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Limitations in American adults' awareness of and beliefs about alcohol as a risk factor for cancer

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ABSTRACT

Alcohol is a carcinogen. Recommendations to reduce alcohol use to lower cancer risk are increasingly common. However, neither the beliefs of US adults about alcohol consumption and cancer risk, nor factors influencing those beliefs, are well understood. We used data from the 2019 Health Information National Trends Survey (analysis N = 4,470) to examine beliefs about whether drinking too much alcohol increases cancer risk. We compared those beliefs to beliefs for three other health problems, and examined whether believing alcohol is a cancer risk factor was related to demographics, risk perceptions, other beliefs about the nature of cancer, and alcohol consumption behavior. Only 33% of US adults reported believing that alcohol is a cancer risk factor; 27% stated that it was not, and the highest proportion (40%) reported they did not know. Misbeliefs and lack of knowledge about alcohol and health outcomes were higher for cancer than other outcomes. Higher age, education, seeking health information, risk perceptions, and pessimistic beliefs about cancer predicted both lack of knowledge and misbeliefs about alcohol use and cancer. However, misbeliefs and lack of knowledge were not limited to those who reported alcohol consumption. Demographic and psychosocial factors are associated with problematic beliefs about alcohol's role as a risk factor for cancer. Because perceived risk for health problems is a driver of behavior change, cancer prevention and control efforts to reduce alcohol consumption must attend to and address both the misperceptions about and lack of knowledge of alcohol's role in increasing risk for cancer.

1. Introduction

Alcohol is a known carcinogen (International Agency for Research on Cancer, 2010; Secretan et al., 2009), leading to cancer through a variety of biological mechanisms (Boffetta and Hashibe, 2006; Seitz and Stickel, 2007). Worldwide, alcohol is responsible for an estimated 5.5% of new cancer cases and 5.8% of cancer deaths (Praud et al., 2016). In light of this evidence, public health (Centers for Disease Control and Prevention, 2018; National Cancer Institute, 2018; Institute, 2020; UK National Health Service, 2019; Cancer Care Ontario, 2014) and medical organizations (International Agency for Research on Cancer, 2010; LoConte et al., 2018; American Cancer Society, 2017) have recommended limiting alcohol consumption to reduce cancer risk. Whether one believes that particular behaviors raise or lower risk for the health problem (Mickens et al., 2010; Marteau and Weinman, 2006; Leventhal et al., 2010; Weinstein, 1999) is one of the factors influencing taking

preventive action to reduce risk for a health problem. Thus, the effectiveness of public health recommendations to reduce cancer risk by limiting alcohol consumption is dependent on people *believing* there is a relation between a behavior such as alcohol consumption and cancer risk.

Despite its importance, to our knowledge, few studies have explored beliefs about alcohol use as a cancer risk factor in a US nationally-representative sample (although there are multiple studies in other countries; Scheideler and Klein, 2018). For example, Wiseman and Klein (Wiseman and Klein, 2019) reported that 38% of US adults reported believing that alcohol consumption increased cancer risk, and this belief was associated with both cancer information seeking and believing that everything causes cancer.

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2. Research questions

This paper addresses two questions that follow from the Wiseman and Klein findings. First, we asked whether beliefs about the alcohol-cancer link are similar to, or different from, beliefs about the link between alcohol and other common diseases. Examining this question allows us to better understand underlying beliefs about the link and to better identify targeted intervention strategies. To address this question, we examined the prevalence of beliefs about the role of alcohol use as a cancer risk factor and of uncertainty about that role. We then compared beliefs about alcohol and cancer to beliefs about three other health problems. Second, we asked how these beliefs related to actual alcohol consumption behavior. This question has implications for the mechanisms, such as defensive processing as a result of the implications of one's own drinking behavior, that might underlie the degree of misbelief around alcohol and cancer. To answer this second question, we examined the relation of beliefs about alcohol as a risk factor and personal alcohol use. We also explored relations with demographics, personal cancer risk perceptions, health history, and beliefs about the nature of cancer.

3. Methods

We analyzed data from the HINTS 5, Cycle 3 survey conducted by the US National Cancer Institute. Data collection took place between January and May 2019. The primary data collection was a mail-based survey with random sampling in a complex sampling frame design (additional details of the sampling design and data collection protocol are available elsewhere (Westat., 2019). Black and Latinx respondents were oversampled to ensure sufficient subpopulation sizes for population-representative analysis. A subset of participants were sampled from the same frame and also recruited by mail but were given the option of a paper versus a web-based survey using one of two different types of web-based administration.

4. Participant characteristics

The final sample size was 5,438. The overall survey response rate was 30.3%. Response rate for the mail (30.2%) and web survey (30.6%) was virtually identical (Westat., 2019). The sample was representative of US adult population, so demographic characteristics in analysis mirror those of the US adult population as a whole. HINTS only asked cancer risk questions to individuals without a personal cancer history, yielding a sample size of 4,470.

5. Measures

5.1. Beliefs about alcohol use as a risk factor for cancer and other health problems

Participants were asked to report their beliefs about the relation between alcohol use and four health problems: cancer, heart disease, diabetes, and liver disease. The question prompt was, "Which of the following health conditions do you think can result from drinking too much alcohol?" For each health problem, response options were "Yes", "No", and "Don't Know".

5.2. Alcohol consumption

Participants reported how many days per week, on average, they had at least one drink in the last 30 days, as well as how many drinks they had, on average, on the days that they drank. Both were recorded as open-ended responses. The alcohol consumption questions are the same as those used in the CDC Behavioral Risk Factor Surveillance System (Centers for Disease Control and Prevention, 2019). The two questions were used to calculate an average drinks per week variable that was used

in analyses.

5.3. Cancer risk perceptions

Participants answered both absolute risk and affective risk questions about their general cancer risk perceptions. For absolute risk, participants were asked "How likely are you to get cancer in your lifetime?", answering on a 5-point response scale with endpoints of 1 = very unlikely and 5 = very likely. For worry, they were asked, "How worried are you about getting cancer?". They responded using a 5-point scale with endpoints of 1 = not at all and 5 = extremely.

5.4. Beliefs about the nature of cancer and personal control

Participants indicated their degree of agreement or disagreement with statements reflecting beliefs about cancer: everything causes cancer, that there are so many recommendations about cancer it is hard to know what to do, and that there is nothing that can be done to prevent cancer. Finally, participants reported whether they believed that they could control their own health and the degree to which they consider future consequences in making behavioral decisions (i.e., try to change future outcomes by controlling their day-to-day behavior). Each of these items was answered on a 4-point scale with (reverse coded) endpoints of 1 = strongly disagree and 4 = strongly agree.

5.5. Demographics

Participants reported age, gender, highest level of education, income, self-identified race/ethnicity, whether they had a primary care provider, and whether they or a family member had ever been diagnosed with cancer. They provided and health information seeking behavior by responding to the question, "Have you ever looked for information about health or medical topics from any source?"

5.6. Data analysis

Data were analyzed using Stata version 16 (StataCorp, LLC, College Station, TX) using survey data commands with sampling and jackknife replicate weights to account for the complex sampling design and provide population-representative estimates. Rates of missing data across predictor variables ranged from 1.7% (gender) to 9.0% (drinking days per week).

We examined whether any variables differed by survey mode. Of the 63 comparisons made (3 modes × 21 variables), only one was significant (the two web-based groups differed in valid responses to the alcohol-diabetes risk question). Given the p < .05 criterion, 1 in 63 comparisons is 1.5% of the comparisons made and therefore likely due to chance. We therefore conducted analyses collapsing participants across survey modes.

All of the reported analyses used STATA's survey weighting procedures. We first examined the proportions of participants who believed that alcohol use was a risk factor for each health problem. Then we examined rates of "don't know" responses to the various risk-behavior belief questions. Because rates of don't know responding may have differed across health problem domains, we conducted additional analyses among only participants who expressed a belief about the relationship between alcohol and cancer. Specifically, we examined the proportion of individuals who believed that alcohol was not a risk factor. To examine the different proportions of beliefs across domains, we made parallel comparisons for beliefs about the link between alcohol and each of the three other health problems.

For each of these comparisons, we used the weighted Chi-Square test, using Rao and Scott's correction (Rao and Scott, 1984) to test whether the proportions differed across health problems. Finally, we explored whether lack of knowledge of the link between alcohol consumption and health problems was a general response tendency (e.g., saying don't

know about many or all health domains) versus being relatively domain specific by examining the proportion of those responding DK who only gave a DK response to one item versus to multiple items.

We then examined whether demographic and psychosocial predictors were associated with no and don't know (versus yes) responses. We used weighted multinomial logistic regression in a multivariable model with answer type as the 3-category outcome variable and the demographic, risk, behavioral, and cancer belief constructs as predictor variables. We then followed up with analyses comparing the no to the don't know responses by re-estimating the weighted multinomial logistic regressions with "no" as the reference category. Included in these predictors is self-reported alcohol use. In addition, to further examine any effects of self-reported alcohol use on health beliefs, we conducted equivalent analyses for the other three alcohol use-health problem questions.

6. Results

Table 1 contains the population weighted estimates for the percentage of individuals without a cancer history who believe that there is a relation between consuming too much alcohol and risk for each health problem (YES responses), do not believe there is an association (NO responses), or express uncertainty or lack of knowledge about the association (DON'T KNOW responses). It shows that 34.4% of US adults believe that there is a relation between alcohol and cancer risk, 26.6% believe there is no relation, and 39.4% do not know.

6.1. Beliefs about relation of alcohol to cancer risk versus other health domains

Although there was some expression of uncertainty about each of the health conditions, there was significantly more uncertainty for the cancer link with alcohol than for any of the other health conditions (X^2 (1,49) all > 314.85, all p < .001). In addition, among those participants who expressed a belief, there was significantly more disbelief that alcohol causes cancer than disbelief that it causes the other three health conditions; (X^2 (1,49) all > 124.1, all p < .001). Nearly half (43.2%; 95% CI 39.7%, 46.8%) of participants did not believe that drinking too much alcohol causes cancer. By contrast, substantially fewer; for liver disease, 2.4% (95% CI 1.9%, 4.3%); for heart disease, 21.8% (95% CI 19.2, 24.6%); and for diabetes, 24.0% (95% CI 20.1, 26.6) did not believe that drinking too much alcohol causes the illness.

There was very little generalized tendency to respond don't know – only 7% of respondents answered don't know to all 4 questions. An additional 16% gave one don't know response; 14% gave 2; and 11% gave 3 don't know responses. Roughly half (51%) of participants never used the don't know response option. There was similar differentiation between items for "yes" and "no" responses; 51% answered yes to all 4 items and 4% answered no to all 4.

6.2. Individual differences associated with beliefs about, and lacking Knowledge/Uncertainty about alcohol as a cancer risk factor

Table 2 reports the multivariable relations of beliefs about alcohol as a cancer risk factor and personal alcohol consumption behavior, perceived risk for cancer, beliefs about the nature of cancer, and demographics. The likelihood of believing that there is no association between drinking too much alcohol and cancer (compared to believing that there is an association) was associated with increasing age, reporting having not ever having sought cancer information, perceiving oneself as being at lower risk, not believing everything causes cancer, believing that there are too many recommendations for cancer prevention, and believing cancer can't be prevented. Predictors of answering don't know (compared to believing that there is an association) included older age, decreasing levels of education, not having ever sought cancer information, and being more likely to report that cancer can't be prevented and that there are too many recommendations. There were no predictors that differentiated between no and don't know responders.

Self-reported alcohol consumption was not associated with either answering don't know or answering no (Table 2). We also examined the

Table 2
Multivariable Relations of Beliefs about the Alcohol-Cancer Link with demographic, health constructs, and psychosocial constructs – weighted multinomial logistic regressions (separate models for No vs Yes and Don't Know vs Ref).

Characteristic	No vs. Yes (Ref) RRR (95% CI)	Don't Know vs. Yes (Ref) RRR (95% CI)
Demographics		
Gender* (M = 0, F = 1)	1.03 (0.70, 1.52)	1.13 (0.77, 1.68)
Age	**0.99 (0.97, 0.99)**	**1.01 (1.00, 1.03)**
Education Level	0.86 (0.74, 1.01)	**0.78 (0.66, 0.91)**
Income Level	1.08 (0.94, 1.23)	1.01 (0.88, 1.16)
Race/Ethnicity*		
White, non-Hispanic	Ref	Ref
Black/AA, non-Hispanic	1.32 (0.80, 2.17)	1.35 (0.81, 2.24)
Hispanic	1.20 (0.71, 2.01)	0.99 (0.63, 1.54)
Asian, non-Hispanic	0.66 (0.31, 1.38)	0.51 (0.20, 1.35)
Family History of Cancer (no = 0, yes = 1)*	0.94 (0.58, 1.52)	0.92 (0.60, 1.42)
Ever Sought Cancer Info (no = 0, yes = 1)*	**0.78 (0.66, 0.92)**	**0.69 (0.49, 0.96)**
Alcohol Use – Average Drinks Per Week	1.00 (0.99, 1.03)	1.01 (0.99, 1.02)
Cancer Risk Perceptions		
Absolute Risk	**0.83 (0.69, 0.99)**	0.88 (0.76, 1.03)
Worry	0.91 (0.75, 1.06)	0.88 (0.76, 1.03)
Beliefs about Cancer and Health		
Everything Causes Cancer	**0.78 (0.66, 0.92)**	0.83 (0.65, 1.07)
Cancer Can't Be Prevented	**1.45 (1.16, 1.82)**	**1.39 (1.12, 1.74)**
Too Many Recommendations	**1.23 (1.01, 1.51)**	**1.25 (1.05, 1.49)**
Ability to Care for Own Health	1.08 (0.92, 1.25)	0.89 (0.78, 1.02)
Consideration of Future Consequences	0.85 (0.72, 1.02)	0.90 (0.73, 1.11)

Bold = sig at p < .05 *denotes categorical variables.

Table 1
Weighted Proportions for Beliefs about Cancer Risk and Alcohol Consumption versus Other Health Problems.

Behavior Health Problem	All Respondents (excluding those with missing data)				Those Espousing a Belief (excluding those responding don't know)			
	Cancer(n = 4904)	Heart Disease(n = 5009)	Diabetes(n = 4978)	Liver Disease(n = 5295)	Cancer(n = 2882)	Heart Disease(n = 3497)	Diabetes(n = 3458)	Liver Disease(n = 4883)
Is alcohol a risk factor?	%(95% CI)	%(95% CI)	%(95% CI)	%(95% CI)	%(95% CI)	%(95% CI)	%(95% CI)	%(95% CI)
Yes	34.4%(32.4, 36.5)	55.2%52.3, 57.5)	53.7%(51.3, 56.1)	90.1%(88.4, 91.5)	56.8%(53.2, 60.3)	78.2%(75.4, 80.9)	76.4%(73.4, 79.2)	97.2%(96.0, 98.1)
No	26.6%(23.6, 29.0)	15.3%(13.4, 17.5)	16.6%(14.6, 18.8)	2.6%(1.8, 3.7)	43.2%(39.7, 46.8)	21.9%(19.2, 24.6)	23.6%(20.8, 26.6)	2.4%(1.9, 4.0)
Don't Know	39.4%(37.1, 41.8)	29.5%(27.3, 31.8)	29.7%(27.9, 31.5)	7.4%(6.2, 8.8)	—	—	—	—

alcohol use-belief relation for the remaining three health problem domains, controlling for demographic and psychosocial variables. None of the associations were statistically significant (all *RRR* confidence intervals include 1.0, all *ps* > 0.10). Full results for these analyses can be found in the Supplemental Materials.

7. Discussion

We identified three important findings. First, the prevalence of US adults who stated believing, correctly, that excess alcohol consumption increases one's risk for cancer was only 34%. The remaining 66% of adults either said that they did not know whether it caused cancer or incorrectly believed that it did not. This low prevalence of acknowledging a relation is consistent with prior work (Wiseman and Klein, 2019). Our finding adds to this work by demonstrating that there are subgroups of individuals who have an incorrect belief about the link and who are uncertain or lack knowledge about the link.

Second, lack of knowledge or uncertainty was substantially more prevalent for alcohol's relation to cancer than for the other three health problems. Nearly five times as many people (39% of the population) said they did not know if alcohol affected cancer risk than did so for the relation of alcohol and liver disease (7%), and don't know responses were 1.3 times more common for alcohol and cancer than for heart disease or diabetes (both 30% of the population). As such, responding don't know does not appear to reflect a generalized response style, consistent with prior work (Kiviniemi et al., 2020). Rather, the don't know responses indicate meaningful variability in beliefs that require specific examination in the alcohol domain.

In addition, substantially more people did not believe that drinking too much alcohol causes cancer (nearly 40% of responses) than did not believe it causes the other three health problems (3–20% of responses). This finding is consistent with qualitative work examining alcohol-cancer beliefs (Meyer et al., 2019), but to our knowledge we are the first to examine it quantitatively in a nationally-representative dataset.

Third, the likelihood of either not knowing whether there is a relation or not believing that there is a relation is associated with both knowledge/education factors (e.g., seeking cancer information) and beliefs about the nature of cancer and health risk (e.g., believing cancer cannot be prevented). In addition, misbeliefs and uncertainty about the alcohol-cancer risk link were *not* related to an individual's self-reported alcohol consumption. This suggests that the mechanisms underlying incorrect beliefs and lack of knowledge are likely related lack of knowledge/education rather than defensive responses based on personal drinking behavior.

8. Implications for research and interventions

Our prior research demonstrates that people who indicate they "don't know" their risk have lower health knowledge and higher information avoidance tendencies compared to people who are able or willing to provide a risk estimate (Orom et al., 2018), or even those who believe themselves at low risk (Waters et al., 2016). That research suggests that, in the context of alcohol use and cancer risk, researchers and interventionists should consider both groups as potential intervention targets, including both individuals who respond "don't know" as well as individuals who explicitly respond that alcohol is not a risk factor.

Different interventions may be needed for people who don't believe drinking too much alcohol causes cancer and people who are uncertain about the relation. For the "no" response, there is a need for intervention strategies that can address the processes that led to the person considering the relation and concluding (incorrectly, from an epidemiological perspective) that there is no relation. There are multiple possibilities—the person may have been exposed to misinformation about the topic (Chou et al., 2018; Johnson et al., 2020), may have formed a belief through a relatively automatic or heuristic process without fully considering the evidence (Chaiken et al., 1989; Cacioppo et al., 1986),

may have heard evidence but decided it was incorrect or not strong enough to motivate change (Albarracin et al., 2012), or may have heard evidence but not believed that the source was trustworthy or credible (McGuire et al., 1989). All of these possibilities are potentially addressable from an intervention perspective but each are different mechanisms requiring different intervention approaches (Albarracin and Shavitt, 2017; Albarracin et al., 2005).

Given the complexities involved in changing existing attitudes and beliefs, the relative "blank slate" of the individuals who answer don't know are potentially a more straightforward path for intervention. Although the possible explanations for why one would answer don't know to the question require different intervention approaches, all involve adding information to lead to belief outcomes rather than having to actively "undo" existing misinformation about beliefs that may be strongly held and resistant to change (Krosnick, 1988).

It is also important to differentiate between no and don't know responses about alcohol as a cancer risk factor in terms of the mechanisms that may underlie each response. Stage theories of behavioral decision making and behavior change differentiate between people who are not aware of health risks posed by behavior from people who are aware but chose not to engage in preventive health behaviors (Weinstein et al., 2002; Prochaska et al., 1992), with implications for diverse motivational mechanisms. Our work finds that the demographic and cancer belief correlates are similar across the two types of responses. Apart from this finding, from a decision-making perspective these theories posit that different decision-making mechanisms may be involved and that therefore different intervention strategies are necessary for each group (Weinstein et al., 2002; Prochaska et al., 1992). Although we believe that it is premature to draw strong conclusions about mechanisms from the data – the above are only hypothesized possibilities – it appears that no and don't know responses are meaningfully different from one another, have different demographic and psychosocial mechanisms, and should be considered and addressed separately.

Although we have primarily focused attention here on the importance of understanding the alcohol-cancer link for individual-level cancer prevention behavior change interventions, it is also important to note that beliefs regarding the alcohol-cancer link also have implications for public policy. In both British (Buykx et al., 2015) and Australian (Bates et al., 2018) population surveys, those who believed that there was a link between alcohol and cancer were more supportive of alcohol control policies in those countries. Neither of those surveys differentiated no from don't know responders in examining the belief-support for policy relation, leaving open the question of whether support would differ between the two.

9. Limitations

There are several limitations to acknowledge. First, the survey design is cross-sectional and therefore only captures attitudes, beliefs, and behavior at a single time point. This means that no reported associations between variables should be interpreted as evidence for causal relations. In addition, given that prevalence of both attitudes, beliefs, and behaviors can change over time, this should be interpreted as a snapshot of the prevalence at the time the data was collected.

Second, because we conducted secondary analyses of an existing, nationally representative survey dataset, the constructs analyzed are necessarily limited to those that were included in the original survey. In particular, while there are global questions about cancer as described and analyzed above, there are not questions specific to risk about alcohol-related cancers nor perceptions of one's overall health risk as a result of alcohol use. Similarly, although comparing perceived risk for cancer to perceived risk for the other three health problems might elucidate potential explanations for the differences in rates of don't know and no responses, only perceived risk for cancer was assessed in the current dataset, limiting our ability to examine whether differences in risk perception across health problems explain any patterns of effects.

Third, the secondary analysis also limits our ability to probe more deeply into what is meant by a no versus a don't know response. There are several plausible interpretations of what is intended when a participant provides each of these responses, but it is not possible to further examine them in the current dataset.

Finally, given the exclusion criteria applied by the survey designers for questions about cancer risk, our analyses include only individuals without a personal cancer history. Because alcohol use is also relevant for cancer survivors for both recovery and recurrence, work that examines these beliefs in cancer survivors is also of importance.

10. Conclusions

Although there is strong etiologic evidence to support alcohol use as a risk factor for cancer, the American public's beliefs about its role are considerably more mixed. Both the high proportion of individuals who do not report believing that there is a relation between alcohol use and cancer as well as the high proportion who say they do not know whether there is a link pose challenges for public health intervention efforts.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pmedr.2021.101433.

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