ADDICTION
SSA SOCIETY FOR THE STUDY OF ADDICTION
RESEARCH REPORT
doi:10.1111/add.15072

Impact of health warning labels communicating the risk of cancer on alcohol selection: an online experimental study

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ABSTRACT

Aims Evidence from tobacco research suggests that health warning labels (HWLs) depicting the adverse consequences of consumption change smoking behaviours, with image-and-text (also known as 'pictorial' or 'graphic') HWLs most effective. There is an absence of evidence concerning the potential impact of HWLs placed on alcohol products on selection of those products. This study aimed to obtain a preliminary assessment of the possible impact of (i) image-and-text, (ii) text-only, and (iii) image-only HWLs on selection of alcoholic versus non-alcoholic drinks. **Design** A between-subjects randomised experiment with a 2 (image: present versus absent) × 2 (text: present versus absent) factorial design. **Setting** The study was conducted on the online survey platform Qualtrics. **Participants** Participants (n = 6024) were adults over the age of 18 who consumed beer or wine regularly (i.e. at least once a week), recruited through a market research agency. **Interventions** Participants were randomised to one of four groups varying in the HWL displayed on the packaging of alcoholic drinks: (i) image-and-text HWL; (ii) text-only HWL; (iii) image-only HWL; and (iv) no HWL. HWLs depicted bowel cancer, breast cancer and liver cancer, which were each displayed twice across six alcoholic drinks. Each group viewed six alcoholic and six non-alcoholic drinks and selected one drink that they would like to consume. **Measurements** The primary outcome was the proportion of participants selecting an alcoholic versus a non-alcoholic drink. **Findings** Alcoholic drink selection was lower for all HWL types compared with no HWL (image-and-text: 56%; image-only: 49%; text-only: 61%; no HWL: 77%), with selection lowest for HWLs that included an image. Image-and-text HWLs reduced the odds of selecting an alcoholic drink compared with text-only HWLs (OR = 0.80, 95% CI = 0.69, 0.92), but increased the odds of selecting an alcoholic drink compared with image-only HWLs (OR = 1.34, 95% CI = 1.16, 1.55). **Conclusions** Health warning labels communicating the increased risk of cancers associated with alcohol consumption reduced selection of alcoholic versus non-alcoholic drinks in a hypothetical choice task in an online setting; labels displaying images had the largest effect. Their impact in laboratory and real-world field settings using physical products awaits investigation.

Keywords alcohol, cancer, choice architecture, graphic warnings, health warning label, pictorial health warning label.

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Submitted 9 August 2019; initial review completed 25 November 2019; final version accepted 1 April 2020

INTRODUCTION

Excessive consumption of alcohol increases the risk of a range of diseases including liver disease, heart disease and some cancers [1,2]. The World Health Organisation (WHO) Global Alcohol Strategy aims to achieve at least a 10% reduction in the harmful use of alcohol by 2025 [3]. One potential method to reduce excessive alcohol consumption is by using labels on alcohol products to inform consumers of their potential harmful effects. This can be considered a choice architecture intervention. Such interventions typically involve altering the properties or placement of objects or products in physical micro-environments to change behaviours, with a close

temporal and spatial relationship between the exposure and the behaviour [4]. Within the typology of interventions in proximal physical micro-environments (TIPPME) intervention typology [4], labelling interventions are classified as 'Information' interventions.

Worldwide, labelling requirements are diverse and are typically limited. In the United Kingdom, it is only mandatory to include alcohol strength on product packaging, although labels may also provide information regarding alcohol unit content, low risk drinking guidelines, pregnancy warnings and the dangers of drink-driving through voluntary, industry-led agreements. However, current UK labelling often falls short of best practice [5], and there is evidence that current labels attract minimal attention [6,7].

The inclusion of additional elements may increase alcohol label effectiveness, including health warnings that provide information to increase the currently low awareness of the link between alcohol and cancer [8,9]. Evidence for the impact of such health warnings principally derives from tobacco control. Health warning labels (HWLs) on tobacco products impact a range of outcomes including cessation related behaviours such as quitting intentions and smoking initiation [10–12]. Mandatory tobacco labelling is currently in place in 118 countries worldwide [13] with guidelines specifying large warnings—no less than 30% of the packaging—that may include images alongside text statements, commonly termed 'pictorial' or 'graphic' HWLs [14]. There are larger effects from image-and-text HWLs compared to text-only HWLs [10,12,15], possibly because of the former eliciting greater negative emotional arousal [16]. Image-and-text HWLs on tobacco products provide clear evidence of a feasible and acceptable population level intervention [17], reaching socially and materially deprived groups [18]. Recent calls for improved alcohol labelling suggest HWLs, akin to those on tobacco packaging, should be implemented [19]. This is, however, in the context of a near-complete absence of evidence of their potential efficacy, with only a small number of relevant, although typically underpowered, studies conducted to date [20–23].

Evidence from the few studies conducted to assess the impact of HWLs on alcoholic beverages suggests that their use shows promise, but there are limited studies looking at selection or consumption-related behaviours [24]. Text-only HWLs that include messages warning of increased cancer risk can increase motivation to reduce drinking and are accepted by consumers [25], with specific messages (i.e. alcohol can increase your risk of bowel cancer), having a stronger effect than general messages (i.e. alcohol increases your risk of cancer) [26,27]. Image-and-text HWLs can slow consumption [21] and reduce intention to drink [22,28] and exert larger effects on quitting and consumption intentions than text-only HWLs [22]. However, one study suggests image-and-text and text-only HWLs are equally effective at reducing speed of consumption [21]. With regard to image-and-text HWLs, uncertainty also remains around the types of images that may exert the greatest effect. Warnings including shocking or explicit pictures are most likely to be believed and are rated as more effective than those with less severe pictures [29]. The former, however, may also increase reactance and avoidance behaviours [28] and may be less acceptable [30]. It is therefore important to assess the potential efficacy of a variety of HWLs, as well as levels of reactance and avoidance, and acceptability.

A further uncertainty concerning HWLs is whether text is necessary for images to impact on behaviour, given poor specification of the mechanisms by which HWLs are effective. Previous work on the use of aversive health-related images suggests that pairing less healthy snack foods with aversive images of adverse health consequences—such as heart disease—without a text warning statement reduces selection of the product, an effect mediated by changes in attitudinal preferences [31,32]. To our knowledge, there are no studies assessing the impact of image-only HWLs on alcohol. Given this absence of evidence and an assumption that some text may be needed for interpretation, we hypothesised that image-only HWLs would be less effective than image-and-text and text-only HWLs. Comparing the impact of an image-and-text HWL to an image-only HWL could valuably indicate the extent to which text is necessary. Additionally, many frequent decisions—such as what to eat or drink—are made under conditions in which individuals' cognitive resources are limited or deployed elsewhere, with individuals more likely to make unhealthy choices under such conditions [33]. Specific nutritional labelling systems may only be effective when cognitive resource is high [34,35]. It is therefore important to assess the impact of HWLs on selection when cognitive resource is limited. One commonly used method for limiting cognitive resource—particularly in the context of labelling—is inducing time pressure, with the available evidence suggesting that limited time prevents people from accessing all available cognitive resources, making non-reflective or impulsive behaviour more likely [34,36,37].

The primary aim of the current study was to assess the impact on selection of alcoholic beverages of different types of HWLs communicating the risk of cancer related to alcohol consumption: (i) image-and-text, (ii) text-only and (iii) image-only. We hypothesised that text-only and image-and-text HWLs would decrease selection of alcoholic drinks compared to image-only HWLs and no HWL. The secondary aims were to assess (i) the impact of HWLs on emotional and cognitive responses—including negative emotional arousal, reactance, avoidance, and acceptability, and (ii) the impact of limited cognitive resource on selection of alcoholic drinks with HWLs.

METHODS

The study protocol and a detailed analysis plan were pre-registered on the Open Science Framework (https://osf.io/pr8zu/).

Design

The study was conducted on the online survey platform Qualtrics, using a between-subjects 2 (image: present versus absent) × 2 (text: present versus absent) factorial experimental design. Participants were randomised via the Qualtrics platform to one of four possible experimental groups (Box 1).

Participants

Participants were adults over the age of 18, who consumed beer or wine regularly (i.e. at least once a week), recruited through a market research agency (https://www.dynata.com/). The research agency set quotas for age and gender to recruit a representative sample of the UK general population, in terms of age and gender.

Based on previous research assessing the impact of different warning labels on selection of sugar-sweetened beverages [38], the expected difference in the proportion of participants selecting an alcoholic beverage between the different label type groups was expected to be 5.7%, decreasing from 38.2% to 32.5%. To detect this difference with power = 0.8, and alpha = 0.0167 (applying

Box 1 Study design

	Image of adverse health consequence	
Health consequence – text statement	*Present*	*Absent*
Text	Group 1 Image-and-text HWL	Group 2 Text-only HWL
		
No text	Group 3 Image-only HWL	Group 4 No HWL
		

[Correction added on 10 June 2020, after first online publication: The image for Group 4 in Box 1 has been changed in this version.]

Bonferroni adjustment for three separate comparisons between the four groups), it was calculated that at least 1497 per label group were needed, giving a minimum sample size requirement of 5988.

Interventions

Label design

The specific adverse health consequences illustrated by the HWLs were chosen based on the results of another study [30], which aimed to identify the images eliciting the highest levels of negative emotional arousal and the lowest desire to consume the product. The three HWLs selected depicted bowel cancer, breast cancer and liver cancer. The same health consequences were used for each HWL group (image-and-text, text-only, image-only). In the control group, branded labels were displayed on the products in their original form. In the HWL groups, brand information was moved so it remained clearly visible. The labels used in the study were prepared by a graphic designer (see https://osf.io/6dx2u/ for study stimuli). Full details on the selection process and the labels that were ultimately used in the current study can be found in the Supporting information (S1).

Outcomes

Primary outcome

Selection task. Participants first viewed images of 12 drinks (six alcoholic and six soft drink/non-alcoholic alternatives) in turn. All drinks—alcoholic and non-alcoholic—were branded, comprising a variety of different brands. The six non-alcoholic drinks comprised three different soft drinks and three different alcohol-free beers or wines. Whether the options shown were beer or wine depended on participant preference specified at the start of the study. Participants then viewed images of all the 12 drinks simultaneously, in random order, and were asked to choose one they would like to consume either immediately or later on that day—to reduce the likelihood of decisions being made based on the time of day. Depending on their allocated group, the alcoholic drinks displayed either no HWL or one of three warning label types (image-and-text, text-only, image-only). In the HWL groups, each alcoholic drink displayed one of the three different HWLs (i.e. one of the three health consequence labels) so that each health consequence was shown twice (i.e. on two drinks) across the selection. The outcome was the proportion of participants selecting an alcoholic beverage (beer or wine).

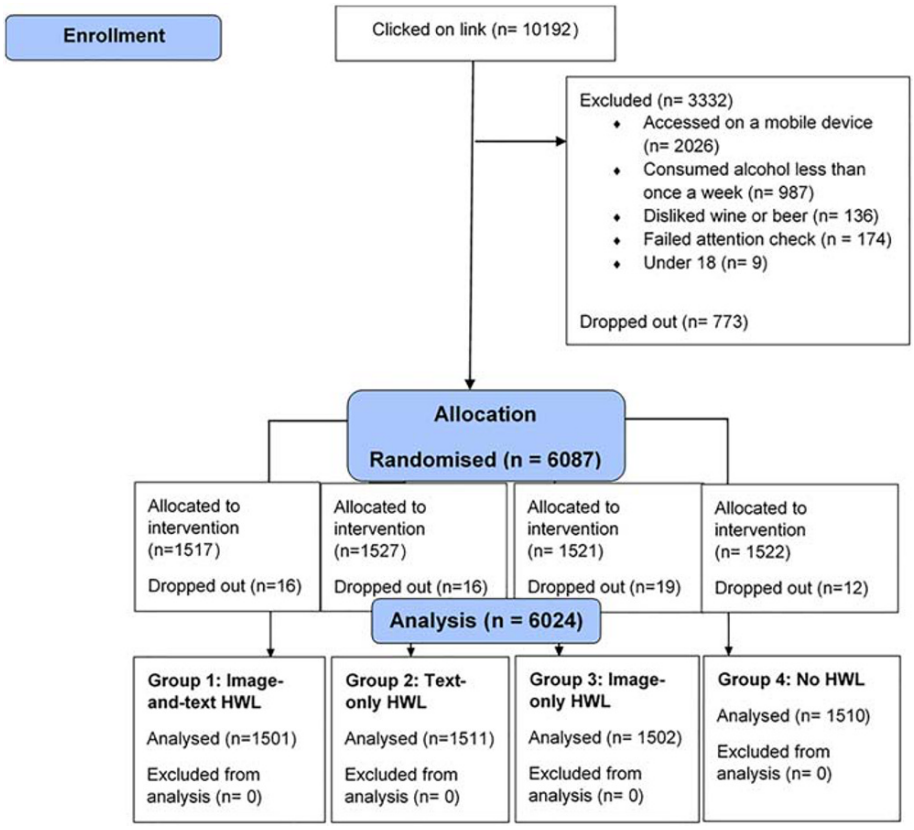

Figure 1 Flow of participants through study [Colour figure can be viewed at wileyonlinelibrary.com]

Secondary outcomes

Negative emotional arousal was assessed using a four-item measure, previously used to assess the impact of warning labels on cigarette packages [39]. Responses were rated on seven point scales: 'How [afraid/worried/uncomfortable/disgusted] does the label on this drink make you feel?' (0 Not at all [afraid /worried/uncomfortable/disgusted] to 7 very [afraid/worried/uncomfortable/disgusted]).

Reactance and avoidance (defensive reactions) were assessed using two items, previously used to assess the impact of warning labels on alcohol products [25]. The items were from a 27-item scale developed by Hall et al. [40] for reactance to tobacco health warnings. Responses were rated on seven point scales: (0 Not at all to 7 [annoying/likely] very [annoying/likely]) to both items: 'Are these labels annoying?'; 'Are you likely to avoid these labels?'

Acceptability of health warning labels was assessed using one item on a seven-point scale, adapted from previous research assessing the impact of sugar tax [41]: 'Do you support or oppose putting this label on alcoholic drinks?' (Strongly oppose—neither oppose nor support—strongly support). Ratings past the midpoint (indicating neither acceptable nor unacceptable), i.e. above 4 on the scale, were taken to indicate that the label was acceptable.

Perceived disease risk relating to drinking the alcoholic beverage was assessed using a three-item measure on seven-point scales adapted from previous research used to assess the impact of warning labels on sugar-sweetened beverages [42]: 'Consuming this drink often would [increase your risk of [cancer/liver disease] /help you lead a healthier life]' (Strongly disagree—neither agree nor disagree—strongly agree). Scores for the three items were combined into a total 'disease risk'

Table 1 Participant characteristics (*n* (%), unless otherwise stated)

	Group 1: image-and-text HWL n = 1501	*Group 2: text-only HWL n = 1511*	*Group 3: image-only HWL n = 1502*	*Group 4: control (no HWL) n = 1510*
Weekly consumption (units)[a]				
0–14	768 (51%)	728 (48%)	745 (50%)	751 (50%)
15–30	402 (27%)	433 (29%)	382 (25%)	398 (27%)
31–50	159 (11%)	179 (12%)	189 (13%)	187 (12%)
51–99	119 (8%)	113 (8%)	128 (9%)	117 (8%)
100+	41 (3%)	52 (3%)	48 (3%)	48 (3%)
Missing	12	6	10	9
Preferred drink				
Wine	667 (44%)	626 (41%)	659 (44%)	669 (44%)
Beer	834 (56%)	885 (59%)	843 (56%)	841 (56%)
AUDIT[b] score (mean ± SD)	5.4 (2.5)	5.5 (2.5)	5.5 (2.6)	5.5 (2.5)
Age (mean ± SD)	49.7 (15.6)	49.4 (15.6)	49.1 (15.2)	49.7 (15.6)
18–39 years	451 (30%)	453 (30%)	450 (30%)	464 (31%)
40–59 years	572 (38%)	589 (39%)	584 (39%)	615 (41%)
60 and over	482 (32%)	468 (31%)	465 (31%)	419 (28%)
Gender				
Male	779 (52%)	725 (48%)	749 (50%)	757 (50%)
Female	721 (48%)	784 (52%)	749 (50%)	752 (50%)
Other	0	1 (<1%)	3 (<1%)	0
Prefer not to say	1	1	1	1
Ethnicity				
White	1401 (93%)	1416 (94%)	1402 (93%)	1410 (93%)
Mixed	26 (2%)	26 (2%)	23 (2%)	29 (2%)
Asian	42 (3%)	44 (3%)	43 (3%)	43 (3%)
Black	15 (1%)	14 (1%)	21 (1%)	17 (1%)
Other ethnic group	5 (<1%)	2 (<1%)	2 (<1%)	2 (<1%)
Prefer not to say	12	9	11	9
Education				
No Bachelor's degree	732 (49%)	831 (55%)	751 (50%)	754 (50%)
Bachelor's degree or higher	765 (51%)	675 (45%)	749 (50%)	753 (50%)
Prefer not to say	4	5	2	3

HWL, health warning label. Note: missing/prefer not to answer data is listed in the table but all % are valid %. [a]All participants in the sample explicitly reported drinking at least once a week in the screener questions. A further weekly drinking measure recorded the amount of alcohol consumed in the previous week as an overall indication of the volume of alcohol consumed weekly. [b]Heavy and binge drinking behaviours (AUDIT-C), three questions to detect heavy and binge drinking behaviour in a general population, with a total score of 0 (low risk) to 12 (high risk) [43].

Table 2 Primary (% (*n*)) and secondary outcomes (mean (SD)).

	Group 1: image-and-text HWL n = 1501	*Group 2: text-only HWL n = 1511*	*Group 3: image-only HWL n = 1502*	*Group 4: control (no HWL) n = 1510*
Primary				
Proportion choosing alcoholic beverage	56% (837)	61% (926)	49% (728)	77% (1157)
Secondary (scale range)				
Negative emotional arousal [1–7]	4.12 (1.71)	3.53 (1.66)	4.23 (1.80)	1.55 (1.20)
Reactance [1–7]	4.66 (1.93)	4.32 (1.96)	4.78 (1.89)	1.66 (1.29)
Avoidance [1–7]	4.32 (1.99)	3.77 (1.92)	4.49 (2.07)	1.96 (1.62)
Perceived disease risk [3–21]	14.99 (3.43)	14.76 (3.30)	15.05 (3.34)	13.16 (3.35)
Acceptability[a] [1–7]	3.60 (1.91)	3.87 (1.76)	3.13 (1.81)	-
Number of alcoholic drinks selected (0–6) with cognitive resource manipulation				
With time pressure	2.25 (1.93)	2.34 (1.85)	2.14 (1.97)	2.37 (1.65)
With no time pressure	3.08 (2.19)	3.14 (2.06)	2.75 (2.19)	3.17 (1.90

HWL, health warning label. [a]Re-randomisation, into one of the other three groups, occurred for the no image group therefore the total n for this variable were: text-only $n = 2020$, image-only $n = 2000$ and image-and-text $n = 2004$. The reference group for this analysis was the text-only condition.

score, with scores reversed for item three: 'help you lead a healthier life'.

Selection in relation to cognitive resource manipulation was adapted from previous research on front-of-pack nutrition labelling [35,37]. After the first selection task, participants were randomised to select a drink under either high (3 seconds) or no time pressure (60 seconds) from six pairs of alcoholic and non-alcoholic drinks (soft drink or zero alcohol) either for immediate consumption or later on that day. The alcoholic drinks displayed either had no HWL or one of the three HWLs depending on randomisation. Participants were required to make a selection six times from six different pairs. The outcome was the number of times an alcoholic drink was selected (a score from 0–6). Not selecting a drink was a possible option. Not selecting a drink and selecting a non-alcoholic drink were each coded as zero.

Procedure

Ethical approval for this study was granted by the Cambridge Psychology Research Ethics Committee (reference: PRE.2018.072). After consenting to participate, participants completed screening questions relating to their normal consumption of alcohol. Eligible participants were asked questions regarding their demographic characteristics (age, gender, ethnicity, education level, household income) and preferred type of alcoholic beverage (beer or wine) to determine the drinks to be viewed in the subsequent task. After completing the screening and demographic questions, participants were randomised to one of four possible experimental groups (Box 1) and were asked to complete all tasks and measures. Participants could not proceed without answering all questions. Prior to randomisation, inattentive participants were screened out via an attention check embedded in the study (those not answering 'never' to the question: 'When did you last fly to Mars?') and sampling continued until the quota was filled. All participants who successfully completed the study were debriefed and reimbursed for their participation. Data were collected in February 2019.

Eligible participants first completed the selection task (see primary outcome). Participants then viewed an image of a beer or wine bottle with or without a HWL depending on their allocated group and were asked to complete questions relating to their perceptions and attitudes toward the HWL (or toward a branded product with no HWL for those in the control group). For the acceptability outcome only, participants in the no label group were re-randomised to one of the other three HWL groups. Participants were then randomised to a time pressure group and completed a second selection task (see secondary outcomes), followed by measures of drinking characteristics (AUDIT-C [43], weekly consumption), height and weight.

Statistical analysis

Descriptive statistics compared baseline characteristics of those allocated to different types of warning label. Logistic regressions were performed to assess the odds of selecting an alcoholic beverage in each group, using the 'no HWL' group as the reference category. The factorial 2 × 2 design was exploited by assessing the impact of text and image simultaneously, and the interaction between the two. Each effect was calculated as an OR with 95% CIs, along with the corresponding *P* value.

For four of the continuous secondary outcomes, normality was assessed, and 2 × 2 ANOVA (analysis of variance) models were used to compare the impact of text and image between study arms. For analysis of the remaining acceptability outcome a one-way ANOVA was conducted between the three study arms. A general linear model using a 2 × 2 × 2 design assessed the differences

in the number of alcoholic drinks selected between the two time–pressure groups (time pressure vs. no time pressure) and the impact of text and image.

Analyses of all secondary outcomes were repeated using a bootstrapping method, using 1000 bootstrap samples due to deviations from normality in their distributions: results were very similar (Supporting information Table S5). The effect size for all secondary outcomes was a difference in means, with 95% CIs, *F* statistics, *P* values and Cohen's *d* all reported. As an exploratory analysis, negative emotional arousal was added to the primary logistic regression model as a covariate to assess the potentially mediating role of negative emotional arousal.

A detailed analysis plan was registered (registration details: https://osf.io/ntq63/).

RESULTS

In total, 6087 participants were randomised and 6024 participants completed the study. Figure 1 shows the flow of participants through the study and Table 1 their characteristics across groups. Half of the sample were female and the mean age was 49.5 (SD = 15.5). Groups were well balanced on all characteristics.

Primary outcome

Alcoholic drink selection was lower when drinks displayed a HWL compared to when no HWL was used (see Table 2). Absolute reductions in percentages compared to no HWL were: image and text: 21% (95% CI = 18%, 24%), image-only: 28% (95% CI = 25%, 31%) and text only: 16% (95% CI = 12%, 19%). All HWLs decreased the odds of selecting an alcoholic drink. Compared to no HWL, the odds of selecting an alcoholic drink was 61% lower for the image-and-text HWL (OR = 0.39, 95% CI = 0.33, 0.45); 52% lower for the text-only HWL (OR = 0.48, 95% CI = 0.41, 0.57) and 71% for the image-only HWL (OR = 0.29: 95% CI = 0.25, 0.34).

The results of a factorial 2 (text versus no text) × 2 (image versus no image) analysis provided evidence of a main effect of including text (OR = 0.84, 95% CI = 0.76, 0.93, $P = 0.001$), an image (OR = 0.49, 95% CI = 0.44, 0.54, $P < 0.001$) and an interaction between the two factors ($P < 0.001$). HWLs displaying images (image-and-text HWL: 56%; image-only HWL: 49%) decreased alcoholic drink selection compared to text alone (61%) and no HWL (77%). Adding an image to text reduced the odds of selecting an alcoholic drink, meaning that image-and-text HWLs reduced selection compared to text-only HWLs (OR = 0.80, 95% CI = 0.69, 0.92, $P = 0.002$). Adding text to an image increased the odds of selecting an alcoholic drink, meaning that image-and-text HWLs increased selection compared to image-only HWLs (OR = 1.34, 95% CI = 1.16, 1.55, $P < 0.001$).

Secondary outcomes

Secondary outcome data are presented in Table 2. Compared to not having any label, all HWLs increased scores on each secondary outcome—negative emotional arousal, reactance, avoidance and disease risk (all $P < 0.001$).

Table 3 Mean differences between HWL groups and no HWL for secondary outcomes

	Mean difference compared with no HWL (95% CI), P value, effect size (Cohen's d)		
Secondary outcome	*Group 1: image-and-text HWL (n = 1501)*	*Group 2: text-only HWL (n = 1511)*	*Group 3: image-only HWL (n = 1502)*
Negative emotional arousal	2.57 (2.46, 2.69) $P < 0.001$, $d = 1.74$	1.98 (1.87, 2.10) $P < 0.001$, $d = 1.37$	2.68 (2.56, 2.80) $P < 0.001$, $d = 1.75$
Reactance	3.00 (2.83, 3.17) $P < 0.001$, $d = 1.82$	2.66 (2.49, 2.83) $P < 0.001$, $d = 1.60$	3.12 (2.94, 3.28) $P < 0.001$, $d = 1.92$
Avoidance	2.36 (2.23, 2.50) $P < 0.001$, $d = 1.30$	1.82 (1.68, 1.95) $P < 0.001$, $d = 1.01$	2.53 (2.39, 2.67) $P < 0.001$, $d = 1.36$
Perceived disease risk[a]	1.83 (1.59, 2.07) $P < 0.001$, $d = 0.53$	1.60 (1.36, 1.84) $P < 0.001$, $d = 0.48$	1.89 (1.65, 2.13) $P < 0.001$, $d = 0.57$
	Mean difference compared with image-and-text HWL (95% CI), P value, effect size (Cohen's d)		
	Group 1: image-and-text HWL (n = 2004)	*Group 2: text-only HWL (n = 2020)*	*Group 3: image only HWL (n = 2000)*
Acceptability	– –	0.27 (0.15, 0.38) $P < 0.001$, $d = 0.15$	−0.47 (−0.59, −0.36) $P < 0.001$, $d = -0.25$

HWL, health warning label. [a]Aggregate measure of three items (cancer, liver disease, perceived healthiness of the drink).

The main effects of image, text and the image × text interaction for all four 2 × 2 ANOVA models showed evidence of significant effects (all $P < 0.001$) (Supporting information Fig. S2 and Table S2). For negative emotional arousal, reactance and avoidance adding an image to text increased scores (all $P < 0.001$). For avoidance only, there was clear evidence that adding text to an image decreased scores ($P = 0.018$). There was a very weak suggestion of a similar pattern for reactance and negative emotional arousal scores. Perceived disease risk in all three HWL groups did not show evidence of being different from each other. Mean differences between each HWL group and the no HWL group are shown in Table 3.

Acceptability of the HWLs

Image-and-text HWLs were less accepted than text-only HWLs (mean difference [MD] = 0.27 95% CI = 0.15, 0.38, $P < 0.001$, $d = 0.15$), and were more accepted than image-only HWLs (MD = −0.47 95% CI = −0.59, −0.36, $P < 0.001$, $d = -0.25$) (Table 2). Overall, 31.74% of participants rated HWLs as acceptable (text-only HWLs: 37.33%; image-and-text HWLs: 34.18%; image-only HWLs: 23.65%). A sensitivity analysis was conducted which included only those participants who were assigned to their original group ($n = 4514$, i.e. it excluded the control group who were re-randomised). The results were similar to the main analysis (see Supporting information S3).

Cognitive resource manipulation

There was a main effect of time pressure (MD = 0.76 95% CI = 0.66, 0.86, $P < 0.001$, $d = 0.39$), indicating that participants selected fewer alcoholic drinks when they were under time pressure in all groups (Table 2). There was no evidence of an interaction between time pressure and HWL group ($P = 0.40$). As non-selections were coded identically to non-alcoholic drink selections, a sensitivity analysis was conducted, coding the non-selections as alcoholic drink selections. The descriptive statistics were similar to the main analysis for the differences between HWL groups (see Supporting information S4). However, the results for the differences in alcohol selection under time pressure were in the opposite direction, with more alcoholic drinks selected, due to more non-selections under time pressure (mean non-selections under time pressure: 1.73; no time pressure: 0.14).

Mediating effect of negative emotional arousal

As an exploratory analysis, negative emotional arousal was added to the primary logistic regression model as a covariate. The OR for selecting an alcoholic drink associated with a text-only HWL changed from 0.48 before adjusting for negative emotional arousal, to 1.11 (95% CI = 0.93, 1.13) after adjustment, while that for an image-only HWL adjusted from 0.29 before, to 0.84 (95% CI = 0.69, 1.01) after, and for an image-and-text HWL adjusted from 0.39 to 1.11 (95% CI = 0.92, 1.34) (Table 4). The model suggested possible mediation by negative emotional arousal of the effect of HWLs on alcohol selection.

DISCUSSION

In an online selection task, placing HWLs on bottles of wine or beer communicating the increased risk of specific cancers associated with alcohol consumption reduced selection of alcoholic drinks. HWLs displaying images were more effective at reducing selection than text-only HWLs, with image-only HWLs most effective at decreasing selection. This pattern of findings partly supported our hypotheses in showing that image-and-text and text-only HWLs decreased selection of alcohol, but we did not predict that image-only HWLs would be most effective.

These findings are consistent with evidence that HWLs decrease selection of other harmful products, such as tobacco and sugar-sweetened beverages [10,38]. They are also consistent with results from laboratory and online studies suggesting that text-only and image-and-text HWLs lower intentions to consume alcohol and reduce speed of consumption [21,22,25,28]. In the current study, although all HWLs reduced selection, labels containing images had the largest effects, even without text. The greater

Table 4 Exploratory mediation analysis (negative emotional arousal) for the primary outcome (was an alcoholic drink selected).

	Type of drink selected		*Model effects*[a]		*Model effects (including negative emotional arousal as a covariate)*[b]	
HWL group	*Non-alcoholic*	*Alcoholic*	*OR (95% CI)*	*P value*	*OR (95% CI)*	*P value*
Control ($n = 1510$)	353 (23)	1157 (77)	–	–	–	–
Text-only ($n = 1511$)	585 (39)	926 (61)	0.48 (0.41, 0.57)	<0.001	1.11 (0.93, 1.32)	0.270
Image-only ($n = 1502$)	774 (52)	728 (49)	0.29 (0.25, 0.34)	<0.001	0.84 (0.69, 1.01)	0.059
Image-and-text ($n = 1501$)	664 (44)	837 (56)	0.39 (0.33, 0.45)	<0.001	1.11 (0.92, 1.34)	0.278

HWL, health warning label. [a]Model includes the main effect of HWL group only. [b]Model includes the main effect of HWL group and negative emotional arousal as a covariate.

effectiveness of images with text compared to text-only is in line with evidence from tobacco research [10,12,15]. One explanation for the superiority of image-based labels is that they arouse more negative emotion than text-only HWLs [16], with this also observed in the current study. An exploratory analysis also suggested a possible mediation of the impact of all HWLs on selection by negative emotional arousal i.e. HWLs increase negative emotional arousal that in turn impacts selection. However, the current study design precluded testing whether this was a causal relationship as negative emotional arousal was measured following the primary outcome. Future studies would need to be designed to examine the causal relationship between these variables.

Image-only HWLs reduced selection to a greater extent than image-and-text HWLs, suggesting that an interpretative text statement is not necessary for effectiveness—at least when the content of images is sufficiently understandable or interpretable—and that this may even reduce the impact of the image. Supporting evidence from food research shows that pairing less healthy snack foods with aversive images of negative consequences without text statements can reduce product selection [31,32]. Future studies should assess whether the relevance of an image to health is important for label effectiveness, or whether simply the aversive nature of any image is sufficient to change behaviour. In the current study, avoidance of the label was increased when labels were displayed without the text statement, suggesting a textual description may be important in attenuating the likely avoidance of labels containing aversive images. Any accompanying text on a label should not however distract from an image, which seems the key component for maximum impact.

All of the HWLs increased defensive reactions—reactance and avoidance—compared to no HWL, with scores for both highest for HWLs with an image. The effect sizes for the difference in scores in the HWL groups compared to no HWL were large (with all Cohen's *d* values over 1), although—as with all secondary outcomes—this study cannot elucidate the practical consequences of these differences. Furthermore, the impact of a public health intervention will be a function of its effect size and scale of application—a small effect that influences the behaviour of a very large number of people (as is conceivably the case here) could potentially be very important. These results are consistent with the findings from another online study, which showed larger increases in self-report measures of reactance and avoidance for more severe images on alcohol HWLs [28]. In addition, evidence of defensive reactions does not necessarily indicate lack of effectiveness—as demonstrated in the current study and previous research on tobacco HWLs [44].

Perceived disease risk was increased with all HWLs compared to no HWL suggesting that HWLs have the potential to increase the currently low awareness of alcohol harms, such as the alcohol-cancer link [8]. An increase in awareness of alcohol harms may also increase HWL acceptability, which was low in the current study. Overall, only 32% of participants rated the HWLs as acceptable to some degree, with the HWLs that were most effective—those with images—being least acceptable, although the differences were small. This is consistent with evidence of the most effective interventions being the least accepted [45]. However, low scores may be more representative of the study population of regular alcohol drinkers than the wider population. Those that drink more heavily may see alcohol as more socially acceptable [46] and have reduced perceptions of alcohol risk susceptibility [28]. Some studies have found relatively high public acceptability for alcohol HWLs, but in neither study were participants shown examples of the images [47,48]. With increased awareness of health risks alongside demonstrated effectiveness, acceptability of HWLs may increase [41]. A recent field study investigating the impact of HWLs on purchasing alcohol focused on communicating risks of cancer from alcohol consumption. These labels increased knowledge of the link between alcohol consumption and cancer, which was associated in turn with increased support for alcohol control policies such as pricing policies [49]. This study was halted due to pressure from the alcohol industry and continued without the cancer HWLs—highlighting potential challenges from industry to interventions that associate their products with health harms [50].

Findings from the cognitive resource manipulation indicated that, across all groups, fewer alcoholic drinks were selected under time pressure. This was in the opposite direction to that anticipated, with reduced cognitive resources leading to less healthy choices [33]. However, in the current task, it was possible for participants to not select any drink, and so it may be that not making any selection was more likely when time was limited. Supporting this possible interpretation, we found there were more non-selections in the time pressure group and a sensitivity analysis (coding the non-selections as alcoholic drinks instead of non-alcoholic drinks, as was done in the original analysis) was in the opposite direction to the original results, with more alcoholic drinks selected under time pressure due to the higher number of non-selections. There was no interaction between time pressure and HWL group, indicating that the impact of the HWLs did not differ under low resource, which is not in line with findings from previous studies [34,35]. This could be due to the nature of the task. First, participants were required to choose between two drinks; it may be that the alcohol-free drinks were disliked or too unfamiliar, supported by a low proportion of participants selecting them in the main selection task: of those who selected a non-alcoholic drink, fewer than a third selected alcohol free wine or beer. Second, the time

pressure task may have been too artificial to adequately induce cognitive load, this being difficult to manipulate in an online setting.

Implications

The current study findings indicate that image-and-text, text-only and image-only HWLs can reduce hypothetical selection of alcohol in an online study. However, findings do not necessarily translate to other more naturalistic settings [51], and further evaluation of these HWLs is now required in laboratory and field settings. Evidence of effectiveness in these contexts would provide support for current recommendations from alcohol public health bodies for larger, prominent labels that clearly describe alcohol-related harms [52].

Strengths and limitations

This pre-registered study provides the most robust evidence to date of the potential for HWLs communicating the increased risk of cancer, designed in line with tobacco HWL guidelines [14], to reduce selection of alcohol in an online setting.

The study design conferred some limitations. First, the setting was artificial, involving the use of images of products and a hypothetical selection task with a limited product range. Although important to highlight the HWLs with the most potential, subsequent evaluation is now needed in more realistic settings. Second, and relatedly, most of the secondary outcome measures were assessed using self-report. As evidence in this context indicates subjective measures may differ from objective measures [28], future study designs should incorporate both.

CONCLUSIONS

Health warning labels communicating the increased risk of cancers associated with alcohol consumption can reduce selection of alcoholic drinks in an online setting, with labels displaying images having the largest effect. These labels now need to be evaluated in laboratory and field settings with physical products, using objective measures.

Acknowledgements

The views expressed in this publication are those of the author(s) and not necessarily those of Wellcome Trust.

Registration and data available on the Open Science Framework: https://osf.io/pr8zu/

Funding

This work was funded by a Collaborative Award in Science from Wellcome Trust (Behaviour Change by Design: 206853/Z/17/Z to T.M.M., Paul Fletcher, G.J.H. and M.R.M.).

Authors contributions

G.J.H., T.M.M., N.C., E.P., E.M. and A.K.M. B. conceived the study and collaborated in designing the procedures. N.C. and E.P. coordinated the study and data collection. K.D., M.R.M. and R.W.M. performed the data analyses. N.C. and G.J.H. drafted the manuscript, with all authors providing critical revisions. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Approved by the Psychology Research Ethics Committee of the University of Cambridge (Reference Number: PRE.2018.072). All participants provided informed consent.

Declaration of interests

The authors declare no competing interests.

References

1. Rehm J., Guiraud J., Poulnais R., Shield K. D. Alcohol dependence and very high risk level of alcohol consumption: a life-threatening and debilitating disease. *Addict Biol* 2018; **23**: 961–8; https://doi.org/10.1111/adb.12646.
2. Sheron N., Gilmore I. Effect of policy, economics, and the changing alcohol marketplace on alcohol related deaths in England and Wales. *BMJ* 2016; **353**: i1860; https://doi.org/10.1136/bmj.i1860.
3. WHO. Global strategy to reduce the harmful use of alcohol. 2015. https://apps.who.int/iris/bitstream/handle/10665/44395/9789241599931_eng.pdf;jsessionid=6978FBB6938C48F649757DDFD5832C33?sequence=1
4. Hollands G. J., Bignardi G., Johnston M., Kelly M. P., Ogilvie D., Petticrew M., *et al.* The TIPPME intervention typology for changing environments to change behaviour. *Nat Hum Behav* 2017; **1**: 0140; https://doi.org/10.1038/s41562-017-0140 https://www.nature.com/articles/s41562-017-0140#supplementary-information.
5. Petticrew M., Douglas N., Knai C., Durand M. A., Eastmure E., Mays N. Health information on alcoholic beverage containers: has the alcohol industry's pledge in England to improve labelling been met? *Addiction* 2016; **111**: 51–5; https://doi.org/10.1111/add.13094.
6. Kersbergen I., Field M. Alcohol consumers' attention to warning labels and brand information on alcohol packaging: findings from cross-sectional and experimental studies. *BMC Public Health* 2017; **17**: 123; https://doi.org/10.1186/s12889-017-4055-8.
7. Sillero-Rejon C., Maynard O., Ibáñez-Zapata J.-Á. Visual attention to alcohol labels: an exploratory eye-tracking experiment. *Addiciones* 2019; **0**: 1207; https://doi.org/10.20882/adicciones.1207.
8. Buykx P., Li J., Gavens L., Lovatt M., Gomes de Matos E., Holmes J., *et al.* An investigation of public knowledge of the link between alcohol and cancer. 2015; https://www.cancerresearchuk.org/sites/default/files/an_investigation_of_public_knowledge_of_the_link_between_alcohol_and_cancer_buykx_et_al.pdf.

9. Scheideler J. K., Klein W. M. P. Awareness of the link between alcohol consumption and cancer across the world: a review. *Cancer Epidemiol Biomarkers Prev* 2018; **27**: 429–37; https://doi.org/10.1158/1055-9965.Epi-17-0645.
10. Hammond D. Health warning messages on tobacco products: a review. *Tobacco Control: An International Journal* 2011; **20**: 327–37; https://doi.org/10.1136/tc.2010.037630.
11. Hammond D., McDonald P., Fong G., Stephen Brown K., Cameron R. The impact of cigarette warning labels and smoke-free bylaws on smoking cessation: evidence from former smokers. *Can J Public Health* 2003201–4.
12. Noar S. M., Hall M. G., Francis D. B., Ribisl K. M., Pepper J. K., Brewer N. T. Pictorial cigarette pack warnings: a meta-analysis of experimental studies. *Tob Control* 2016; **25**: 341–54; https://doi.org/10.1136/tobaccocontrol-2014-051978.
13. CCS Cigarette Package Health Warnings: International Status Report. 2018. https://www.fctc.org/wp-content/uploads/2018/10/CCS-international-warnings-report-2018-English-2-MB.pdf
14. Hammond D. Tobacco Labelling & Packaging Toolkit: A guide to FCTC Article 11. 2009. https://www.who.int/fctc/guidelines/adopted/article_11/en/
15. Brewer N. T., Hall M. G., Noar S. M., Parada H., Stein-Seroussi A., Bach L. E., *et al.* Effect of pictorial cigarette packwarnings on changes in smoking behavior a randomized clinical trial. *JAMA Intern Med* 2016; **176**: 905–12; https://doi.org/10.1001/jamainternmed.2016.2621.
16. Cho Y. J., Thrasher J. F., Yong H.-H., Szklo A. S., O'Connor R. J., Bansal-Travers M., *et al.* Path analysis of warning label effects on negative emotions and quit attempts: a longitudinal study of smokers in Australia, Canada, Mexico, and the US. *Soc Sci Med* 2018; **197**: 226–34; https://doi.org/10.1016/j.socscimed.2017.10.003.
17. Hagger M. S., Weed M. DEBATE: do interventions based on behavioral theory work in the real world? *Int J Behav Nutr Phys Act* 2019; **16**: 36; https://doi.org/10.1186/s12966-019-0795-4.
18. Thrasher J. F., Carpenter M. J., Andrews J. O., Gray K. M., Alberg A. J., Navarro A., *et al.* Cigarette warning label policy alternatives and smoking-related health disparities. *Am J Prev Med* 2012; **43**: 590–600; https://doi.org/10.1016/j.amepre.2012.08.025.
19. RSPH. Labelling the point: towards better alcohol health information. 2018. https://www.rsph.org.uk/uploads/assets/uploaded/4ae31b49-c4d7-4355-ad94a660aba36108.pdf
20. Bollard T., Maubach N., Walker N., Ni Mhurchu C. Effects of plain packaging, warning labels, and taxes on young people's predicted sugar-sweetened beverage preferences: an experimental study. *Int J Behav Nutr Phys Act* 2016; **13**: 95; https://doi.org/10.1186/s12966-016-0421-7.
21. Stafford L. D., Salmon J. Alcohol health warnings can influence the speed of consumption. *Journal of Public Health (Germany)* 2017; **25**: 147–54; https://doi.org/10.1007/s10389-016-0770-3.
22. Wigg S., Stafford L. D. Health warnings on alcoholic beverages: perceptions of the health risks and intentions towards alcohol consumption. *PLOS ONE* 2016; **11**; https://doi.org/10.1371/journal.pone.0153027.
23. Jarvis W., Pettigrew S. The relative influence of alcohol warning statement type on young drinkers' stated choices. *Food Quality and Preference* 2013; **28**: 244–52; https://doi.org/10.1016/j.foodqual.2012.08.011.
24. Hassan L. M., Shiu E. A systematic review of the efficacy of alcohol warning labels: insights from qualitative and quantitative research in the new millennium. *J Soc Mark* 2018; **8**: 333–52; https://doi.org/10.1108/JSOCM-03-2017-0020.
25. Blackwell A. K. M., Drax K., Attwood A. S., Munafò M. R., Maynard O. M. Informing drinkers: can current UK alcohol labels be improved? *Drug Alcohol Depend* 2018; **192**: 163–70; https://doi.org/10.1016/j.drugalcdep.2018.07.032.
26. Pettigrew S., Jongenelis M. I., Glance D., Chikritzhs T., Pratt I. S., Slevin T., *et al.* The effect of cancer warning statements on alcohol consumption intentions. *Health Educ Res* 2016; **31**: 60–9; https://doi.org/10.1093/her/cyv067.
27. Pettigrew S., Jongenelis M. I., Chikritzhs T., Slevin T., Pratt I. S., Glance D. Developing cancer warning statements for alcoholic beverages. *BMC Public Health* 2014; **14**: 786; https://doi.org/10.1186/1471-2458-14-786.
28. Sillero-Rejon C., Attwood A. S., Blackwell A. K. M., Ibáñez-Zapata J.-A., Munafò M. R., Maynard O. M. Alcohol pictorial health warning labels: the impact of self-affirmation and health warning severity. *BMC Public Health* 2018; **18**: 1403; https://doi.org/10.1186/s12889-018-6243-6.
29. Maynard O., Gove H., Skinner A. L., Munafò M. R. Severity and susceptibility: measuring the perceived effectiveness and believability of tobacco health warnings. *BMC Public Health* 2018; **18**: 468; https://doi.org/10.1186/s12889-018-5385-x.
30. Pechey E, Clarke N, Mantzari E, Blackwell AKM, De-loyde K, Morris R, Marteau TM, Hollands GJ. *Image-and-text health warning labels on alcohol and food: potential effectiveness and acceptability.* In press, BMC Public Health 2020. **20**(1),376. https://psyarxiv.com/gxynw/
31. Hollands G., Prestwich A., Marteau T. M. Using aversive images to enhance healthy food choices and implicit attitudes: an experimental test of evaluative conditioning. *Health Psychol* 2011; **30**: 195–203; https://doi.org/10.1037/a0022261.
32. Hollands G. J., Marteau T. M. Pairing images of unhealthy and healthy foods with images of negative and positive health consequences: impact on attitudes and food choice. *Health Psychol* 2016; **35**: 847–51; https://doi.org/10.1037/hea0000293.
33. Hofmann W., Friese M., Wiers R. W. Impulsive versus reflective influences on health behavior: a theoretical framework and empirical review. *Health Psychol Rev* 2008; **2**: 111–37; https://doi.org/10.1080/17437190802617668.
34. Sanjari S. S., Jahn S., Boztug Y. Dual-process theory and consumer response to front-of-package nutrition label formats. *Nutr Rev* 2017; **75**: 871–82; https://doi.org/10.1093/nutrit/nux043.
35. Werle YT. When detailed information works better: Comparison between 3-colors and 5-colors simplified front-of-pack nutritional systems. In preparation.
36. Dhar R., Gorlin M. A dual-system framework to understand preference construction processes in choice. *Journal of Consumer Psychology* 2013; **23**: 528–42; https://doi.org/10.1016/j.jcps.2013.02.002.
37. van Herpen E. Trijp HCMv. Front-of-pack nutrition labels. Their effect on attention and choices when consumers have varying goals and time constraints. *Appetite* 2011; **57**: 148–60; https://doi.org/10.1016/j.appet.2011.04.011.
38. Mantzari E., Vasiljevic M., Turney I., Pilling M., Marteau T. M. Impact of warning labels on sugar-sweetened beverages on parental selection: an online experimental study. *Prev Med Rep* 2018; **12**: 259–67; https://doi.org/10.1016/j.pmedr.2018.10.016.

39. Kees J., Burton S., Craig Andrews J., Kozup J. Understanding how graphic pictorial warnings work on cigarette packaging. 2010265–76.
40. Hall M. G., Sheeran P., Noar S. M., Ribisl K. M., Bach L. E., Brewer N. T. Reactance to health warnings scale: development and validation. *Ann Behav Med* 2016; **50**: 736–50; https://doi.org/10.1007/s12160-016-9799-3.
41. Reynolds J. P., Pilling M., Marteau T. M. Communicating quantitative evidence of policy effectiveness and support for the policy: three experimental studies. *Soc Sci Med* 2018; **218**: 1–12; https://doi.org/10.1016/j.socscimed.2018.09.037.
42. Roberto C. A., Wong D., Musicus A., Hammond D. The influence of sugar-sweetened beverage health warning labels on Parents' choices. *Pediatrics* 2016; **137**: e20153185; https://doi.org/10.1542/peds.2015-3185.
43. Bush K., Kivlahan D. R., McDonell M. B., Fihn S. D., Bradley K. A. The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory care quality improvement project (ACQUIP). Alcohol use disorders identification test. *Arch Intern Med* 1998; **158**: 1789–95.
44. Osman A., Thrasher J. F., Yong H.-H., Arillo-Santillan E., Hammond D. Disparagement of health warning labels on cigarette packages and cessation attempts: results from four countries. *Health Educ Res* 2017; **32**: 524–36; https://doi.org/10.1093/her/cyx065.
45. Diepeveen S., Ling T., Suhrcke M., Roland M., Marteau T. M. Public acceptability of government intervention to change health-related behaviours: a systematic review and narrative synthesis. *BMC Public Health* 2013; **13**: 756; https://doi.org/10.1186/1471-2458-13-756.
46. Al-Hamdani M., Smith S. M. Alcohol health-warning labels: promises and challenges. *J Public Health* 2017; **39**: 3–5; https://doi.org/10.1093/pubmed/fdx010.
47. Reynolds J. P., Archer S., Pilling M., Kenny M., Hollands G. J., Marteau T. M. Public acceptability of nudging and taxing to reduce consumption of alcohol, tobacco, and food: a population-based survey experiment. *Soc Sci Med* 2019; **236**: 112395; https://doi.org/10.1016/j.socscimed.2019.112395.
48. Vallance K., Romanovska I., Stockwell T., Hammond D., Rosella L., Hobin E. "We have a right to know": exploring consumer opinions on content, design and acceptability of enhanced alcohol labels. *Alcohol Alcohol* 2017; **53**: 20–5; https://doi.org/10.1093/alcalc/agx068.
49. 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**; https://doi.org/10.3390/ijerph17020398.
50. Vallance K., Stockwell T., Hammond D., Shokar S., Schoueri-Mychasiw N., Greenfield T., *et al*. Testing the effectiveness of enhanced alcohol warning labels and modifications resulting from alcohol industry interference in Yukon, Canada: protocol for a quasi-experimental study. *JMIR Res Protoc* 2020; **9**: e16320; https://doi.org/10.2196/16320.
51. Clarke N, Pechey E, Kosīte D, König LM, Mantzari E, Blackwell AKM, et al. Impact on selection and consumption of image-and-text and text-only health warning labels on food and alcohol products: systematic review with meta-analysis. Manuscript Under Review https://psyarxiv.com/jt52m/
52. Commission E. Labelling of alcoholic beverages in the EU: some facts? ; 2018. https://ec.europa.eu/food/safety/labelling_nutrition/labelling_legislation/alcohol_en20/09/2018

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. HWL and branding – example products.
Figure S2 Interactions between text and image for each secondary outcome. The left hand gap (a) represents the effect of image with no text. The right hand gap (b) represents the effect of image with text. The image line gradient (c) represents the effect of text with image. The no image line gradient (d) represents the effect of text without image. See **Table S2** for values.
Table S2 The interactions between text and image for each secondary outcome relating to **Fig S2**.
Table S4 Time pressure task outcome sensitivity analysis.
Table S5 Bootstrap results for secondary outcomes. Based on 1000 bootstrap samples.

