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RESEARCH ARTICLE

Designing Effective Alcohol Warnings: Consumer Reactions to Icons and Health Topics

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Introduction: New warning labels for alcohol could reduce alcohol-related health harms. This study examined consumer responses to alcohol warnings with different designs.

Methods: A national sample of 3,051 U.S. adults completed an online survey in August 2021. Participants were randomized to 1 of 4 warning topics (addiction, liver damage, early death, or colon cancer). Participants viewed 3 labels presented in random order: 2 types of warning labels (text-only and icon) showing a newly developed warning message about their assigned topic and a text-only control label showing a neutral message. Participants rated each label on effectiveness at discouraging alcohol consumption (primary outcome) and attention (secondary outcome) using 1-to-5–point Likert-type scales. Participants also rated warnings with different causal language variants (e.g., "increases the risk of", "contributes to") and marker words (e.g., "WARNING", "SURGEON GENERAL WARNING").

Results: Both the text-only and icon warnings were perceived as more effective (average differential effects=0.79 and 0.86, respectively) and more attention grabbing (average differential effects=0.43 and 0.69, respectively) than control labels (all $p<0.001$). The icon warnings were rated as more effective and attention grabbing than the text-only warnings (average differential effects=0.07 and 0.27, respectively, both $p<0.001$). Although all warning topics outperformed the control messages, warnings about addiction were rated as less effective and attention grabbing than warnings about the other topics. A majority (60%) of participants selected "increases the risk of" as the most discouraging causal variant, and a plurality (47%) selected "SURGEON GENERAL WARNING" as the most discouraging marker word.

Conclusions: New alcohol warnings could discourage alcohol consumption, especially if warnings include icons.

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INTRODUCTION

Alcohol consumption poses substantial health risks, accounting for >140,000 deaths per year in the U.S.[1–3] Even in light and moderate amounts, alcohol consumption is associated with chronic health problems, including some types of heart disease and cancer.[4–11] Despite evidence of the harms of alcohol consumption, two thirds of U.S. adults report drinking.[12]

Warning labels are an important tool for ensuring access to information about alcohol's harms, increasing awareness of these harms, and reducing alcohol-

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related morbidity and mortality.[13,14] However, the current alcohol warning in the U.S. was mandated more than 30 years ago[15] and is now out of date. Evidence suggests that warnings are likely to be more effective when labels are large,[16–19] are displayed prominently on the front of product packaging,[17,19] and include a pictorial element such as an image or icon.[17,19–25] However, the current U.S. alcohol warning lacks each of these features: it is small, typically appears on the side or back of alcohol containers, and does not include a pictorial element (Figure 1A).[26] Research suggests that the current warning has had a limited impact on overall alcohol consumption.[15,27] By contrast, a quasiexperiment from the Yukon Territory in Canada found that displaying large warnings with icons on the front of alcohol containers increased attention to and processing of labels,[28] improved recall of drinking guidelines,[29] and reduced alcohol sales.[30] In addition, most (although not all[31]) laboratory and online experiments suggest that large, pictorial warnings can impact drinking-related outcomes, including intentions,[32] alcohol selection,[33,34] and speed of drinking.[35]

Adopting new, evidence-based warnings on alcohol containers in the U.S. could reduce harmful alcohol consumption, but questions remain about how to design these warnings. For example, studies show that warnings with graphic images are more effective than text-only warnings at reducing the selection and consumption of unhealthy products (including alcohol)[20,21,25,33,36]; however, it is unknown whether these findings extend to alcohol warnings with icons (i.e., symbolic depictions of the warning message). This is important because warnings with icons may be more politically or legally feasible than warnings with graphic images in some jurisdictions. In addition, more evidence about which health harms most motivate consumers to reduce their alcohol consumption could guide the selection of health topics to address in warnings, particularly given that most studies on alcohol warning topics have been conducted with non-U.S. samples.[37–39] Warnings can also communicate causality in different ways (e.g., "contributes tov

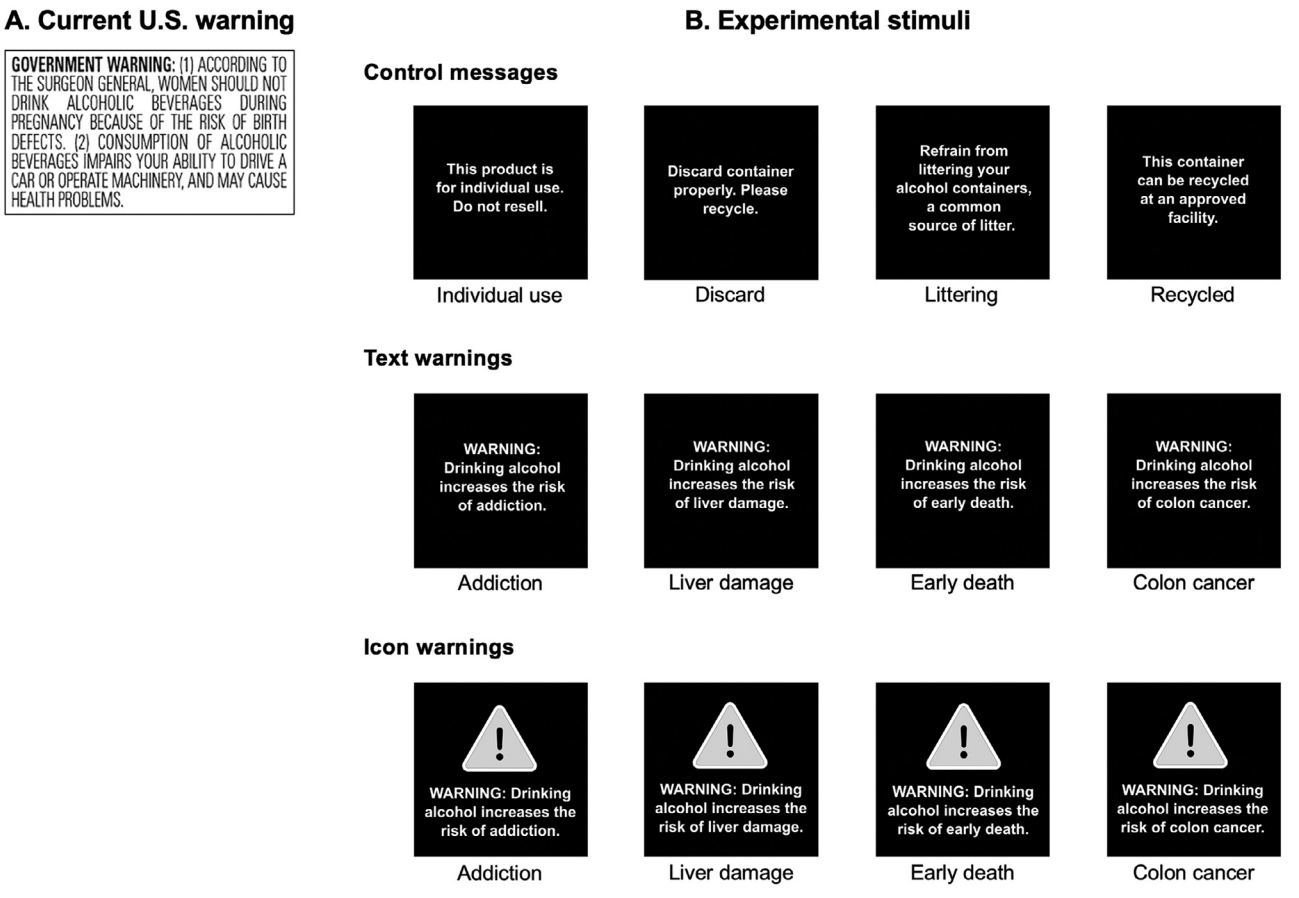

Figure 1. (A) Current warning required in the U.S. and (B) experimental stimuli used in this study.
Note: The icon warnings were shown in color in the experiment; the icons were yellow.

versus "increases the risk of") and adopt various marker words at the beginning of the message (e.g., "WARNING" versus "GOVERNMENT WARNING"), but it remains unclear how consumers respond to different causal variants[38] and marker words[40] in alcohol warnings.[41]

This study aimed to evaluate U.S. adults' reactions to text-only and text-plus-icon alcohol warnings discussing various warning topics (i.e., health harms). This study also evaluated which causal variants and marker words were perceived as most discouraging alcohol consumption.

METHODS

Study Sample

A national convenience sample of 3,674 adults was recruited in August 2021 by Cloud Research Prime Panels, a survey research firm. Participants were eligible if they lived in the U.S. and were aged ≥18 years. Cloud Research focused recruitment efforts such that the sample approximately reflected the U.S. adult population in terms of gender, age, race/ethnicity, and Census region. Online convenience samples can yield generalizable findings for experiments such as the one in this study.[42] The Harvard Longwood Campus IRB approved the study.

Procedures

Participants completed an online survey (median completion time=13.1 minutes). After providing informed consent, participants completed 2 short experimental tasks unrelated to alcohol (one in which they selected their preferred snacks and non-alcoholic beverages and one in which they selected their preferred meals from restaurant menus). Next, participants completed the present experiment about alcohol warnings. The alcohol warnings experiment varied the characteristics of warnings using a 4 × 2 plus control between-within-subjects design. First, participants were randomly assigned to 1 of 4 between-subjects conditions representing different warning topics: (1) addiction, (2) liver damage, (3) early death, and (4) colon cancer. These topics were selected on the basis of the epidemiologic literature linking alcohol consumption with addiction,[7,43–45] liver damage,[46,47] early death,[47–49] and colon cancer[50–52] and to allow assessment of various types of harms. In addition, previous studies have found that messages about these topics are promising for reducing the use of E-cigarettes,[22,53] sugary drinks,[54,55] red meat,[56] and alcohol.[33,37,55,57]

Participants viewed a message with their assigned warning topic twice, on 2 labels that differed on warning type: (1) a text-only warning (referred to as text warning in the remaining part of this paper) and (2) a text-plus-icon warning (referred to as icon warning in the remaining part of this paper). Participants additionally viewed a third label that displayed 1 of 4 randomly assigned control messages. Control messages discussed neutral topics unrelated to alcohol harms (e.g., recycling) using similar length and syntax as the warning messages, similar to previous studies.[22,58,59] Participants viewed the 3 types of labels (text warning, icon warning, and control label) in random order. Message type was selected as the within-subjects factor to maximize the power to detect differences between text and icon warnings. Appendix Figure 1 (available online) depicts the survey flow.

Warning labels were developed following recommendations from previous research.[7,25,59,60] First, researchers created warning messages discussing the link between alcohol consumption and each of the 4 warning topics (addiction, liver damage, early death, and colon cancer) using language similar to the sugary drink warning message adopted in San Francisco, California.[61] Messages used simple wording, the marker word "WARNING", and stronger causal language on the basis of research indicating that these design characteristics enhance warning efficacy.[62,63] This study focused on health harms rather than on social outcomes because U.S. warnings for alcohol,[26] cigarettes,[64] and sugary drinks[61] each describe health harms.

Next, a professional graphic designer developed 12 different labels: 4 labels for each message type (text warning, icon warning, or control label) (Figure 1B). The 4 text warnings displayed the 4 warning messages in white text centered in a black label, similar to the food warnings mandated in several Latin American countries[65] and to previous studies.[22,59,62] The 4 icon warnings added an icon above the warning message. The icon depicted an exclamation mark inside a triangle; this design was chosen because it was proposed for sugary drink warnings in California,[66] could trigger automatic associations with yield signs,[24] and is perceived as dangerous[67] and unhealthy.[60] The 4 control labels mimicked text warnings but displayed the neutral control messages.

Measures

First, the survey assessed exposure to the warning label currently required on alcohol containers in the U.S. using an item adapted from the International Tobacco Control Policy Evaluation Survey,[68] *Alcohol containers have health warning labels on them. In the last 30 days, how often have you read or looked closely at any of the health warning labels on alcohol containers?* Response options were *all of the time, often, sometimes, rarely*, or *never*.

Next, for the main experimental task, participants viewed 3 labels (text warning, icon warning, control label) one at a time in random order and responded to questions about each label. The primary outcome was perceived effectiveness at discouraging alcohol consumption, assessed using a single item adapted from the UNC Perceived Message Effectiveness Scale[69]: *How much does this message discourage you from wanting to drink alcohol?* The secondary outcome was attention to the labels, assessed using a single item adapted from studies of cigarette warnings[68,70]: *How much does this message grab your attention?* Both items used 5-point Likert-type response options ranging from *Not at all* (coded as 1) to *A great deal* (coded as 5). These outcomes were selected because they are predictive of warnings' potential to influence health behaviors.[70–73]

Next, to provide additional insights on alcohol warning design, the survey assessed the causal language variant and marker words participants perceived as most effective at discouraging alcohol consumption using additional survey questions shown after participants completed the main experimental task. To identify discouraging causal variants, participants viewed 4 warning messages for alcohol (displayed simultaneously in random arrangement) that varied the causal language used in the warning: "increases the risk of", "contributes to", "can contribute to", and "may contribute

to". The warnings read the following: "WARNING: Drinking alcohol [causal variant] stroke" (underlining shown in survey). Participants selected the message that would most discourage them from wanting to drink alcohol, similar to a previous study.[63] To identify discouraging marker words, participants viewed 4 warning messages (displayed simultaneously in random arrangement) that varied the marker words used in the warning: "WARNING", "GOVERNMENT WARNING", "ALCOHOL AND TOBACCO TAX AND TRADE BUREAU WARNING", and "SURGEON GENERAL WARNING". The warnings read the following: "[MARKER WORDS]: Drinking alcohol increases the risk of stroke" (underlining shown in survey). Participants selected the message that would most discourage them from wanting to drink alcohol. To reduce respondent burden, the survey randomly selected a subsample of participants to respond to the causal variant question (n=676) and a separate subsample to respond to the marker words question (n=678).

The survey also assessed standard demographic characteristics (e.g., age, gender, race/ethnicity, income) and frequency of alcohol consumption. Alcohol consumption was only assessed among participants aged ≥21 years.

Statistical Analysis

Analyses excluded participants who did not complete the survey or requested that their data be excluded after viewing the survey debrief (Appendix Figure 2, available online). Primary analyses included 3,051 participants.

Analyses examined exposure to the current alcohol warning by calculating the proportion of participants who reported reading or looking closely at the current warning *all of the time, often, sometimes, rarely*, or *never*. Sensitivity analyses examined exposure among participants who reported consuming alcohol at least 1 day in the previous 30 days.

Analyses of the main experiment used mixed effects linear regression to (1) test the main effect of message type (text warning, icon warning, control label), (2) test the main effect of warning topic (addiction, liver damage, early death, colon cancer), (3) assess whether the impact of message type differed by warning topic, and (4) assess whether the impact of message type differed by demographic characteristics. Models regressed outcomes on indicator variables for each combination of experimental factors plus indicators for the 4 control messages. Models assessing moderation by demographic characteristics additionally included indicator variables representing interactions between message type and participant characteristics. Analyses used the mixed models to estimate average differential effects (ADEs) (i.e., differences in predicted means between groups) for each comparison of interest and to test the significance of interaction terms, following standard procedures.[74] Sensitivity analyses controlled for the random order in which messages were displayed; results were identical to those of the uncontrolled analyses, so the uncontrolled analyses are presented. Additional sensitivity analyses examined the main effects of the experimental factors among participants who reported consuming alcohol at least 1 day in the previous 30 days.

Finally, analyses examined the proportion of participants who selected each causal language variant and each marker word as most discouraging. All tests were 2 sided and used critical alpha=0.05. Analyses were conducted in 2022 in Stata MP, Version 17. Before data collection, the study questions, predictions, design, and analysis plan were preregistered on AsPredicted.org (https://aspredicted.org/KZS_DV3). Deviations from this plan are described and justified in Appendix Exhibit 1 (available online).

RESULTS

Participants were on average aged 45.6 years (SD=18.7). Approximately 60% identified as women (Table 1). Appendix Table 1 (available online) reports the sample characteristics by experimental group. Two thirds of participants (66%) identified as White, and 19% identified as Black. Approximately 13% identified as Latino(a) (regardless of race). One third had a household income <150% of the Federal Poverty Level. Among those aged ≥21 years, about 60% reported consuming alcohol on at least 1 day in the previous 30 days. The study sample was similar to the U.S. overall in distributions of age, race, ethnicity, education, and alcohol consumption but had a higher proportion of females and households with lower income than the U.S. overall (Appendix Table 2, available online).

Exposure to the current alcohol warning label was low: only 13% of participants reported reading or looking closely at the label *often* (8%) or *all of the time* (5%), whereas 20% reported reading or looking closely *sometimes* (Appendix Figure 3, available online). Two thirds of participants reported that they *never* (49%) or *rarely* (19%) read or look closely at the current alcohol warnings. Exposure to the current warning was similarly low in sensitivity analyses examining participants who reported consuming alcohol in the past 30 days (Appendix Figure 3, available online).

In the main experimental task examining responses to new alcohol warnings, both the text warnings (ADE=0.79; 95% CI=0.74, 0.83; p<0.001) and the icon warnings (ADE=0.86; 95% CI=0.82, 0.90; p<0.001) received higher ratings on the primary outcome, perceived effectiveness at discouraging alcohol consumption, than the control labels (Figure 2 and Appendix Table 3, available online). Moreover, the icon warnings received higher perceived effectiveness ratings than the text warnings (ADE=0.07; 95% CI=0.03, 0.12; p<0.001). Results for the secondary outcome, attention to the labels, followed a similar pattern. Both the text warnings and icon warnings led to higher attention ratings than the control labels (range of ADEs=0.43−0.69, both p<0.001), and the icon warnings led to higher attention ratings than the text warnings (ADE=0.27; 95% CI=0.22, 0.31; p<0.001) (Figure 2 and Appendix Table 3, available online).

Table 1. Participant Characteristics, N=3,051 U.S. Adults

Characteristics	*n* (%)
Age	
18–29 years	775 (25)
30–44 years	786 (26)
45–59 years	610 (20)
≥60 years	880 (29)
Gender	
Female	1,828 (60)
Male	1,154 (38)
Nonbinary or another gender	52 (2)
Gay, lesbian, or bisexual	392 (13)
Latino(a) or Hispanic	386 (13)
Race	
White	2,005 (66)
Black or African American	574 (19)
American Indian or Alaska Native	59 (2)
Asian or Pacific Islander	166 (5)
Other or Multiracial	230 (8)
Education	
High-school diploma or less	907 (30)
Some college	794 (26)
College graduate or associates degree	1,014 (33)
Graduate degree	320 (11)
Household income, annual	
$0–$24,999	935 (31)
$25,000–$49,999	864 (29)
$50,000–$74,999	517 (17)
≥$75,000	705 (23)
Household income <150% Federal Poverty Level	1,003 (33)
Days with alcohol consumption during the past 30 days	
0 days	1,098 (40)
1–5 days	986 (36)
≥6 days	690 (25)
Read or look at the current alcohol warning label	
Never	1,481 (49)
Rarely	564 (19)
Sometimes	609 (20)
Often	230 (8)
All the time	163 (5)
Political party identification	
Democrat	1,317 (44)
Republican	789 (26)
Independent or another party	917 (30)

Note: Missing data ranged from 0.0% to 1.4% for all demographics except for alcohol consumption (9.1%), which was not queried for participants aged <21 years. Appendix Table 1 (available online) provides sample characteristics by experimental group.

Warnings about any of the 4 warning topics (addiction, liver damage, early death, and colon cancer) received higher perceived effectiveness ratings than the control labels (range of ADEs=0.58–0.97, all $p<0.001$) (Figure 2 and Appendix Table 3, available online). When comparing warning topics with one another, warnings about liver damage, early death, and colon cancer received higher perceived effectiveness ratings than the addiction warning (range of ADEs=0.27–0.39, all $p<0.001$). In addition, the cancer warning was perceived to be more effective than the early death warning (ADE=0.11; 95% CI=0.02, 0.21; $p=0.02$). The pattern of results was similar for attention. The 4 warning topics received higher attention ratings than the control labels (range of ADEs=0.42–0.62; all $p<0.001$). Warnings about liver damage, early death, and colon cancer received higher attention ratings than the addiction warning (range of ADEs=0.17–0.20; all $p<0.001$). There were no other differences in attention between the warning topics. The pattern of results was similar to that of sensitivity analyses examining participants who reported consuming alcohol in the past 30 days (Appendix Table 4, available online).

In moderation analyses examining the interaction between message type and topic, the impact of message type (i.e., control, text warning, or icon warning) on the outcomes did not differ across the 4 warning topics (all p for interaction>0.08). In analyses examining the potential moderation of message type by demographic characteristics, the impact of message type on perceived effectiveness did not differ by any of the 9 characteristics studied, including by gender, age, sexual orientation, frequency of alcohol consumption, race, ethnicity, educational attainment, political party, or income (all p for interaction>0.23).

When responding to the additional survey questions querying which causal language variant would most discourage them from warning to drink alcohol, a majority (60%) of participants selected the warning that used "increases the risk of", followed by the warning that used "contributes to" (21%), "can contribute to" (11%), and "may contribute to" (9%) (Figure 3). When asked to select the most discouraging marker words, about half (47%) of participants selected the warning that used "SURGEON GENERAL WARNING" (the attributed source in the current alcohol warning), followed by the warning that used "WARNING" (27%), "ALCOHOL AND TOBACCO TAX AND TRADE BUREAU WARNING" (17%), and "GOVERNMENT WARNING" (9%) (Figure 3).

DISCUSSION

In this experiment with a large sample of U.S. adults, a minority of participants reported reading or looking closely at the current U.S. alcohol warnings. By contrast,

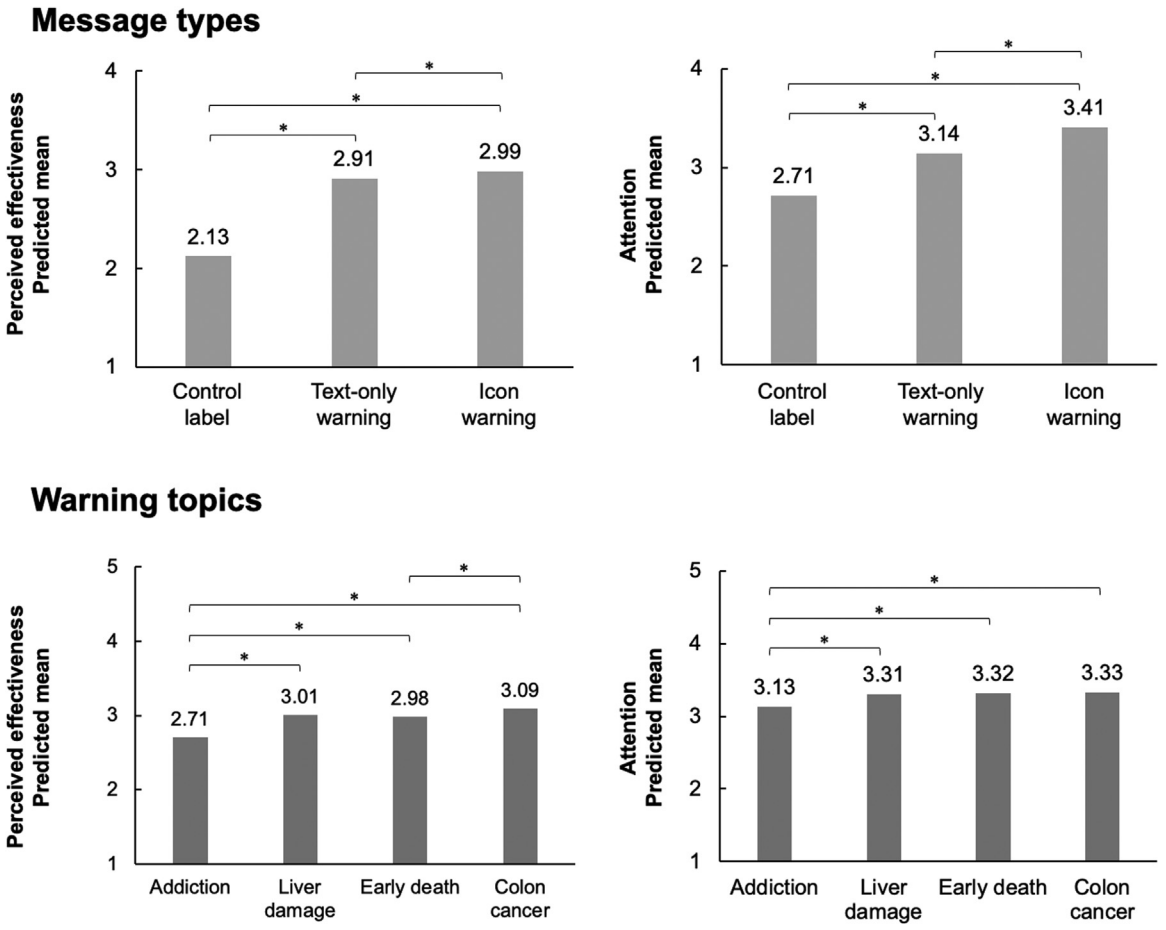

Figure 2. Perceived effectiveness and attention by message type and warning topic, N=3,051 U.S. adults.
Note: Figure shows the predicted mean perceived effectiveness and attention by message type and warning topic, as estimated using mixed effects linear regression. *$p<0.05$. Comparisons without brackets are not significantly different from one another ($p>0.05$).

participants perceived newly developed, evidence-based alcohol warnings—particularly warnings with icons—as more effective and more attention grabbing than control labels. Warning effectiveness did not differ by participant characteristics, including age, gender, race/ethnicity, and alcohol consumption, providing early evidence that well-designed alcohol warnings may not exacerbate disparities. The findings in this study align with a quasiexperiment from the Yukon Territories that showed that implementation of large warnings with icons (which depicted standard drink amounts and low-risk drinking guidelines) increased attention to warnings[28] and lowered alcohol sales.[30] This study's findings are also consistent with experimental evidence that pictorial alcohol warnings with graphic images can exert beneficial effects on behavioral intentions,[32] alcohol selection,[33,34] and speed of drinking.[35]

Previous studies have shown that alcohol warnings with graphic images are more effective than text-only warnings at increasing fear[32] and reducing consumers' hypothetical selection of alcohol.[33] However, studies have not examined alcohol warnings with icons. This experiment found that icon warnings were rated as more effective and more attention grabbing than text-only warnings, indicating that adding icons to warnings could enhance warnings' effectiveness. These findings may be especially important in the U.S. context, where implementation of warnings with graphic images for tobacco has been delayed because of industry litigation,[75] but icon warnings have been successfully implemented in New York[76] and Philadelphia[77] for high-sodium restaurant menu items. Future studies should compare alcohol warnings with graphic images to those with icons. More research is also needed to evaluate additional aspects of warning design such as label color,[60,62,78,79] other warning topics, and additional icon designs.

All warning topics (addiction, liver damage, early death, colon cancer) were rated as more effective and attention grabbing than the control messages. Although the addiction warning was perceived to be less effective and less attention grabbing than the other topics (similar

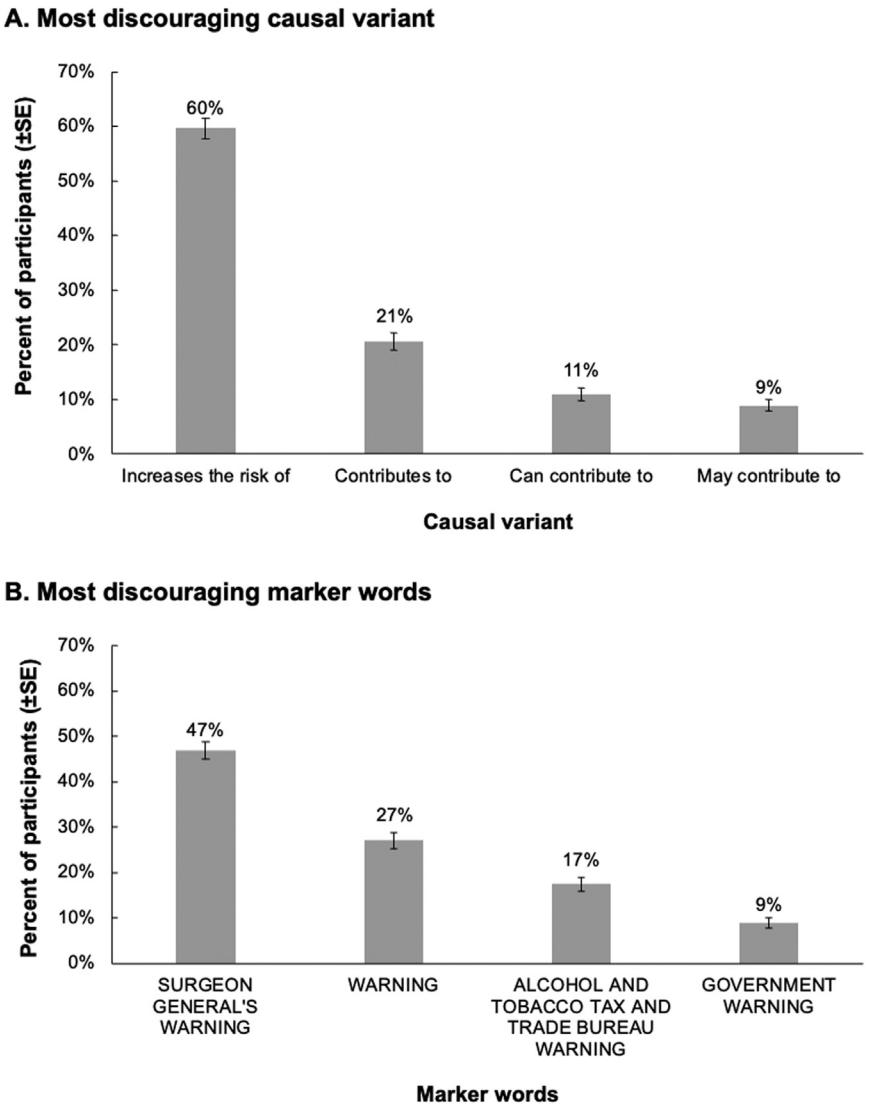

Figure 3. Percentage of participants selecting most discouraging (A) causal variants (n=676 U.S. adults) and (B) marker words (n=678 U.S. adults).

to findings from tobacco control research on addiction messages[22,53]), there were few other differences between the warning topics. These results suggest that policymakers have several options for harms to describe in alcohol warnings.

Limitations

Strengths of this study include the experimental design and the large, diverse sample. Limitations include that outcomes were self-reported and may not reflect real-world responses; studies using objective measures (e.g., eye tracking) are warranted. In addition, this message development experiment did not assess alcohol consumption, precautionary behaviors,[80] or other aspects of the persuasion process (e.g., emotional reactions, risk perceptions) and did not assess awareness of health harms. The study also did not assess all relevant causal variants, marker words, or health harms. Finally, survey items were adapted from research on tobacco warnings, and their psychometric properties have not been studied in the context of alcohol warnings.

CONCLUSIONS

Health warnings could discourage harmful alcohol consumption, but most adults in this study rarely or never read or looked closely at the alcohol warnings currently mandated in the U.S. New, evidence-based alcohol warnings could attract attention and reduce harmful alcohol consumption, especially if warnings include icons.

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CREDIT AUTHOR STATEMENT

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SUPPLEMENTAL MATERIAL

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