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promoting excellence in psychology

British Journal of Health Psychology (2022), 27, 30–49

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The effect of calorie and physical activity equivalent labelling of alcoholic drinks on drinking intentions in participants of higher and lower socioeconomic position: An experimental study

Eric Robinson*, Jemma Smith and Andrew Jones
Department of Psychology, University of Liverpool, UK

Objectives. The primary objective of the study was to examine the effect of calorie labelling and physical activity equivalence labelling of alcoholic drinks on drinking intentions in participants of lower and higher socioeconomic position (SEP).

Methods. Participants (N = 1,084) of higher and lower SEP were recruited into an online study and randomized into one of three drink label conditions; Control (standard alcohol labelling), kcal labelling (standard labelling plus drink kilocalorie information), or kcal + PACE labelling (standard labelling and kilocalorie information, plus information on physical activity needed to compensate for drink calories). After viewing drink labels, participants reported alcohol drinking intentions. Participants also completed measures of alcoholic drink energy content estimation, beliefs about how calorie labelling would affect health behaviour and support for calorie labelling of alcoholic drinks.

Results. kcal labelling (d = 0.31) and kcal + PACE labelling (d = 0.38) conditions had significantly lower drinking intentions compared to the control condition (ps < .001). There was no evidence that effect of labelling condition on drinking intentions was moderated by SEP. A subset of participants also reported that they believed calorie labelling would be likely to positively change their eating and exercise behaviour. Estimates of the energy content of alcoholic drinks tended to be inaccurate and the majority of participants supported the introduction of calorie labelling on alcoholic drinks.

Conclusions. Calorie labelling of alcoholic drinks resulted in small reductions to intended drinking and testing of the effect calorie labelling has on behaviour in real-world settings is now warranted.

Statement of contribution

What is already known on this subject?

- Heavy alcohol consumption and obesity are major public health challenges.
- Calories from alcohol may contribute to obesity prevalence.

**Correspondence should be addressed to Eric Robinson, Department of Psychology, Eleanor Rathbone Building, University of Liverpool, Liverpool L69 7ZA, UK (email: eric.robinson@liv.ac.uk).*

DOI:10.1111/bjhp.12527

- Calorie labelling of alcoholic drinks is a potential policy to reduce both alcohol consumption and obesity.

What does this study add?

- The first experimental evidence that calorie labelling results in reductions to intended drinking in UK adults of both higher and lower socioeconomic position.
- Participants were largely unaware of the number of calories in alcoholic drinks and also reported that labelling would be likely to affect dietary choices and exercise.
- Participants reported that they would support the introduction of calorie labelling.

Background

Higher alcohol consumption is associated with an increased risk of developing various health conditions, including but not limited to liver disease and cardiovascular disease (Holmes et al., 2014; Williams et al., 2018). Furthermore, due to the energy content of alcohol, alcohol consumption may contribute to weight gain and obesity (Traversy & Chaput, 2015) and in line with this a number of studies suggest that energy derived from alcohol consumption makes a substantial contribution to daily energy intake (Grech, Rangan, & Allman-Farinelli, 2017; Sherk, Naimi, Stockwell, & Hobin, 2019). These considerations are particularly important because obesity is now prevalent in most developed countries and causes a substantial public health burden (Ng et al., 2014). Therefore, there is a need to identify population level interventions to reduce alcohol consumption and obesity.

A number of studies have examined how information presented on alcoholic drinks labels, such as health warning messages, may affect drinking behaviour. Although findings to date have been mixed (Hassan & Shiu, 2018; Kersbergen & Field, 2017), there is some evidence that labelling information clearly describing the damaging health effects of alcohol consumption can result in intentions to reduce alcohol consumption (Glock & Krolak-Schwerdt, 2013; Wigg & Stafford, 2016) and change drinking behaviour (Stafford & Salmon, 2017). Real-world evidence also indicates that the introduction of alcohol warning labels is associated with reduced alcohol sales (Zhao, Stockwell, Vallance, & Hobin, 2020). However, less research has examined the impact that presenting nutrition information (such as calorie content) about alcohol has on behaviour. A recent study found no effect of nutrition information on volume of alcohol consumed during a mock taste test in a laboratory setting (Maynard et al., 2018). The impact calorie labelling of alcoholic drinks has on behaviour is of importance at present because although law does not currently require calorie information to be provided on alcoholic drinks or on drink menus when served by the glass, both the EU (2020) and UK government (Department of Health & Social Care, 2020) are considering making this a legal requirement.

Psychological models of behaviour change outline the importance of motivation to comply with health behaviours (e.g., Theory of Reasoned Action) and personal relevance of health messaging is an important determinant of how motivated people are to change their behaviour (Lustria, 2017). Because it is common for adults in developed countries to be attempting to manage their energy intake and weight (Santos, Sniehotta, Marques, Carraça, & Teixeira, 2017), the provision of calorie information on alcoholic drinks has potential to motivate changes in drinking behaviour. However, a recent rapid systematic review concluded that there was very low-quality evidence indicative of calorie labelling having no effect on alcohol drinking-related outcomes (Robinson, Humphreys, & Jones, 2020). Yet, these conclusions were based on a small number (n = 6) of largely low methodological quality studies. Furthermore, few studies have examined how calorie labelling of alcoholic drinks may impact on other health behaviours (e.g., healthier eating and exercise). Similarly, there has been a lack of examination of potential unintended consequences, such as labelling resulting in an increase in unhealthy dieting practices (Bryant, Darkes, & Rahal, 2012). From the same systematic review, there was also moderate evidence from a relatively small number of studies that consumers tend to be unaware of the energy content of alcoholic drinks and that people tend to support calorie labelling of alcohol drinks (Robinson, Humphreys, et al., 2020). However, it is unclear the extent to which consumers tend to under or overestimate energy content (Robinson, Humphreys, et al., 2020). Moreover, research is required to determine whether calorie labelling is universally supported (e.g., across demographics such as lower vs. higher socioeconomic position) and supported among population sub-groups who may be adversely affected by calorie information, such as those with a previous diagnosis of an eating disorder (Merrick, 2020).

To date, no published research has examined potential socioeconomic inequalities in relation to alcohol calorie labelling. Lower socioeconomic position (SEP) is associated with being less health conscious (Wardle & Steptoe, 2003). There is also some evidence that lower socioeconomic position) is associated with a reduced likelihood of changing behaviour in response to health-based information provision interventions (Sarink et al., 2016), which may result in calorie labelling contributing to health inequality (e.g., labelling disproportionately benefiting higher as opposed to lower SEP groups). However, in the context of calorie labelling of alcoholic drinks it is also plausible that because higher SEP is associated with greater health literacy (Stormacq, Van den Broucke, & Wosinski, 2019), people of lower SEP may be less aware of the energy content of drinks and therefore be more likely to benefit from calorie labelling. Therefore, there is a need to understand how calorie labelling of alcoholic drinks may impact people of lower and higher SEP differently.

The primary aim of the present research was to examine the effect that calorie labelling of alcoholic drinks has on intentions to reduce alcohol consumption among participants of lower vs. higher SEP. Consistent with previous research examining consumer responses to labelling interventions (Marty, Jones, & Robinson, 2020), in the present study highest education level was the primary measure of SEP and because calorie labelling is being considered as an obesity public health policy by UK government (Department of Health & Social Care, 2020), we sampled UK adults. We compared two types of calorie labels against a standard label control condition. In one experimental condition, participants were provided with standard calorie information, and in the second, participants were also provided with physical activity calorie equivalent (PACE) information; the number of minutes walking required to 'burn off' the energy content of the drink. PACE information has been proposed to be easier to understand, more meaningful to consumers and therefore potentially more effective than standard calorie labelling at changing dietary choice (Daley, McGee, Bayliss, Coombe, & Parretti, 2020; Swartz, Dowray, Braxton, Mihas, & Viera, 2013).

Although studies to date have not produced convincing evidence of calorie labelling affecting alcohol-related outcomes (Robinson, Humphreys, et al., 2020), we hypothesized that the addition of PACE information may lead to a small reduction in drinking intentions. To further understand the need for and potential consequences of calorie labelling of alcoholic drinks as a public health policy, we also examined self-reported beliefs about ways that calorie labelling of alcoholic drinks may affect health behaviours (e.g., alcohol use, healthier eating, physical activity, and unhealthy dieting practices), whether consumers are accurate in their estimation of alcohol drink energy content and support for calorie labelling of alcoholic drinks.

Method

Participants

Participants were recruited through the online platform Prolific (https://www.prolific.co/) into a study examining 'Perceptions of alcoholic drinks and drinking behaviour'. Prolific provides high-quality data with less dishonest participants compared with other online recruitment platforms (Peer, Brandimarte, Samat, & Acquisti, 2017). Eligibility criteria were as follows: UK resident, aged 18 or above (legal drinking age in the UK), fluent in English, regular alcohol drinker (at least once per month), and access to an Internet connection (there were no limits on the device the study was completed on, e.g., computer vs. mobile phone). We aimed to stratify recruitment by gender (50:50) and by highest achieved educational level (approximately 50% with A levels/equivalent or higher vs. 50% lower than A levels; typically completed at age 18).

Design and interventions

Participants were randomly allocated (equal allocation using Qualtrics online research suite) into one of three conditions: control condition (standard alcohol label information), kcal condition (standard alcohol label information plus drink kilocalorie information), or kcal + PACE condition (standard alcohol label information, drink kilocalorie information and minutes of walking required to burn off calories in drink). Participants were shown images of four drinks (pint of beer, pint of cider, medium glass of white wine, gin, and tonic). Underneath each drink, the serving size (in ml) and alcohol by volume (ABV%) of the drink was presented. Next to each drink was the drink label information. In the control condition, participants were shown information that is advised in the United Kingdom (Alcohol Change UK, 2019): the number of units in the drink, the UK Chief Medical Officer's recommendation for maximum weekly unit consumption (no more than 14 units), and a pregnancy drinking warning symbol near the message 'Drink Responsibly'. In the kcal condition, in addition to the above information and in line with law for energy labelling of non-alcoholic products (EU, 2020), the number of kcals (and kilojoules) per drink serving and per 100 ml were presented, alongside energy content as a % of recommended intake (of 2,000 kcals). The message 'On average women need 2,000 kcal per day and men need 2,500 kcal per day' was also presented. In the kcal + PACE condition, in addition to the above information, a message reading 'It takes X minutes walking to burn off the kcals in 1 serving of this drink' was presented next to a figure of a person walking. Energy values for drinks were obtained from Drink Aware UK (2020). For the minutes walking, we used the energy expenditure of a 160 pound adult walking at a rate of 30 min per mile (3.2 kcal/min), to be consistent with previous research (Swartz et al., 2013). Each drink was presented on a separate survey page (order randomized). For an example drink label and information presented for all drinks, see Figure 1.

Primary outcome measure

For each drink, participants answered four items relating to drinking intentions in response to label information. 'If I saw the information displayed about this this drink, I would intend to. . .': 'Drink less alcohol'; 'Have fewer alcoholic drinks'; 'Choose a drink with fewer calories instead'; and 'I would not drink this drink'. Each item was rated on a 5-point Likert scale ranging from 'Strongly agree' to 'Strongly disagree'.

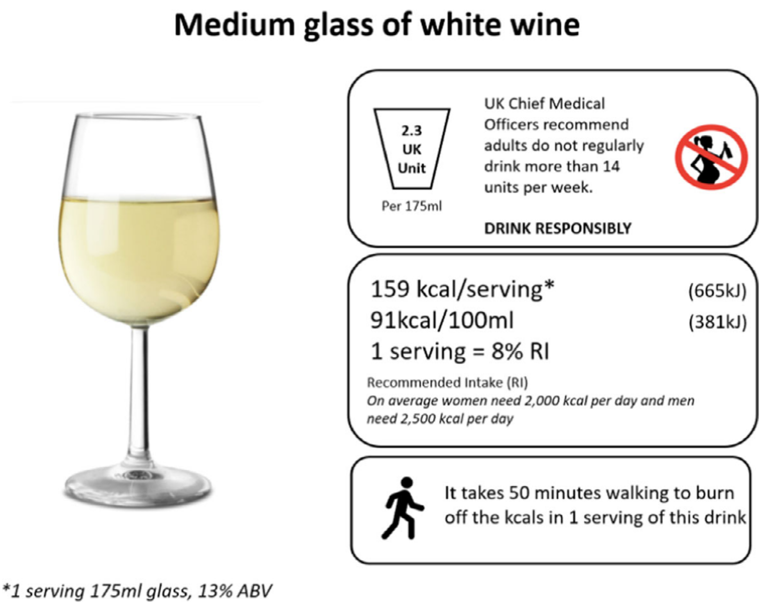

Figure 1. Example alcohol label: kcal + PACE condition label for white wine. kcal condition included the above-presented information (except for the PACE information). Control condition included the above-presented information (except for the kcal and PACE information). Information presented for other drinks; Pint of beer (4%): 32 kcal per 100 ml and 182 kcal per 568 ml pint, 57 min walking. Pint of cider (4.5%): 38 kcal per 100 ml and 216 kcal per 568 ml pint, 68 min walking. Gin and tonic: 50 kcal per 100 ml and 88 kcal per serving (25 ml gin (40%) and 150 ml tonic), 28 min walking. [Colour figure can be viewed at wileyonlinelibrary.com]

Other measures

Perceived behavioural effects of energy labelling on alcoholic drinks

All participants completed items on how labelling may affect their drinking and eating behaviour more generally: 'If I saw calorie information on alcoholic drinks I would. . .'; ten items: 'Drink fewer alcoholic drinks'; 'Choose lower calorie alcoholic drinks'; 'Choose smaller serving sizes of alcoholic drinks'; 'Eat more healthily on drinking days'; 'Eat smaller meals on drinking days'; 'Skip a meal on drinking days'; 'Do more exercise on drinking days'; 'On days I wasn't drinking I would try and limit the number of calories I was eating'; 'On days I wasn't drinking I would try and burn more calorie by exercising more'; and 'Use laxatives or make myself vomit to control my weight'. Each item was rated using a 5-point scale ranging from 'Very likely' to 'Very unlikely'.

Estimation of calorie content and walking required to burn off calories

Participants were shown an image of each drink (randomized order) without label information and were asked to estimate how many calories were in the drink and the number of minutes of walking required to 'burn off' the calories in the drink (order randomized).

Support for and perception of energy labelling on alcoholic drinks
Participants completed items assessing level of support for calorie labelling of alcohol drinks: 'Alcoholic drinks should have calorie labels', 'Pubs, restaurants and bars should display calorie labelling for alcoholic drinks', 'It should be a legal requirement that calorie information is provided on alcoholic drinks', 'I would like to able to see information about calories on the labels of alcoholic drinks'. Two items measured perceived effectiveness 'Calorie labelling of alcoholic drinks will help with problematic drinking in the UK' and 'Calorie labelling of alcoholic drinks will help solve England's problem with obesity', and one item measured self-perceived understanding of calories in alcoholic drinks 'I am unsure about the number of calories in alcoholic drinks'. All items were rated using a 5-point Likert scale (*Strongly agree* to *Strongly disagree*). Items were based on previous research examining public acceptability of public health policies (Reynolds, Pilling, & Marteau, 2018).

Demographic and participant characteristic measures
Age, gender, height, weight, ethnicity, employment status, household income, and highest education level were self-reported. Highest education level was assessed using the question: 'What is your highest educational qualification?'. We categorized qualifications below A Levels (level 3) as 'lower' SEP, and participants with A Levels and above as 'higher' SEP. Participants were asked to record any history of mental health diagnosis (including eating disorders); 'Have you ever had a diagnosis of a mental health/psychiatric condition?' (participants then selected from a list of common mental health conditions). The 3-item Alcohol Use Disorders Identification Test (AUDIT-C) was used to assess alcohol use (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993).

Procedure
The study was administered using Qualtrics. Participants first completed the demographic and personal characteristic questions before being randomly allocated to one of the three conditions. After viewing the alcoholic drinks with label information and completing the intention measures, participants then completed the following measures in randomized order; estimation of calorie content and walking required to burn off calories, support for and perception of energy labelling on alcoholic drinks; and perceived behavioural effects of energy labelling on alcoholic drinks. Participants were then debriefed and compensated for their time. Two attention checks were included in the survey (see Supporting Information). The study took approximately 10–15 min to complete and participants were reimbursed ~£1.25 for their time.

Statistical analyses
All statistical analyses were performed in SPSS24. The pre-registered analysis protocol and study data are available on the Open Science Framework (https://doi.org/10.17605/OSF.IO/AYDUM). We excluded all participants that did not meet eligibility criteria, failed one or more attention checks, did not complete the study in full, or provided implausible weight and height data (weight values <30 kg to >250 kg, height values <120 cm to >3m, or BMI values <12 or >70), as in Robinson, Gillespie, and Jones (2020).

Primary analysis

The primary analysis examined the effect of labelling condition on alcohol drinking intentions, tested using a 3 × 2 × 4 mixed subjects ANOVA (between-subject factors of labelling condition: control vs. kcal labelling vs. kcal + PACE labelling, and education level: higher vs. lower, within-subject factor of drink type: wine, beer, cider, gin, and tonic). The four intention items were expected to correlate and load onto the same factor, resulting in an average score being used as the dependent variable. Alpha level for primary analyses was $p < .05$.

Secondary analyses

Alpha level for all secondary analyses was set at $p < .01$. The same mixed 3 × 2 × 4 ANOVA design described above was used to examine perceptions of energy content (in kcals) and minutes of walking required to burn off drink energy content (two separate ANOVAs, dependent variables: number of kcals and minutes of walking). For each drink type, we conducted one-sample t-tests (test values = actual number of calories in drink and number of minutes walking required for drink) to test whether the sample significantly overestimated/underestimate energy content, on average. We also planned to calculate the proportion of participants correctly identifying the number of calories/minutes required walking for each drink type. Responses that were −10% to +10% of the actual values were considered ‘accurate’, while all other responses below and above this range were considered underestimation and overestimation. We planned to average the four items assessing policy support to create a continuous dependent variable and examine predictors of the variable in a linear regression model with the following independent variables; kcal condition and kcal + PACE conditions dummied against control condition, education level (higher vs. lower), age, gender (male vs. other), BMI, ethnicity (white or not), household income, previous diagnosis of a mental health condition (no vs. yes), and AUDIT total score. We had originally intended to include previous diagnosis of alcohol use disorder and previous diagnosis of an eating disorder as predictor variables, but did not due to very small sample size for each (<1% and 2% of sample, respectively). For items measuring perceived effects of policy on behaviour, because there were ten items in total and each item measured a different type of behaviour, we planned to conduct exploratory factor analysis to examine whether multiple items measure the same construct and then use linear regression (independent variables as above) to predict perceived behavioural effects of labelling.

Sample size calculation

Given there is uncertainty as to whether calorie labelling of alcoholic drinks has any effect on drinking behaviour (Robinson, Humphreys, et al., 2020), we based our power calculation on being able to detect a statistically small effect in primary analyses. To be able to detect a statistically small effect of labelling condition or a labelling condition × education level interaction ($f = 0.1$, 80% power, $p < .05$, GPOWER 3.1.9.7) in ANOVA, we required a minimum $N = 969$. We aimed to recruit ~1,200 participants to account for participant exclusions and to have reasonable power in any follow-up analyses. See Supporting Information for full power calculation details.

Results

A total of 1892 participants were recruited into the study ($N = 669$ non-UK participants were recruited in error and their data were discarded). Two participants did not complete the study in full, 42 participants were not fluent in English, 46 were not regular alcohol drinkers (less than monthly), and a further 33 participants failed one or more of the attention checks. Of the remaining participants, 16 had implausible weight or height data and after their exclusion, the final analytic sample was $N = 1{,}084$. Participant characteristics and demographics are reported in Table 1 and by experimental condition in Table S1. There were $N = 355$ (178 female) in the control condition, $N = 366$ (206 female) in the kcal condition, and $N = 363$ (173 female) in the kcal + PACE condition.

Effects of label condition on alcohol drinking intentions

The four intention measures were strongly correlated (rs = .62 to .92) and loaded onto a single factor using principal component analysis (loadings = .83 to .92) and were therefore averaged ($\alpha = .89$). There was a main effect of drink type [$F(3, 1{,}076) = 129.9$, $p < .001$, $\eta_p^2 = .266$] and a main effect of label condition [$F(2, 1{,}078) = 14.8$, $p < .001$, $\eta_p^2 = .027$]. There was a significant interaction between drink type and label condition [$F(6, 2{,}154) = 9.6$, $p < .001$, $\eta_p^2 = .026$]. There was no significant main effect of education level [$F(1, 1{,}078) = 0.5$, $p = .50$, $\eta_p^2 < .001$], no significant interaction between label condition and education level [$F(2, 1{,}078) = 1.0$, $p = .375$, $\eta_p^2 = .002$] or between drink type, label condition, and education level [$F(6, 2{,}152) = 0.9$, $p = .512$, $\eta_p^2 = .002$]. To examine the label condition × Drink type interaction, we conducted separate between-subject ANOVAs for each drink type. Results are reported in full in Table 2. For beer, cider, and wine, there was an effect of label condition and pairwise comparisons indicated that the kcal and the kcal + PACE label conditions had significantly lower alcohol drinking intentions compared to the control condition and did not significantly differ to each other.

Table 1. Sample characteristics

Participant characteristic	*N* (%) or *M* (*SD*)
Gender (female)[a]	557 (51%)
Ethnicity (White)	964 (89%)
Age	36 years (*SD* = 14)
Highest education level (A-Level or higher)	652 (60%)
Household income	£46,562 (*SD* = £80,767)
Employment (full-time employed)	449 (41%)
BMI (weight/height^2)	25.9 (*SD* = 6.3)
Underweight (BMI < 18.5)	61 (6%)
Normal weight (BMI 18.5–24.9)	504 (47%)
Overweight (BMI 25–29.9)	299 (28%)
Obesity (BMI ≥ 30)	220 (20%)
Previous mental health diagnosis (yes)	380 (35%)
Eating disorder diagnosis	23 (2%)
Alcohol drinking (2–3 times per week or more)	370 (34%)

Note. $N = 1{,}084$. Values are number of participants (%) or mean (standard deviation).
[a]Participants were asked 'what is your gender' and were given the following response options: male, female, non-binary, other.

Table 2. Results for effect of labelling condition on intentions to reduce alcohol consumption

	Beer	Cider	Gin and tonic	Wine
ANOVA results	$F(2, 1{,}084) = 19.4$, $p < .001$, $\eta_p^2 = .035$	$F(2, 1{,}084) = 24.6$, $p < .001$, $\eta_p^2 = .044$	$F(2, 1{,}084) = 0.17$, $p = .857$, $\eta_p^2 < .001$	$F(2, 1{,}084) = 11.8$, $p < .001$, $\eta_p^2 = .021$
Control condition ($N = 355$)	3.66 (0.80)	3.70 (0.80)	3.90 (0.83)	3.67 (0.80)
kcal condition ($N = 366$)	3.34 (0.88)	3.38 (0.88)*	3.87 (0.76)	3.47 (0.87)*
kcal + PACE condition ($N = 363$)	3.29 (0.93)	3.24 (0.99)*	3.87 (0.80)	3.37 (0.95)*

Note. $N = 1{,}084$. Intention data are an average of four items scored on a 1–5 response format (1 = *strongly agree*, 5 = *strongly disagree*), whereby lower scores indicate intentions to reduce alcohol consumption.

*Significantly different to control condition at $p < .01$. kcal versus kcal + PACE condition did not differ at $p < .01$ for any comparisons.

There was no effect of label condition for the Gin and tonic drink type. Pooled across the four drink types, the difference in drinking intentions between the control condition versus kcal condition ($d = 0.31, p < .001$) and versus kcal + PACE condition ($d = 0.38$, $p < .001$) was small to moderate in statistical size and the difference between the kcal versus kcal + PACE ($d = 0.09, p = .20$) was small in statistical size.

Perceived behavioural responses to calorie labelling of alcoholic drinks

Participant responses to items measuring perceived behavioural responses to calorie labelling are reported in Table 3. A sizeable minority of participants reported that it would be likely they would change their drinking, eating, or exercise behaviour in response to calorie labelling, both on drinking days (e.g., 47% reported they would be very likely or likely to choose lower calorie drinks) and non-drinking days (e.g., 29% reported it was very likely or likely they would limit number of calories eaten on non-drinking days). A small minority of participants reported that they would be likely to use laxatives or vomit to control their weight in response to labelling (2%) or that they would skip meals on drinking days (13%).

In exploratory factor analysis of perceived behavioural response items, we identified two factors that related to relatively 'healthy' responses to labelling (items 1–8 in Table 3) and 'unhealthy' responses (items 9–10, meal skipping and laxative use/vomiting). The two items loading onto the unhealthy factor had low internal consistency ($\alpha = .42$), so no further analysis was conducted. The eight items loading onto the healthy response factor had high internal consistency ($\alpha = .87$), and we therefore examined predictors of these averaged items. Labelling condition was not a significant predictor. Participants with a higher education level, female, and younger reported significantly greater healthy responses to calorie labelling of alcoholic drinks (ps $< .01$). See Table S2 for results in full.

Table 3. Perceived behavioural responses to calorie labelling of alcoholic drinks

	Very likely	Likely	Unsure	Unlikely	Very unlikely
1. I would drink fewer alcoholic drinks	77 (7%)	279 (26%)	212 (20%)	363 (34%)	153 (14%)
2. I would choose lower calorie alcoholic drinks	188 (17%)	328 (30%)	175 (16%)	246 (23%)	147 (14%)
3. I would choose smaller serving sizes of alcoholic drinks	88 (8%)	296 (27%)	173 (16%)	347 (32%)	180 (17%)
4. I would eat more healthily on drinking days	113 (10%)	348 (32%)	194 (18%)	279 (26%)	150 (14%)
5. I would eat smaller meals on drinking days	57 (5%)	204 (19%)	157 (15%)	392 (36%)	274 (25%)
6. On days I was not drinking I would try and limit the number of calories I was eating	64 (6%)	253 (23%)	180 (17%)	379 (35%)	208 (19%)
7. I would do more exercise on drinking days	69 (6%)	266 (25%)	204 (19%)	343 (32%)	202 (19%)
8. On days I was not drinking I would try and burn more calories by exercising more	98 (9%)	353 (33%)	193 (18%)	273 (25%)	167 (15%)
9. I would skip a meal on drinking days	29 (3%)	110 (10%)	77 (7%)	368 (34%)	500 (46%)
10. I would use laxatives or make myself vomit to control my weight	9 (1%)	13 (1%)	15 (1%)	77 (7%)	970 (90%)

Note. $N = 1,084$.

Table 4. Estimation of energy content of alcoholic drinks

	Beer	Cider	Gin and tonic	Wine
Actual kcals	182	216	88	159
Estimated kcals	244 (256)* $d = 0.24$	235 (238)* $d = 0.08$	124 (129)* $d = 0.28$	170 (153)* $d = 0.07$
% Accurate (kcals)	255 (23.5%)	252 (23.2%)	225 (20.8%)	141 (13.0%)
% Underestimating (kcals)	336 (31.0%)	427 (39.4%)	341 (31.5%)	341 (23.0%)
% Overestimating (kcals)	493 (45.5%)	405 (37.4%)	518 (47.8%)	694 (64.0%)
Actual minutes walking required	57	68	28	50
Estimated minutes walking	86 (83)* $d = 0.35$	86 (86)* $d = 0.21$	54 (113)* $d = 0.23$	67 (71)* $d = 0.24$
% Accurate (minutes walking)	268 (24.7%)	118 (10.9%)	313 (28.9%)	221 (20.4%)
% Underestimating (minutes walking)	393 (36.3%)	617 (56.9%)	316 (29.2%)	424 (39.1%)
% Overestimating (minutes walking)	423 (39.0%)	349 (32.2%)	449 (41.4%)	439 (40.5%)

Note. *Estimated value significantly different to actual value at $p < .01$. Values in brackets are standard deviations: $d =$ (actual $-$ estimated)/standard deviation.

Estimation of energy content of alcoholic drinks

Calorie content

There was a significant main effect of drink type on calorie estimation [F(3, 1,076) = 113.8, $p < .001$, $\eta_p^2 = .241$, explained by calorie estimates differing between drinks (see Table 4), but there were no other significant main effects or interactions (largest $\eta_p^2 = .007$). Estimated calories (averaged across drinks) in the three conditions were as follows: control condition (M = 209.4 kcals, SD = 187.5), kcal condition (M = 182.4, SD = 144.0), and kcal + PACE condition (M = 188.2, SD = 163.0). On average, participants tended to overestimate the number of calories for all drink types (ps < .001). A minority of participants accurately estimated calorie content (13–25% accurate across drink types) and both underestimation (23–31%) and overestimation (37–64%) of calorie content were common across drink types.

Walking

There was a significant main effect of Drink type on walking minutes estimation [F(3, 1,076) = 44.6, $p < .001$, $\eta_p^2 = .111$] and a significant main effect of labelling condition [F(2, 1,072) = 5.6, $p = .004$, $\eta_p^2 = .010$]. There were no other significant main effects or interactions (largest $\eta_p^2 = .004$). The main effect of labelling condition was explained by participants in the kcal + PACE condition (M = 70.5, SD = 47.4) having a lower estimated number of minutes than participants in the Control (M = 97.4, SD = 92.6, $p < .001$, $d = 0.39$) and kcal condition (M = 91.6, SD = 96.7, $p = .001$, $d = 0.29$), whereas the control and kcal conditions did not significantly differ ($p = .34$, $d = 0.06$). On average, participants overestimated the number of minutes walking required to burn off energy in alcoholic drinks (see Table 4) for all drink types. A minority of participants accurately estimated number of minutes walking required to burn off energy content (11–20% accurate across drink types) and both underestimation (36–57%) and overestimation (32–41%) were common across drink types.

Support for calorie labelling and perception of policy

Participants tended to support calorie labelling of alcoholic drinks (e.g., >50% of participants strongly agreed or agreed for each item measuring policy support; see Table 5). The majority of participants reported being unsure about the number of calories in alcoholic drinks (83%). A minority of participants believed the policy would reduce obesity (25% strongly agreed or agreed) and problem drinking (26% strongly agreed or agreed) in the United Kingdom. In regression analyses examining predictors of policy support (four items, $\alpha = .92$), participants with lower AUDIT scores more strongly supported the policy and no other variables were significant predictors (see Table S3).

Unplanned exploratory analyses

Participants with eating disorders policy support

A subset of participants reported having been diagnosed with an eating disorder (N = 23), and we examined their support for calorie labelling. Participants with eating disorders tended to support the policy (>50% of participants strongly agreed or agreed for each item measuring policy support) and did not score significantly lower than non-eating disorder participants on the summed measure of support. See Table S4 for full details.

Table 5. Support and perception of calorie labelling policy

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
Alcoholic drinks should have calorie information on the labels	350 (32%)	495 (46%)	143 (13%)	59 (6%)	34 (3%)
Pubs, restaurants, and bars should display calorie labelling for alcoholic drinks	273 (26%)	496 (46%)	178 (17%)	75 (7%)	49 (5%)
It should be a legal requirement that calorie information is provided on alcoholic drinks	272 (25%)	393 (37%)	245 (23%)	106 (10%)	59 (6%)
I would like to see information about calories on the labels of alcoholic drinks	326 (30%)	425 (39%)	186 (17%)	98 (9%)	49 (5%)
I am unsure about the number of calories in alcoholic drinks	372 (35%)	514 (48%)	82 (8%)	95 (9%)	16 (2%)
Calorie labelling of alcoholic drinks will help solve the UK's problem with obesity	57 (5%)	218 (20%)	220 (20%)	376 (35%)	209 (19%)
Calorie labelling of alcoholic drinks will help with problematic alcohol drinking in the UK	62 (6%)	210 (20%)	183 (17%)	412 (38%)	210 (20%)

Note. *N*: 1,071–1,084 due to error in data recording.

Unplanned exploratory analyses

Certainty of calorie content of alcoholic drinks as a moderator of the effect of labels on drinking intentions

Although it was most common for participants to agree that they were unsure about the number of calories in alcoholic drinks (N = 751, 83%), a subset of participants did not agree with this statement (N = 193, 19%). To address whether the effect that calorie labelling has on intentions may be determined by whether or not a person is unsure about calories in drinks, we therefore conducted moderation analysis. Among participants that reported being unsure, results were consistent with the main analyses (kcal and kcal + PACE label conditions had significantly lower drinking intentions than Control). Among participants that did not report being unsure, the effect of labelling condition was significantly smaller in size and statistically non-significant, whereby intentions did not differ between labelling conditions (see Table S5).

Discussion

We examined the effect of alcoholic drink calorie information and calorie plus PACE information on intentions to reduce alcohol consumption in an online study of UK adults. Compared to a standard labelling control condition, both calorie and calorie plus PACE information resulted in a significant but relatively small decrease in alcohol consumption intentions and the two calorie label conditions did not significantly differ. Furthermore, we found no evidence that these effects were moderated by SEP, indicating that the effect calorie labelling has on drinking intentions was not significantly different in participants with higher versus lower education levels. A secondary aim of the study was to examine participant beliefs about how calorie labelling of alcoholic drinks may affect health behaviour. A sizeable minority (24–41%) reported that it would be very likely or likely that they would eat more healthily and exercise more in response to alcoholic drink calorie labels on both drinking and non-drinking days. In terms of unhealthy behavioural responses to calorie labelling, the proportion of participants reporting that they would skip meals (13%) or use laxatives/vomit (2%) was low.

Our results suggest that calorie labelling of alcoholic drinks may result in a small proportion of the population intending to drink less. If these intentions translate to behaviour change, labelling may lead to a modest but meaningful reduction in population level alcohol consumption. There is limited evidence on the impact of calorie labelling of alcoholic drinks on alcohol consumption and studies have tended not find evidence of calorie labelling affecting drinking behaviour (Robinson, Humphreys, et al., 2020). However, a larger number of studies have examined the effect of calorie labelling of food products on eating behaviour and the best available evidence to date suggests that calorie labelling may have a small beneficial effect on calories ordered when eating out (Crockett et al., 2018). Therefore, although intentions were measured (and not behaviour) in the present study, findings are consistent with calorie labelling of food and drink products having small beneficial effects on energy intake.

Consistent with other research (Christensen, Meyer, Dalum, & Krarup, 2019; Kypri et al., 2007), although participants tended to disagree that calorie labelling would reduce obesity and problem drinking in the United Kingdom, there was consistent support for calorie labelling of alcoholic drinks. We found little evidence that policy support varied by participant characteristics, with the exception that less frequent alcohol consumers were more supportive of the policy. A small subset of participants reported having previously been diagnosed with an eating disorder ($N = 23$) and given there are concerns from eating disorder advocacy groups about the potential harmful consequences of calorie labelling (Merrick, 2020), we examined policy support among this group. Participants with eating disorders tended to be supportive of calorie labelling of alcoholic drinks, although the sample size of this group was small and caution should be taken in generalizing findings. Further research examining the impact calorie labelling of alcoholic drinks has on those with a history of eating disorders would now be informative.

Results indicated that accuracy when estimating the calorie content of alcoholic drinks was low (13–25% of participants were accurate based on drink type) and similar to a pooled estimate from other results of other studies; 26% (Robinson, Humphreys, et al., 2020). Although there was a directional tendency (i.e., higher mean than actual number of calories) of the overall sample to overestimate both the calorie content and PACE information for drinks, both underestimation and overestimation of energy content were relatively common, suggesting that consumer understanding of the energy content of alcoholic drinks is limited at present.

In exploratory analyses, we found evidence that the effect labelling had on drinking intentions was primarily observed among participants that reported being unsure of the number of calories in alcoholic drinks. Interestingly, we found evidence that calorie labelling impacted on drinking intentions for three of the four drink types, but not gin and tonic. Gin and tonic had the lowest energy content (e.g., less than half of the number of calories in a pint of beer), and therefore, energy content information may have been less motivating for this drink type. Alongside the finding that participants accuracy when estimating energy content was consistently poor, these findings suggest that calorie labelling may impact on drinking intentions in part as it provides consumers with information about drink energy content that they would otherwise be unaware of (and is therefore relatively novel and engaging information). Consistent with this, calorie labelling has been shown to be more likely to affect eating behaviour when the number of calories in a labelled product is unexpected (Tangari, Bui, Haws, & Liu, 2018). However, there are other mechanisms by which calorie labelling may affect behaviour, such as by priming dieting goals (Papies, 2016) and further research designed to examine different mechanisms of action would be informative. It would also be informative to understand whether people who tend to overestimate versus underestimate the energy content of alcoholic drinks are similarly affected by calorie labels. In the present study, we measured estimation of energy content after exposure to calorie labels, and therefore, future work will be required to answer this question.

We did not find evidence that the inclusion of PACE information significantly lowered drinking intentions (compared to calorie information) and this finding is consistent with two meta-analyses of the impact that PACE labelling has on food choice (Daley et al., 2020; Seyedhamzeh, Bagheri, Keshtkar, Qorbani, & Viera, 2018). However, we used a single type of PACE information (walking) and it is plausible that other forms or presentations of exercise information (e.g., running) may be more impactful and are worthy of empirical testing.

Although intention-based measures predict actual alcohol consumption behaviour (Cooke, Dahdah, Norman, & French, 2016), we do not know the extent to which the present findings would translate to real-world behaviour. Only one experimental study we are aware of has examined the effect of calorie labelling of alcoholic drinks on behaviour (Maynard et al., 2018). Further research examining real-world behaviour and considering the multiple pathways by which labelling could influence health behaviour that were identified in the present study (e.g., choosing different drinks or serving sizes, eating more healthily, exercising more) would now be valuable. Likewise, it will be important to understand any unintended or negative consequences of labelling, as a small minority of participants in the present study reported they may be likely to engage in unhealthy practises as a result of calorie labelling. Although we found no evidence of moderation by SEP in our primary analyses examining alcohol drinking intentions, we did find evidence that women, younger adults and those with higher education levels were more likely to believe they would behave more healthily as a result of alcohol calorie labelling. Similar demographic patterning of self-reported use of calorie labels to inform healthier behaviour has been observed in relation to calorie labelling of food products (Kiszko, Martinez, Abrams, & Elbel, 2014; Sarink et al., 2016). These findings may be explained by social patterning of health consciousness (Wardle & Steptoe, 2003) and highlight that future work will need to consider how equitable calorie labelling of alcoholic drinks is as a public health policy.

We conceptualized SEP based on highest education level because education level is associated with health consciousness and motivation (Marty et al., 2020; Wardle & Steptoe, 2003). However, future research may benefit from exploring other conceptualizations of SEP that have been linked to health choice behaviours, such as subject socioeconomic status (Cheon & Hong, 2017). The sample in the present study was relatively large and diverse, but not fully representative of the UK population and this is a limitation. For example, the sample had slightly more participants with higher education levels than the general population; ~10% (Office of National Statistics, 2011). Our sample was also predominantly white, and therefore, it is unclear whether results would generalize to more ethnically diverse samples. In the present study, calorie information was presented on screen next to an image of each drink and this is a limitation of the study. In real-world settings, calorie information would be provided on bottles and/or on menus and therefore would be less salient. Given that there is evidence that drinkers will often not attend to or notice labelling (Kersbergen & Field, 2017), in real-world settings any effects of calorie labelling on drinking behaviour may therefore be smaller in size. A further limitation of the present study is that its design does not allow us to rule out demand characteristics affecting study findings (Robinson, Bevelander, Field, & Jones, 2018). Because intention measures were designed to ask participants about how labels would affect their behaviour, it is plausible that participants answered in a socially desirable manner (Kersbergen, Whitelock, Haynes, Schroor, & Robinson, 2019). Although we used a between-subjects design, so participants were unaware of label information in different conditions and we presume that any socially desirable responding bias would be consistent across conditions of the study. Nonetheless, this limitation highlights the need to study alcohol calorie labelling using objective measures of actual behaviour in settings that minimize demand characteristics (e.g., real-world drinking). Furthermore, for all measures used to examine other potential effects of calorie labelling, participants reported their level of agreement with statements that related to engagement in behaviours ('I would do more exercise on drinking days' as opposed to 'I would not change my exercise on drinking days') and if alternative phrasing had been used, reported intended behaviour change may have been less common.

Conclusions

Calorie labelling of alcoholic drinks resulted in small reductions to intended drinking and testing of the effect calorie labelling has on behaviour in real-world settings is now warranted.

Acknowledgements

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant reference: PIDS, 803194).

Conflicts of interest

All authors report no conflicts of interest. ER has previously received funding from the American Beverage Association and Unilever for projects unrelated to the present research.

Author contributions

Eric Robinson (Conceptualization; Data curation; Formal analysis; Methodology; Writing – original draft; Writing – review & editing) Jemma Smith (Methodology; Project administration; Resources; Writing – review & editing) Andrew Jones (Methodology; Project administration; Software; Supervision; Writing – review & editing).

Data availability statement

Pre-registered protocol and study data available online at https://osf.io/aydum/?view_only=066c458dc89d44b2806eef1d3b6e911c (blinded).

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Received 15 September 2020; revised version received 19 April 2021

Supporting Information

The following supporting information may be found in the online edition of the article:

Appendix S1. Online supporting material.