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Use as directed: do standard drink labels on alcohol containers help consumers drink (ir)responsibly? Real-world evidence from a quasi-experimental study in Yukon, Canada

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Abstract

Introduction and Aims. *This paper examines the impact of an alcohol labelling intervention on recall of and support for standard drink (SD) labels, estimating the number of SDs in alcohol containers, and intended and unintended use of SD labels.* ***Design and Methods.*** *A quasi-experimental study was conducted in Canada where labels with a cancer warning, national drinking guidelines and SD information were applied to alcohol containers in the single liquor store in the intervention site, while usual labelling continued in the two liquor stores in the comparison site. Three waves of surveys were conducted in both sites before and at two time-points after the intervention with 2049 cohort participants. Generalised estimating equations were applied to estimate changes in all outcomes.* ***Results.*** *Participants in the intervention relative to the comparison site had greater odds of recalling [adjusted odds ratio (AOR) 5.69, 95% confidence interval (CI) 3.02, 10.71] and supporting SD labels (AOR 1.49, 95% CI 1.04, 2.12) and lower odds of reporting using SD labels to purchase high strength, low-cost alcohol (AOR 0.65, 95% CI 0.45, 0.93). Exposure to the labels had negligible effects on accurately estimating the number of SDs (AOR 1.06, 95% CI 0.59, 1.93) and using SD labels to drink within guidelines (AOR 1.04, 95% CI 0.75, 1.46).* ***Discussion and Conclusions.*** *Evidence-informed labels increased support for and decreased unintended use of SD labels. Such labels can improve accuracy in estimating the number of SDs in alcohol containers and adherence to drinking guidelines.* [Schoueri-Mychasiw N, Weerasinghe A, Stockwell T, Vallance K, Hammond D, Greenfield TK, McGavock J, Hobin E. Use as directed: do standard drink labels on alcohol containers help consumers drink (ir)responsibly? Real-world evidence from a quasi-experimental study in Yukon, Canada. *Drug Alcohol Rev* 2020]

Key words: alcohol, standard drink, labelling, drinking guidelines, cancer warning.

Introduction

Alcohol is associated with over 200 diseases and injuries, and in 2016 contributed to 2.8 million deaths worldwide (6.8% and 2.2% of total deaths among males and females, respectively) [1]. With 2.4 billion people now drinking regularly and total alcohol per capita consumption projected to increase 17% over the next decade [1,2], addressing alcohol use at a population level is a critical public health issue.

To promote safer consumption and reduce alcohol-related harms, national drinking guidelines have been released in numerous jurisdictions globally, using the concept of a 'standard drink' (SD) or 'alcohol unit' to communicate the dose of alcohol [3]. A SD contains a

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fixed amount of pure alcohol, though the amount of pure alcohol in a SD varies across jurisdictions [3]. In Canada, a SD is defined as 13.45 g or 17.05 mL of ethanol and is equivalent to: a 341 mL (12 oz.) can of 5% beer or cooler; a 142 mL (5 oz.) glass of 12% wine; and a 43 mL (1.5 oz.) shot of 40% distilled alcohol [4]. Canada's Low-Risk Drinking Guidelines (LRDG), released in 2011, recommend up to 15 SDs a week for men with no more than 3 SDs on most days and up to 10 SDs a week for women with no more than 2 SDs on most days [4]. As such, the concept of a SD is foundational for understanding the drinking guidelines and for those who wish to comply with them [5].

Most jurisdictions, including Canada, that mandate the disclosure of alcohol content on beverage containers require percentage alcohol by volume (%ABV) information (62.9% of countries) [6]. Communicating alcohol content on beverage containers using %ABV information is problematic because most national drinking guidelines are expressed in terms of SDs or alcohol units an adult male and female can consume at relatively lower risk per day and/or per week. The inconsistency in messaging causes consumer confusion and creates barriers for consumers to comply with drinking guidelines [7–13]. To adhere to drinking guidelines and reduce risk of negative consequences due to alcohol, consumers need consistent, easy-to-use information to accurately track their consumption. Therefore, supplementing %ABV information with SD information on alcohol labels may improve consumers' ability to estimate alcohol consumption and facilitate adherence to drinking guidelines. Currently, eight countries mandate SD labelling on alcohol containers [14]. Yet, to date, there have been no formal real-world evaluations of these labels.

Experimental research, including three studies conducted by co-authors of this paper, indicates Canadians are open to having health messaging prominently displayed on alcohol containers and providing SD information on labels better supports consumers in accurately estimating alcohol content in a container and pouring a SD as compared to %ABV [7,8,10–13,15], with size and location of labels affecting use of information [13]. Specifically, larger size labels located on the front of containers improve their use. However, even when SD labels are provided on containers, accuracy in estimating a SD appears to largely depend on beverage type and alcohol strength. For example, evidence suggests that consumers are better able to accurately estimate a SD for beer as compared to wine or spirits. This is likely because beer tends to be sold in single-serve bottles or cans while wine and spirits are sold in multi-serve containers, requiring additional effort and knowledge to accurately estimate the appropriate size of a SD of these beverages [7,13]. The impact of SD labels on actual drinking behaviour is less clear [16]. A review concluded that SD labels have the potential to increase awareness of SDs but the impact on alcohol consumption requires further exploration, especially among populations at higher risk for heavy consumption and alcohol-related harms [13]. A real-world experiment evaluating the impact of SD labels on drinking behaviours is recommended.

Qualitative studies have raised concerns about the potential for consumers to use SD labels to purchase high strength, low-cost alcohol, especially among younger and high-volume consumers [17,18]. Another study found that those with high educational attainment were the most accurate in estimating SDs [7], and sex is a confounder that is commonly adjusted for in labelling studies.

This paper is part of a larger study examining the impact of an alcohol labelling intervention. The alcohol labelling intervention consisted of three rotating labels with: (i) a warning linking alcohol to cancer; (ii) national drinking guidelines; and (iii) SD information for two of the most common alcoholic strengths for each of wine, spirits and beer, and the most common strength for coolers (Figure 1) [19,20]. Informed by evidence [5,8], the intervention labels were large in size (5.0 × 3.2 cm) and bright yellow with a red border to make them visually prominent on containers. The specific objectives of the current paper are to examine the impact of the labelling intervention on: (i) recall of SD labels; (ii) estimating the number of SD in an alcohol container; (iii) intended and unintended use of SD labels and associations with participant characteristics; and (iv) support for SD labels.

Methods

This study used three waves of survey data conducted in both the intervention and comparison sites before and at two time-points after the alcohol labelling intervention. Full details of the quasi-experimental study have been published elsewhere [21]. Briefly, this study was conducted among cohort participants recruited in the single government-run liquor store in Whitehorse, Yukon, Canada (intervention site) and the only two government-run liquor stores in Yellowknife, Northwest Territories, Canada (comparison site). Whitehorse and Yellowknife have similar government-owned alcohol distribution systems, per capita alcohol sales, population size and socio-demographic profiles [19,22–24]. Both jurisdictions have mandated post-manufacturer warning labels on alcohol containers since 1991 that caution about drinking during

Label 1 – Cancer warning | **Label 2 – Canada's national drinking guidelines** | **Label 3 – Standard drink information (example for wine)**

Figure 1. *Intervention alcohol warning labels (actual size 5.0 × 3.2 cm each). Note: Alcohol containers sold in the liquor store in the intervention condition were each labelled with one of the three label options displayed.*

pregnancy, with additional label messages in Northwest Territories warning of drinking while driving or operating machinery, and alcohol may cause health problems [22,23]. The alcohol labelling intervention included labels with a cancer warning, national drinking guidelines and SD information [21,25,26]. The labels with a cancer warning and drinking guidelines were applied to alcohol containers in the liquor store in the intervention site starting in November 2017, with the SD labels slated to follow shortly thereafter, and were scheduled to continue for 8 months alongside a social marketing campaign that supports the label messages. However, due to pressure from Canada's national alcohol industry [21,27], the intervention site paused their participation in the study and stopped applying labels in December 2017, only 1-month into the 8-month intervention period. Based on remaining label stock, approximately 47 000 cancer labels and 53 000 drinking guideline labels were applied between November and December 2017. The intervention site resumed participation in April 2018, on the condition that the cancer warning label be excluded. Thus, the label with the drinking guidelines was reintroduced starting April 2018, and the SD label starting May 2018, up to the end of the intervention period on 31 July 2018. Approximately 117 000 drinking guideline labels and 92 000 SD labels were applied to containers between April and July 2018. The planned social marketing campaign was not implemented, with the exception of a toll-free helpline listed on the intervention labels and an informational website that provided resources about drinking guidelines and calculating SDs.

Procedure

A prospective cohort of liquor store patrons was systematically recruited in Wave 1 (May to June 2017) by trained research assistants as they exited the liquor stores during peak retail hours on all days of operation in both the intervention and comparison sites. The research assistants used a standard intercept technique of approaching every person that passed a preestablished landmark in the liquor store. Participants completed a screener and the survey on a tablet without assistance and were offered a $10 incentive as remuneration. In Wave 2 (February to March 2018) and Wave 3 (June to July 2018), participants who provided their contact information at an earlier wave were emailed survey instructions, a unique survey link and an e-transfer as remuneration. In Wave 2, participants were remunerated $10 and this increased in Wave 3 to $15 to increase recruitment and reduce attrition. Additionally, due to attrition in Waves 2 and 3, the sample was replenished using Wave 1 recruitment protocols. All three survey periods lasted approximately 6 weeks, the survey took approximately 18 min to complete, and survey measures and protocols were consistent across waves and sites. Study procedures were approved by the Research Ethics Boards at Public

Health Ontario (ID 2017-010.04) and the University of Victoria (Protocol 17-161).

Participants

Participants were eligible to participate if they were of legal drinking age (19+ years), were residents of either the intervention or comparison cities, and at the time of initial recruitment were current drinkers (consumed ≥1 alcoholic drink in the past 30 days), purchased alcohol at the liquor store and did not self-report being pregnant or breastfeeding.

Measures

Measures in the questionnaire were presented in the following order: noticing labels; unprompted and prompted SD message recall; estimating the number of SDs; support for SD labels; and unintended and intended use of SD labels.

Noticing labels. To assess noticing the alcohol labels, participants were asked if they had seen any warning labels on bottles or cans of beer, wine, hard liquor, coolers or ciders. Response options included 'Yes', 'No', 'Don't know' and 'Prefer not to say', dichotomised as 'Yes' versus all other responses. The measure at Wave 1 was anchored with 6 months prior, Wave 2 from November prior to follow up and Wave 3 from April prior to follow up.

Unprompted and prompted SD message recall. Among those that indicated noticing warning labels, participants were first asked an unprompted open-ended question to indicate what messages they had seen on the labels. Subsequently, to assess prompted recall, participants were shown a list of possible label messages and asked to select all messages that they saw on alcohol containers. Response options included alcohol and cancer, LRDG, number of SDs in bottles or cans, alcohol may be an addictive drug, alcohol and liver disease, alcohol and trauma, alcohol and foetal alcohol spectrum disorder, and drinking alcohol and driving a car or operating machinery, with 'Do not know' and 'Prefer not to say' as additional options. Both recall measures were anchored similarly to the noticing labels measure. For the unprompted recall measure, a research assistant blinded to experimental condition coded each response. A second coder reviewed ambiguous responses and discussed to reach consensus. Any reference to SD was coded as recall of the SD message versus all other responses.

Estimating the number of SDs. To assess participants' ability to estimate the number of SDs in an alcohol container, participants were first asked what type of drink they mainly have when they drink alcohol. Options included beer, wine, spirits (hard alcohol), coolers/cider, in addition to 'Don't know' and 'Prefer not to say'. Participants were then shown an image of their preferred drink (wine if they chose 'Don't know' or 'Prefer not to say') and were asked how many 'standard drinks' are in the alcoholic container shown on the screen. The displayed sizes and strengths of each beverage varied: 473 mL 5% beer (1.4 SDs; irregular sized beer container), 750 mL 12% wine (5 SDs), 750 mL 40% spirits (18 SDs) and 375 mL 4.5% cider (1 SD). Participants had to provide an exact correct answer to be categorised as 'correct'. Responses were dichotomised as correct versus all other responses.

Intended and unintended use of SD labels. Intended use was assessed by asking: 'If the number of standard drinks were displayed on bottles and cans of alcoholic beverages, would you ever use the information to help yourself or someone else stay within the daily drink limit advised in the low-risk drinking guidelines?'. Unintended use was assessed by asking: 'If the number of standard drinks were displayed on bottles and cans of alcoholic beverages, would you ever use the information to compare brands to get the most alcohol for the least amount of money?' Participants were shown an on-screen image of a SD label for reference. Response options included 'Yes', 'No', 'Don't know' and 'Prefer not to say', dichotomised as 'Yes' versus all other responses.

Support for SD labels. Participants were asked to report the extent to which they disagree or agree that cans and bottles of alcoholic beverages should be labelled with the number of SDs per container. Responses were given on a 5-point Likert scale from 1 = 'Strongly disagree' to 5 = 'Strongly agree', with 'Don't know' and 'Prefer not to say' as options. Responses were dichotomised as 'Agree/Strongly agree' versus all other responses.

Socio-demographics. Socio-demographic measures included age, sex, ethnicity (White, Aboriginal and Other/Don't know/Prefer not to say/missing), education [low (completed high school or less), medium (completed trades or college certificate, some university or university certificate below bachelor's), high (university degree or post-graduation) and unknown (Don't know/Prefer not to say/missing)] and income [low (<$30 000), medium ($30 000–$59 999), high

(≥$60 000) and unknown (Don't know/Prefer not to say/missing)].

Other covariates. Health literacy was assessed using the Newest Vital Sign assessment tool [28] and responses were categorised as: limited (≤1 correct responses); possibility of limited (2–3 correct responses); adequate literacy (4–6 correct responses); and unknown (Don't know/Prefer not to say/missing). Alcohol use was measured using the quantity/frequency method [29]. Participants were asked to indicate how often they drank alcohol beverages in the past 6 months and how many drinks they usually drank per occasion. Responses were combined to provide a mean number of drinks per week and categorised using Canada's LRDG: low (≤10 for females/15 for males per week); risky (11–19/16–29 per week); high (≥20/30 per week) [4]; and unknown (Don't know/Prefer not to say/missing). Lastly, a time-in-sample variable was created to adjust for participants who participated in one, two or all three survey waves.

Statistical analysis

Generalised estimating equation (GEE) models [30] using a binomial distribution with logit link function were used to examine the impact of the intervention labels on six outcomes: unprompted and prompted recall of the SD labels message; estimating the number of SDs in an alcohol container; intended and unintended use of SD labels; and support for SD labels. GEE models can account for a mix of within-subject correlation that arises from the cohort participants being asked the same questions over multiple survey waves plus the replenishment sample. In order to test for an intervention effect, difference-in-difference (DID) terms (interaction between survey wave and site) were added to each model to assess the change in outcomes between sites over time. Socio-demographics and other covariates were included in all models, with ethnicity defined as White versus all other responses. The model estimating the number of SDs in an alcohol container also adjusted for preferred drink. While ethnicity was controlled for in all models, it is not reported in the results as outlined in research agreements obtained for the current study. Education, income and health literacy were found to be correlated; thus, to improve the stability of the models, only education was used. A sensitivity analysis evaluated the effect of adjusting for health literacy or income instead of education and this did not substantially alter the main results. DID comparisons between Waves 1 and 3 are presented for all outcomes aside from unprompted recall of the SD labels. The GEE model estimating unprompted recall did not converge due to cell counts of 0 in both sites at Wave 1 (no outcome events). Thus, only unadjusted percentages are presented for unprompted recall. 'Prefer not to say'/missing responses were excluded from the outcome measures in all of the models. All analyses were conducted using SAS 9.3 [31].

Results

The final sample consisted of 2049 unique participants. Response rates in the intervention and comparison sites were 8.9% and 8.0%, respectively [32], with 53.2% of participants retained in Wave 2 and 47.5% in Wave 3 (see the study's detailed protocol for the cohort structure) [21]. In total, 836 participants completed Wave 1, 1256 participants completed Wave 2 and 1185 participants completed Wave 3. Participants lost to follow up between waves were more likely to be younger, male, have lower education, income and literacy, consume risky, high or unknown levels of alcohol and be in the comparison site. Table 1 presents the sample characteristics of participants by site at time of initial recruitment.

Noticing labels

The majority of participants reported noticing labels in both the intervention (Wave 1 = 80.4%, Wave 2 = 76.7%, Wave 3 = 80.5%) and comparison (Wave 1 = 87.0%, Wave 2 = 78.5%, Wave 3 = 72.9%) sites.

Unprompted and prompted SD message recall

For unprompted recall, cell counts of 0 in both sites in Wave 1 prevented applying a GEE model to estimate intervention effects. Figure 2a illustrates the increase in unprompted recall between Waves 1 and 3 in the intervention versus comparison site (+11.9% vs. +0.3%).

For prompted recall, results of the DID analyses indicate that between Waves 1 and 3, there were greater odds of participants recalling the SD label message in the intervention relative to the comparison site [+32.6% vs. +3.2%, adjusted odds ratio (AOR) 5.69, 95% confidence interval (CI) 3.02, 10.71; Figure 2b; Table 2].

Estimating the number of SDs

Results of the DID analyses indicate that between Waves 1 and 3, there were slightly greater odds of

Table 1. *Sample characteristics by site at time of recruitment*

	Intervention site (n = 1233), n (%)	Comparison site (n = 816), n (%)
Wave of recruitment		
1	505 (41.0)	331 (40.6)
2	491 (39.8)	320 (39.2)
3	237 (19.2)	165 (20.2)
Age, mean (standard deviation)*	47.4 (14.6)	41.2 (13.7)
*Age categories, years**		
19–24	77 (6.2)	100 (12.3)
25–44	436 (35.4)	379 (46.5)
45+	720 (58.4)	337 (41.3)
*Ethnicity**		
White	891 (72.3)	481 (59.0)
Aboriginal	219 (17.8)	198 (24.3)
Other	123 (10.0)	137 (16.8)
*Sex***		
Female (vs. male)	625 (50.7)	368 (45.1)
*Education levels***		
Low (completed high school or less)	250 (25.3)	184 (22.6)
Medium (trades or college certificate, some university or university certificate below bachelor)	437 (35.4)	292 (35.8)
High (bachelor degree or higher)	490 (39.7)	285 (34.9)
Unknown (DK, PNS, missing)	56 (4.5)	55 (6.7)
*Income levels****		
Low (<$30 000)	197 (16.0)	87 (10.7)
Medium ($30 000 to <$60 000)	222 (18.0)	128 (15.7)
High (≥$60 000)	698 (56.6)	489 (59.9)
Unknown (DK, PNS, missing)	116 (9.4)	112 (13.7)
*Alcohol use levels****		
Low volume (≤10 SD for females/15 SD for males per week)	912 (74.0)	555 (68.0)
Risky volume (11–19/16–29 SD per week)	96 (7.8)	50 (6.1)
High volume (≥20/30 SD per week)	121 (9.8)	105 (12.9)
Unknown (DK, PNS, Missing)	104 (8.4)	106 (13.0)
*Health literacy levels**		
Limited literacy (score ≤1)	369 (29.9)	287 (35.2)
Possibility of limited literacy (score 2–3)	240 (19.5)	160 (19.6)
Adequate literacy (score 4–6)	563 (45.7)	299 (36.6)
Unknown (DK, PNS, missing)	61 (5.0)	70 (8.6)

*Pearson χ^2 test, $P < 0.0001$. **Pearson χ^2 test, $P < 0.05$. ***Pearson χ^2 test, $P < 0.001$. DK, don't know; PNS, prefer not to say; SD, standard drinks.

participants providing correct estimates of the number of SDs in their preferred drink in the intervention relative to the comparison site (+6.3% vs. +5.5%, AOR 1.06, 95% CI 0.59, 1.93; Figure 2c, Table 2). A sensitivity analysis adjusted for type of preferred drink as lower (cider, beer or wine) versus higher (spirits) strength alcohol. This did not substantially change the DID results in terms of direction or magnitude. However, those who indicated that their preferred drink was spirits had lower odds of providing a correct response, compared to those who preferred lower strength alcohol, independent of intervention effects (AOR 0.23, 95% CI 0.14, 0.37). We also further examined estimation of SDs as a four-level categorical outcome: underestimate, correct, overestimate and don't know (17% of responses). When comparing 'correct' versus 'underestimate', the DID analyses revealed a 6.3% greater increase in correct estimates in the intervention relative to the comparisons site between Waves 1 and 3 (+11.0% vs. +9.3%, AOR 1.06, 95% CI 0.75, 1.51). When comparing 'correct' versus 'overestimate', the DID analyses revealed a 5.8% greater increase in correct estimates in the intervention relative to the comparisons site between Waves 1 and 3 (+4.5% vs. +3.8%, AOR 1.06, 95% CI 0.79, 1.41).

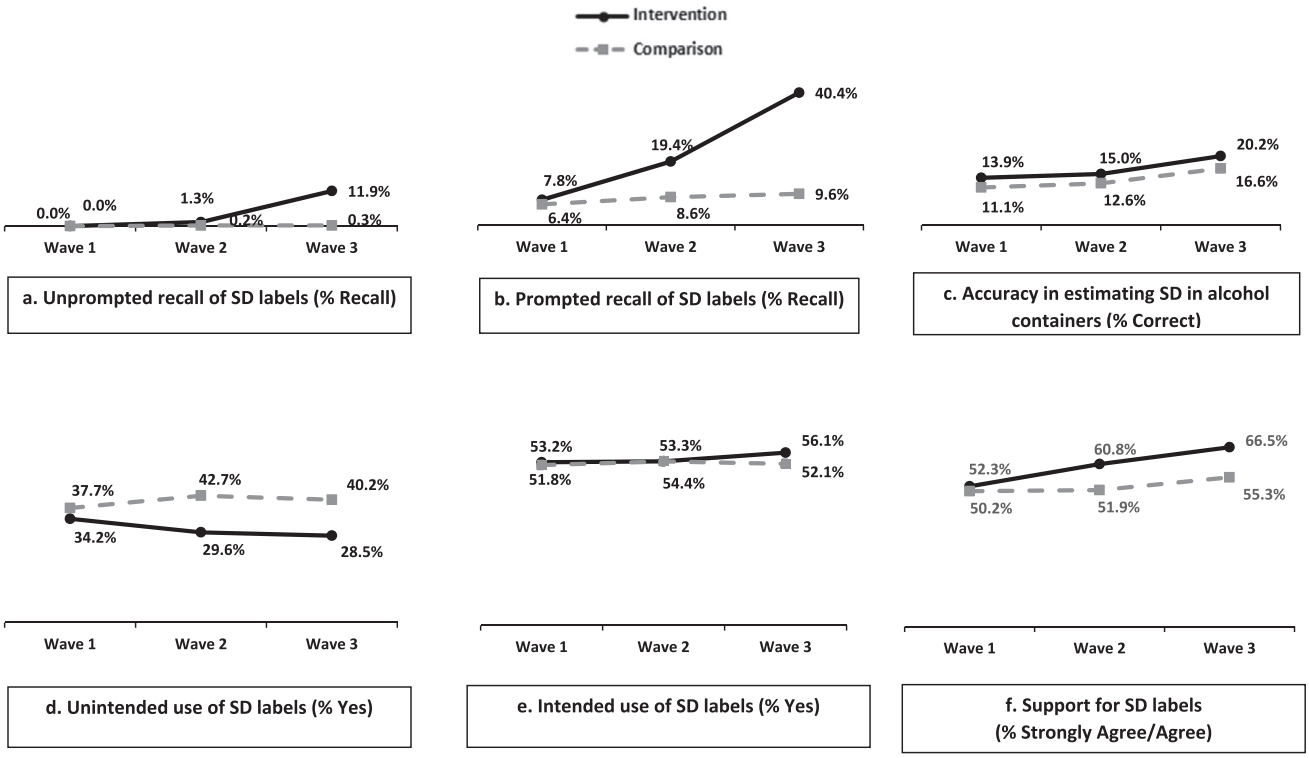

Figure 2. *(a–f). Impact of intervention alcohol labels on outcomes in intervention and comparison sites (Waves 1 to 3), unadjusted %.*

Intended and unintended use of SD labels

Between Waves 1 and 3, DID results indicate that there were slightly greater odds of participants reporting using the SD labels to help themselves or someone else stay within the LRDG limits in the intervention relative to the comparison site (+2.9% vs. +0.3%, AOR 1.04, 95% CI 0.75, 1.46; Figure 2e, Table 2). Overall, across both sites and survey waves (independent of intervention), females and those reporting high education levels (vs. low) were more likely to indicate using SD labels to help themselves or someone else stay within the LRDG limits, while older participants (vs. <25) and those reporting high alcohol or unknown consumption levels were less likely to indicate using SD labels for this purpose (Table 3).

Between Waves 1 and 3, DID results indicate that there were lower odds of participants reporting that they would use the SD labels to purchase higher strength alcohol for lower cost in the intervention versus comparison site (−5.7% vs. +2.5%, AOR 0.65, 95% CI 0.45, 0.93; Figure 2d, Table 2). Overall, across both sites and survey waves (independent of intervention), older participants (vs. <25), those reporting high education levels (vs. low) and those participating in all three survey waves (vs. one wave) were less likely to report using SD labels to purchase higher strength alcohol for lower cost, while those reporting high alcohol consumption (vs. low) were more likely to report using SD labels for this purpose (Table 3).

Table 2. *Results of generalised estimating equation (GEE) models for label outcomes—intervention versus comparison site: Waves 3 versus Wave 1*[a,b]

Measure	AOR	95% CI
Prompted recall of SD labels	5.69	3.02, 10.71
Accuracy in estimating SD in alcohol containers	1.06	0.59, 1.93
Unintended use of SD labels	0.65	0.45, 0.93
Intended use of SD labels	1.04	0.75, 1.46
Support for SD labels	1.49	1.04, 2.12

[a]All models adjusted for age, ethnicity, sex, education, time-in-sample and alcohol use. [b]Separate logistic models were estimated using GEE for each of the individual measures of warning label effectiveness. AOR, adjusted odds ratio; CI, confidence interval; SD, standard drinks.

Contribution of the cancer message and drinking guidelines

To test the contribution of including labels with a cancer warning and drinking guidelines alongside the SD labels, a GEE model estimating the relationship

between recall of the cancer message or drinking guidelines, either unprompted or prompted, and recall of the SD label message, either unprompted or prompted, was conducted, adjusting for socio-demographics and other covariates. The results suggest those who recalled the cancer message or drinking guidelines had higher odds of recalling the SD label message compared with those who did not recall the cancer message or drinking guidelines (AOR 6.53, 95% CI 5.16, 8.27).

Degree of support for SD labels on alcohol containers

Between Waves 1 and 3, DID results indicate that there were greater odds of participants supporting SD labels in the intervention relative to the comparison site (+14.2% vs. +5.1%, AOR 1.49, 95% CI 1.04, 2.12; Figure 2f, Table 2).

Discussion

Rotating alcohol labels with a cancer warning, national drinking guidelines and SD information is a strategy with the potential to improve consumers' ability to track their alcohol consumption and facilitate adherence to national drinking guidelines. To our knowledge, this is the first real-world study to experimentally test the impact of an alcohol labelling intervention that includes SD information. Overall, consumers exposed to intervention labels, relative to those unexposed to the labels, had greater odds of recalling SD information and supporting SD labels on containers and lower odds of reporting using SD labels to purchase high strength, low-cost alcohol. Moreover, exposing consumers to the labels had small but positive effects on using SD labels to drink within drinking guidelines and accurately estimating the number of SDs in their preferred drink. Those who recalled both the cancer warning and drinking guidelines also had higher odds of recalling the SD label.

Table 3. *Associations between selected variables and unintended and intended use of standard drink labels*

	Unintended use	Intended use
	OR (95% CI)	OR (95% CI)
Sex		
Male	1.00	1.00
Female	1.02 (0.86, 1.21)	1.44 (1.22, 1.69)***
Age, years		
19–24	1.00	1.00
25–44	0.42 (0.31, 0.58)***	0.65 (0.48, 0.89)*
45+	0.25 (0.18, 0.34)***	0.46 (0.34, 0.62)***
Education levels		
Low	1.00	1.00
Medium	0.88 (0.69, 1.12)	1.00 (0.79, 1.26)
High	0.74 (0.58, 0.95)*	1.40 (1.10, 1.78)*
Unknown	0.75 (0.47, 1.19)	0.98 (0.46, 1.56)
Alcohol use levels		
Low volume	1.00	1.00
Risky volume	0.99 (0.75, 1.32)	0.81 (0.62, 1.05)
High volume	1.34 (1.02, 1.75)*	0.66 (0.52, 0.85)*
Unknown	1.12 (0.84, 1.51)	0.60 (0.45, 0.80)**
Time-in-sample		
1	1.00	1.00
2	0.89 (0.73, 1.10)	0.99 (0.81, 1.20)
3	0.79 (0.63, 1.00)*	0.91 (0.74, 1.12)
Wave		
1	1.00	1.00
2	1.28 (0.97, 1.68)	1.10 (0.84, 1.44)
3	1.20 (0.90, 1.59)	1.00 (0.76, 1.30)
Site		
Comparison	1.00	1.00
Intervention	1.10 (0.81, 1.48)	1.13 (0.85, 1.49)

*Pearson χ^2 test, $P < 0.05$. **Pearson χ^2 test, $P < 0.001$. ***Pearson χ^2 test, $P < 0.0001$. CI, confidence interval; OR, odds ratio.

Exposure to the labelling intervention had a small effect on consumers' ability to estimate the number of SDs in their preferred alcoholic beverage. A number of previous laboratory-based studies show that SD labels help consumers estimate the alcohol content in their drinks compared to %ABV labels [7,8,11,12], while one study conducted by Maynard and colleagues [16] found no impact. The studies observing positive label effects on estimation included an education component prior to the task to support participants in comprehending the concept of a SD [7,11,12]. One possible explanation for the modest label effects in the current study is that consumers did not fully understand how to use the information on the SD labels. The information on the SD labels tested in this study was relatively complicated because the labels were applied at the point-of-sale in the liquor store and not by manufacturers. As such, the SD information was not specific to the alcohol container but instead included two of the most common alcoholic strengths for that beverage type (i.e. beer, wine, spirits and coolers). Future research examining SD labels applied by alcohol manufacturers with information specific to the container size and alcohol strength is needed. Moreover, the planned social marketing campaign designed to support label messages, particularly the SD label information, was not implemented during the intervention and the SD labels were applied to containers in the intervention site for a briefer-than-intended period (2.5 months) due to the alcohol industry's interference. The industry's concerns were primarily centred on the inclusion of the cancer warning, and while the local government was able to avoid the potential threat of litigation and resume the study by proceeding without the cancer label [21], the resulting interruption reduced the duration of the intervention period and consumers' overall exposure to the more complex SD label information. The shortened intervention period may have impacted the extent to which consumers familiarised themselves with and understood the SD label information. In the present study, the option of individualised container-specific SD labels was considered but deemed too time-consuming and prone to error in a setting in which the labels were being applied individually and by hand by liquor store employees.

The alcohol industry and some researchers argue that SD labels will be used to purchase high strength, low-cost alcohol and promote risky drinking [16–18]. Prior to the labelling intervention, one-third of participants in both sites in this study reported that they would use SD labels for purchasing high strength, low-cost alcohol. Participants reporting that they would use SD labels for this purpose were more likely to be high-volume consumers. However, after the labelling intervention, those exposed to the intervention had lower odds of reporting using the labels to purchase high strength, low-cost alcohol relative to those unexposed. It is possible that once consumers are exposed to SD labels and become more familiar with the concept of a SD to track and monitor their alcohol consumption, they may be less likely to consider applying this information for unintended purposes. This may be particularly true of certain population subgroups, such as those who are older and with higher levels of education. Additionally, results from this study found a small but negligible increase in using the SD labels for staying within drinking guidelines. Focus groups conducted previously by our research team suggest that as participants learn the concept of a SD and how it relates to drinking guidelines, they better appreciate the value of the information [5]. Thus, it is important to educate consumers about SD label information and how to apply this information to track and monitor their consumption as it may facilitate not only their own but also others' improved adherence to drinking guidelines.

Support for SD labels was high overall and increased after exposure to the intervention labels. These findings are consistent with research on tobacco labelling, where support for comprehensive labelling policies increased after implementation [33]. Consumers want and support more information on alcohol products to facilitate informed decisions [5,7]. Evidence-informed labels such as those tested in this study have been shown to raise awareness of alcohol-related risks and subsequently increase support for or be associated with other, more restrictive public health measures including minimum pricing and marketing and advertising restrictions, [26] and should therefore be considered as a potentially effective and important component of a broader alcohol control strategy.

This study has several limitations to consider. First, due to the alcohol industry's interference, the intervention was interrupted and briefer-than-intended, which may have weakened the alcohol labels' impact. The interruption also caused two varying time gaps between data collection waves, which may have impacted memory retrieval for time-bound outcomes and led to some seasonal effects [34]. Additionally, the social marketing campaign originally planned to support label messages and educate consumers about the SD information was not implemented, which likely reduced the impact of the SD labels. A longer, uninterrupted real-world study is needed to confirm our findings. Furthermore, the SD labels used were generic to a beverage category rather than individualised to each of the several thousand varieties of container size and strength, as is required in SD labelling in both Australia and New Zealand [35].

Additionally, the study sample was not representative of the site populations, as participants were recruited from liquor stores in city centres using non-probability-based methods, limiting generalisability. Further, the survey responses were self-reported and measures related to the intended or unintended use of the SD labels may have been subject to social desirability bias. Lastly, we were not powered to detect significant three-way interactions assessing differential label impacts by key socio-demographic characteristics. Our estimates of the label impacts, therefore, are likely to be conservative.

Conclusion

Consumers recalled SD label messages and exposure to the alcohol labelling intervention that included SD labels increased support for and decreased unintended use of SD labels. Enhanced alcohol labels may be a promising tool for improving consumer accuracy in estimating the number of SD in an alcohol container and adherence to drinking guidelines, and warrant inclusion as part of broader alcohol control strategies.

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Conflict of Interest

The authors declare that they have no competing interests, with the exception of TS who received research funds and travel expenses from both the Swedish (Systembolaget) and Finnish (ALKO) government retail alcohol monopolies for the conduct of research into the impacts of their policies on alcohol consumption and related harm and TKG whose research has been partially supported by the National Alcohol Beverage Control Association.

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