BMJ Nutrition, Prevention & Health

Implementation and sales impact of a capacity building intervention in Australian sporting facility food outlets: a longitudinal observational study

Miranda R Blake [1], Helena Romaniuk [2], Devorah Riesenberg [1], Tara Boelsen-Robinson [1], Adrian J Cameron [1], Liliana Orellana [2], Anna Peeters [3]

To cite: Blake MR, Romaniuk H, Riesenberg D, *et al*. Implementation and sales impact of a capacity building intervention in Australian sporting facility food outlets: a longitudinal observational study. *BMJ Nutrition, Prevention & Health* 2022;**5**:e000445. doi:10.1136/bmjnph-2022-000445

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/bmjnph-2022-000445).

For numbered affiliations see end of article.

Correspondence to
Dr Miranda R Blake, Deakin University, Global Obesity Centre, Institute for Health Transformation, Geelong, Victoria, Australia; miranda.blake@deakin.edu.au

Received 14 February 2022
Accepted 25 May 2022
Published Online First 4 July 2022

ABSTRACT

Background Few studies have explored behavioural and financial impacts of retail initiatives after 2 years to address the unhealthy food environments common in local government sporting settings.

Aims To evaluate the impact of a 2-year local government capacity building intervention in sporting facility food outlets on (1) the healthiness of refrigerated drink choices available and visible to customers, (2) healthiness of refrigerated drinks sold and (3) refrigerated drink revenue.

Methods 52 sporting facilities within 8 local governments from Victoria, Australia, participated in an intervention between March 2018 and February 2020 by limiting 'red' (least healthy) drinks to ≤20% of refrigerator display and increasing 'green' (healthiest) drinks to ≥50% of display. Mixed models assessed changes in mean percentage of 'red', 'amber' and 'green' drinks displayed over time, compared with baseline.

Facilities provided electronic weekly itemised sales data (December 2015 to February 2020). Weekly volume of 'red' or 'green' drinks sold as a proportion of total drinks sold, and total refrigerated drinks revenue were compared preimplementation and postimplementation using mixed models (seasonal facilities), and mixed-effect interrupted time series models (non-seasonal facilities).

Results Display of 'red' drinks decreased by mean −17.1 percentage points (pp) (95% CI −23.9 to −10.3) and 'green' drinks increased 16.1 pp (95% CI 9.30, 22.9) between baseline and 18-month audits.

At nine seasonal facilities, compared with the summer preimplementation, the mean volume of 'red' drinks sold decreased by −19.0 pp (95% CI −28.6, to −9.51) and refrigerated drink revenue decreased by−AU$81.8 (95% CI −AU$123 to −AU$40.8) per week. At 15 non-seasonal facilities, by February 2020, the volume of 'red' drinks sold decreased on average by −11.0 pp (95% CI −21.6 to −0.41) with no change in drink revenue.

Conclusion Reducing the display of unhealthy drinks can be an effective public health policy to improve the healthiness of customer purchases, provided there is consideration of potential impacts on revenue.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Limited availability of healthy food and drink options in sporting food environments is a key driver of unhealthy purchases. Increasing healthier options can drive healthier purchasing.

WHAT THIS STUDY ADDS

⇒ Healthy changes to facility drink offerings and customer purchasing were sustained after a 2-year local government capacity building intervention. We demonstrate, for the first time, that sales impacts may differ between seasonal and non-seasonal facilities, including in revenue outcomes.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE AND/OR POLICY

⇒ The study emphasises the value of capacity-building interventions of at least 2 years to promote healthier purchasing, as well as the need to tailor interventions to outlet context, with potentially different expectations and support required for optimal outcomes.

BACKGROUND

Sport and recreation facilities offer a unique opportunity to promote health through both physical activity and providing a healthy food environment.[1] Despite this, food environments in these facilities, including in the USA, Canada, Australia and New Zealand, generally offer and promote nutritionally poor foods that may contribute to excess energy intake.[1–3] Parents and children have expressed concern that sport-related food environments do not support healthy eating for children.[4]

Limited availability of healthy options in sporting food environments has been found to be a key driver of unhealthy food purchases, and increasing healthier options can drive healthier purchasing.[1] A scoping review of healthy eating interventions in

sporting settings[1] reported several interventions of mostly less than 1-year duration which demonstrated improvements in healthiness of retail practices[5–8]; one showed no effect.[9] For example, two Canadian capacity building interventions in sport and recreation facilities or clubs, an 8-month pre–post study[8] and the 18-month 'Eat, Play, Live' randomised controlled trial (RCT),[7] found significant improvements in policy development and changes to the food environment in those facilities provided with support compared with those not provided with support. Neither capacity building intervention reported on changes in food and drink sales. Some previous studies have reported modest improvements in the healthiness of customer purchases,[5 6 10–12] while others have showed no impact.[1 13]

The extent to which an intervention facilitates capacity building may partly explain heterogeneity of retail intervention impact. Longer-term capacity building programmes that increase organisational knowledge, skills and resources and are tailored to the individual challenges of each organisation, have been suggested as facilitating sustained implementation of healthy food retail initiatives in sporting settings.[1] Over the longer term, implementation of healthy food retail practices may vary due to factors such as staff turnover and stakeholder buy-in.[14] Retailer insights also suggest repeated customer exposure to a retail intervention may result in either magnification or reduction in the effectiveness of an intervention over the longer term.[15] To date, we have identified only two published studies that have assessed capacity building healthy retail interventions in sport and recreation facilities for more than 1-year postimplementation,[6 7] though neither examined changes in sales or implementation using repeated measures beyond pre–post evaluation. Evaluation of the implementation and longer-term maintenance of interventions, including measurement of changes to customer purchasing and the financial consequences for the retailer, is crucial to support evidence-based policy development and optimal implementation of initiatives.[16]

Evidence of financial impacts after 2 or more years is needed to address retailer fears of profit loss—a key barrier to retailer adoption of healthy retail changes within sporting[14 17–19] and other retail settings.[20] A 2019 review of healthy food retail business outcomes,[16] as well as more recent publications,[5 14 21] found commercial viability outcomes of interventions up to 1 year within sporting settings were either neutral,[6 10 13] mixed[8 12 14 21] or unfavourable,[5 17 18] with no studies finding favourable outcomes to date. We must know if and how both public health and retailer aims can be achieved in the longer term in order to realise permanent healthy retail transitions.

The context in which interventions are implemented is another likely driver of heterogeneity in implementation and sales outcomes observed previously. Seasonal and non-seasonal facilities differ systematically in food and drink offerings and customer characteristics. It is unclear whether customer and staff responses to healthy retail initiatives, and therefore policy learnings, are generalisable between facility types. To date, we are not aware of any evaluations of the impact of large-scale capacity building interventions on the healthiness of items sold in seasonal facilities (those only open a part of the year), or any studies examining the impact of a capacity building intervention on revenue and healthiness of purchases in both seasonal and non-seasonal sporting facilities.

This study advances the previous literature on healthy food retail interventions in sporting settings by reporting behavioural and revenue impacts at 2 years after implementation, and examining responses from seasonal and non-seasonal facilities separately. We aimed to evaluate the impact of a 2-year local government capacity building intervention in Australian sports and recreation facilities on changes over time on (1) the healthiness of prepackaged refrigerated drink choices visible to customers, (2) healthiness of refrigerated drinks sold and (3) refrigerated drink revenue.

METHODS

Setting and intervention

This study evaluated an intervention designed and funded by an Australian state-based health promotion agency (the Victorian Health Promotion Foundation (VicHealth)). The 'Water in Sport' capacity building intervention aimed to support local government-owned and/or managed sport and recreation facilities (including sporting clubs) to reduce customer purchases of sugar-sweetened beverages and make water the drink of choice. From March 2018 to June 2020, VicHealth funded eight local government areas (LGAs) in Victoria, Australia to each appoint a project officer responsible for implementing the initiative.

The healthiness of drinks available in each participating facility was assessed using the Victorian Government's Healthy Choices guidelines (HCGs) for sport and recreation facilities.[22] The HCGs are voluntary and include classification of food and drinks based on their major ingredients and their energy and nutritional content per serve (and per 100 mL), into 'green' ('best choice', eg, water), 'amber' ('choose carefully', eg, diet soft drinks) and 'red' ('limit', eg, full sugar soft drinks).[23] The role of the project officers was to encourage and support all recruited facilities in their LGA to implement 'nudges' increasing the display of 'green' drinks to at least 50% and either (1) limiting display of 'red' drinks to no more than 20% of display space or (2) removing 'red' drinks from display altogether. Additional details on the design and implementation of the 'Water in Sport' initiative are found in online supplemental appendix 1.

Study design

The implementation of the 'Water in Sport' initiative in facilities, along with its impact on the healthiness of customer purchases and facility financial outcomes was assessed using an observational study design. Figure 1

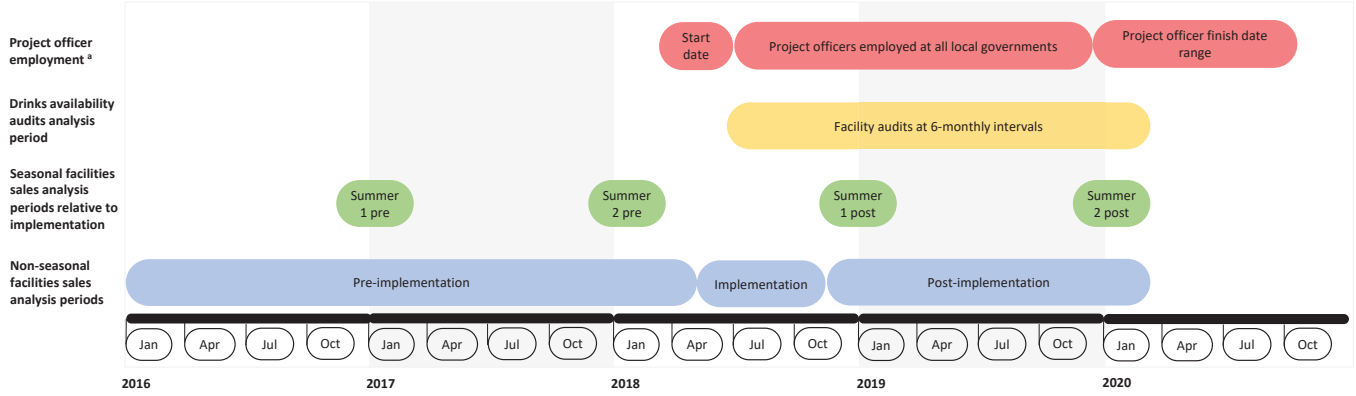

Figure 1 'Water in Sport' project implementation and data collection timeline. [a]Project officer employment start dates ranged between 1 March and 18 June 2018, and employment finish dates ranged between 20 December 2020 and 30 October 2021.

provides an overview of the project timeline and the study data collection periods, with key evaluation dates shown in table 1.

Data collection

Effect of initiative on implementation

Evaluation of drink displays was used to assess implementation of the intervention against project targets. An audit of refrigerated prepackaged drinks displays was undertaken by project officers every 6 months by taking photographs of each refrigerator at every participating facility during the implementation and postimplementation period (see audit instructions in online supplemental appendix 2). Details on drinks classification based on refrigerator audit are presented in online supplemental appendix 3.

Effect of initiative on facility sales

Sales data were used to assess impact of intervention on consumer purchases. Facilities provided itemised electronic weekly sales data from November 2015 to March 2020 for all prepackaged drinks (table 1). Data for each drink product line included the unit size (mL), unit price and number of units sold per week. Each product line was assessed using the HCG classification by project officers.

Outcomes

Effect of initiative on implementation

The primary implementation outcome was the mean percentage of 'red' drinks displayed across all refrigerators by a facility at each audit; and secondary outcomes were the mean percentages of 'amber' and 'green' drinks displayed. A secondary binary outcome measured compliance with the HCGs target, with facilities classified

Table 1 Key dates for evaluation of the 'Water in Sport' initiative

	Available data range (week beginning)			Analysis date range (week beginning)		
Data source	**Start date**	**End date**	**Period name**	**Start date**	**End date***	**Period duration**
Implementation audit	22 January 2018	20 March 2020	Baseline audit (0 month)	20 May 2018	10 June 2019	Single time point
			6 month†	15 October 2018	6 January 2020	Single time point
			12 month‡	4 March 2019	9 December 2019	Single time point
			18 month§	18 February 2019	17 February 2020	Single time point
Sales data: seasonal facilities	2 November 2015	23 March 2020	Summer 1 preimplementation	5 December 2016	27 February 2017	13 weeks
			Summer 2 preimplementation	4 Dec 2017	26 February 2018	13 weeks
			Summer 1 postimplementation	3 December 2018	25 February 2019	13 weeks
			Summer 2 postimplementation	2 December 2019	24 February 2020	13 weeks
Sales data: non-seasonal facilities	2 November 2015	23 March 2020	Preimplementation	4 January 2016	26 February 2018	113 weeks
			Implementation	5 March 2018	24 September 2018	30 weeks
			Postimplementation	1 October 2018	24 February 2020	74 weeks

*Analysis date ranges for all data sources ended February 2020, due to COVID-19-related shutdowns of sporting facilities from March 2020.
†Mean 160.3 (SD 64.4) days post baseline audit.
‡Mean 363.2 (SD 42.9) days post baseline audit.
§Mean 504.1 (SD 80.4) days post baseline audit.

as compliant only if all refrigerators within a facility met both HCG targets of no more than 20% 'red' drinks and at least 50% 'green' drinks on display.

Effect of initiative on facility sales

For each week, the primary sales outcomes were: (1) 'red' drinks sold as a percentage of total volume of drinks sold and (2) total refrigerated drink revenue (AU$). Secondary outcomes included: (3) 'amber' drinks sold as a percentage of total volume of drinks sold, (4) 'green' drinks sold as percentage of total volume of drinks sold, (5) total volume of drinks sold (L), (6) water sold as a percentage of total volume of drinks sold, (7) free sugar content of drinks sold (g/100 mL) and (8) revenue (AU$) from all other drink and food sales.

Analysis

Effect of initiative on implementation

Facilities were excluded from the analysis if less than two valid audits were available and/or if audits were based on menu (number of product lines available) rather than refrigerator display and, therefore, the number of drink facings was unable to be determined.

Mixed models (or multilevel models)[24 25] were used to estimate the change in the display of drinks during the project officer employment period, with facility as the clustering factor to account for repeated outcomes within each facility. Linear mixed models were used for percentage drink display outcomes and logistic mixed models for compliance with HCG target outcomes. We estimated the effect of intervention implementation at 6, 12 and 18 months relative to the baseline audit, unadjusted and then adjusted for: food outlet type, season and seasonality of facility opening (see table 2). We estimated marginal means and probabilities from the adjusted models at the mean values of the covariates included in the model.

We performed a simple count of the number of facilities who increased the raw percentage of 'red' drinks on display and/or increased percentage of 'green' drinks on display between baseline and 18-month audits.

Effect of initiative on facility sales

Facilities were excluded from the sales data analysis if they did not sell any 'red' drinks prior to the start of intervention implementation or did not provide data required (figure 2).

Seasonal facilities

See figure 1 and table 1 for date ranges for the four summer seasons used in analysis of seasonal facilities (which included sporting clubs and outdoor pools that were only open over summer months, December to February). For each sales outcome, a mixed linear model[24] was fitted with facility as a random effect, and summer season (included as a four-level categorical variable) and covariates used for adjustment as fixed effects. As there were breaks in the sequential measures of the sales outcomes, we were not able to model time trends over the entire study period, instead we compared mean changes in sales between summer seasons. Sales in the summer immediately before the start of the initiative (summer 2 preimplementation, reference category) were compared with the sales in the other three seasons (summer 1

Table 2 Covariates for analyses

Covariates	Classification based on	Categories
Food outlet type	The kind of food and drink sold	Kiosk (ice-cream, prepackaged snacks and drinks only) Canteen (ice-cream, prepackaged snacks and drinks, and a small selection of hot and cold foods) Café (ice-cream, prepackaged snacks and drinks, variety of hot and cold foods, food could be made to order)
Facility size	Median number of cold packaged drink units sold per week during study period	<50 units sold per week ≥50 units sold per week
Area level socioeconomic disadvantage	Socioeconomic Indexes for Areas (SEIFA) measure of disadvantage[30]	Higher disadvantage (SEIFA ≤5th decile) Lower disadvantage (SEIFA ≥6th decile)
Seasonality of facility opening	Months of year facility usually open	Seasonal (included sporting clubs and outdoor pools which were often open only over the summer months)* Non-seasonal (open all year)
Season of audit	Month of audit	Summer (December–February) Autumn (March–May) Winter (June–August) Spring (September–November)
Mean maximum daily temperature for each week	Daily maximum temperature of the closest weather station to each local government area obtained from the Australian Bureau of Meteorology website[31]	N/A—continuous variable

*One facility that was open all year had a low weekly number of unit sales outside the summer season so for the purposes of this analysis was also considered a seasonal facility.
N/A, not applicable.

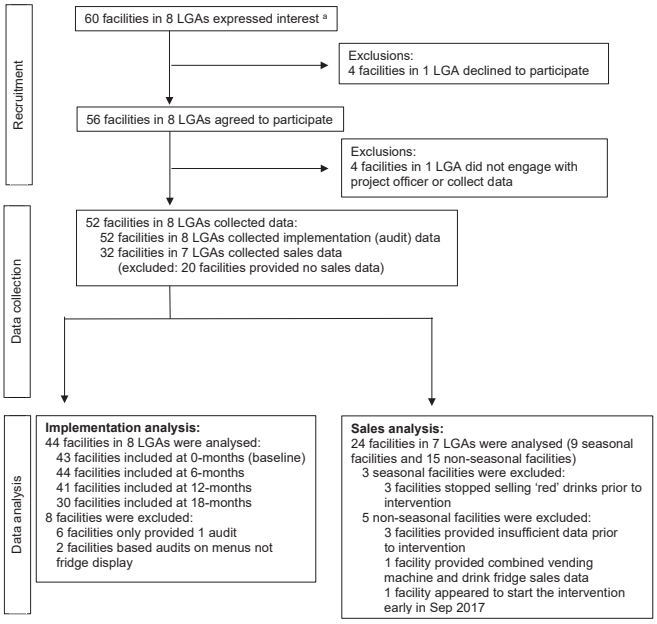

Figure 2 Flow diagram of facilities in the 'Water in Sport' evaluation. [a]Number of facilities that expressed an interest to participate in the intervention and were included in the initial application for funding to VicHealth by local governments. LGA, local government area.

preimplementation; summer 1 postimplementation; summer 2 postimplementation). Model effects were estimated adjusting for mean maximum weekly temperature. For the percentage outcomes (volume of 'red', 'amber' and 'green' drinks, water and free sugar content sold), we additionally adjusted for facility size (table 2). Marginal means for each summer season were estimated from the adjusted models at the mean values of the covariates.

Non-seasonal facilities

For non-seasonal facilities, the effect of the intervention was assessed using interrupted time series analysis (ITSA),[26] an approach widely used to estimate the effect of interventions in observational studies, allowing for shifts in outcome at specific time points and changes over time. For each outcome, a mixed ITSA model was fitted with facility as a random effect and autocorrelation over time (time lag of 3 weeks assumed). Fixed effects were included in the model as (1) two break points (at the start and end of the implementation period, see figure 1 and table 1) to allow for a change in mean sales at these times, (2) time trends preimplementation, during implementation and postimplementation that were assumed linear and independent and (3) covariates used for adjustment (see online supplemental appendix 4 for further model specification details). The model was used to estimate the difference between the observed outcome under the intervention and the counterfactual outcome (the expected outcome that would have been observed if the initiative had not been implemented) for the week beginning 3 February 2020. For all outcomes, model effects were estimated adjusted for calendar month and mean maximum daily temperature for each week (see table 2). Models for revenue outcomes and total volume of drinks sold were additionally adjusted for outlet type.

All analyses were conducted under an intention to treat approach. All analyses were performed in Stata V.16.1.

RESULTS

Implementation of the 'Water in Sport' initiative

Of the 60 facilities in the 8 LGAs that received funding, 52 (87%) collected implementation data, and of these 44 facilities (85%) provided at least 2 valid audits and were included in the analysis (see figure 2). The eight excluded facilities did not differ to those included in the implementation analysis in terms of type of food retail outlet or area level socioeconomic position (online supplemental table S1). Of the 44 facilities included in the analysis, 14 (32%) were kiosks, 24 (55%) canteens and 6 (14%) cafés; 35 (80%) were in areas with higher disadvantage; and 26 (59%) were non-seasonal.

After adjustment, we found that the mean percentage of 'red' drinks available significantly decreased at each postintervention audit compared with the baseline audit, 'green' increased and 'amber' remained the same (table 3, figure 3).

At the baseline audit, 20.5% (95% CI 7.07% to 33.9%) of facilities met the HCG targets of no more than 20% 'red' drinks displayed and at least 50% 'green' drinks displayed in all refrigerators. At the 18-month audit, 63.8% (95% CI 41.9% to 85.8%) of facilities met the HCG targets (online supplemental table S2). The odds of compliance increased at each successive audit from 0 to 18 months. In all but one case, facilities who did not already meet the HCG targets at the baseline audit decreased the raw percentage of 'red' drinks on display and/or increased the percentage of 'green' drinks on display between baseline and 18-month audits.

Effect of the 'Water in Sport' initiative on healthiness of customer purchases and facility-level packaged drinks revenue

Of the 52 facilities that participated in the initiative, 32 (62%) collected sales data, and of these, 9 seasonal and 15 non-seasonal facilities (75%) were included in the analysis (see figure 2). The facilities that participated in the initiative but were not included in the sales analysis were more likely to be from areas of higher socioeconomic disadvantage than those included (see online supplemental table 3 and box 1).

Seasonal facilities

In the adjusted model, there was no change in the mean percentage of 'red' drinks sold between summer 1 preimplementation and summer 2 preimplementation in seasonal facilities (figure 4; online supplemental table 4). Compared with summer 2 preimplementation, there was a reduction in mean percentage of 'red' drinks sold in summer 1 postimplementation (−18.2 percentage points

Table 3 Percentage of refrigerated drinks on display, by traffic light classification at each audit time point, in 44 facilities

		Facilities audited		Percentage on display†		Change in percentage on display†		
Drink type	Audit time point*	n	%	Mean	(95% CI)	β	(95% CI)	P value
'Red'	0 months	43	98	30.2	(22.9 to 37.5)	Ref		
	6 months	44	100	18.0	(12.4 to 23.6)	−12.3	(−18.0 to −6.53)	<0.001
	12 months	41	92	14.7	(9.72 to 19.6)	−15.6	(−21.2 to −9.99)	<0.001
	18 months	30	68	13.2	(6.55 to 19.8)	−17.1	(−23.9 to −10.3)	<0.001
'Amber'	0 months	43	98	22.4	(16.8 to 27.9)	Ref		
	6 months	44	100	22.1	(17.5 to 26.7)	−0.28	(−4.70 to 4.14)	0.902
	12 months	41	92	18.9	(14.3 to 23.6)	−3.43	(−8.24 to 1.38)	0.162
	18 months	30	68	24.6	(19.0 to 30.2)	2.24	(−3.25 to 7.72)	0.424
'Green'	0 months	43	98	47.2	(39.7 to 54.6)	Ref		
	6 months	44	100	60.5	(54.3 to 66.7)	13.4	(7.93 to 18.8)	<0.001
	12 months	41	92	66.3	(60.4 to 72.2)	19.2	(12.9 to 25.4)	<0.001
	18 months	30	68	63.3	(57.2 to 69.4)	16.1	(9.30 to 22.9)	<0.001

*Fewer audits were conducted at the 18-month time point due to some project officer contracts ending, and COVID-19-related shutdowns of sporting facilities from March 2020 meaning audits after that time were not included for analysis.
†Adjusted for season, seasonality of facility and outlet type.

(pp); 95% CI −27.8 to −8.67) and summer 2 postimplementation (−19.0% pp; 95% CI −28.6 to −9.51). For weekly revenue from refrigerated drinks, there was only evidence of a statistically significant reduction for summer 2 postimplementation compared with summer 2 preimplementation (−AU$81.8; 95% CI −AU$123 to −AU$40.8), equivalent to −25.2% (95% CI −32.6% to −17.7%). We found no difference in the change in 'red' drink sales or revenue between the two summers postimplementation.

We found no difference in sales for any of the secondary outcomes summer 1 preimplementation versus summer 2 preimplementation, or summer 1 postimplementation versus summer 2 postimplementation (online supplemental table 4). We saw an increase in mean percentage sales of 'amber' drinks in summer 1 postimplementation (7.45 pp; 95% CI 0.20 to 14.7) and summer 2 postimplementation (13.3 pp; 95% CI 2.66 to 23.9) compared with summer 2 preimplementation. The mean percentage sales of 'green' drinks sold increased in summer 1 postimplementation (10.6 pp; 95% CI 0.10 to 21.2), compared with summer 2 preimplementation. No significant changes were found in revenue from other drinks and food, free sugar content of drinks sold, volume of water sold or overall volume of drinks sold in summer 1 postimplementation or summer 2 postimplementation, compared with summer 2 preimplementation (online supplemental table 4).

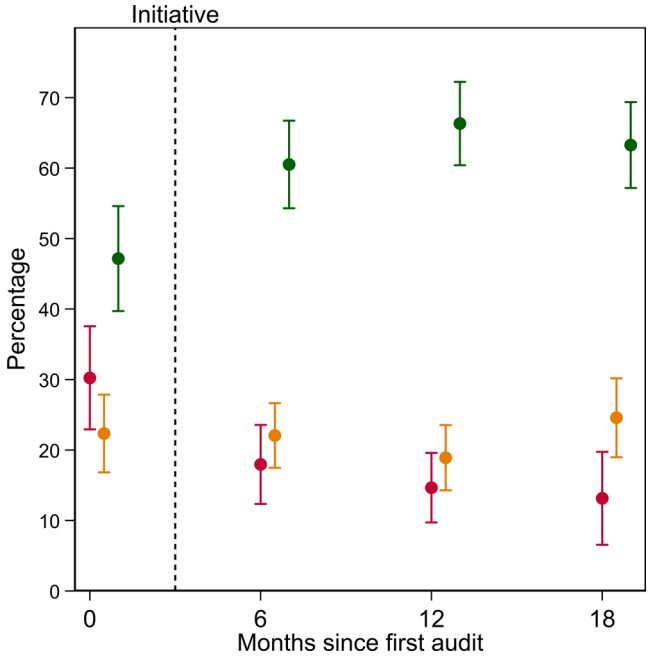

Figure 3 Percentage [a] of refrigerated drinks on display by traffic light classification over time[b], in 44 facilities.
[a] Marginal means and 95% CI estimated from multilevel models adjusted for season, seasonality of facility and outlet type. [b]Healthy Choices guidelines target were to display no more than 20% 'red' drinks (eg, sugary soft drinks), at least 50% 'green' drinks (eg, sparkling waters) and the remainder 'amber' drinks (eg, diet soft drinks).

Non-seasonal facilities

In non-seasonal facilities, there were significant time trends with the percentage volume of 'red' drinks sold reducing over time in each phase of the study (preimplementation, during implementation and postimplementation; see table 4, first block of estimates; figure 5). When we compared to see if the sales time trends were the same in each period of the study (table 4, second block), we found that the reduction per week in sales of 'red' drinks during the implementation period (−0.41 pp; 95% CI −0.68 to −0.14) was significantly greater than in the preimplementation period (−0.06 pp; 95% CI −0.11 to −0.02) and the postimplementation period (−0.10 pp; 95% CI −0.19 to −0.02). There was no statistical difference between the preimplementation and

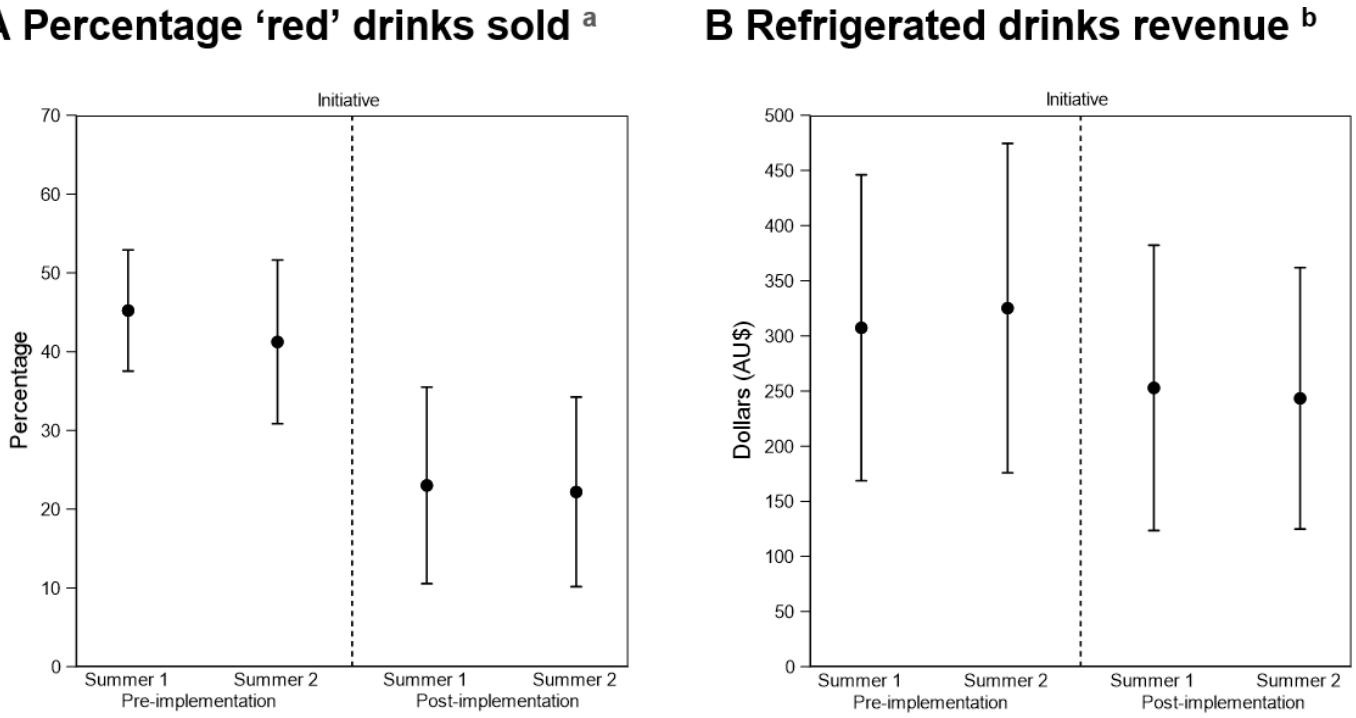

Figure 4 Weekly sales of 'red' drinks and drinks revenue, by summer season, in nine seasonal facilities. [a]Marginal means and 95% CI estimated from multilevel model adjusted for calendar month, maximum weekly temperature. [b]Marginal means and 95% CI estimated from multilevel models adjusted for calendar month, maximum weekly temperature, size of facility.

postimplementation time trends. There was no immediate shift in the percentage of 'red' drinks sold at the start of the implementation period or the end the implementation period (table 4, third block), suggesting that changes occurred gradually over time. The estimated effect of the intervention by February 2020, was −11.0 pp in 'red' drinks (95% CI -21.6 to −0.41) sold per week.

For refrigerated drinks revenue, there was no evidence of a sales time trend either preimplementation or during initiative implementation. There was some evidence of a time trend postimplementation of −AU$1.32 per week (95% CI −AU$2.62 to −AU$0.02), however it did not differ significantly to the time trends preintervention and during intervention. There was no evidence of a change in revenue for refrigerated drinks in February 2020 compared with expected sales.

For the secondary outcomes, the estimated outcome differed from the counterfactual outcome by February 2020 only for free sugar content sold (−0.78 g/100 mL; 95% CI −1.55 to −0.001).

DISCUSSION

The evaluation of the 'Water in Sport' initiative, the longest follow-up of an intervention to promote healthy eating in both seasonal and non-seasonal sporting facilites to date, demonstrates that a capacity building approach is an effective way of supporting healthy retail change over 2 years. In a 2-year intervention, the healthiness of drink choices visible to customers and the healthiness of drinks sold in sports and recreation facilities both improved, with only small reductions in total refrigerated drink revenue (and only in seasonal facilities).

We demonstrated a large decline in display of the least healthy ('red') drinks, and a larger increase in the healthiest ('green') drink display over time than has been shown in other large RCTs over longer than 1 year in sporting facilities to date,[6 7] with percentage display of 'red' drinks nearly halving over 18 months. However, it is worth noting that even by the end of the intervention, only 63% of facilities were compliant with the HCG target. Improved implementation in the current study may be related to the intensiveness and capacity building nature of the intervention. Although it is in theory possible that the changes observed could be due to overall trends toward healthier food environments over time, this is highly unlikely given the lack of change in sales observed between the first and second years preimplementation or the first and second year postimplementation in seasonal facilities, and our time series analysis adjusting for preintervention trends in non-seasonal facilities.

Following the implementation of the 'Water in Sport' initiative, percentage sales volume of 'red' drinks decreased in both seasonal and non-seasonal facilities. A recent pre–post evaluation of a sugary drink reduction policy in 16 Victorian YMCA sport and recreation facilities reported that volume sales of 'red' drinks decreased by 46.2% 1 year after implementation in non-seasonal facilities,[5] a larger reduction in targeted products than was seen using similar interventions in smaller studies.[1] The relatively smaller change in sales of 'red' drinks in

Table 4 Weekly sales of primary and secondary outcomes,* in 15 non-seasonal facilities (continued)

Outcome (first block of estimates)	Preimplementation time trend			During implementation time trend			Postimplementation time trend		
	β	(95% CI)	P value	β	(95% CI)	P value	β	(95% CI)	P value
Volume 'red' drinks (%)	−0.06	(−0.11 to −0.02)	0.008	−0.41	(−0.68 to −0.14)	0.003	−0.10	(−0.19 to −0.02)	0.016
Refrigerated drinks revenue (AU$)†	−0.03	(−0.49 to 0.43)	0.887	−3.52	(−7.98 to 0.95)	0.122	−1.32	(−2.62 to −0.02)	0.046
Volume 'amber' drinks (%)	0.01	(−0.04 to 0.06)	0.659	−0.04	(−0.16 to 0.09)	0.547	0.12	(0.07 to 0.17)	<0.001
Volume 'green' drinks (%)	0.05	(0.02 to 0.08)	0.001	0.39	(0.15 to 0.63)	0.001	−0.02	(−0.08 to 0.04)	0.511
Total volume of drinks sold (L)†	0.09	(−0.25 to 0.07)	0.261	−0.51	(−1.18 to 0.15)	0.129	−0.21	(−0.39 to −0.03)	0.024
Volume water (%)	0.04	(0.02 to 0.07)	<0.001	0.21	(0.02 to 0.40)	0.034	−0.02	(−0.07 to 0.03)	0.395
Free sugar content (g/100 mL)	−0.003	(−0.007 to 0.001)	0.156	−0.02	(−0.04 to −0.004)	0.018	−0.007	(−0.01 to −0.001)	0.034
Revenue food and other drinks (AU$)†	1.74	(−0.56 to 4.03)	0.138	−13.3	(−31.9 to 5.36)	0.163	−2.66	(−6.20 to 0.88)	0.141
Outcome (second block of estimates)	**Change in time trend from preimplementation to during implementation**			**Change in time trend from preimplementation to postimplementation**			**Change in time trend from during implementation to postimplementation**		
	β	(95% CI)	P value	β	(95% CI)	P value	β	(95% CI)	P value
Volume 'red' drinks (%)	−0.35	(−0.62 to −0.08)	0.011	−0.04	(−0.14 to 0.06)	0.437	0.31	(0.02 to 0.59)	0.036
Refrigerated drinks revenue (AU$)†	−3.48	(−8.06 to 1.09)	0.136	−1.29	(−2.78 to 0.21)	0.091	2.2	(−1.10 to 5.49)	0.191
Volume 'amber' drinks (%)	−0.05	(−0.20 to 0.10)	0.510	0.11	(0.04 to 0.18)	0.004	0.16	(0.05 to 0.27)	0.004
Volume 'green' drinks (%)	0.34	(0.11 to 0.57)	0.004	−0.07	(−0.16 to 0.01)	0.101	−0.41	(−0.68 to −0.14)	0.003
Total volume of drinks sold (L)†	−0.42	(−0.97 to 0.12)	0.130	−0.12	(−0.25 to 0.01)	0.074	0.31	(−0.20 to 0.81)	0.236
Volume water (%)	0.16	(−0.03 to 0.35)	0.091	−0.07	(−0.13, −0.003)	0.039	−0.23	(−0.43 to −0.02)	0.030
Free sugar content (g/100 mL)	−0.02	(−0.04 to −0.001)	0.041	−0.004	(−0.01 to 0.005)	0.370	0.01	(−0.005 to 0.03)	0.141
Revenue food and other drinks (AU$)†	−15	(−35.7 to 5.65)	0.154	−4.4	(−10.0 to 1.20)	0.123	10.6	(−4.85 to 26.1)	0.179
Outcome (third block of estimates)	**Change in level at start of implementation‡**			**Change in level at end of implementation‡**			**Change in outcome February 2020‡**		
	β	(95% CI)	P value	β	(95% CI)	P value	β	(95% CI)	P value
Volume 'red' drinks (%)	0.16	(−2.22 to 2.53)	0.897	−8.19	(−17.3 to 0.91)	0.078	−11.0	(−21.6 to −0.41)	0.042
Refrigerated drinks revenue (AU$)†	23.8	(−54.3 to 102)	0.551	22.0	(−78.7 to 123)	0.668	−68.1	(−165 to 28.7)	0.168
Volume 'amber' drinks (%)	−0.45	(−3.71 to 2.82)	0.789	−2.93	(−7.47 to 1.62)	0.207	4.71	(−3.21 to 12.6)	0.244
Volume 'green' drinks (%)	0.7	(−1.89 to 3.29)	0.596	11.6	(5.08 to 18.0)	<0.001	6.43	(−0.68 to 13.5)	0.076
Total volume of drinks sold (L)†	5.36	(−8.91 to 19.6)	0.462	7.10	(−10.4 to 24.6)	0.427	−1.22	(−21.7 to 19.2)	0.907
Volume water (%)	0.87	(−1.12 to 2.87)	0.391	7.07	(2.00 to 12.1)	0.006	2.5	(−3.74 to 8.74)	0.433
Free sugar content (g/100mL)	0.06	(−0.14 to 0.27)	0.544	−0.49	(−1.06 to 0.07)	0.087	−0.78	(−1.55 to −0.001)	0.050
Revenue food and other drinks (AU$)†	172	(−228 to 571)	0.400	232	(−347 to 811)	0.432	−75.9	(−439 to 288)	0.682

Study periods: Preimplementation (4 January 2016 to 4 March 2018 ; Implementation (5 March 2018 to 30 September 2018); Postimplementation (1 October 2018 to 24 February 2020).
*Estimates obtained under a model using weekly data, adjusting for calendar month and maximum weekly temperature.
†Models for total outcomes additionally adjusted for facility type (café; kiosk; canteen).
‡Difference in level compared with the counterfactual outcome.

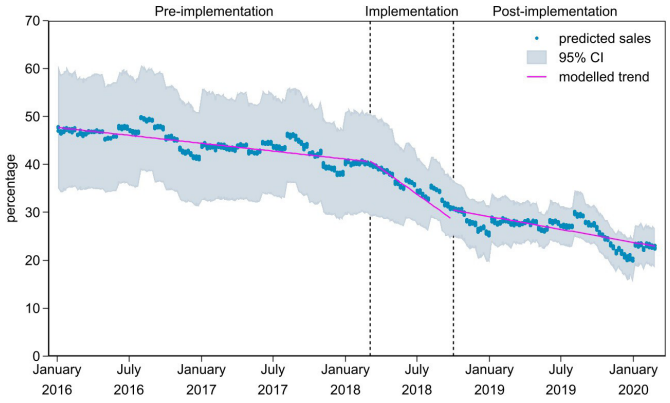

Figure 5 Weekly sales of percentage of 'red' drinks sold [a] with sales time trend, in 15 non-seasonal facilities. [a] Predicted values and sales trend using weekly data, estimated at mean values of the covariates from models adjusted for calendar month and maximum weekly temperature. Study periods: Preimplementation (4 January 2016 to 4 March 2018; Implementation (5 March 2018 to 30 September 2018); Postimplementation (1 October 2018 to 24 February 2020).

'Water in Sport' facilities may be because the priority to promote healthy drink purchasing was already high in the included local governments prior to the implementation of the project, and because of the more modest policy target to reduce 'red' drink display to no more than 20% of available drinks, rather than eliminate 'red' drinks sales altogether.

We found differences in preinitiative sales patterns and observed greater reductions in sales of 'red' drinks and revenue in seasonal compared with non-seasonal facilities. We are not aware of any previous studies explicitly comparing the response of seasonal and non-seasonal facilities. Differences in sales patterns between seasonal and non-seasonal facilities may reflect underlying differences in facility offerings, type of facility customers, food outlet turnover, the influence of weather events such as bushfires or heatwaves, and systematic variations in customer and staff response to the initiative. The mixed effects on revenue (in seasonal and non-seasonal facilities) align with a previous review of business outcomes of healthy food retail initiatives which found mixed financial impact across settings.[16]

The revenue loss observed in seasonal facilities was low in absolute terms (mean –AU$81.80 per facility per week) but equivalent to an approximate 25% decrease. While previous evidence suggests that food retail may be viewed as an auxiliary source of revenue by sporting facilities,[14] relatively small losses could be critical for seasonal (often smaller) facilities. As well as the public health impact, evidence for the cost of implementation per facility is needed to assess the value of the intervention to the local government, retailers and broader communities.[27]

On average, facilities that achieved the HCG targets did so after 12 months, with 'red', 'amber' and 'green' drinks displayed being approximately the same at both 12 months and 18 months after the first audit. Similarly, changes in sales were greatest in both seasonal and non-seasonal facilities during the first year after the intervention. We are aware of only two other capacity building studies of longer than 2 years in sport and recreation settings.[5 6] Multifaceted and sustained term capacity building interventions may increase effectiveness of food environment change[1] by increasing stakeholder commitment to change and embedding policies to encourage maintenance.[14] Trials of more than 2 years will be important to investigate if and how favourable changes in purchasing can be maintained in the longer term.

Purchases in 'Water in Sport' intervention facilities are likely to only form a small part of the total diet, however aligning the messaging of sports and nutrition may strengthen healthy eating messages for individual customers.[4] Our findings are likely generalisable to capacity building interventions of a similar intensity in sport and recreation facilities. Common barriers and enablers have been found across countries in food retail interventions,[1] and retail interventions often have similar barriers and enablers across setting type.[28]

Strengths and limitations

The evaluation of the 'Water in Sport' initiative included rigorous multilevel analysis of objective drink display and sales data. The comprehensive evaluation and follow-up 18 months after implementation provides evidence of the longer-term implications of capacity building interventions in local government sporting settings on changes to facility practice, health behaviour impacts and financial outcomes for facilities.

Our sales data analysis approach aimed to control for the temporal trend before implementation but includes the assumption that this trend would remain the same after 2 years; the validity of this assumption cannot be assessed in natural experiments without a comparable control group. For the seasonal facilities data, as only short data sales periods were available each year, we could not estimate time trends and therefore intervention effects might be biased due to temporal changes independent of the intervention. We adjusted for facility characteristics including facility size, however, we did not investigate if intervention effects differed by facility characteristics. Larger RCTs would be needed to overcome these limitations and to isolate the effect of the intervention from external campaigns, funding and industry and consumer trends.

We found no change in the overall volume of refrigerated drinks sold, or in revenue from food and non-refrigerated drinks, before and after the initiative. However, without detailed food purchasing data or direct measures of consumer consumption we cannot account for substitution effects in purchases between food and drinks, or between intervention facilities and external facilities.

This study did not capture changes in nutritional content of specific drink products over time, as drink HCG classifications and free sugar content were each

collected at a single time point. HCG classifications are likely to be minimally affected by reformulation as 'red', 'amber' and 'green' classifications relate mainly to the type of drink (eg, sugar-sweetened beverage, fruit juice) and portion size. The absolute free sugar content of drinks purchased preintervention was low as it comprised all drinks including water (eg, mean 2.87 g/100 mL (95% CI 2.23 to 3.50) in the week before the intervention began). This low mean sugar content created a difficulty in detecting changes in free sugar content of purchases, and means that results would have been minimally affected by modest industry sugar reformulation efforts over the study period.[29]

CONCLUSION

The evaluation of the 'Water in Sport' initiative demonstrated that a 2-year local government capacity building intervention created healthier drink environments in almost all participating facilities, and resulted in reduced purchases of targeted unhealthy drinks by sport and recreation patrons. The different findings observed between seasonal and non-seasonal facilities, including in revenue outcomes, emphasises the need to tailor interventions to outlet context, with potentially different expectations and support required for desirable outcomes. Follow-up studies longer than 2 years will be important to investigate if and how favourable changes in food environment and purchasing can be maintained permanently.

Author affiliations
[1]Deakin University, Global Obesity Centre, Institute for Health Transformation, Geelong, Victoria, Australia
[2]Deakin University, Biostatistics Unit, Faculty of Health, Geelong, Victoria, Australia
[3]Deakin University, Institute for Health Transformation, Faculty of Health, Geelong, Victoria, Australia

Twitter Miranda R Blake @MirandaRBlake, Devorah Riesenberg @devriesenberg, Tara Boelsen-Robinson @taraboelsenr, Adrian J Cameron @ay_jay_cee and Anna Peeters @annapeetersaus

Contributors AP, TB-R, AJC and MRB conceived of the study. AP, MRB, DR and AJC designed the study. DR coordinated data acquisition and analysis. HR and LO analysed and interpreted the sales data. DR and MRB analysed and interpreted the implementation data. MRB wrote the manuscript with assistance from DR and HR. AP is guarantor of the study. All authors read and approved the final manuscript.

Funding This project was funded by the Victorian Health Promotion foundation (VicHealth) 'Water in Sport' project, including salary support for DR. MRB, AJC, AP, LO, DR, and TB-R are researchers within the National Health and Medical Research Council (NHMRC) funded Centre of Research Excellence in Food Retail Environments for Health (RE-FRESH) (APP1152968). The opinions, analysis, and conclusions in this paper are those of the authors and should not be attributed to the NHMRC or VicHealth. MRB is funded by a post-doctoral fellowship from the Deakin University Institute for Health Transformation. TB-R is supported by a Deakin University Executive Dean's Fellowship. AP is supported by an NHMRC Investigator Grant. AJC is support by a National Heart Foundation Future Leader Fellowship.

Competing interests No, there are no competing interests.

Patient consent for publication Not applicable.

Ethics approval Implementation audit and sales data collection were approved as part of the 'Water in Sport' project evaluation by Deakin University Faculty of Health Human Ethics Advisory Group (reference HEAG-H 35_2018). No consent was required for the collection of non-human data described in this manuscript.

Provenance and peer review Not commissioned; externally peer reviewed by Penny Breeze, United Kingdom of Great Britain and Northern Ireland.

Data availability statement Implementation data are available on reasonable request. Sales data are not available as they were provided on a commercial-in-confidence basis.

ORCID iDs
Miranda R Blake http://orcid.org/0000-0002-0649-2320
Helena Romaniuk http://orcid.org/0000-0002-5801-2077
Devorah Riesenberg http://orcid.org/0000-0003-2797-2574
Tara Boelsen-Robinson http://orcid.org/0000-0003-1671-3091
Adrian J Cameron http://orcid.org/0000-0002-0568-5497
Liliana Orellana http://orcid.org/0000-0003-3736-4337
Anna Peeters http://orcid.org/0000-0003-4340-9132

REFERENCES

1 Westberg K, Stavros C, Parker L, *et al*. Promoting healthy eating in the community sport setting: a scoping review. *Health Promot Int* 2022;37:daab030.
2 Boelsen-Robinson T, Chung A, Khalil M, *et al*. Examining the nutritional quality of food and beverage consumed at Melbourne aquatic and recreation centres. *Aust N Z J Public Health* 2017;41:184–6.
3 Naylor P-J, Bridgewater L, Purcell M, *et al*. Publically funded recreation facilities: obesogenic environments for children and families? *Int J Environ Res Public Health* 2010;7:2208–21.
4 Smith M, Signal L, Edwards R, *et al*. Children's and parents' opinions on the sport-related food environment: a systematic review. *Obes Rev* 2017;18:1018–39.
5 Boelsen-Robinson T, Orellana L, Backholer K, *et al*. Change in drink purchases in 16 Australian recreation centres following a sugar-sweetened beverage reduction initiative: an observational study. *BMJ Open* 2020;10:e029492.
6 Wolfenden L, Kingsland M, Rowland BC, *et al*. Improving availability, promotion and purchase of fruit and vegetable and non sugar-sweetened drink products at community sporting clubs: a randomised trial. *Int J Behav Nutr Phys Act* 2015;12:35.
7 Olstad DL, Raine KD, Prowse RJL, *et al*. Eat, play, live: a randomized controlled trial within a natural experiment examining the role of nutrition policy and capacity building in improving food environments in recreation and sport facilities. *Int J Behav Nutr Phys Act* 2019;16:51.
8 Naylor P-J, Olstad DL, Therrien S. An intervention to enhance the food environment in public recreation and sport settings: a natural experiment in British Columbia, Canada. *Child Obes* 2015;11:364–74.
9 Clinton-McHarg T, Gonzalez S, Milner S, *et al*. Implementing health policies in Australian junior sports clubs: an RCT. *BMC Public Health* 2019;19:556.
10 Olstad DL, Vermeer J, McCargar LJ, *et al*. Using traffic light labels to improve food selection in recreation and sport facility eating environments. *Appetite* 2015;91:329–35.
11 Olstad DL, Lieffers JRL, Raine KD, *et al*. Implementing the Alberta nutrition guidelines for children and youth: in a recreational facility. *Can J Diet Pract Res* 2011;72:e212–20.
12 Olstad DL, Goonewardene LA, McCargar LJ, *et al*. If we offer it, will children buy it? sales of healthy foods mirrored their availability in a community sport, commercial setting in Alberta, Canada. *Child Obes* 2015;11:156–64.

13 Olstad DL, Goonewardene LA, McCargar LJ, *et al*. Choosing healthier foods in recreational sports settings: a mixed methods investigation of the impact of nudging and an economic incentive. *Int J Behav Nutr Phys Act* 2014;11:6.
14 Blake MR, Boelsen-Robinson T, Hanna L, *et al*. Implementing a healthy food retail policy: a mixed-methods investigation of change in stakeholders' perspectives over time. *Public Health Nutr* 2021;24:2669–80.
15 Blake MR, Sacks G, Zorbas C, *et al*. The 'Eat Well @ IGA' healthy supermarket randomised controlled trial: process evaluation. *Int J Behav Nutr Phys Act* 2021;18:1–13.
16 Blake MR, Backholer K, Lancsar E, *et al*. Investigating business outcomes of healthy food retail strategies: a systematic scoping review. *Obes Rev* 2019;20:1384–99.
17 Olstad DL, Raine KD, McCargar LJ. Adopting and implementing nutrition guidelines in recreational facilities: public and private sector roles. A multiple case study. *BMC Public Health* 2012;12:376.
18 Olstad DL, Raine KD, McCargar LJ. Adopting and implementing nutrition guidelines in recreational facilities: tensions between public health and corporate profitability. *Public Health Nutr* 2013;16:815–23.
19 Vander Wekken S, Sørensen S, Meldrum J, *et al*. Exploring industry perspectives on implementation of a provincial policy for food and beverage sales in publicly funded recreation facilities. *Health Policy* 2012;104:279–87.
20 Gupta A, Alston L, Needham C, *et al*. Factors influencing implementation, sustainability and scalability of healthy food retail interventions: a systematic review of reviews. *Nutrients* 2022;14:294.
21 Huse O, Orellana L, Ferguson M, *et al*. Retailer-led healthy pricing interventions: a pilot study within aquatic and recreation centres in Victoria, Australia. *Health Promot Int* 2021;36:430–48.
22 Department of Health & Human Services. *Healthy choices: policy guidelines for sport and recreation centres*. Melbourne, Victoria: Victorian Government, 2016. https://www.health.vic.gov.au/sites/default/files/migrated/files/collections/policies-and-guidelines/1/1604006-hc-policy-guidelines-for-sport-and-recreation-centres.pdf
23 Department of Health. *Healthy choices: food and drink classification guide*. Melbourne, Victoria: Victorian Government, 2020. https://www.health.vic.gov.au/publications/healthy-choices-food-and-drink-classification-guide
24 Goldstein H. *Multilevel statistical models*. 4th ed. John Wiley & Sons, 2011.
25 Snijders TA, Bosker RJ. *Multilevel analysis: an introduction to basic and advanced multilevel modeling*. 2nd ed. Sage, 2011.
26 Kontopantelis E, Doran T, Springate DA, *et al*. Regression based quasi-experimental approach when randomisation is not an option: interrupted time series analysis. *BMJ* 2015;350:h2750.
27 Tran HNQ, McMahon E, Moodie M, *et al*. A systematic review of economic evaluations of health-promoting food retail-based interventions. *Int J Environ Res Public Health* 2021;18:1356.
28 Middel CNH, Schuitmaker-Warnaar TJ, Mackenbach JD, *et al*. Systematic review: a systems innovation perspective on barriers and facilitators for the implementation of healthy food-store interventions. *Int J Behav Nutr Phys Act* 2019;16:108.
29 KPMG. *Sugar Reduction Pledge by the Australian non-alcoholic beverage industry: aggregation report for the year ended 21 December 2020*. KPMG, 2021. https://www.australianbeverages.org/wp-content/uploads/2022/04/ABCL-Sugar-Reduction-Pledge-Report-CY2021.pdf
30 Australian Bureau of Statistics. Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA) 2016 Canberra, Australia: ABS; 2016 [updated 27 Mar 2018; cited 2021 11 Aug]. Available: http://stat.data.abs.gov.au/Index.aspx?DataSetCode=ABS_SEIFA2016_LGA [Accessed 11 Aug 2021].
31 Australian Bureau of Meteorology. Climate data online Canberra, Australia: Bureau of Meteorology, 2021. Available: http://www.bom.gov.au/climate/data-services/station-data.shtml [Accessed Mar 23 2021].

Supplementary material to Implementation and sales impact of a capacity building intervention in Australian sporting facility food outlets: a longitudinal observational study

Authors

Dr Miranda R Blake [1], Dr Helena Romaniuk [2], Ms Devorah Riesenberg [1], Dr Tara Boelsen-Robinson[1], A/Prof Adrian J Cameron [1], Prof Liliana Orellana [2], Prof Anna Peeters [3]

Affiliations

[1] Deakin University, Geelong, Global Obesity Centre, Institute for Health Transformation, Australia

[2] Deakin University, Geelong, Biostatistics Unit, Faculty of Health, Australia

[3] Deakin University, Geelong, Institute for Health Transformation, Australia

All Correspondence to:

Dr Miranda Blake, Research Fellow

Address: Global Obesity Centre, Institute for Health Transformation, School of Health and Social Development, Deakin University, 221 Burwood Hwy, Burwood 3125, Australia

Telephone: +61 3 9246 8487

Email: miranda.blake@deakin.edu.au

Appendix 1: Additional details on the design and implementation of the 'Water in Sport' initiative

The 'Water in Sport' initiative was designed by The Victorian Health Promotion Foundation (VicHealth) based on prior work with local governments areas (LGA)[1] and other unpublished locally generated evidence. Local governments applied to VicHealth for funding and were selected for participation by VicHealth based on their high sugar-sweetened beverage consumption prevalence, high obesity rates and poor dental health outcomes.[2] Eligible local governments were also required to demonstrate commitment from council and facilities to make healthy outlet changes. The recruitment process and selection criteria for facilities was determined by each local government. Facilities involved in the initiative were either open all year (non-seasonal) or only open for a portion of the year (seasonal).

Project officers, who were primarily health promotion staff, assisted facilities to implement changes, including by developing healthy food and/or drink policies and refrigerator planograms to guide drink placement, negotiating with suppliers, and developing marketing materials to communicate and promote changes to customers. Most project officers were employed for approximately 2 years, with the first 6 months (from approx. March to October 2018) focused on working with facilities to implement changes, and the remaining time focused on drafting council policies, engaging sporting clubs, and capacity building with council and facility staff and helping policies to be adopted into legislation. The number of days the project officer was employed by each LGA ranged between 1 to 4 days per week depending on the number of recruited facilities and clubs.

VicHealth provided funds to the Healthy Eating Advisory Service run by Nutrition Australia (Victorian Division) to offer program delivery support to each local government project officer. The support included face-to-face and monthly phone assistance to trouble-shoot implementation challenges, local government project officer training (e.g., how to use Healthy Choices Guidelines (HCGs) and policy development) and convening a community-of-practice

meeting every six months of all project officers to facilitate sharing of resources and knowledge.

Appendix 2: 'Water in Sport' evaluation photographic audit protocol

- The following protocol is intended to be carried out immediately prior to and post changes made to drink availability.
- The aim of carrying our photo-audits is to monitor availability of beverages on display
- Please select the same day and time to repeat this audit every six months on a weekday
- Please ensure that there no people in the photo audit pictures
- Please ensure to the best of your ability that the fridge and vending machine and food items are well stocked at the time of audit.
- Please ensure this is conduct during opening hours
- This audit should be used to complete the drink assessment on FoodChecker

Check in with the café staff

- Introduce yourself if haven't previously and explain purpose of audit

Photos of overall display per fridge

- For each please take a photo of the overall fridge machine present in one frame
- Take photos in which each product line is clearly visible to allow categorisation into red/amber/green categories (e.g. this may be up to 3 photos per door of a fridge)
- Take photos of any beverage advertising or promotion (e.g. branding stickers, 2-for-1 deal signage)

- Please ensure the fridge door is open to reduce glare
- Where milkshake/ smoothie and tea/ coffee making facilities are available in the café, please take:
    - Photos of items the fridge/ freezer in which drink- specific ingredients are kept. Some of this may be on the bench. If ingredients for making milkshakes are present (e.g. syrup), please take pictures of that also
    - If milk for making tea/ coffee cannot be seen, ask staff which milk is being used as the default for tea/ coffee making.
- Please provide us with a document that provides us with the beverage menu (if available).
    - Preferably in word or PDF form, or take a photo. Please save the fridge menu image as Location_DD.MM.YY_FridgeX_Menu

Vending Machine

- For each please take a photo of the overall vending machine present in one frame
- Take photos in which each product line is clearly visible to allow categorisation into red/amber/green categories (e.g. this may be 3 photos per door of a fridge)
- Take photos of any vending advertising or promotion (e.g. branding stickers, 2-for-1 deal signage)
- Please provide us with the stock list of the vending machine. Please save the vending menu image as Location_DD.MM.YY_VendingX_Menu

Photos of food and menu

- For all food displayed please take a photo of the overall café in one frame.
- Please take detailed photos of the food items on display. If the food item is labelled please include this in the picture. Please ensure it is possible to identify what the food item is.
    - Please save the food image as Location_DD.MM.YY_Food
- Take photos of any food advertising or promotion (e.g. branding stickers, 2-for-1 deal signage) Location_DD.MM.YY_Advertising
- Please provide us with detailed description of the food menu. Where possible please provide us with a word document or PDF rather than a picture. Please save the food menu image as Location_DD.MM.YY_Food_Menu

Please save the file name as Location_DD.MM.YY_FridgeX or Location_DD.MM.YY_VendingX or Location_DD.MM.YY_Food. Please allocate each fridge and vending machine a number and keep that consistent for the duration of the study (e.g. Fridge1, Vending2). Please save all picture items as a JPG or PNG

Please email your sample audit to XXX with a subject line ‘Sample audit_Location_Date’

Appendix 3: Drinks classification based on refrigerator audit

Each drink 'facing' was counted as one drink, where a 'facing' is the drink positioned at the front of the shelf in the refrigerator that is visible to the customer (all other hidden drinks behind the front bottle/can are assumed to be the same product line). Non-drinks items in the refrigerator were not included in this assessment. Information from photographs was entered into FoodChecker [3], an online tool provide by the Healthy Eating Advisory Service, to determine the percentage of 'red', 'amber' and 'green' drinks on display according to the HCGs, over the total number of drink facings in a refrigerator [4].

HCG classifications for each drink product, including each package size, for each facility were determined by local government project officers at the earliest audit timepoint at which each product was available for sale. Free sugar content for each product (g/100mL) was determined by a research dietitian in mid-2020. For water-based and fruit-based drinks, free sugar content information was collected directly using total sugar content as reported on the manufacturer or supplier website. For flavoured milk-based drinks, which include a mixture of free sugars and intrinsic sugars, free sugar content was calculated as a percentage of total sugar content, based on the percentage free sugar content of a similar generic product in the AUSNUT database.[5] Free sugar information was identified for 95% of the 1580 drink products available for sale during the study period. The remaining products could not be identified (e.g., brand not identified in sales data). HCG classifications and free sugar information were not updated during the study period.

Appendix 4: Model specification for analysis of non-seasonal facilities sales outcomes

For non-seasonal facilities, the effect of the intervention on each outcome was assessed using a multilevel interrupted time series model [6], to account for the clustering induced by facilities and the autocorrelation (lag 3) over time. The model displayed in the following equation was used to estimate the effect of the intervention on each sales outcome Y_{it} where i represents site and t time in weeks $(t = 0,1,2, \dots ,216)$; $I(B)$ is an indicator function taking the value 1 if condition B is true and 0 otherwise; W represents mean maximum daily temperature at each site for each week; $M_{1,\mathrm{it}}$ to $M_{12,\mathrm{it}}$ are indicator variables for calendar month with July $M_{7,\mathrm{it}}$ used as the reference category

$$
\begin{aligned}
Y_{it} = {} & \beta_0 + \beta_1 t + I(113 \le t < 143)[\beta_2 + \beta_3(t - 113)] + I(t \ge 143)[\beta_4 + \beta_5(t - 143)] \\
& + \beta_6 W_{it} + \beta_7 M_{1,it} + \beta_8 M_{2,it} + \beta_9 M_{3,it} + \beta_{10} M_{4,it} + \beta_{11} M_{5,it} + \beta_{12} M_{6,it} + \beta_{13} M_{8,it} \\
& + \beta_{14} M_{9,it} + \beta_{15} M_{10,it} + \beta_{16} M_{11,it} + \beta_{17} M_{12,it} + \upsilon_i + \epsilon_{it}
\end{aligned}
$$

The model included two break points (at the start (week 113) and end of the implementation period (week 143), see Figure 1 and Table 1), assumed independent linear trends pre-, during, and post-implementation allowing for different slopes at different periods (β_1, $\beta_1 + \beta_3$, $\beta_1 + \beta_5$), and for a shift at each breakpoint (β_2, β_4). The slope and breakpoint coefficients were assumed to be the same for all facilities while the random variable υ_i represents the departure of the i-th facility's intercept from the overall population intercept term β_0. The model was used to estimate the difference between the expected outcome under the intervention and the expected counterfactual outcome (the expected outcome that would have been observed if the initiative had not been implemented) for the week beginning 3 February 2020. For all outcomes, model effects were estimated adjusted for calendar month and mean maximum daily temperature for each week (see Table 2). Models for revenue outcomes and total volume of drinks sold were additionally adjusted for outlet type.

Appendix 5: Detailed results

Table S1. Characteristics of facilities participating in 'Water in Sport' by inclusion in implementation data analysis

Characteristic	Facilities (n (%))		p-value
	Analysed (n=44)	Excluded (n=8)	
Food retail outlet type			0.089 [a]
Kiosks	14 (32)	0 (0)	
Canteens	24 (55)	8 (100)	
Cafés	6 (14)	0 (0)	
Higher disadvantage [c]	35 (80)	8 (100)	0.323 [b]
Non-seasonal	26 (59)	0 (0)	0.004 [b]

[a] Joint test of significance

[b] Fisher's exact test

[c] Local government areas are ranked from most disadvantaged (1) to least disadvantaged (10) using the decile rank within state. Higher disadvantage, SEIFA (Socio-economic Indexes for Areas) ≤5th decile; lower disadvantage, SEIFA ≥6th decile.

Table S2. Facility compliance with the *Healthy Choices* guidelines [a] over time, in 44 facilities

Audit timepoint	Facilities				Odds of compliance [b]			Percentage compliant [b]		
	Assessed		Compliant							
	n	(%)	n	(%)	Odds ratio	(95% CI)	P-value [c]	%	(95% CI)	P-value [c]
0 months	43	(98)	9	(21)	Ref			20.5	(7.07, 33.9)	
6 months	44	(100)	20	(45)	4.65	(1.36, 15.9)	0.014	46.1	(28.7, 63.3)	0.014
12 months	41	(92)	23	(56)	8.37	(2.41, 29.1)	0.001	57.2	(39.8, 74.5)	0.001
18 months	30	(68)	19	(63)	12.0	(2.41, 60.1)	0.002	63.8	(41.9, 85.8)	0.002

[a] Facility compliance with the Victorian Government *Healthy Choices* guidelines was defined as all refrigerators meeting target of ≤20% 'red' drinks (e.g. sugary soft drinks) and ≥50% 'green' drinks (e.g. sparkling waters) displayed

[b] Adjusted for season, seasonality of facility and outlet type and correlation between repeated measures at the facility-level

[c] p-value from test comparing each timepoint to first audit timepoint (0 months)

Table S3. Characteristics of facilities participating in 'Water in Sport' by inclusion in sales data analysis

Characteristic	Facilities (n (%))		p-value
	Analysed (n=24)	Excluded (n=28)	
Food retail outlet type			0.920 [a]
Kiosks	7 (25)	7 (25)	
Canteens	14 (58)	18 (64)	
Cafés	3 (11)	3 (11)	
Higher disadvantage [b]	16 (67)	27 (96)	0.008 [b]
Non-seasonal	15 (63)	11 (39)	0.164 [b]

[a] Joint test of significance

[b] Fisher's exact test

[c] Local government areas are ranked from most disadvantaged (1) to least disadvantaged (10) using the decile rank within state. Higher disadvantage, SEIFA (Socio-economic Indexes for Areas) ≤5th decile; lower disadvantage, SEIFA ≥6th decile

Box S1: Characteristics of facilities included in sales data analysis, by seasonality

Of the 12 seasonal facilities that provided sales data, 9 were included in the analysis and provided a mean of 50 weeks of data. Six had canteens and 3 had kiosks, with 5 of the included facilities selling median <50 drink units each week.

Of the 20 non-seasonal facilities that provided sales data in the period of interest, 9 were included in the analysis. Facilities provided a mean of 202 weeks of sales data (range 151 to 217). Eight of the non-seasonal facilities were canteens, 4 were kiosks, and 3 were cafés, with 5 of the facilities selling <50 drink units each week, 5 selling from 50 to 89 units, and 5 selling ≥90 units per week.

Table S4. Estimated weekly sales and change in weekly sales of refrigerated drinks between summer seasons, in 9 seasonal facilities[a]

Outcome	Summer season [b]	Weekly sales [c]		Change in sales		
		Mean	(95% CI)	β	(95% CI)	P-value [d]
Primary outcomes						
Volume 'red' drinks (%)	Summer 1 pre-implementation	45.2	(37.5 to 52.9)	3.99	(-1.06, 9.04)	0.122
	Summer 2 pre-implementation	41.2	(30.8 to 51.6)	Reference time period		
	Summer 1 post-implementation	23.0	(10.5 to 35.5)	-18.2	(-27.8, -8.67)	<0.001
	Summer 2 post-implementation	22.2	(10.2 to 34.2)	-19.0	(-28.6, -9.51)	<0.001
Refrigerated drinks revenue (AU$)	Summer 1 pre-implementation	307	(169 to 446)	-17.8	(-57.1, 21.4)	0.373
	Summer 2 pre-implementation	325	(176 to 475)	Reference time period		
	Summer 1 post-implementation	253	(124 to 382)	-72.3	(-208, 63.2)	0.296
	Summer 2 post-implementation	243	(125 to 362)	-81.8	(-123, -40.8)	<0.001
Secondary outcomes						
Volume 'amber' drinks (%)	Summer 1 pre-implementation	15.5	(7.68 to 23.3)	0.17	(-6.18, 6.52)	0.958
	Summer 2 pre-implementation	15.3	(6.99 to 23.6)	Reference time period		
	Summer 1 post-implementation	22.8	(19.2 to 26.3)	7.45	(0.20, 14.7)	0.044
	Summer 2 post-implementation	28.6	(21.4 to 35.8)	13.3	(2.66, 23.9)	0.014
Volume 'green' drinks (%)	Summer 1 pre-implementation	39.4	(31.4 to 47.5)	-3.07	(-10.7, 4.58)	0.432
	Summer 2 pre-implementation	42.5	(34.0 to 51.0)	Reference time period		
	Summer 1 post-implementation	53.2	(40.9 to 65.4)	10.6	(0.10, 21.2)	0.048
	Summer 2 post-implementation	47.4	(37.5 to 57.3)	4.88	(-0.53, 10.3)	0.077
Overall volume drinks (L)	Summer 1 pre-implementation	42.9	(23.3 to 62.6)	-1.91	(-9.44, 5.62)	0.619
	Summer 2 pre-implementation	44.9	(22.1 to 67.6)	Reference time period		
	Summer 1 post-implementation	38.8	(19.8 to 57.7)	-6.08	(-29.2, 17.1)	0.607
	Summer 2 post-implementation	36.1	(18.7 to 53.6)	-8.71	(-18.3, 0.90)	0.076
Volume water (%)	Summer 1 pre-implementation	36.0	(31.8 to 40.2)	0.34	(-6.22, 6.91)	0.918
	Summer 2 pre-implementation	35.7	(28.5 to 42.9)	Reference time period		
	Summer 1 post-implementation	45.6	(37.0 to 54.3)	10.0	(-1.46, 21.4)	0.087
	Summer 2 post-implementation	39.8	(33.8 to 45.9)	4.17	(-2.36, 10.7)	0.211
Free sugar content (g/100mL)	Summer 1 pre-implementation	4.00	(2.95 to 5.06)	0.45	(-0.06, 0.96)	0.082
	Summer 2 pre-implementation	3.55	(2.48 to 4.62)	Reference time period		
	Summer 1 post-implementation	2.55	(1.61 to 3.50)	-1.00	(-2.22, 0.22)	0.108

Outcome	Summer season [b]	Weekly sales [c]		Change in sales		
		Mean	(95% CI)	β	(95% CI)	P-value [d]
Revenue other drinks and food (AU$)	Summer 2 post-implementation	2.54	(1.52 to 3.56)	-1.01	(-2.28, 0.26)	0.119
	Summer 1 pre-implementation	1055	(696 to 1413)	-3.77	(-80.5, 73.0)	0.923
	Summer 2 pre-implementation	1058	(705 to 1411)	Reference time period		
	Summer 1 post-implementation	926	(552 to 1300)	-132	(-552, 289)	0.538
	Summer 2 post-implementation	876	(540 to 1212)	-182	(-417, 52.1)	0.127

[a] Estimated from mixed models with adjusted for maximum weekly temperature; percentage outcomes volume 'red', 'amber', 'green', water and free sugar content additionally adjusted for size of facility.

[b] Reference category of Summer 2 pre-implementation (December 2017 – February 2018) compared to Summer 1 pre-implementation (9 December 2016 – February 2017), Summer 1 post-implementation (December 2018 – February 2019), and Summer 2 post-implementation (December 2019 – February 2020)

[c] Marginal means and 95% confidence intervals estimated at the mean values of the covariates included in the multilevel model

[d] p-value from comparison of each summer season to reference summer season (Summer 2 pre-implementation)

References

1. Blake MR, Boelsen-Robinson T, Hanna L, et al. Implementing a healthy food retail policy: a mixed-methods investigation of change in stakeholders' perspectives over time. *Public Health Nutr* 2020;24(9):2669-80.
2. Department of Health and Human Services. Victorian Population Health Survey 2014. Melbourne, Victoria: State of Victoria, 2018.
3. Healthy Eating Advisory Service. FoodChecker Melbourne, Victoria: State of Victoria; 2016 [cited 2020 Apr 16]. Available from: http://foodchecker.heas.health.vic.gov.au/ accessed 16 Apr 2020.
4. Department of Health. Healthy Choices: food and drink classification guide. Melbourne, Victoria: Victorian Government, 2020.
5. FSANZ. AUSNUT 2011–13–Australian food composition database. Canberra: FSANZ, 2014.
6. Kontopantelis E, Doran T, Springate DA, et al. Regression based quasi-experimental approach when randomisation is not an option: interrupted time series analysis. *BMJ* 2015;350