



Public Health
England

Protecting and improving the nation's health

Hospital vending machines: helping people make healthier choices

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Executive summary

In England, the prevalence of obesity among adults rose from 14.9% to 26.9% between 1993 and 2015 (1). By 2050 obesity is predicted to affect 60% of adult men and 50% of adult women (2). Obesity is associated with a range of health problems including type-2 diabetes, cardiovascular disease and some cancers. The resulting NHS costs attributable to overweight and obesity are projected to reach £9.7 billion by 2050, with wider costs to society estimated to reach £49.9 billion per year (2). Preventing obesity is, therefore, a major public health challenge.

In August 2016, the government published its 10-year plan to reduce England's rate of childhood obesity (3). Evidence to support the initial focus on sugar showed that "the recommended average population maximum intake of free sugar¹ should be halved: it should not exceed 5% of total dietary energy" and that "consumption of sugar sweetened drinks should be minimised by both adults and children" (4). These were recommendations published in the Scientific Advisory Committee on Nutrition (SACN) Carbohydrate and Health report (5) and subsequently included in government dietary recommendations. After the first year of the Childhood Obesity Plan, Public Health England announced that the focus on children's sugar consumption would widen to overall calorie consumption (including those from sugar) (6).

Vending machines have been criticised for providing convenient access to food and drinks that are high in saturated fat, sugar and salt (7-12). Hospitals have a role to play in the food provided to staff and visitors as well as to patients. Interest in approaches to support healthier choices has included the role of vending within hospital settings. This trial of 17 machines within the Leeds Teaching Hospitals NHS Trust was implemented to assess the impact of changing product availability and positioning. The 11 cold drinks machines and 6 mixed snack machines (crisps, confectionery, dried fruit and nuts and other snacks) included in the trial were managed by Selecta UK Limited. Two interventions were implemented, tested over 2 distinct phases and compared to baseline data. The first phase increased the availability of healthier food and drinks by applying nutritional standards (including some of the Government Buying Standards for Food best practice criteria). The second phase altered the placement of products, moving healthier products to more prominent, salient positions within the machines.

¹ 'Free sugars' includes all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and unsweetened fruit juices. Under this definition, lactose (milk sugar), when naturally present in milk and milk products and sugars contained within the cellular structure of foods (particularly fruits and vegetables), are excluded.

Key findings:

- There were meaningful effects on purchasing behaviours from altering the availability and placement of healthier products in the vending machines as follows:
- Sales of cold drinks increased at the same time as a decrease in the average energy (kJ/kcal) and total sugar content (g) per product purchased
- There was a small decrease in the average energy (kJ/kcal) purchased from the mixed snack machines but an increase in total sugar per product purchased and a decrease in sales. However, this appears to be associated with an increase in sales of dried fruit products, which are not a source of free sugars

Such changes are commercially viable and in response to these findings, Selecta have changed the product selection of both drinks and mixed snacks in line with Phase 2 of this trial in all 632 machines they manage in all of their 105 NHS sites.

Due to the positive shift in purchasing behaviour observed in the drinks vending machines, both regarding health-related outcomes and commercial viability, it is recommended that other vending machine retailers replicate the approach of this trial adhering to both Government Buying Standards for Food and Catering Services (GBSF) and altering the placement of products. Due to the findings in purchasing behaviour observed in the mixed snacks vending machines, we encourage further implementation of such approaches with ongoing transparent evaluation to add to this emerging evidence base and enable early identification of potential negative effects. We also recommend further research to be conducted to identify optimal strategies for healthier purchasing behaviour in a mixed snack machine environment. In particular, these results suggest that further adjustments in mixed snacks vending machines could help people limit their consumption of dried fruit between meals to help reduce the risk of tooth decay (13).

1. Introduction

1.1 Background

Most people in employment spend 60% of their waking hours in a work environment (14) where they will typically consume drinks, snacks and at least one meal. The workplace therefore provides an opportunity to positively influence eating habits. Encouraging healthy eating habits in the workplace may have a wider impact by influencing the food choices made in the home environment (15-17). Furthermore, encouraging healthy eating amongst NHS staff may also translate into better patient care by enabling healthcare professionals to lead by example and inform patients and the public about how diet can improve health. Healthy eating amongst NHS staff has, therefore, been the focus of a number of activities over the previous years.

In 2014, the Hospital Food Standards Panel report identified a set of food standards for routine practice across NHS Hospitals (18). These food standards include 2 relating specifically to food and drink sold on site (19). The report recommended that NHS hospitals should develop and maintain a food and drink strategy including healthier eating for the whole hospital community but especially staff, and suggested a CQUIN (Commissioning for Quality and Innovation) relating to the availability of food and drink. NHS England (NHSE) built on this approach in the Five-Year-Forward View (20), making a commitment to ensure the NHS as an employer sets a national example relating to food and drink sold on NHS premises.

In 2015, NHSE announced further plans to support the commitment, outlining a major drive to improve the health and wellbeing of NHS staff (21). Specifically, NHSE would work with Public Health England (PHE) and other agencies to challenge and support catering contractors and Private Finance Initiative providers to “*raise the standards of food and nutrition*”.

In 2016, the Childhood Obesity Plan (3) was published, which specified the need to tackle the obesogenic environment including the introduction of a Soft Drinks Industry Levy (22) and a comprehensive sugar and calorie reduction programme (6). The Plan also committed to make healthy options more available in the public sector and specified collaborative work between the Department of Health and Social Care (DHSC), PHE and NHSE to trial behavioural interventions in NHS hospitals.

In 2017, NHSE announced that sugary drinks would be banned in hospital shops from 2018 unless suppliers voluntarily take decisive action to cut their sales (23). Leading retailers have agreed to support this and continue voluntarily reducing sales of sugary drinks to 10 percent or less of their total drinks sales. The NHS staff health & wellbeing

CQUIN for 2017-19 further supports restrictions on the sales of sugary drinks and limits the calories allowed in confectionery and sweets (24).

1.2 Food and drink vending

Unhealthy diets have been shown to contribute to an increased risk of obesity and, subsequently, the risk of developing obesity-related comorbidities such as cardiovascular disease, hypertension, diabetes and some cancers (25). PHE, amongst many other health organisations, recommends minimising consumption of food and drinks high in saturated fat, sugar and salt (HFSS) (26-29), specifically recommending that intake of free sugars should not exceed 5% of total dietary energy (5). This is equivalent to no more than 7 sugar cubes (30g) a day (30). Vending machines have been criticised for providing convenient access to HFSS food and drinks (7-12) and, therefore, have been subject to closer scrutiny (31, 32). Consequentially, there has been support for public health efforts to improve the nutritional quality of vended food and beverages (33, 34).

In 2015, there were 157,600 vending machines providing snack food and/or cold drinks in the UK. In total these machines dispensed 922.2million products and generated an estimated £671million revenue (35). 85% of vending machines are located in workplaces (35). As vending machines are commonly found in NHS workplaces, they offer a significant opportunity to encourage healthy consumption habits amongst NHS staff (27, 28). Industry too has recognised the growing interest for healthier vending as consumers “increasingly demand healthy options”. Currently, 39% of vended cold drinks in the UK are low-sugar, diet or water and 14% of snacks were labelled as ‘healthier’ (35). The underlying approaches used to define healthier items are, however, often inconsistent with government dietary recommendations and associated messaging. Industry recognises the consumer trend towards healthier purchasing and are as such introducing a range of ‘healthier’ products into machines to further understand consumer preferences and to drive positive perceptions (35).

1.3 Food standards

Government Buying Standards for Food and Catering Services (GBSF) are one of the hospital food standards (18). DEFRA has overall responsibility for the GBSF (36) and DHSC lead on its nutrition-related standards. GBSF are mandatory for all central government departments and their agencies and are recommended more widely across the public sector and beyond. They include both mandatory standards (that is, mandatory for government departments and their agencies) and best practice criteria for those who wish to go further. Including these standards in catering specifications is strongly encouraged to facilitate the implementation of GBSF and the provision of a healthier, more sustainable catering offer. GBSF mandatory elements are included in the NHS standards contract (37). The best practice criteria cover food and drink options

that are commonly found in vending machines (that is, confectionery, savoury snacks and sugar sweetened beverages) and these were used in this study (Section 2.1.2)

The nutrient profiling model (NPM) (38) was developed by the Food Standards Agency in 2004-2005 as a tool to help Ofcom to identify 'less healthy' foods and drinks that were subject to restrictions during children's television programming. It has sometimes been inappropriately used for other purposes. The Childhood Obesity Plan included a review of the existing model to reflect current dietary recommendations (3).

1.4 Behavioural insights

It is argued that much of our consumption behaviour is automatic, largely unconscious and triggered by stimuli within the environment (39). Behavioural insights refers to the application of behavioural science to policy and practice with a focus on, but not exclusively, these 'automatic' processes.

Two vending interventions that are consistent with the behavioural insights approach and are explored in this report are alterations to the availability of products and altering the physical location of products within vending machines. These approaches can be described as 'choice architecture' interventions where choice architecture is defined as follows:

"Interventions that involve altering the properties or placement of objects or stimuli within micro-environments with the intention of changing health-related behaviour. Such interventions are implemented within the same micro-environment as that in which the target behaviour is performed, typically require minimal conscious engagement, can in principle influence the behaviour of many people simultaneously, and are not targeted or tailored to specific individuals" (40)

1.4.1 Availability

A recent systematic literature review of interventions in vending machines to encourage consumers to make healthier choices (41) found that increasing the availability of healthier items was effective in increasing purchases of these items. Increasing the availability of healthier products may increase selection of these items through 2 proposed mechanisms. Firstly, and very simply, increasing the availability of healthier products makes it easier for an individual to obtain a healthier product of their preference. Secondly, increased selection of healthier items may signify healthier products as the social norm and, thus, encourage individuals to select these items.

1.4.2 Product placement

Another recent systematic review found a positive effect of positional influences on food choice (42). 16 of the 18 studies included in the review reported that altering the position of food products (proximity and order) resulted in a significant increase in participants selecting, purchasing and consuming healthier food items. None of the included studies, however, examined positioning in vending machines. The position of a product may increase the probability of selection by making the product easier to physically obtain and/or making the product more salient. Arguably, altering the position of a product within a vending machine does not affect the physical ease by which a customer can obtain a product and we are, therefore, relying on the effect of the increased salience of products when moved into more prominent positions within the machines.

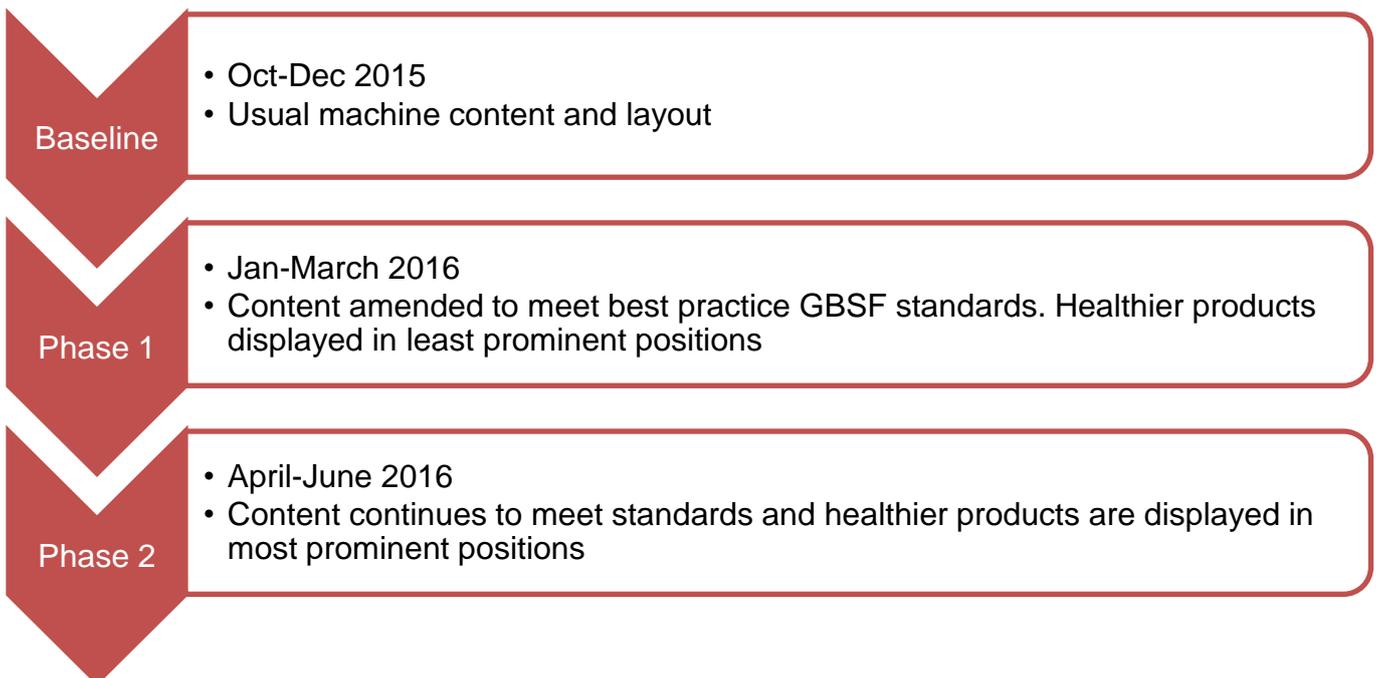
2. An opportunity to generate insight

In 2015 the DHSC worked with Selecta and the Leeds Teaching Hospitals NHS Trust to implement 2 behavioural insights approaches (outlined above) to vending machines across the NHS hospital site. Sales data from the machines was provided to PHE presenting an opportunity to generate insight of the impact of such approaches. The aim of this report is therefore to communicate the findings of the evaluation. The report provides evidence to address 2 questions:

- What is the impact of the introduction of nutritional standards including some of the GBSF best practice criteria on vended drinks and mixed snacks in a hospital setting?
- What is the impact of positioning healthier mixed snack and drinks in more prominent positions within vending machines in a hospital setting?

2.1 The intervention

The 2 interventions were applied to 17 vending machines at the Leeds Teaching Hospital NHS Trust site. These included eleven cold drinks machines and 6 mixed snack machines (containing both sweet and savoury products). Details of the availability and positioning of products is described in more detail in sections 2.1.1 to 2.1.3. The vending machines were managed by Selecta who agreed to implement the changes and share the sales data to enable an evaluation. The figure below outlines the approach taken.



2.1.1 Baseline

The drinks vending machines consisted of 45 'facings' distributed over 5 rows. At baseline 23 of the facings were Sugar-Sweetened Beverages (SSBs)² and the remaining 22 facing were non-SSBs. The exact positioning of products is outlined in Appendix 6.1. The classification of the individual products by 'SSB' or 'non-SSB' can be found in Appendix 6.7. The mixed snacks vending machines contained 2 distinct sections. The top section of the machine consisted of twelve facings distributed over 3 rows. At baseline 10 of these facing contained crisps and other savoury products, such as cheese biscuit snacks and corn chips (from this point in the report these products will be referred to generically as 'crisps'). The other 2 facings in the machine contained a popcorn snack and a sharing bag of confectionery. The bottom section of the machine consisted of 24 facings distributed over 3 rows. At baseline the bottom section of the vending machine consisted of 17 confectionery products, 5 dried fruit and nut products and 2 other snack products. The exact positioning of products is outlined in Appendix 6.4. The classification of the individual products (ie 'crisps', 'confectionery', 'dried fruit and nuts' or 'other snacks') can be found in Appendix 6.8. Data for the 3 month baseline phase was taken from historic sales.

2.1.2 Phase one

Phase 1 sought to increase the availability of healthier items within the vending machines. For this intervention the selection of products was altered to meet 2 nutritional standards. The vending provider elected to carry out an initial sifting of the products supplied within vending machines using the nutrient profiling model (38). While this is outdated and not recommended, it was the common approach of retailers at that time (see section 4.1 for the limitation of this approach). This was then followed by the removal of products which did not meet the following GBSF best practice criteria:

- SSBs to be no more than 330ml pack size and no more than 20% of beverages (procured by volume) may be sugar sweetened. No less than 80% of beverages (procured by volume) may be low calorie/no added sugar beverages (including fruit juice and water)³
- Savoury Snacks are only available in packet sizes of 30g or less

² Sugar sweetened beverages incorporate beverages which are not low calorie and which have added sugar. If they are low calorie or if they have no added sugar then they do not fall within this definition. Products sweetened with a combination of artificial/natural sweeteners and sugars would, if not meeting the low calorie criteria, fall within this definition.

³ The terms 'low calorie' and 'no added sugar' are legal terms. 'Low calorie' refers to a product that does not contain more than 40 kcal (170 kJ)/100 g for solids or more than 20 kcal (80 kJ)/100 ml for liquids. 'No added sugar' refers to a product where sugars have not been added and this claim can only be made when the product does not contain any mono- or disaccharides or any other food used for its sweetening properties.

http://ec.europa.eu/food/safety/labelling_nutrition/claims/nutrition_claims_en

Further, PHE recommend a maximum daily serving size of 150ml for fruit juices and that these are consumed with meals to reduce the risk of tooth decay.

- Confectionery and packet sweet snacks are in the smallest standard single serve portion size available within the market and do not to exceed 250kcal

Within the drinks machines, 9 non-compliant products (ie did not meet the GBSF best practice criteria for drinks outlined above) were removed from sale. A further 2 SSB products were removed from sale to result in a ratio of facings in the vending machines reflecting the 80% to 20% GBSF criteria. In practice, 36 of the 45 facings in the vending machine were assigned to non-SSBs with the remaining 9 facings stocking SSBs but in volumes of no more than 330ml per product. This is depicted in Appendix 6.2.

In the top section of the mixed snack machines all products (10 types of crisps, popcorn and sharing confectionery bag) were replaced with 4 types of crisps assigned to 3 facings each. In the bottom section of the mixed snack machine one non-compliant confectionery product was removed from sale.⁴ This product was replaced by a lower calorie confectionery product resulting in the number of confectionery, dried fruit and nuts and other snack products remaining the same as baseline (17, 5 and 2 respectively). The exact locations of the products within the mixed snack machines are outlined in Appendix 6.5.

Further to the alterations outlined above, the positions of the healthier items were moved to the least prominent positions within the vending machines (see section 4.1 for the limitation of this approach). The definitions of most and least prominent positions within the machines are described in Section 2.1.3.

2.1.3 Phase 2

Phase 2 sought to rearrange the contents of the vending machines to place the healthiest items in the most prominent positions and the unhealthiest items in the least prominent positions. Within the drinks vending machines the most prominent position was deemed to be the rows closest to eye level (ie the top 3 row of the machine). The least prominent position was deemed to be the bottom row of the machine ie the row furthest from the natural eye line. The exact locations of the products within the drinks machines are outlined in Appendix 6.3. Within the mixed vending machine the same principle was applied, however, rearrangement was slightly more complex due to the split between the top half of the machine (containing crisps) and the bottom half of the machine (containing confectionery, dried fruit and nuts and other snacks). As there was no substantial difference between the crisps products the positioning of products in the top half of the machines remained as per Phase 1. Within the bottom half of the machine, healthier items were moved to the top row of the bottom half of the machine

⁴ Overall, therefore, 2 confectionery products were removed when including the sharing confectionery bag in the top section.

as this row was closest to eye-level. The exact locations of the products within the mixed snack machines are outlined in Appendix 6.6.

2.2 Implementation and fidelity

The intervention planograms outlined in the appendices were applied identically to all vending machines across the NHS Trust sites. The vending provider, Selecta, was responsible for implementing the intervention including stocking the machines and collecting the data. Customers of the vending machines were not explicitly made aware of the alterations to the vending machines. The DHSC and individuals in the NHS Trust conducted photographic fidelity checks to ensure the machines met trial protocol.

2.3 Data collection

When a customer used a vending machine a product was released from the spiral. The vending machines were subsequently restocked and the barcode of each product placed in the machine was scanned and recorded as a 'spiral fill'. The number of spiral fills are used within analyses as they directly reflects sales of products from the machines. The data was collected by Selecta and provided directly to the DHSC project team at the end of each of the 3 phases of the study (January, April and July 2016). This data was cleaned and provided to PHE for evaluation.

2.4 Outcome measures

The outcome measures are:

- Sales: Number of items sold
- Mean energy per product (kcal and kJ)
- Mean sugar per product (grams of total sugar)
- Volume: Observing changes in volume (ml/g) per product purchased enables an assessment of the change in type of product purchased (eg bottles vs. cans)

2.5 Statistical methods

The summary statistics for the outcome measures outlined above are presented in the following section. The outcomes are presented for the drinks and snacks separately. Changes between phases of the trial are noted as percentage increases or decreases.

3. Findings

The findings are presented in 2 distinct sections. The first outlines the findings from the drinks machines whilst the second outlines the findings from the mixed snack machines. Within the drinks machine findings, the outcome measures outlined in Section 2.4 are presented for all drinks products and also for SSB and non-SSB products. To provide further insights the products are further categorised as either 'water', 'non-SSB carbonates', 'fruit juice', 'non-SBB juice drinks', 'SSB carbonates', 'energy drinks' or 'SSB juice drinks'. The classification of the individual products into these 7 categories can be found in Appendix 6.7. Within the mixed snack machines findings, the outcome measures outlined in Section 2.4 are presented for all products and also for the 4 snack categories (crisps, confectionery, dried fruit and nuts and other snacks).

3.1 Drinks machines

Overall sales of drinks increased across the 2 intervention phases (Figure 1). There was a notable shift from SSBs to non-SSBs in Phase 1 which continued in Phase 2 (Table 1). This occurred across categories, with for example carbonated SSBs sales decreasing across the trial period whilst carbonated non-SSBs sales increased. As a result we observe large decreases in total energy and energy per drink across both phases (Tables 2 and 4). Similarly we observe large decreases in total sugar and sugar per drink across both phases (Tables 3 and 4).

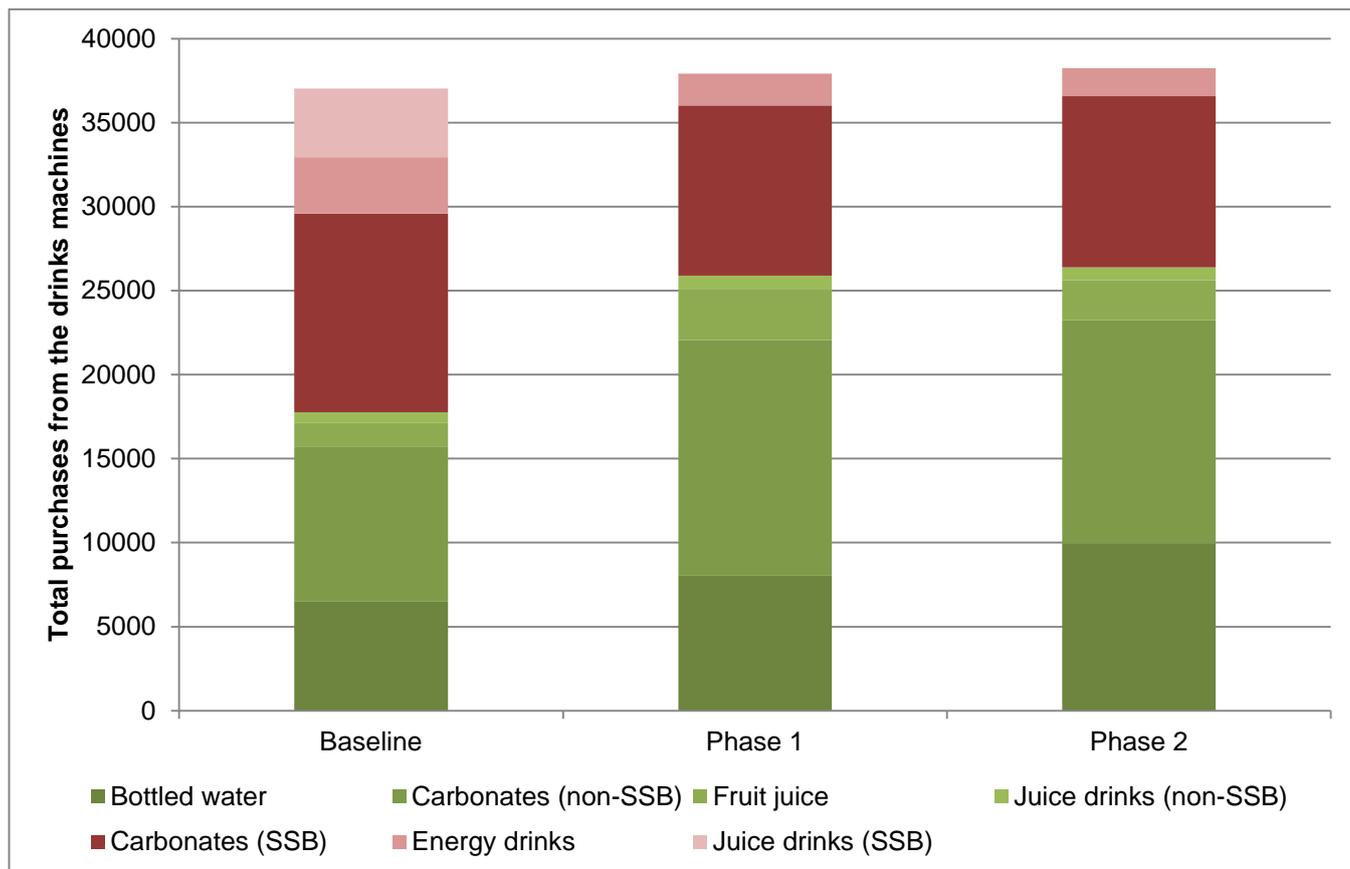


Figure 1: Total purchases from the drinks vending machines by product category and intervention phase

3.2.1 Sales

		Sales (n)			% change in sales		% of total sales		
		Baseline	Phase 1	Phase 2	Baseline to Phase1	Phase 1 to Phase 2	Baseline	Phase 1	Phase 2
Non-SSBs	Water	6,488	8,027	9,980	23.7%	24.3%	17.5%	21.2%	26.1%
	Carbonates (non-SSBs)	9,234	14,024	13,276	51.9%	-5.3%	24.9%	37.0%	34.7%
	Fruit Juice	1,388	2,992	2,372	115.6%	-20.7%	3.7%	7.9%	6.2%
	Juice Drink (non-SSBs)	654	857	767	31.0%	-10.5%	1.8%	2.3%	2.0%
TOTAL Non-SSBs		17,764	25,900	26,395	45.8%	1.9%	48%	68.2%	69%
SSBs	Carbonates (SSBs)	11,808	10,118	10,179	-14.3%	0.6%	31.9%	26.7%	26.6%
	Energy Drinks	3,366	1,881	1,681	-44.1%	-10.6%	9.1%	5.0%	4.4%
	Juice Drinks (SSBs)	4,088	52	0	-98.7%	-100.0%	11.0%	0.1%	0%
TOTAL SSBs		19,262	12,051	11,860	-37.4%	-1.6%	52.0%	31.8%	31.0%
TOTAL		37,026	37,951	38,255	2.5%	0.8%	100%	100%	100%

Table 1: Total sales, percentage change in sales and percentage of total sales from the drinks vending machines by product category and intervention phase

3.2.2 Energy

		Energy (kcal)			% change in energy		% of total energy		
		Baseline	Phase 1	Phase 2	Baseline to Phase1	Phase 1 to Phase 2	Baseline	Phase 1	Phase 2
Non-SSBs	Water	0	0	0	0%	0%	0%	0%	0%
	Carbonates (non-SSBs)	18,500	30,749	27,712	66.2%	-9.9%	0.6%	1.6%	1.5%
	Fruit Juices	187,661	415,272	321,037	121.3%	-22.7%	6.1%	21.2%	17.9%
	Juice Drinks (non-SSBs)	45,340	58,276	52,520	28.5%	-9.9%	1.5%	3.0%	2.9%
TOTAL Non-SSBs		251,501	504,298	401,269	100.5%	-20.4%	8.2%	25.7%	22.4%
SSBs	Carbonates (SSBs)	1,739,759	1,232,876	1,204,286	-29.1%	-2.3%	56.7%	62.9%	67.1%
	Energy Drinks	585,695	216,097	189,113	-63.1%	-12.5%	19.1%	11.0%	10.5%
	Juice Drinks (SSBs)	491,926	5,579	0	-98.9%	-100%	16.0%	0.3%	0%
TOTAL SSBs		2,817,380	1,454,552	1,393,398	-48.4%	-4.2%	91.8%	74.3%	77.6%
TOTAL		3,068,881	1,958,849	1,794,667	-36.2%	-8.4%	100%	100%	100%

Table 2: Total energy, percentage change in energy and percentage of total energy from the drinks vending machines by product type and intervention phase

3.2.3 Sugar

		Sugar (g)			% change in sugar		% of total sugar		
		Baseline	Phase 1	Phase 2	Baseline to Phase1	Phase 1 to Phase 2	Baseline	Phase 1	Phase 2
Non-SSBs	Water	0	0	0	0%	0%	0%	0%	0%
	Carbonates (non-SSBs)	2	4	3	78.6%	14.2%	<0.01%	<0.01%	<0.01%
	Fruit Juices	40,736	90,227	69,689	121.5%	-22.8%	5.6%	19.4%	16.3%
	Juice Drinks (non-SSBs)	10,202	13,198	11,866	29.4%	-10.1%	1.4%	2.8%	2.8%
TOTAL Non-SSBs		50,940	103,429	81,559	103.0%	-21.1%	7.0%	22.2%	19.1%
SSBs	Carbonates (SSBs)	432,682	307,902	299,492	-28.8%	-2.7%	59.1%	66.2%	70.1%
	Energy Drinks	136,645	52,658	46,228	-61.5%	-12.2%	18.7%	11.3%	10.8%
	Juice Drinks (SSBs)	111,278	1,284	0	-98.8%	-100%	15.2%	0.3%	0.0%
TOTAL SSBs		680,605	361,843	345,719	-46.3%	-4.5%	93.0%	77.8%	80.9%
TOTAL		731,545	465,272	427,278	-36.4%	-8.2%	100%	100%	100%

Table 3: Total sugar, percentage change in sugar and percentage of total sugar from the drinks vending machines by product type and intervention phase

3.2.4 Volume, energy and sugar per product

		Volume per product (ml)			Energy per product (kcal)			Sugar per product (g)		
		Baseline	Phase 1	Phase 2	Baseline	Phase 1	Phase 2	Baseline	Phase 1	Phase 2
Non-SSBs	Water	500.0	500.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0
	Carbonates (non-SSBs)	460.8	489.3	477.7	2.0	2.2	2.1	<0.01	<0.01	<0.01
	Fruit Juice	591.4	330.0	330.0	135.2	138.8	135.3	29.3	30.2	29.4
	Juice Drinks (non-SSBs)	200.0	200.0	200.0	69.3	68.0	68.5	15.6	15.4	15.5
All Non-SSBs		475.7	464.6	464.8	14.2	19.5	15.2	2.9	4.0	3.1
SSBs	Carbonates (SSBs)	403.3	332.2	330.0	147.3	121.8	118.3	36.6	30.4	29.4
	Energy Drinks	337.0	253.3	250.0	174.0	114.9	112.5	40.6	28.0	27.5
	Juice Drinks (SSBs)	342.5	467.7	0.0	120.3	107.3	-	19.3	12.3	-
All SSBs		378.8	320.4	318.7	146.3	120.7	117.5	35.3	30.0	29.2
All		425.3	418.8	419.5	82.9	51.6	46.9	19.8	12.3	11.2

Table 4: Volume, energy and sugar per product purchased from the drinks vending machines by product type and intervention phase

3.3 Mixed snack machines

Overall sales of snacks decreased over the 2 phases of the intervention (Figure 2). In Phase 1 the overall decrease was driven by reduced sales of crisps alongside an increase in the sales of confectionery, dried fruit and nuts and other snacks. In Phase 2, however, we observed a continued decline in the sales of crisps along with a decrease in sales of confectionery and dried fruit and nuts; although, these 2 product categories remained at a higher sales point in Phase 2 than at baseline (Table 5).

We observed an overall decrease in the total energy from snacks (Table 6), however, this is a result of the overall decrease in sales rather than a decrease in the energy per product which remains relatively stable across the 3 time periods (Table 5). We observed an increase in total sugar from snacks in Phase 1 and Phase 2 compared to baseline (Table 7) with average sugar per product increasing both between baseline and Phase 1 and again between Phase 1 and Phase 2 (Table 8).

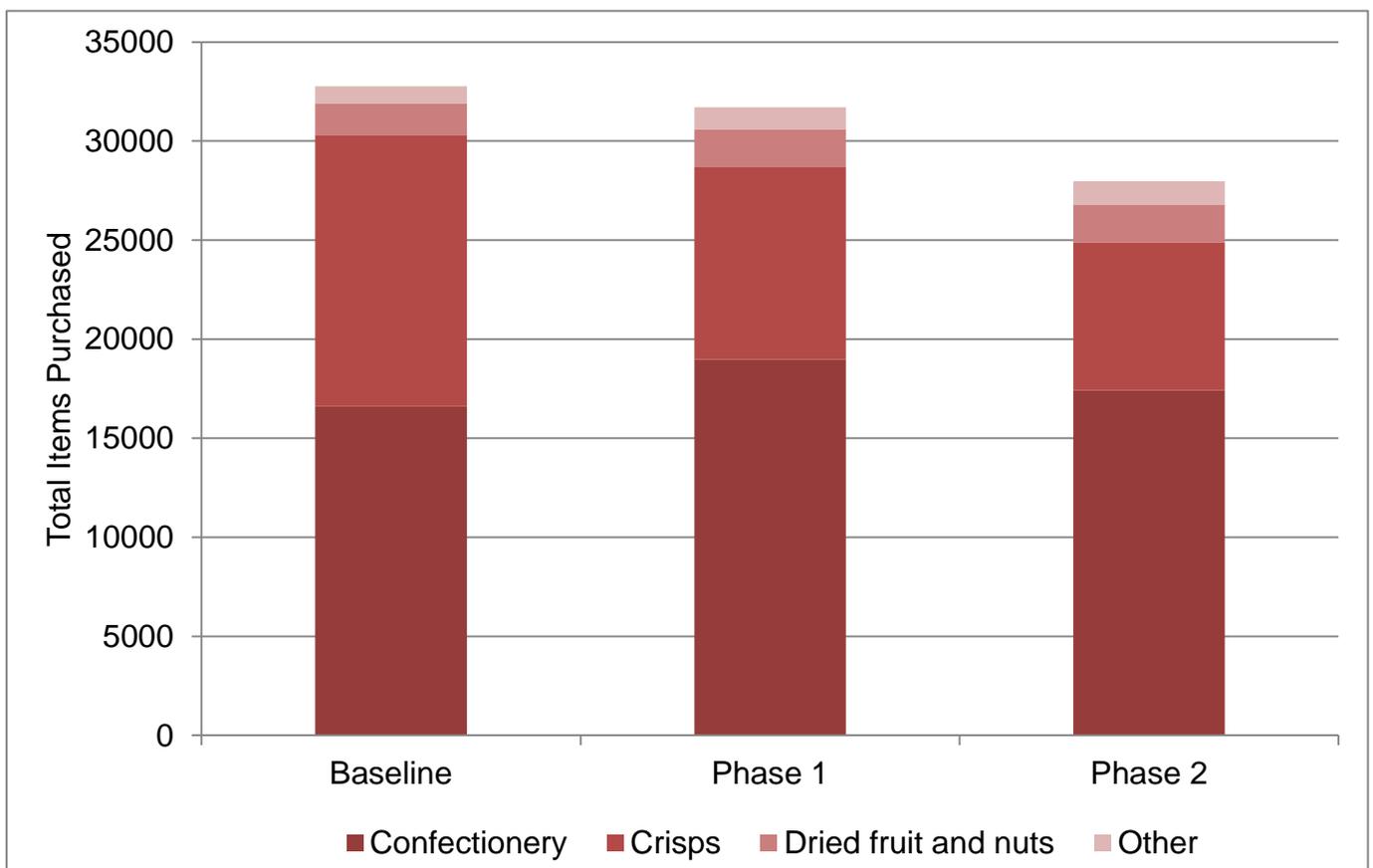


Figure 2: Total purchases from the mixed snacks vending machines by product category and intervention phase

3.3.1 Purchases from the mixed snack machines

	Sales (n)			% change in sales		% of total sales		
	Baseline	Phase 1	Phase 2	Baseline to Phase1	Phase 1 to Phase 2	Baseline	Phase 1	Phase 2
Crisps	13,693	9,705	7,459	-29.1%	-23.1%	41.8%	30.6%	26.7%
Confectionery	16,612	18,966	17,417	14.2%	-8.2%	50.7%	59.8%	62.3%
Dried fruit and nuts	1,569	1,933	1,918	23.2%	-0.8%	4.8%	6.1%	6.9%
Other snacks	891	1,101	1,168	23.6%	6.1%	2.7%	3.5%	4.2%
TOTAL	32,765	31,705	27,962	-3.2%	-11.8%	100%	100%	100%

Table 5: Total sales, percentage change in sales and percentage of total sales from the mixed snacks vending machines by product category and intervention phase

3.3.2 Energy

	Energy (kcal)			% change in energy		% of total energy		
	Baseline	Phase 1	Phase 2	Baseline to Phase1	Phase 1 to Phase 2	Baseline	Phase 1	Phase 2
Crisps	2,273,129	1,166,852	849,939	-48.7%	-27.2%	34.2%	19.6%	15.7%
Confectionery	3,890,061	4,182,632	3,907,944	7.5%	-6.6%	58.5%	70.2%	72.5%
Dried fruit and nuts	289,652	358,887	368,198	23.9%	2.6%	4.4%	6.0%	6.8%
Other snacks	201,779	249,422	264,422	23.6%	6.0%	3.0%	4.2%	4.9%
TOTAL	6,654,621	5,957,793	5,390,552	-10.5%	-9.5%	100%	100%	100%

Table 6: Total energy, percentage change in energy and percentage of total energy from the mixed snacks vending machines by product type and intervention phase

3.3.3 Sugar

	Sugar (g)			% change in sugar		% of total sugar		
	Baseline	Phase 1	Phase 2	Baseline to Phase1	Phase 1 to Phase 2	Baseline	Phase 1	Phase 2
Crisps	18,371	12,116	9,127.8	-34.0%	-24.7%	3.9%	2.4%	1.9%
Confectionery	421,368	454,988	429,791	8.0%	-5.5%	89.3%	89.7%	89.5%
Dried fruit and nuts	22,738	28,430	28,976	25.0%	1.9%	4.8%	5.6%	6.0%
Other snacks	9,349	11,801	12,143	26.2%	2.9%	2.0%	2.3%	2.5%
TOTAL	471,825	507,335	480,038	7.5%	-5.4%	100%	100%	100%

Table 7: Total sugar, percentage change in sugar and percentage of total sugar from the mixed snacks vending machines by product type and intervention phase

3.3.4 Energy and sugar per Product

	Energy per product (kcal)			Sugar per product (g)		
	Baseline	Phase 1	Phase 2	Baseline	Phase 1	Phase 2
Crisps	166.0	120.2	113.9	1.3	1.2	1.2
Confectionery	234.2	220.5	224.4	25.4	24.0	24.7
Dried fruit and nuts	184.6	185.7	192.0	14.5	14.7	15.1
Other snacks	226.5	226.5	226.4	10.5	10.7	10.4
All Products	203.1	187.9	192.8	14.4	16.0	17.2

Table 8: Energy and sugar per product purchased from the mixed snacks vending machines by product type and intervention phase

4. Discussion

Findings from the drinks vending machines show that simple changes can support people to make healthier choices without a negative effect on commercial viability. Overall we observed increased sales of drinks in both Phase 1 and Phase 2 compared to baseline. This finding is coupled with substantial decreases in average energy and total sugar content per drink purchased. The increase in sales suggests that when non-compliant drinks are removed from sale within vending machines customers switch to alternative products. Analysis of changes in sales of individual products reveals that when multiple SSBs are removed (Appendix 6.7), sales of cans ($\leq 330\text{ml}$) of SSB carbonates, bottles ($\geq 500\text{ml}$) of non-SSB carbonates and bottles of water (500ml) increased (unpublished, commercially sensitive data). As a result average volume per drink purchased remained stable throughout the trial ($\sim 420\text{ml}$) as did the fall in energy purchased. While the reduction in calories and sugar consumed associated with the apparent switching between carbonated SSBs and carbonated non-SSBs is assumed to have a positive impact on health, the role of artificially-sweetened beverages in preventing weight gain and their other long-term effects on health remain unclear (43). In contrast, switching from SSBs to water has clearer health benefits.

The GBSF best practice criteria outlines that no more than 20% of beverages (procured by volume) may be sugar sweetened. Many organisations have incompletely interpreted the practical delivery of this as being the number of facings within the drinks vending machines so that only 20% of facings contained SSBs (see Section 2.1.2). This resulted in 24% of the total volume of drinks purchased being SSBs. While shifting to a sales-weighted approach may be more likely to result in the target 80-20 ratio (Appendix 6.10), stock-piling may become an issue. Using number of facings may therefore be the best practical approach to adhere to the GBSF criteria. This study provides a useful basis for assessing the impact of GBSF in this area and suggests future work to build on this might include qualitative research to identify consumer response to further reduction of SSBs in overall facings within machines (ie reducing the percentage of SSBs allowed within GBSF), impact of reducing refill of SSBs relative to lower sugar alternatives and complete removal of SSBs within machines. The impact of the latter on sales, energy and total sugar has been the subject of a natural experiment in 2 workplace settings, the results of which are currently in preparation for publication/in press.

Findings from the mixed snacks vending machines are more complex though we do observe a decrease in total energy. We cannot observe individual purchasing behaviour over time; however, the findings suggest that consumers switched their purchasing from crisps to confectionery (and to a lesser extent dried fruit and nut and other snacks). As the average total sugar content is substantially lower in crisps than confectionery, dried fruit and nuts and other snacks, we observe an increase in the total sugar and average

total sugar per snack item purchased. Although the findings for sugar are not positive we do observe a decrease in total energy (although this is largely due to a decrease in overall sales) and in energy per snack product purchased. This highlights the opportunity for manufacturers to reformulate products to decrease total energy – a complementary strategy of the Childhood Obesity Plan that is led by PHE (3). Furthermore, in secondary analyses we also find that the average salt and saturated fat per packet of crisps purchased was substantially lower in Phase 1 and Phase 2 compared to baseline (see Appendix 6.9).

It is suggested that the reduction in sales of crisps may be, in part, due to the removal of popular, well known brands. Of the 10 crisps products available at baseline, 9 were removed as they exceeded the 30g limit for savoury snacks outlined in GBSF best practice criteria. Many of the brands of crisps removed from sale are, however, produced in packet sizes below 30g but are only available in multipacks. As such, they are not available for individual sale and, therefore, cannot be stocked within vending machines. Exploratory analysis suggested that there would be 23-35% reduction in calories, sugar, salt and saturated fat purchased if smaller pack sizes were available in the machines (Appendix 6.9). There remains a good opportunity for manufacturers to help impact on dietary behaviour through vending by enabling these smaller pack sizes to be vended.

Whilst substantial changes were made to the product selection in the top section (crisps) of the mixed snacks vending machine, there was little change made to the products for sale in the bottom section (confectionery, dried fruit and nuts and other snacks). At baseline, 90% of the products in the bottom section of the mixed snack machines were fully compliant with GBSF best practice criteria (ie ≤ 250 kcal) resulting in removal of only 2 products. The continued availability of a generous selection of popular, well known confectionery products coupled with the changes to the crisps selection may have amplified the suggested switching behaviour.

Of importance to discussion are insights regarding the commercial viability of the interventions. Following the intervention, Selecta have changed the product selection of both drinks and mixed snacks in line with Phase 2 of this trial in all 632 machines they manage in all of their 105 NHS sites. Whilst this report cannot comment on revenue or profitability of the changes, this action indicates the commercial acceptability of the approach.

4.1 Limitations

A significant limitation is that this trial was run in a 'live' hospital setting rather than an experimental laboratory and therefore we cannot separate the effects of the interventions from other confounding factors. The context in which the trial was conducted did not allow for a randomised trial approach and, therefore, the multi-phase

pre-post analysis was considered the best method available providing reasonable strength of evidence which can be used to inform other hospitals to implement similar changes to vending machines. A further limitation is, however, the timing of the phases of the trial. The baseline phase of the trial ran for 3 months ending in December 2015. Due to the pre-post nature of the trial we cannot determine to what extent findings result from the intervention or from seasonal variations in behaviour. With only vending machine sales data available, a further limitation is the lack of data on individual behaviour during the trial or sales data from alternative sources of food and drink in the hospital. We were therefore unable to explore whether people went elsewhere to purchase products no longer available in the vending machines.

As referenced in Section 2.1.2, the use of the nutrient profiling model is a limitation of the intervention as it is over 10 years old and does not reflect recent scientific advice (3) such as the SACN report (5) or new products now available on the market. As a result of using the nutrient profiling model the top selling brand of crisps at baseline was removed from sale in Phase 1 despite meeting the GBSF best practice criteria. We cannot know the exact effect of the removal of this product, however, it is suggested that sales may not have reduced to the extent observed had popular brands of crisps been retained. It is, therefore, recommended that organisations wishing to implement similar approaches adhere simply to the GBSF best practice criteria outlined in this report or apply more stringent approaches which are discussed.

A further limitation of the approach is that multiple changes to the vending environment were applied in Phase 1. As well as alteration to availability, the healthier items were placed in the least prominent positions making it difficult to assess the independent impacts of availability and placement. This limits the overall recommendations that can be made. In the bottom half of the mixed snacks vending machines there was, however, little change to the product availability but substantial changes to the placement of products at both phases. This presented an opportunity to examine the effect of placement across the 3 time periods. Positioning analyses are presented in Appendix 6.11 with the hypothesis that moving a product to a more salient position (ie moving products towards eye-level) would result in increased sales. Changes in sales between Phase 1 and Phase 2 support this hypothesis; however, between baseline and Phase 1 we observe the opposite effect. Whilst these findings suggest the positioning of products in a vending machine can impact purchasing behaviour, the direction of change is unclear and, thus, warrants further investigation.

4.2 Implications and further research

Due to the positive shift in purchasing behaviour observed in the drinks vending machines, both regarding health-related outcomes and commercial viability, it is recommended that other vending machines replicate the approach of this trial adhering to both GBSF and altering the placement of products. It is recommended, however, that

due to the limitation outlined above, vending sales should be monitored to ensure alterations reflect the positive finding of this trial. Extensions to research in drinks vending may include the implementation of stricter standards (for example, the removal of SSBs in line with or beyond NHS England's Sugar Action (23)), testing favourable pricing for healthier products (for example, in line with or beyond the Government's Soft Drinks Industry Levy (22)) and/or utilising behavioural insights to develop messaging within the vending context to encourage further behaviour change.

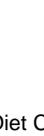
Due to the mixed findings in purchasing behaviour observed in the mixed snacks vending machines, it is recommended that further research is required to explore interventions to encourage healthier purchasing. In particular future interventions may wish to consider and examine the effect of product range on purchasing behaviour. From discussions we suggest retaining a broader selection of compliant products particularly within savoury snacks including those which were removed from the machines in this trial but are GBSF compliant. A valuable extension to the research would be to remove and replace other snacks (particularly confectionery products) that are higher in calories and total sugar content with products which meet more stringent criteria, such as, a maximum energy content of 150kcal per snack. As two-thirds of the available product facings in the snack vending machines are other snacks (dried fruit, nuts and confectionery), interesting further research may include alterations to the ratio of crisps, confectionery, dried fruit and nuts and other snacks. Finally, these results suggest that further adjustments in mixed snacks vending machines could help people limit their consumption of dried fruit between meals, an important contributing factor to tooth decay (13).

5. Conclusion

In conclusion this study has found a positive effect of introducing some GBSF best practice criteria and placing healthier products in more prominent positions in drinks vending machines. Due to the increase in sales coupled with the decrease in calories and sugar per product it is recommend that other drinks vending machines replicate the approach of this study. Regarding mixed snack machines the findings are more complex. The approach of the trial resulted in decreased sales and energy but an increase in total sugar purchased. We recommend using GBSF criteria to optimise the placement of healthier products to support purchasing behaviours with close monitoring to enable the early identification of any negative effects. We also encourage the implementation of improvements across the wider vending machine sector to meet GBSF standards for foods and drinks commonly found in vending machines.

6. Appendix

Appendix 6.1: Planogram drinks machines baseline

 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Lucazade Orange (380ml, 235.gkcal, 47.5g)	 Mountain Dew (500ml, 240.0kcal, 65.0g)
 Juicy Drench O&P (440ml, 114.4kcal, 26.4g)	 Oasis Summerfruits (500ml, 90.0kcal, 20.5g)	 Oasis Summerfruits (500ml, 90.0kcal, 20.5g)	 Tango Orange (600ml, 114.0kcal, 25.8g)	 Tango Orange (600ml, 114.0kcal, 25.8g)	 Juicy Drench C&R (440ml, 145.2kcal, 33.9g)	 Dr Pepper (500ml, 210.0kcal, 51.5g)	 Dr Pepper (500ml, 210.0kcal, 51.5g)	 Pepsi Max Cherry (600ml, 3.6kcal, 0g)
 Red Bull (250ml, 112.5kcal, 27.5g)	 Red Bull (250ml, 112.5kcal, 27.5g)	 My5 Apply and Blackcurrant (200ml, 68.0kcal, 15.4g)	 Pepsi Max (330ml, 1.3kcal, 0g)	 Sunmagic Orange (330ml, 135.3kcal, 29.4g)	 Britvic Orange (330ml, 148.5kcal, 32.3g)	 7UP (330ml, 141.9kcal, 37.0)	 Tango Orange (330ml, 62.7kcal, 14.2g)	 Tango Orange (330ml, 62.7kcal, 14.2g)
 Coke (500ml, 210kcal, 53g)	 Coke (500ml, 210kcal, 53g)	 Coke (500ml, 210kcal, 53g)	 Coke (500ml, 210kcal, 53g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)
 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Pepsi Max (330ml, 1.3kcal, 0g)

Appendix 6.2: Planogram drinks machines phase 1

 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)
 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)
 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Tango Orange (330ml, 62.7kcal, 14.2g)	 Tango Orange (330ml, 62.7kcal, 14.2g)	 Red Bull (250ml, 112.5kcal, 27.5g)	 Red Bull (250ml, 112.5kcal, 27.5g)
 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)
 My5 Apply and Blackcurrant (200ml, 68.0kcal, 15.4g)	 My5 Apply and Blackcurrant (200ml, 68.0kcal, 15.4g)	 Sunmagic Orange (330ml, 135.3kcal, 29.4g)	 Sunmagic Orange (330ml, 135.3kcal, 29.4g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)

Appendix 6.3: Planogram drinks machines phase 2

 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)
 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)	 Ballygowan Water (500ml, 0kcal, 0g)
 My5 Apply and Blackcurrant (200ml, 68.0kcal, 15.4g)	 My5 Apply and Blackcurrant (200ml, 68.0kcal, 15.4g)	 Sunmagic Orange (330ml, 135.3kcal, 29.4g)	 Sunmagic Orange (330ml, 135.3kcal, 29.4g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)	 Diet Coke (330ml, 1.3kcal, 0g)
 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Diet Coke (500ml, 2.0kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)	 Pepsi Max (600ml, 2.4kcal, 0g)
 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Coke (330ml, 138.6kcal, 35.0g)	 Tango Orange (330ml, 62.7kcal, 14.2g)	 Tango Orange (330ml, 62.7kcal, 14.2g)	 Red Bull (250ml, 112.5kcal, 27.5g)	 Red Bull (250ml, 112.5kcal, 27.5g)

Appendix 6.4: Planogram mixed machines baseline

 <p>McCoy's Flame Grilled (50g, 263kcal, 1.5g sugar)</p>		 <p>Doritos Chili (40g, 198kcal, 2.3g sugar)</p>		 <p>Hula Hoops BBQ (34g, 172kcal, 0.3g sugar)</p>		 <p>Kettle Chips Salt and Vinegar (40g, 201kcal, 0.5g sugar)</p>	
 <p>Walkers Ready Salted (33g, 171kcal, 0.1g sugar)</p>		 <p>Walker Cheese and Onion (33g, 169kcal, 0.8g sugar)</p>		 <p>Mini Cheddars Big Bag (50g, 261kcal, 2.3g sugar)</p>		 <p>Kettle Chips Sweet Chilli (40g, 202kcal, 1.72g sugar)</p>	
 <p>Metcalfes Sweet and Salty Popcorn (17g, 78kcal, 3.3g sugar)</p>		 <p>Walkers Baked Cheese and Onion (38g, 157kcal, 2.6g sugar)</p>		 <p>Quavers (20g, 107kcal, 0.8g sugar)</p>		 <p>Kinder Schoko-Bons (599.0kcal, 54.3g)</p>	
 <p>Twirl (235.4kcal, 24.6g)</p>	 <p>Eat Natural Almond and Apricot (225.5kcal, 7.7g)</p>	 <p>Cranberry Raw Nuts (240.9kcal, 2.0g)</p>	 <p>Cranberry Mixed Fruits and Nuts (190.0kcal, 17.2g)</p>	 <p>Cranberry Dried Mango Pieces (93.0kcal, 18.5g)</p>	 <p>Nakd Berry Delight (105.9kcal, 12.5g)</p>	 <p>Cranberry Yoghurt Cranberries (178.8kcal, 25.1g)</p>	 <p>Kit Kat (229.5kcal, 23.5g)</p>
 <p>Yorkie Raisin and Biscuit (223.5kcal, 25.7g)</p>	 <p>Belvita Honey and Nut (227.5kcal, 13.5g)</p>	 <p>Maltesers (186.9kcal, 18.0g)</p>	 <p>M&M Peanut (230.0kcal, 24.0g)</p>	 <p>Snickers (244.8kcal, 21.7g)</p>	 <p>Mars (229.5kcal, 30.5g)</p>	 <p>Kinder Bueno (246.0kcal, 17.7g)</p>	 <p>Twix (247.5kcal, 24.4g)</p>
 <p>Galaxy Caramel (239.0kcal, 26.8g)</p>	 <p>Galaxy (229.3kcal, 23.3g)</p>	 <p>Snack Shortcake (204.3kcal, 11.4g)</p>	 <p>Double Decker (250.7kcal, 29.2g)</p>	 <p>Polo (136.7kcal, 32.5g)</p>	 <p>Skittles (222.2kcal, 49.4g)</p>	 <p>Bounty (278.2kcal, 27.2g)</p>	 <p>Aero Peppermint (193.7kcal, 22.2g)</p>

Appendix 6.5: Planogram mixed machines phase 1

 Burts Cheese and Onion (25g, 129.8kcal, 2.7g)		 Burts Sea Salt and Vinegar (25g, 129.8kcal, 0.2g)		 Kettle Chips Baked Sweet Chilli (25g, 99.0kcal, 1.2g)		 Kettle Chips Baked Cheese and Chive (25g, 97.0kcal, 0.9g)	
 Burts Cheese and Onion (25g, 129.8kcal, 2.7g)		 Burts Sea Salt and Vinegar (25g, 129.8kcal, 0.2g)		 Kettle Chips Baked Sweet Chilli (25g, 99.0kcal, 1.2g)		 Kettle Chips Baked Cheese and Chive (25g, 97.0kcal, 0.9g)	
 Burts Cheese and Onion (25g, 129.8kcal, 2.7g)		 Burts Sea Salt and Vinegar (25g, 129.8kcal, 0.2g)		 Kettle Chips Baked Sweet Chilli (25g, 99.0kcal, 1.2g)		 Kettle Chips Baked Cheese and Chive (25g, 97.0kcal, 0.9g)	
 Twirl (235.4kcal, 24.6g)	 Galaxy Caramel (239.0kcal, 26.8g)	 Galaxy (229.3kcal, 23.3g)	 Snack Shortcake (204.3kcal, 11.4g)	 Double Decker (250.7kcal, 29.2g)	 Polo (136.7kcal, 32.5g)	 Skittles (222.2kcal, 49.4g)	 Kit Kat (229.5kcal, 23.5g)
 Yorkie Raisin and Biscuit (223.5kcal, 25.7g)	 Belvita Honey and Nut (227.5kcal, 13.5g)	 Maltesers (186.9kcal, 18.0g)	 M&M Peanut (230.0kcal, 24.0g)	 Snickers (244.8kcal, 21.7g)	 Mars (229.5kcal, 30.5g)	 Kinder Bueno (246.0kcal, 17.7g)	 Twix (247.5kcal, 24.4g)
 Eat Natural Almond and Apricot (225.5kcal, 7.7g)	 Cranberry Raw Nuts (240.9kcal, 2.0g)	 Cranberry Mixed Fruits and Nuts (190.0kcal, 17.2g)	 Cranberry Dried Mango Pieces (93.0kcal, 18.5g)	 Nakd Berry Delight (105.9kcal, 12.5g)	 Cranberry Yoghurt Cranberries (178.8kcal, 25.1g)	 Caramel Wafer (134.4kcal, 10.4g)	 Aero Peppermint (193.7kcal, 22.2g)

Appendix 6.6: Planogram mixed machines phase 2

 Burts Cheese and Onion (25g, 129.8kcal, 2.7g)		 Burts Sea Salt and Vinegar (25g, 129.8kcal, 0.2g)		 Kettle Chips Baked Sweet Chilli (25g, 99.0kcal, 1.2g)		 Kettle Chips Baked Cheese and Chive (25g, 97.0kcal, 0.9g)	
 Burts Cheese and Onion (25g, 129.8kcal, 2.7g)		 Burts Sea Salt and Vinegar (25g, 129.8kcal, 0.2g)		 Kettle Chips Baked Sweet Chilli (25g, 99.0kcal, 1.2g)		 Kettle Chips Baked Cheese and Chive (25g, 97.0kcal, 0.9g)	
 Burts Cheese and Onion (25g, 129.8kcal, 2.7g)		 Burts Sea Salt and Vinegar (25g, 129.8kcal, 0.2g)		 Kettle Chips Baked Sweet Chilli (25g, 99.0kcal, 1.2g)		 Kettle Chips Baked Cheese and Chive (25g, 97.0kcal, 0.9g)	
 Belvita Honey and Nut (227.5kcal, 13.5g)	 Eat Natural Almond and Apricot (225.5kcal, 7.7g)	 Cranberry Raw Nuts (240.9kcal, 2.0g)	 Cranberry Mixed Fruits and Nuts (190.0kcal, 17.2g)	 Cranberry Dried Mango Pieces (93.0kcal, 18.5g)	 Nakd Berry Delight (105.9kcal, 12.5g)	 Cranberry Yoghurt Cranberries (178.8kcal, 25.1g)	 Kit Kat (229.5kcal, 23.5g)
 Yorkie Raisin and Biscuit (223.5kcal, 25.7g)	 Twirl (235.4kcal, 24.6g)	 Maltesers (186.9kcal, 18.0g)	 M&M Peanut (230.0kcal, 24.0g)	 Snickers (244.8kcal, 21.7g)	 Mars (229.5kcal, 30.5g)	 Kinder Bueno (246.0kcal, 17.7g)	 Twix (247.5kcal, 24.4g)
 Galaxy Caramel (239.0kcal, 26.8g)	 Galaxy (229.3kcal, 23.3g)	 Snack Shortcake (204.3kcal, 11.4g)	 Double Decker (250.7kcal, 29.2g)	 Polo (136.7kcal, 32.5g)	 Skittles (222.2kcal, 49.4g)	 Caramel Wafer (134.4kcal, 10.4g)	 Aero Peppermint (193.7kcal, 22.2g)

Appendix 6.7: Categorisation of drinks to SSB and Non-SSB

The products in red were in the baseline display but removed from the vending machines in Phase 1 and 2. The products in black remained in the display.

Non-SSB

Ballygowan Still Water Bottle (1)
Britvic Orange Juice Can (4)
Diet Coke Bottle (3)
Diet Coke Can (3)
Diet Pepsi Can (3)
My5 Apple & Blackcurrant Fruit Shoot (6)
Pepsi Max Bottle (3)
Pepsi Max Can (3)
Pepsi Max Cherry Bottle (3)
Sunmagic Orange Juice Bottle (4)

SSB

7-Up Can (2)
Coke Bottle (2)
Coke Can (2)
Dr Pepper Bottle (2)
Juice Drench Cranberry & Raspberry (5)
Juicy Drench Orange & Passionfruit (5)
Lucozade Orange Energy Bottle (7)
Mountain Dew Bottle (7)
Oasis Summerfruit Bottle (5)
Pepsi Can (2)
Red Bull Can (7)
Tango Orange Bottle (2)
Tango Orange Can (2)

Reference

- 1 Bottled water
- 2 Carbonates (SSB)
- 3 Carbonates (non-SSB)
- 4 Fruit juice
- 5 Juice drinks (SSB)
- 6 Juice drinks (non-SSB)
- 7 Energy drinks

Appendix 6.8: Categorisation of snacks

The products in red were in the baseline display but removed from the vending machines in Phase 1 and 2. The products in black remained in the display.

Row Labels	Category
Burts Crisp Cheddar and Spring Onion	Crisps
Burts Crisp Salt and Vinegar	Crisps
Kettle Cream Cheese & Chive	Crisps
Kettle Baked Sweet Chilli	Crisps
Walkers Cheese & Onion	Crisps
Mini Cheddars	Crisps
McCoy's Flame Grilled	Crisps
Quavers Cheese	Crisps
Doritos Chilli	Crisps
Baked Cheese and Onion	Crisps
Metcalfe's Popcorn Sweet & Salty	Crisps
Kettle Sweet Chilli	Crisps
Walkers Ready Salted Crisps	Crisps
Kettle Sea Salt & Balsamic Vinegar	Crisps
Hula Hoops BBQ	Crisps
Kinder Bueno	Confectionery
Twirl	Confectionery
Snickers	Confectionery
Kit Kat	Confectionery
Snack Shortcake	Confectionery
Twix	Confectionery
Mars	Confectionery
Maltesers	Confectionery
Double Decker	Confectionery
M&M Peanut	Confectionery
Skittles	Confectionery
Yorkie Raisin & Biscuit	Confectionery
Polo Mints	Confectionery
Galaxy Milk Standard	Confectionery
Caramel Wafer	Confectionery
Aero Peppermint Medium	Confectionery
Galaxy Caramel	Confectionery
Bounty Milk	Confectionery
Bueno Schoko Bons	Confectionery
Cranberry Yogurt Raisins	Fruit and nuts
Cranberry Raw Nuts	Fruit and nuts
Cranberry Mix Fruit and Nut	Fruit and nuts
Cranberry Dried Mango Pieces	Fruit and nuts
Nakd Berry Delight Bar	Fruit and nuts

Belvita Honey Nuts Breakfast Biscuits
 Eat Natural Almonds Apricots Bar

Other
 Other

Appendix 6.9: Further analysis of crisps

	Baseline	Phase 1	Phase 2
Average saturated fat per crisp packet sold	1.15g	0.53g	0.44g
Average salt fat per crisp packet sold	0.54g	0.37g	0.35g

Exploratory analysis with smaller pack sizes (<30g) and assuming same sales levels:

	Total		Average per item		% change
	Baseline	If packs <30g	Baseline	If packs <30g	
Calories	2273129.1	1655967.5	166.0	120.9	-27%
Sugar	18370.5	14175.9	1.3	1.0	-23%
Salt	7347.5	5140.0	0.5	0.4	-30%
Saturated fat	15709.4	10161.5	1.1	0.7	-35%

Appendix 6.10: Percentage of total volume-Non-SSB and SSB products

	Baseline	Phase 1	Phase 2
Non-SSB	54%	76%	76%
SSBs	46%	24%	24%

Appendix 6.11: Positioning analysis

In each phase of the trial, the planogram for food confectionery, fruit and nut and other snacks changed. To see if the position of the products had made any influence on customer choice, product sales by position have been evaluated. Our hypothesis is that product sales increase as they move to more prominent positions. In the context of the snack vending machines the top row of the food confectionery, fruit and nut and other snacks section of the vending machine is closest to eye-level and, thus, we expect to observe increase in sales of items which move to this row. Similarly the bottom row is considered the least salient position and we, therefore, expect to observe decreases in sales following a move to this row.

Figure 3 presents the number of units sold for each position in the vending machine. A darker shade of green refers to higher selling products and the lighter shades to lower selling products. Row 2 consistently had the highest sales throughout the trial period. The contents of Row 2 remained mostly unchanged.

	Baseline							Total sales	
Row 1	1,311	462	461	400	161	139	408	1,170	4,512
Row 2	926	429	705	919	1,287	920	1,429	995	7,610
Row 3	636	761	1,136	902	902	821	587	612	6,357
Phase 1									
Row 1	1,634	871	617	1,215	1,049	903	1,012	1,351	8,652
Row 2	990	573	1,094	1,017	1,386	1,136	1,924	1,143	9,263
Row 3	528	589	392	167	163	614	869	736	4,058
Phase 2									
Row 1	543	625	612	316	37	179	774	1,152	4,238
Row 2	884	1,640	1,017	978	1,266	1,002	1,862	1,123	9,772
Row 3	635	776	1,079	881	727	947	751	697	6,493
Sales Key:	1,000+	750-999	500-749	250-499	0-149				

Figure 3: Sales of food confectionery, fruit and nut and other snacks by positioning

We expected to observe a decrease in the sales of products that moved from row 1 to row 3. Conversely we observe an increase in sales when we compare Phase 1 to baseline. As Table 9 shows, individual products that were moved from row 3 to row 1 (ie to the most salient position) saw less of an increase in sales (9.9%) than products that were moved from row 1 to row 3 (ie to the least salient positions; 20.8%). Products that remained in the same row during both phases had the largest increase in sales (21.3%). Products that were removed or only present in one phase of the trial are excluded from Table 9 and subsequent tables.

Baseline		Phase 1		Difference	% change	
Row	Sales	Row	Sales			
Row 3	5,158	→	Row 1	5,667	509	9.9%
Row 1	2,031	→	Row 3	2,453	422	20.8%
Unchanged	10,703	→	Unchanged	12,984	2,281	21.3%

Table 9: Positions and sales of other snacks at baseline and Phase 1.

Comparing Phase 1 to Phase 2, we observe some product sales moving in the predicted direction. As Table 10 shows, products that moved from row 3 to row 1 had a 3.7% increase in sales, while products that moved from row 1 to row 3 had a 11.0% decrease in sales. This time products that remained in the same row during both phases decreased in sales by 7.6%.

Phase 1		Phase 2		Difference	% change	
Row	Sales	Row	Sales			
Row 3	2,453	→	Row 1	2,543	90	3.7%
Row 1	5,667	→	Row 3	5,045	-622	-11.0%
Row 1	2,624	→	Row 2	2,524	-100	-3.8%
Row 2	573	→	Row 1	543	-30	-5.2%
Unchanged	10,656	→	Unchanged	9,848	-808	-7.6%

Table 10. Positions and sales of other snacks in Phase 1 and Phase 2

The planograms at baseline and in Phase 2 are similar with only 2 products changing position. One chocolate bar moved from row 1 to row 2 and one fruit and nut bar moved from row 1 to row 2. Table 11, therefore, presents the change in sales of these 2 products. From Table 11 we observe increases in the sale of both products despite one product moving to a more prominent position and the other moving to a less prominent position. Products that were in the same row in Phase 2 as in the baseline phase also sold more in Phase 2 (10.0% increase).

Baseline		Phase 2		Difference	% change	
Row	Sales	Row	Sales			
Row 1	1,311	→	Row 2	1,640	329	25.1%
Row 2	429	→	Row 1	543	114	26.6%
Unchanged	17,463	→	Unchanged	19,209	1,746	10.0%

Table 11. Positions and sales of other snacks at baseline and Phase 2

7. References

1. Moody A. Adult overweight and obesity. 2016. Report No.: 978-1-78386-896-4.
2. Butland B, Jebb S, Kopelman P, McPherson K, Thomas S, Mardell J, et al. Foresight Tackling Obesity: Future Choices – Project report. Government Office for Science. 2007:1-161.
3. HM Government. Childhood Obesity: A Plan for Action. 2016.
4. Tedstone A, Anderson S, Allen R, Targett V, Allen R. Sugar Reduction: The evidence for action. Public Health England. 2015(October):48-.
5. Scientific Advisory Committee on Nutrition. Carbohydrates and Health. London: Public Health England; 2015.
6. Department of Health & Social Care, Public Health England. Next stage of world-leading childhood obesity plan announced - GOV.UK. 2017.
7. Lawrence S, Boyle M, Craypo L, Samuels S. The Food and Beverage Vending Environment in Health Care Facilities Participating in the Healthy Eating, Active Communities Program. Pediatrics. 2009;123(Supplement 5):S287-S92.
8. Bell C, Pond N, Davies L, Francis JL, Campbell E, Wiggers J. Healthier choices in an Australian health service: A pre-post audit of an intervention to improve the nutritional value of foods and drinks in vending machines and food outlets. BMC Health Services Research. 2013;13(1).
9. Rideout K, Levy-Milne R, Martin C, Ostry A. FOOD SALES OUTLETS, FOOD AVAILABILITY, AND THE EXTENT OF NUTRITION POLICY IMPLEMENTATION IN SCHOOLS IN BRITISH COLUMBIA. Canadian Journal of Public Health. 2007;98(5).
10. Pasch KE, Lytle LA, Samuelson AC, Farbakhsh K, Kubik MY, Patnode CD. Are School Vending Machines Loaded With Calories and Fat: An Assessment of 106 Middle and High Schools. Journal of School Health. 2011;81(4):212-8.
11. Byrd-Bredbenner C, Johnson M, Quick VM, Walsh J, Greene GW, Hoerr S, et al. Sweet and salty. An assessment of the snacks and beverages sold in vending machines on US post-secondary institution campuses. Appetite. 2012;58(3):1143-51.
12. Kelly B, Flood VM, Bicego C, Yeatman H. Derailing healthy choices: an audit of vending machines at train stations in NSW. Health Promotion Journal of Australia. 2012;23(1):73-5.
13. Public Health England. Health matters: child dental health - GOV.UK. 2017.
14. Peersman G, Harden A, Oliver S. Effectiveness of health promotion interventions in the workplace: a review. London; 1998.
15. World Health Organization. Occupational health: workplace health promotion.
16. Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K. Creating Healthy Food and Eating Environments: Policy and Environmental Approaches. Annual Review of Public Health. 2008;29(1):253-72.
17. Macera CA. Promoting Healthy Eating and Physical Activity for a Healthier Nation. Chronic Disease Prevention and Control. 2013;28(4):48-.
18. Department of Health. The Hospital Food Standards Panel's report on standards for food and drink in NHS hospitals. 2014.
19. Nutrition Advice Team. Healthier and more sustainable catering: a toolkit for serving food to adults. London; 2017.
20. Nhs. Five year forward view. 2014.
21. NHS England. Simon Stevens announces major drive to improve health in NHS workplace 2015 [<https://www.england.nhs.uk/2015/09/nhs-workplace/>].
22. HM Revenue & Customs. Guidance: Soft Drinks Industry Levy - GOV.UK 2018 [Available from: <https://www.gov.uk/guidance/soft-drinks-industry-levy>].

23. NHS England. NHS and leading suppliers join forces to cut sugary drinks 2017 [Available from: <https://www.england.nhs.uk/2017/04/nhs-and-leading-suppliers-join-forces-to-cut-sugary-drinks/>].
24. NHS England. NHS staff health & wellbeing : CQUIN 2017-19 Indicator 1 Implementation Support. 2017.
25. Public Health England. From evidence into action: opportunities to protect and improve the nation's health. London; 2014.
26. Public Health England. The Eatwell Guide - GOV.UK 2016 [updated 28 February 2017. Available from: <https://www.gov.uk/government/publications/the-eatwell-guide>].
27. US Department of Agriculture, US Department of Health and Human Services. Dietary Guidelines for Americans 2010. Washington, DC; 2010.
28. National Health and Medical Research Council. Australian Dietary Guidelines. Canberra; 2013.
29. World Health Organization. Diet, nutrition and the prevention of chronic diseases. Geneva; 2003. Report No.: 0512-3054 (Print)\n0512-3054 (Linking).
30. Buttriss J. Why 5%? An explanation of the Scientific Advisory Committee on Nutrition's recommendations about sugars and health, in the context of current intakes of free sugars, other dietary recommendations and the changes in dietary habits needed to reduce consumption. London; 2015.
31. Minaker LM, Storey KE, Raine KD, Spence JC, Forbes LE, Plotnikoff RC, et al. Associations between the perceived presence of vending machines and food and beverage logos in schools and adolescents' diet and weight status. Public Health Nutrition. 2011;14(08):1350-6.
32. French SA, Story M, Fulkerson JA, Gerlach AF. Food Environment in Secondary Schools: À La Carte, Vending Machines, and Food Policies and Practices. American Journal of Public Health. 2003;93(7):1161-7.
33. Public Health England. Sugar reduction and wider reformulation programme: interim review - GOV.UK 2017 [Available from: <https://www.gov.uk/government/publications/sugar-reduction-and-wider-reformulation-interim-review/sugar-reduction-and-wider-reformulation-programme-interim-review>].
34. Public Health England. Health matters: obesity and the food environment - GOV.UK 2017 [Available from: <https://www.gov.uk/government/publications/health-matters-obesity-and-the-food-environment/health-matters-obesity-and-the-food-environment--2>].
35. Colston Consultants. 2015 UK Vending Industry Census. Census. The Automatic Vending Association; 2016 April 2016.
36. Department for Environment FRA. The Government Buying Standard for Food and Catering Services. 2015.
37. NHS Standard Contract Team. NHS Standard Contract 2016 / 17 Service Conditions. NHS England; 2015.
38. Department of Health. Nutrient Profiling Technical Guidance. London; 2011.
39. Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: The importance of targeting automatic processes. Science. 2012;337(6101):1492-5.
40. Hollands GJ, Shemilt I, Marteau TM, Jebb SA, Kelly MP, Nakamura R, et al. Altering Micro-Environments to Change Population Health Behaviour: Toward an Evidence Base for Choice Architecture Interventions. BMC public health. 2013;13(1):1218-.
41. Grech A, Allman-Farinelli M. A systematic literature review of nutrition interventions in vending machines that encourage consumers to make healthier choices. Obesity Reviews. 2015;16(12):1030-41.

42. Bucher T, Collins C, Rollo ME, McCaffrey TA, De Vlieger N, Van Der Bend D, et al. Nudging consumers towards healthier choices: A systematic review of positional influences on food choice. *British Journal of Nutrition*. 2016;115(12):2252-63.
43. Borges MC, Louzada ML, de Sa TH, Lavery AA, Parra DC, Garzillo JM, et al. Artificially Sweetened Beverages and the Response to the Global Obesity Crisis. *PLoS Med*. 2017;14(1):e1002195.