Interventions to reduce sugar-sweetened beverage consumption using a nudge approach in Victorian community sports settings

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Abstract

Objective: To assess the effectiveness of interventions using a nudge approach to reduce sugar-sweetened beverage purchases in community sports settings.

Methods: A total of 155 community sporting organisations participating in VicHealth funded programs were invited to nominate a nudge based on a traffic light approach to drinks classification. These included limit red drinks, red drinks off display, water the cheapest option, and meal deals. Sales data was collected for a predetermined period prior to and following the introduction of the nudge. Nudges were classified initially on whether they were implemented to VicHealth standards. Appropriately implemented nudges were classified as successful if they achieved a relative decrease in sales from drinks classified as red.

Results: In all, 148 organisations trialled 195 nudges; 15 (7.7%) were successful and 20 (10.3%) were appropriately implemented but unsuccessful. Limit red drinks was the most frequently attempted nudge (30.8%). Red drinks off display had the greatest rate of success (20.0%).

Conclusions: Red drinks off display was the simplest and most successful nudge.

Implications for public health: Guidelines limiting the display of sugar-sweetened beverages may be an effective means of altering consumer behaviour.

Key words: community sports, nudge, canteen, public health, sugar-sweetened beverage

One in four Australian children and two-thirds of Australian adults are overweight or obese, placing them at higher risk of developing type 2 diabetes and cardiovascular disease.[1,2] Diets high in energy-dense foods strongly contribute to the development of obesity.[3] Sugar-sweetened beverages (SSBs) are a significant contributor to sugar and energy intake and have consistently been shown to be associated with increased body weight in the Australian population.[4-6] Low socioeconomic status (SES) has also been consistently associated with SSB consumption in both children and adults and the mean SSB consumption continues to rise in a subset of the population who have a lower SES.[4,7-11] Australian males, young people, and those of lower SES have reported a perception that SSBs are better value than water, with males and young people more likely to purchase SSBs as part of a 'meal deal'.[12]

A 2017 survey of 3,430 Australian adults found nearly half (47.3%) had consumed SSBs in the previous week, with 13.6% consuming SSBs daily.[13] In that study, higher soft drink consumption was associated with obesity, heart disease and depression, prompting the authors to recommend a comprehensive approach to reduce consumption, including the active promotion of water. There is compelling evidence that a reduction in SSB consumption can reduce the prevalence of obesity and obesity-related diseases.[14]

Environmental interventions including traffic light labelling (TLL) of beverages, reducing the availability of SSBs and increasing the price of SSBs are all associated with reductions in SSB sales and/or consumption.[15] The TLL system classifies foods and beverages based on their nutrient composition: green represents the healthiest options; amber represents choices with some nutritional value; and red represents choices that are high in sugar, salt or unhealthy fats.[16] Interventions using the TLL classification may categorise foods to support consumers to make informed choices or to guide policies on the display of foods and drinks and their availability for purchase. In Victoria, Australia, the State Government's Healthy Choices Guidelines includes sample policies, implementation plans and toolkits for sport and recreation settings.[16]

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In community sports settings, energy-dense food and drink choices, including SSBs, are often the norm.[17,18] However, non-SSB consumption has been shown to increase in response to the increased availability of non-SSB drink options in Canadian and Australian community recreation settings.[19,20] An Australian intervention incorporating multiple strategies (availability and positioning of SSBs vs. non-SSBs, pricing incentives, meal deal promotions, signage, posters, policies, and promotion through coaches) across 85 football clubs was successful in increasing non-SSB sales and consumption.[21] However, it is uncertain whether this was related to any particular strategy used, and all outcomes were self-reported with no study-specific measurement of sales data. Detailed sales data were collected from 16 aquatic and recreation centres in Victoria, Australia, and found that removal of all SSBs classified as red drinks led to a decrease in red and total drink sales, but was not accompanied by an increase in sales of green drinks despite the use of complementary strategies including drink placement, traffic light labels at point of sale and promotional posters.[22] Despite promising results, these studies leave gaps in our understanding of which strategies are most acceptable and successful in reducing SSB consumption.

Many of the interventions described above may be classified as nudges. In behavioural economics, a nudge is a term used to describe how one can influence others' choices by organising the context in which they make decisions.[23] Nudges align with the mid-levels of the Nuffield intervention ladder where choice is guided by changing the default, or through the use of incentives or disincentives.[24] However, nudges must also be easy and cheap to avoid, and not go so far as to restrict or eliminate choice.[25] Thus, interventions using a traffic light approach to classify drinks and manipulating the display or promotion of products to influence individual purchasing behaviours are considered nudges, while interventions removing SSBs from sale altogether are not. Nudges have been shown to be acceptable to both consumers and retailers, perhaps because healthy options are promoted without restricting choice.[26,27] Nudges have been used most frequently in public health interventions to influence eating and drinking behaviour.[28] However, the quality of studies performed has typically been limited by small sample sizes, minimal methodological detail and a lack of use of reporting guidelines.[28,29]

Practical solutions are needed to address concerning SSB intake among Australians. Community sport settings, where SSBs are widely available, present an opportunity to trial nudges in a targeted setting. However, it is not clear which nudges are most practical to implement and successful in reducing SSB consumption. Furthermore, other studies have been conducted in limited settings (Australian football clubs; aquatic centres), and have used either multiple combined nudges[21] or restricted choices.[22]

The Victorian Health Promotion Foundation (VicHealth) adopted a nudge approach to its initiatives that aimed to reduce SSB consumption in community sports settings. Halpern's TEST (target, explore, solution, trial) framework was used to guide the development and implementation of a trial.[30] Ultimately, Victorian community sporting clubs/venues were invited to undertake projects using one of four nudge approaches that aimed to increase the consumption of water and reduce the purchase of SSBs. The aim of this research was to assess the effectiveness of interventions using a nudge approach to reduce SSB purchase as an indicator of consumption in community sports settings.

Methods

Framework

This study was designed using Halpern's TEST framework.[30] This involved the following steps:

- **T**arget (define the outcome): To reduce SSB consumption in community sports settings (using purchase as a proxy measure)
- **E**xplore (understand the context): Allow individual organisations to design and select an intervention that they believe will best suit their context
- **S**olution (build your intervention): Refine to four evidence-based nudges that align with organisation preferences and capabilities
- **T**rial (test, learn and adapt): Formal trial, dissemination of results and continued support

Participants

Sporting clubs in Victoria, Australia, involved in the State Sport Program (SSP; April 2016 – June 2017), Regional Sport Program (RSP; April 2016 – September 2017) and Water Initiative Program (WIP; January – August 2017) (n = 155 total) were invited to participate. Henceforth, these clubs will be referred to as the 'intervention organisations', for ease of reporting and to distinguish them from the 'funded organisations', i.e. the State Sporting Associations, Regional Sports Assemblies, and Local Government Authorities (LGAs) that received funding from VicHealth to implement the program. All intervention organisations were deidentified and allocated a numeric code for analysis and reporting. The socioeconomic status of the population attending the club/facility was represented using the Socioeconomic Indexes for Australia (SEIFA) Index of Relative Socio-economic Advantage and Disadvantage.[31] This scale ranks areas identifiable by postcode into deciles, with 10 being the most advantaged.

Intervention

Intervention organisations were asked to nominate their own nudge initiative(s). The first group of intervention organisations, in the *explore* phase, used a range of self-determined strategies based on broad guidance from VicHealth. This was refined following the first program evaluation in April 2017 at the *solution* phase, with new intervention organisations choosing from one of four possible options that had been developed and documented by VicHealth and La Trobe University for the *trial phase*. In the *Limit red drinks* initiatives, clubs restricted the number of red drinks available to no more than 20% of drinks for sale, with green drinks displayed at eye level. The *Red drinks off display* required clubs to keep beverages classified as red drinks hidden from consumers, for example, behind fridge decals or posters or behind the counter, but permitted the sale of these beverages where requested. Clubs could choose to make *Water the cheapest option* by reducing the price of water or increasing the sales price of other beverages accordingly. The *Meal deal* involved packaging water with a food item to provide a relative cost saving to consumers. All options were designed to provide a nudge to consumers with beverage classification based on the Victorian Government's Healthy Choices Guidelines traffic light system.[16]

Intervention organisations were supported by their funded organisation to implement the nudge, and also had direct access to two members of the research team for further support. A representative of the funded organisation met in person with a member of

the intervention organisation to explain the nudge concept and process. To encourage participation, some funded organisations offered intervention organisations an incentive. Incentives varied depending on the funded organisation and included direct payments, nutrition education sessions, sporting equipment, canteen equipment and canteen stock (for example, a supply of green drinks). Intervention organisations were supported with resources to assist with the implementation and evaluation of the nudge, such as the 'Nudge Toolkit', which comprised:

- a simple table detailing the research process for the stocktake method* for both baseline and nudge implementation periods (*stock was calculated by counting all stock on display and in storage at the start of the specified period, adding all stock purchased during the specified period, then subtracting all stock on display and in storage at the end of the specified period);
- 'Facility Information' identifying minimum criteria for site selection;
- a 'Photo Taking Guide'; and
- simple documentation for recording baseline and nudge data per project location.

The resources in the Nudge Toolkit were further supported by communication tools developed by VicHealth regarding drink classification and the nudge interventions. Education sessions with external nutrition experts were provided to upskill intervention organisations prior to nudge implementation.

Data collection

Intervention organisations were asked to collect baseline sales data from their canteen or retail outlet for a pre-determined period of time (e.g. four weeks) while they continued business as usual. Where an intervention organisation had suitable baseline sales data from a previous period of operation of the same duration as the nudge, which allowed drinks to be classified accordingly, this was used.

The selected intervention was then deployed and implemented for a duration equivalent to the baseline data collection. Where multiple nudges were trialled by the same intervention organisation, they were implemented in sequence (i.e. one at a time), and each nudge was implemented for a duration equivalent to the baseline data collection. Photos were taken to document the intervention at baseline and once the nudge was implemented, and sales data were collected from the canteen or retail outlet throughout the intervention period. The minimum duration of baseline and intervention was related to the context of the site, with no changes in operation or pricing made throughout the baseline and intervention phases, and no major events or playoffs (finals) held during either phase. All sites were required to provide data on total attendance and daily weather (temperature in degrees Celsius) throughout both phases to identify any confounding variables. Only drinks sold from the fridge were included in analyses; hot beverages (tea, coffee, hot chocolate) were not included in the nudges or the analyses. Hot drinks were excluded because: i) canteens were unable to confirm the volume of beverage served relative to the TLL rating; ii) many canteens had only one item on the register for all hot drinks, making it impossible to determine the breakdown of the type of hot drinks sold; and iii) some venues had private coffee vans that would set up during games/matches, and as such the majority of hot beverages were sold by a third party provider that was not part of the intervention or the evaluation.

Evaluation

At the end of the intervention, a member of the research team reviewed all data collected, including sales data, attendance, weather and photographic evidence of the intervention. Projects were classified based on their implementation initially, and then on their outcomes (Figure 1):

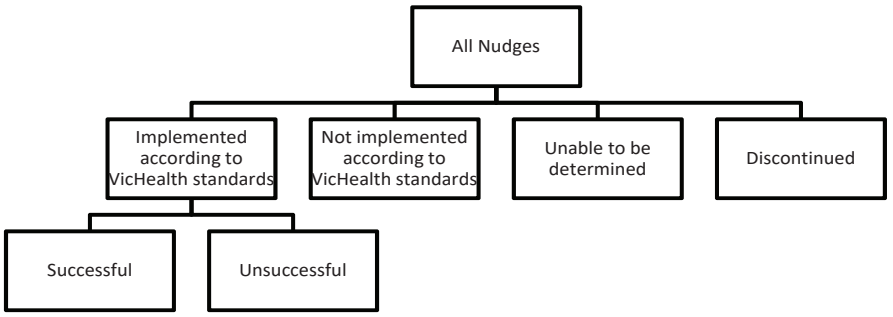
- Successful: implemented the intervention to VicHealth standards and had an increase in the percentage of total sales from green/amber drinks and/or a decrease in the percentage of total sales from red drinks compared to the baseline period.
- Unsuccessful: implemented the intervention to VicHealth standards and did not have an increase in sales of green/amber drinks and/or a decrease in sales of red drinks relative to total sales compared to the baseline period (including projects with no change reported).
- Not implemented according to VicHealth standards: based on photographic evidence
- Unable to be determined: due to unclear dates, missing or poor quality photographs, missing sales, attendance or weather data, or low volumes of sales (<150 drinks per week).
- Discontinued: intervention not completed due to stakeholder breakdown or interference from product company sales representatives.

Statistical methods

No *a priori* power calculation was performed as the sample size was determined by the total number of eligible organisations willing to participate in the study. All analyses were performed using Microsoft Excel version 16.45. The types of intervention organisations are reported using frequency analysis. The frequency of each type of nudge was stratified by evaluation status (successful, unsuccessful, not implemented to standards, unable to be determined, discontinued).

Characteristics of successful and unsuccessful nudges reported at baseline and post-intervention include total drink sales, total number and proportion of sales from green, amber and red drinks, outdoor temperature, attendance, profit margin, total profit and profit per week (reported for each intervention and as mean± standard deviation), and SEIFA deciles (reported for each intervention and as median and interquartile range). Characteristics of nudges classified as not implemented to standards,

Figure 1: Categorisation of Nudge initiatives.



nudges where success could not be determined and discontinued nudges, were not reported.

For each characteristic (other than SEIFA), the change from baseline to post-intervention was calculated and expressed in total value for temperature, and as percentage change for all other variables. Differences between baseline and post-intervention values were assessed using paired samples *t*-tests. Differences in percentage change between groups were assessed using independent samples *t*-tests.

Ethics approval for the conduct of this study was provided by the La Trobe University Human Ethics Committee (E15/081). Participation by intervention organisations was voluntary and all provided consent to participate in this research.

Results

Sample

A total of 148 sporting clubs, associations and facilities (i.e. intervention organisations) participated in the nudge trials; 63 of these were football (AFL) and/or netball clubs (Table 1). In total, the 148 intervention organisations trialled 195 nudges by implementing one (n=105), two (n=39) or three (n=4) nudges in sequence.

Table 1: Intervention organisation breakdown for Nudge trials.

Club/Association/Facility	Total
Baseball	3
Basketball	9
Bowls	6
Football (AFL)	8
Football (AFL) and Netball	45
Gymnastics	8
Hockey	4
Indoor multipurpose	19
Netball	10
Outdoor swimming pool	7
Soccer/Football	10
Tennis	4
Touch Football	6
Other*	9
TOTAL	148

Note:
**Includes: Adventure playground (1); Cricket (1); Cycling (1); Golf (2); Motor vehicle (1); Squash (2); and Volleyball (1)*

Evaluation of interventions

Fifteen of the 195 nudges implemented the intervention to VicHealth standards and had an increase in sales of green/amber drinks and/or a decrease in sales of red drinks; as such, were deemed successful (Table 2).

Frequency and success of nudges

Limit red drinks was the most frequently attempted nudge intervention (30.8%), while *red drinks off display* and guidelines experienced the greatest rate of success (both 20.0%) (Table 4). *Water the cheapest option* and *meal deals* were less popular (20.5% and 9.7% of nudges, respectively), and when chosen as a nudge, also less successful (success rates 2.5% and 10.5%, respectively). Promotions were used only in the pilot (*explore*) group of nudges, were inconsistent in their implementation, and had no successful outcomes.

Characteristics of successful and unsuccessful nudges

The characteristics of successful and unsuccessful nudge projects are presented in Table 3.

Red drinks off display was the most commonly used nudge in successful interventions (n =7, 46.7%). *Limit red drinks* was used four times (26.7%), two (13.3%) nudges used *meal deals* and *water the cheapest option* and guidelines for positional change were each used once only (6.7%). There was a decrease in attendance at seven venues, and a drop in temperature reported at all external venues from baseline to the nudge period. Only three of the 15 successful projects also resulted in an increase in profit at the time of the nudge. The profit margin increased in eight of 12 nudges with profit data reported, but the total number of drink sales declined in 11 nudges.

Twenty unsuccessful nudges across 17 sites (Table 3) either had no/negligible change or a reduction in the percentage sales of green drinks. Of these 20 nudges, 13 had profit data available and nine of these reported a reduction in overall profit from baseline to nudge. Profit margin decreased in eight nudges and total drink sales decreased in 15. Attendance was lower in the nudge than baseline period for nine nudges, and the temperature was lower in the nudge than baseline period for all nudges besides two internal venues.

Comparison of successful and unsuccessful nudges

In contrast to successful nudges, *red drinks off display* was used in only one unsuccessful intervention (5%). *Water the cheapest option* was the most frequently attempted unsuccessful nudge (n=8, 46.7%), followed by promotions (n = 5, 25%), *limit red drinks* (n = 3, 15%) and *meal deals* (n=3, 15%).

Successful and unsuccessful nudges were implemented for similar durations (3.60 ± 3.62 and 3.45 ± 1.43 weeks, respectively), and had similar attendance (2423.56 ± 2022.57 and 2284.80 ± 1628.09, respectively) and total drink sales (1254.27 ± 1193.97 and 1583.90 ± 1078.16, respectively) at baseline. There were similar levels of socioeconomic advantage and disadvantage in both groups (SEIFA decile 4 [2,7] and 3 [2,6], respectively). There were lower profit margins ($1.85 ± 0.35 and $1.89 ± 0.32, respectively; $p<0.01$) but not levels of profit ($711.06/week ± 996.06 and $995.92/week ± 705.62, respectively)

Table 2: Success of each type of nudge intervention.

	Limit red drinks	Red drinks off display	Water the cheapest option	Meal deals	Guidelines	Promotions	Not selected	Total
Successful	5	5+1*	1	2	1	0	0	15 (7.7%)
Unsuccessful	3	1	8	3	0	5	0	20 (10.3%)
Not implemented to standards	4	1	0	0	0	0	0	5 (2.6%)
Unable to be determined	43	20+1*	28	14	4	26	0	136 (69.7%)
Discontinued	5	1	3	0	0	0	10	19 (9.7%)
Total	60 (30.8%)	30 (15.4%)	40 (20.5%)	19 (9.7%)	5 (2.6%)	31 (15.9%)	10 (5.1%)	195
Success rate	8.3%	20%	2.5%	10.5%	20%	0%	0%	

Notes:
**removed red drinks instead of red drinks off display*
~ 10 projects were discontinued before a Nudge was selected

in successful nudges at baseline. Successful and unsuccessful nudges had similar levels of sales from beverages classified as green (32.63% ± 14.6 and 34.42% ± 19.00, respectively) and red drinks (53.99% ± 11.77 and 51.92% ± 19.31, respectively) at baseline.

There was a significant decrease in temperature during the nudge period for both successful (-2.94°C ± 3.62, p=0.03) and unsuccessful interventions (-5.10 ± 3.18, p<0.01). This did not appear to affect attendance but did result in a decrease in total drink sales that was significant for successful (-17.11% ± 37.79, p=0.02) but not unsuccessful nudges (-14.20% ± 20.29).

Successful nudges had no significant change in total drink sales of green or amber drinks but did have a large decrease in the total number of red drinks sold (-38.75% ± 22.82, p<0.01). When expressed as a percentage of total drink sales, successful nudges had an increase in the proportion of green drinks sold (13.34% ± 6.64, p<0.01), a decrease in the proportion of red drinks sold (-11.17% ± 7.96, p<0.01) and no change in the proportion of amber drinks sold.

Unsuccessful nudges had a reduction in the

Table 3: Results of successful and unsuccessful nudge projects.

Code	Nudge type	SEIFA decile	Initiative duration	Change in % of total beverage sales			Attendance (n, total across the period)			Temperature (mean °C)			Total drink sales (n)			Profit margin ($)			Profit ($)		
				Green	Amber	Red	baseline	Nudge	% change	baseline	Nudge	change in mean °C	baseline	Nudge	% change	baseline	Nudge	% change	baseline	Nudge	% change
Successful Nudge projects																					
1	LRD	9	6	3.8	12.4	-16.2	1,366	1,232	-9.8	19	12.8	-6.2	823	659	-19.9	1.99	2	0.5	1,636.2	1,315.6	-19.6
2	LRD	2	4	8.5	-1.1	-7.4	17,937	18,554	3.4	IV	IV	IV	500	427	-14.6	1.55	1.63	5.2	1,679.4	1,787.7	6.4
3	LRD	7	2	17.2	-15.7	-1.5	600	600	0	18	8	-10	1,531	661	-56.8	N/A	N/A	N/A	N/A	N/A	N/A
4	LRD	8	2	1.9	0.3	-2.3	1,550	750	-51.6	18.5	12	-6.5	508	199	-60.8	N/A	N/A	N/A	N/A	N/A	N/A
5	RDOD	7	4	7.2	10.9	-18.1	1,250	2,050	64	16.6	15.5	-1.1	484	510	5.4	1.75	1.85	5.7	851.6	944.9	11
6	RDOD	4	6	11.8	1.8	-13.6	21,576	23,178	7.4	21.1	20.6	-0.6	2,079	1,950	-6.2	1.14	1.15	0.9	2,381.4	2,233.4	-6.2
7	RDOD	6	4	6.8	11.5	-18.3	51,389	50,766	-1.2	IV	IV	IV	1,903	2,026	6.5	2.09	2.04	-2.4	N/A	N/A	N/A
8	RDOD	4	3	8	1.9	-9.9	1,510	1,441	-4.6	15.3	15	-0.3	529	462	-12.7	2.35	2.4	2.1	1,245.3	1,110.9	-10.8
9	RDOD	1	3	8.9	14.1	-23	22,400	26,297	17.4	19.5	18.4	-1	1,708	1,348	-21.1	2.14	2.08	-2.8	3,657.2	403.5	-89
10	RDOD	4	4	21.3	-7.4	-13.9	19,668	11,984	-39.1	17.9	14.5	-3.4	785	217	-72.4	1.84	1.95	6	1,444.2	422.7	-70.7
11	RDOD	1	3	3.1	10.8	-13.8	5,400	5,400	0	N/A	N/A	N/A	213	142	-33.3	1.42	1.32	-7	301.7	187.5	-37.9
12	WCO	3	6	10.9	-8.3	-2.6	3,736	3,067	-17.9	11.7	9.3	-2.3	1,927	1,298	-32.6	1.75	1.78	1.7	3366	2,316.5	-25.8
3	MD	7	2	7.7	-4	-3.7	600	600	0	18	10	-8	1,531	608	-60.3	N/A	N/A	N/A	N/A	N/A	N/A
13	MD	10	2	26.9	-3.2	-23.7	5,800	5,800	0	IV	IV	IV	289	551	90.7	1.93	2.65	37.3	559.1	1,458.5	160.9
14	G	1	3	2.2	-1	-1.2	42,145	33,311	-21	IV	IV	IV	4,874	3,858	-20.8	2.2	2.19	-0.5	10,749.00	8,451	-21.4
Mean		4*	3.6	9.7	1.5	-11.3	13,088.5	12,295.3	-3.5	17.6	13.6	-3.9	1,312.3	994.4	-20.6	1.8	1.9	3.9	1,712.21	1,875.65	-9.47
Standard Deviation		2,7**	1.5	7.1	8.8	7.8	16,054.2	15,157.6	25.8	2.7	4	3.5	1,184.2	991.7	39.3	0.3	0.4	11.1	1,121.6	2,294.2	64.11
Unsuccessful Nudge projects																					
15	LRD	3	2	-3.4	-4.5	7.9	1,150	1,050	-8.7	22.5	14.5	-8	548	459	-16.2	N/A	N/A	N/A	N/A	N/A	N/A
7	LRD	6	2	-1.2	0.8	0.4	N/A~	N/A~	N/A~	IV	IV	IV	1,122	1,053	-6.1	1.9	1.87	-1.6	2,132.9	1,970.05	-7.6
16	LRD	4	3	-4	-1.4	5.4	2,600	2,000	-23.1	21.7	15	-6.7	2,518	1,654	-34.3	1.86	1.86	0	4,672.9	3,083.1	-34
21	RDOD	2	3	0.2	1	-1.3	1,800	1,500	-16.7	14.4	13.3	-1.1	736	756	2.7	2.05	1.99	-2.9	1,505.3	1,504.9	0
22	WCO	2	3	-2.1	-1.3	3.5	544	231	-57.5	20.7	11.7	-9	1,209	542	-55.2	N/A	N/A	N/A	N/A	N/A	N/A
23	WCO	9	4	3.6	5.6	-9.2	31,671	31,709	0.1	27.2	17.2	-10	3,743	3,993	6.7	2.44	2.51	2.9	9,148.8	10,040.90	9.8
24	WCO	3	8	-0.7	-2.4	3.1	2,830	2,400	-15.2	15.8	14.4	-1.4	2,370	2,137	-9.8	1.54	1.35	-12.3	3,638.8	2,885.6	-20.7
25	WCO	2	3	-0.6	5.5	-4.9	2,400	2,400	0	18	16	-2	543	409	-24.7	1.35	1.21	-10.4	734.3	498.4	-32.1
26	WCO	4	3	-7	6.3	0.7	1,750	1,520	-13.1	18.4	14.4	-4	1,871	1,682	-10.1	1.42	1.47	-10.6	2,665.5	2,185	-18
27	WCO	3	4	1	-3.8	2.8	3,500	3,300	-5.7	18.3	11.5	-6.8	4,324	1,796	-58.5	2.3	2.3	0	9,988.4	4,195.6	-58
28	WCO	8	4	0.8	0.1	-0.9	2400	2,400	0	19.3	14.3	-5	1,390	1,739	25.1	1.87	1.84	-1.6	2,594.5	3,203.2	23.4
29	WCO	2	3	0.7	-2.3	1.6	1120	1,050	6.3	22	14.3	-7.7	939	678	-27.8	2.12	2.39	12.7	1,993.1	1,621.1	-18.7
30	MD	10	4	-2.7	7.5	-4.8	58,539	61,283	4.7	27.6	17.4	-10.2	2,951	3,077	4.3	N/A	N/A	N/A	N/A	N/A	N/A
31	MD	9	4	7.4	-0.4	-7	21,941	21,442	-2.3	24.8	17.2	-7.6	730	629	-13.8	N/A	N/A	N/A	N/A	N/A	N/A
32	MD	10	6	-2.6	3.4	-0.8	6750	7,620	12.9	19.5	16.2	-3.3	1,290	1,358	5.3	2.05	2.06	0.5	2,644.3	4,761.5	80.1
22	O	2	3	-12.5	10.6	1.9	544	328	-39.7	20.7	12	-8.7	1,209	600	-50.4	N/A	N/A	N/A	N/A	N/A	N/A
33	O	1	2	-0.85	2.1	-1.3	500	500	0	16	14	-2	776	498	-35.8	1.83	1.96	7.1	1,420	979.7	-31
7	O	6	2	-1.2	0.5	0.7	N/A~	N/A~	N/A~	IV	IV	IV	1,122	1,064	-5.2	1.9	1.88	-1.1	2,132.9	2,003.6	-6.1
34	O	1	3	-8.7	1.3	7.4	3,300	3,300	0	18.6	15.2	-3.4	1,645	1,320	-19.8	N/A	N/A	N/A	N/A	N/A	N/A
34	O	1	3	-9.6	4.6	5	3,300	3,300	0	18.6	11.6	-7	1,645	1,160	-29.5	N/A	N/A	N/A	N/A	N/A	N/A
Mean		3*	3.4	-1.06	1.02	0.04	22,84.8	2,193.27	-7.23	19.56	14.5	-5.1	1,583.9	1,330.2	-14.2	1.89	1.9	-1.21	3,469.91	2,994.82	-8.1
Standard Deviation		2,6**	1.4	5.03	4.98	4.38	1,628.09	1,832.92	13.43	4.25	1.91	3.18	1,078.16	925.78	20.29	0.32	0.39	6.99	2,887.83	2,438.61	34

Notes:

*IV = indoor venue; *median; ** IQR; ~consistent across the period; LRD = limit red drinks; RDOD = red drinks off display; WCO = water cheapest option; MD = meal deal; G = guidelines/positional change of water in fridge; O = other (promotion)*

total number of red drinks sold (-18.68% ± 20.52, p=0.02), and no change in total sales of green or amber drinks. However, when expressed as a percentage of total drink sales, there were no significant changes in the proportion of sales from green, amber or red drinks. There were no significant changes to profit margins or total profit for either group.

Successful nudges appeared to have smaller drops in temperature (-2.94°C ± 3.62 and -5.10 ± 3.18, respectively) and attendance (-3.53% change ± 25.84 and -7.23% change ± 13.43, respectively) during the nudge period, but these were not significantly different between groups. Changes from baseline to the nudge period were also not significant between groups for total drink sales, profit margin and total profit.

Discussion

Overall, the number of successful nudges was small, and there were a large number of nudges with outcomes that were unable to be determined. Successful nudge organisations did not differ from unsuccessful organisations at baseline. They were located in areas with similar relative levels of disadvantage (SEIFA deciles), had similar levels of drink sales and profit, and had similar proportions of sales from beverages classified as green and red drinks. Mean temperature and attendance levels were also similar. Interventions were implemented for similar durations but had considerably different outcomes. Both groups experienced a reduction in the total number of red drinks sold, but this only led to a shift in the proportion of green and red drinks sold in the successful nudges. The type of nudge was the key variable that differed between groups, with red drinks off display appearing more efficacious than other nudges.

Red drinks off display comprised nearly half (46.7%) of successful interventions and was only unsuccessful in one instance (5% of all unsuccessful interventions). *Limit red drinks* was the most popular nudge (30.8%) but it had a lower success rate (8.3%) than *red drinks off display* (20%). *Water the cheapest option*, *meal deals* and promotions all had low levels of success (2.5%, 10.5%, 0% respectively). Use of policies/guidelines on the display and/or sale of red drinks had a similar effect to *red drinks off display*, and although used infrequently (5/195), they had a relatively high rate of success (20%). The success of *red drinks off display* nudges in this study adds to the body of literature of interventions that have successfully reduced red drink purchases through *red drinks off display* interventions in hospital retail cafés and policies leading to the removal of SSBs classified as red drinks.[22,32]

Red drinks off display was the simplest nudge to implement by removing all red drinks from sight while still making them available for purchase. The ease of implementation may have contributed to the relative success of this nudge. Of the five nudges that were not implemented according to VicHealth Guidelines, four attempted a *limit red drinks* nudge that allows up to 20% of beverages on display to be red drinks. This is challenging to implement and maintain as the fridge is continually restocked – often by many different club volunteers. Interestingly, one positional guideline was also successful. Positional influence has previously been found to be ineffective, or the subject of poor-quality studies.[28,33] However, a clear and simple guideline that is easy to implement and maintain may have a similar impact on purchasing behaviour as *red drinks off display*.

In some cases, a reduction in red drinks was accompanied by an increase in amber drinks instead of water; for example, as customers chose low/no sugar soft drink and sports drink options. This was also apparent in a six-week *red drinks off display* intervention trial in a self-service café.[32] In that study, red drink sales decreased from 33% to 10% of total drink sales, with most of the change accounted for by an increase in amber rather than green drinks. Smith and Toprakkiran argued that the impact of nudges on choice architecture may have limited overall effectiveness if the social, economic and political factors influencing individual choices are not considered.[34] Choice architecture is complex and dynamic, and it is not possible to control for the myriad of other factors that may lead an individual to swap their red drink for amber instead of green. However, multidimensional nudges incorporating a range of influences such as positioning, price, promotion and education may help to address these factors and encourage the desired choice. Indeed, the Wolfenden et al. nudge intervention in 85 football clubs found that the use of multiple strategies including positioning of drinks, pricing incentives, meal deal promotions, posters, signs, policies, and messaging through coaches led to an increase in non-SSB sales and consumption.[21]

Many community sports clubs rely on profit from their canteen to support club operations. As profit is closely related to sales volume, interventions that lead to a decrease in drink sales may be unsustainable. Overall, profit decreased in both successful and unsuccessful nudges (mean -3.4% SD 58.8, mean -8.1% SD 34.0, respectively). These changes were not statistically significant (p=0.10, p=0.37, respectively), but would still have a meaningful impact on the operations of the affected clubs. For example, five successful and five unsuccessful nudges experienced a drop of more than 20% profit in these short-term interventions, with intervention organisation 9's successful nudge intervention resulting in a $1,084.57/week (89.0%) decline in profit and intervention organisation 27's unsuccessful intervention resulting in a $1,448.20/week (58.0%) decline in profit. Boelsen-Robinson et al. also found that total drink sales decreased by 24.3% when they removed SSBs from 16 aquatic and recreation centres for 12 months.[22] However, some of the successful nudges in the current study, such as used by intervention organisation 2, maintained total profit despite a reduction in sales volume by increasing profit margin. Careful planning in relation to pricing and profit margin may assist sport clubs to minimise any loss of profit associated with a reduction in red drink sales.

Strengths and limitations

Although challenging to implement, this practice-based large-scale study provides a large volume of data to contribute to the literature on nudge interventions to reduce SSB purchase and consumption in community sports settings. With 148 sites and 195 interventions, we believe this is the largest study of its kind. One of the key strengths of this study was the detailed data collection process and the availability of an external research team to support the implementation and collection of data throughout the study period. The short time frame of the intervention (two to eight weeks each of baseline and intervention) supported participation but also limited an understanding of the sustainability and long-term impact of these nudges on purchasing behaviour.

The time of year plays an important role in determining drink sales in community sports. Warmer weather and high attendance at playoffs (finals) are likely to lead to an

increase in overall drink sales. In this study, nudges took place in cooler weather than baseline data collection, and this may have contributed to a reduction in demand for drinks and especially bottled water. To account for temperature, attendance and sales volume, it would be helpful to collect data for a full year, or over the same study period in two different years.

Other possible contributing factors such as access to freely available potable water in drinking fountains at venues were not identified/collected and thus were unable to be considered for analysis. Concurrent public health campaigns promoting water as the beverage of choice and public awareness around reducing single-use plastic use may have also influenced patrons to carry their own reusable bottles of water, thus reducing drink sales despite an overall increase in water consumption. Future studies may consider surveys of patrons in their evaluation of nudges in order to assess the impact on overall drinking behaviour, instead of focusing only on purchasing behaviour.

This study did not include sales from hot drinks, so it is not possible to determine the true level of beverage consumption from green, amber and red drinks. Most hot drinks are classed as green (coffee, tea) or amber (hot chocolate). Given the decrease in temperature across all interventions, it is likely that hot drink consumption rose as total fridge drink sales declined, leading to a larger shift in drink sales to green and amber than was identified through fridge sales alone.

Conclusion

When invited to select their own nudge, community sports clubs/facilities favoured *limit red drinks*. However, *red drinks off display* was much more successful. Future interventions should compare nudge outcomes to baseline data taken one year before to account for seasonal differences in temperature, attendance and total drink sales. Consideration should also be given to strategies that support an increase in profit margin to offset any profit losses as a result of reduced total drink sales. Finally, interventions should consider incorporating multiple nudges to overcome social, economic and political factors influencing the personal choice of beverages.

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