a definitive response, it appears all age groups within the United States would benefit from educational interventions about the role of alcohol consumption on cancer risk.

Research on the impact of alcohol on cancer survival, mortality, and recurrence is still building; however, there is some evidence that alcohol consumption after cancer diagnosis can increase cancer-specific mortality and recurrence (46). As evidence on the impact of alcohol on cancer treatment success, mortality, and recurrence accumulates, guidelines for alcohol consumption among cancer survivors may also evolve; thus, understanding awareness in cancer survivors is important. In this study, cancer

history was not associated with awareness; however, the prevalence of a "Don't know" response was particularly high (45.5%). This finding is similar to previous research conducted in the United States (22, 39), which found that awareness of cancer risk factors is similar between people with and without a cancer diagnosis. As the prevalence of cancer survivors continues to grow (47), understanding and increasing awareness in this group will remain an important area of investigation.

This study was also the first to consider health-related beliefs and cancer information seeking as potential characteristics associated with awareness of alcohol as a risk factor for cancer. Consistent with our conceptualization, information seeking, cancer fatalism, and health self-efficacy were all associated with awareness. Specifically, lower levels of health self-efficacy were associated with increased odds of reporting "Don't know" and increased levels of cause ambiguity were associated with increased odds of awareness. Previous literature found that cause ambiguity levels were highest among those who were unaware of colorectal cancer screening (27). Thus, continued research is needed to determine how cause ambiguity levels are associated with awareness of different cancer risk factors and cancer prevention strategies. The addition of these variables was particularly informative because, except for age, these variables were the only ones to reveal statistically significant associations with awareness in the multivariable models.

In this study, we chose to distinguish between respondents who reported "Don't know" and "No." Although past research has combined both responses, recent evidence and our results suggest that there is a distinction between people reporting "No" versus "Don't know" when responding to awareness items (37). Future research should continue to explore differences between people who do not believe alcohol is a risk factor for cancer and those who are unclear as different educational strategies may be needed to increase awareness in both groups.

The strongest association found for awareness of alcohol as a risk factor for cancer was with cancer information seeking. Specifically, people who had looked up information about cancer had higher odds of awareness, indicating that information available about this association may be informative to those who are searching. As this is the first-time cancer information seeking has been considered as a correlate of awareness, it is unknown if this construct is associated with awareness in other countries or for other cancer risk factors. The low level of awareness in the population, positive association between information seeking and awareness, and lack of associations between other personal characteristics and awareness indicate that broad reaching public health media campaigns are warranted to increase interest and awareness of this important association. Public educational campaigns are effective in part because they increase interest in a specific health topic, which can lead people to seek information (48). To our knowledge, no programs have systematically attempted to increase awareness of alcohol as a risk factor for cancer in the United States; therefore, it is unknown whether a campaign would result in increased awareness.

#### Limitations

This study has several limitations. First, data come from a cross-sectional survey and therefore the temporality of associations are unknown. Further, this is a secondary data analysis; therefore, not all potential variables of interest were available. For example, actual drinking behavior was not assessed. Previous research

indicates that higher levels of alcohol consumption are associated with lower awareness (24), and it would be beneficial to quantify the magnitude of this association in the U.S. population. However, future iterations of the HINTS survey could include measures of actual alcohol use, which would allow inclusion of this variable in future analyses. The question used to assess awareness in HINTS 5 Cycle 1 prompted respondents by providing cancer as a possible disease associated with alcohol consumption. Other studies assessing awareness have used a question without direct prompts, asking participants to list the factors that they believe increase someone's risk for cancer. Using this question, awareness of alcohol as a risk factor appears much lower (23); thus, it is possible that our findings are an overestimate of knowledge in the population (10). It is also unknown how awareness might differ if respondents are asked to list all potential health conditions due to alcohol use. We considered all "No" responses to mean that a respondent did not believe that an association exists between alcohol and cancer; however, it is also possible that a "No" response could indicate that a lack of knowledge of alcohol as a risk factor for cancer. Further, people might have responded differently if asked about "alcohol" rather than "too much alcohol"; it is also possible that awareness might have been even lower if this qualifier had not been included. Continued cognitive interviewing of survey respondents can help clarify uncertainty surrounding these issues for future administrations of awareness items.

## Conclusions

Awareness of the association between drinking too much alcohol and cancer risk is low across multiple groups in the United States, and educational campaigns may be needed to increase awareness. Future health communication campaigns might consider beginning by targeting groups most in need of education about the association between alcohol and cancer

risk such as cancer survivors (46). In addition, research should continue to explore the association between health-related beliefs and information seeking with awareness of cancer risk factors, particularly the potential direct and indirect associations between these constructs. Future research should also consider the association between awareness and receptivity to alcohol policy in the United States. If relationships in the United States mirror those found in the United Kingdom and Australia, promotion of health information seeking may increase awareness and, as a result, increase receptivity for alcohol reduction policies.

## Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

## Authors' Contributions

**Conception and design:** K.P. Wiseman, W.M.P. Klein

**Development of methodology:** W.M.P. Klein

**Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis):** K.P. Wiseman, W.M.P. Klein

**Writing, review, and/or revision of the manuscript:** K.P. Wiseman, W.M.P. Klein

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# BLOOD CANCER DISCOVERY

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