Paying the Price

New evidence on the link between price promotions, purchasing of less healthy food and drink, and overweight and obesity in Great Britain

March 2019

Together we will beat cancer

CANCER RESEARCH UK

Reference

This report should be referred to as follows:

"Paying the price: New evidence on the link between price promotions, purchasing of less healthy food and drink, and overweight and obesity in Great Britain". Timothy Coker, Harriet Rumgay, Emily Whiteside, Gillian Rosenberg, Jyotsna Vohra. 2019.

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Acknowledgements

Cancer Research UK

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Foreword

I am delighted to introduce this study from Cancer Research UK on the relationships between price promotions, purchasing behaviour and excess weight in Great Britain.

Obesity is a national health concern of top priority. Overweight and obesity are linked to 13 types of cancer, accounting for around 6% of all cancer cases in the UK, and it is estimated that overweight and obesity costs the NHS around £5.1bn every year. Tackling obesity is therefore of vital importance to improving the country's health and to relieve strain on our health service, with effective, evidence-based policy-making at the forefront of this challenge. The UK, Scottish, and Welsh governments' plans to reduce obesity rates are therefore much-needed and timely.

Retailers and manufacturers clearly use price promotions to influence consumer purchasing behaviour, but academic evidence on the long-term effects on consumer preferences and obesity status is still emerging. Several reports have suggested that use of price promotions generally leads to overconsumption, rather than simply saving money to buy the same amount, and same kinds, of food. This study builds on these findings by demonstrating that, in Great Britain, high use of price promotions is associated with a significantly increased prevalence of overweight and obesity. Crucially, it also found that increased promotional purchasing is associated with increased purchasing of discretionary food categories and foods which are high in fat, salt or sugar (HFSS), at the cost of healthier foods such as fruit and vegetables.

Inequalities have played a substantial role in the obesity epidemic. In the UK, the most deprived areas have the highest prevalence of overweight and obesity, and thus disproportionately experience the associated ill-health and disease. Evidence suggests that population-level measures are the most effective way to reduce health inequalities, by transforming the currently obesogenic food environment into one that encourages and empowers everyone to make healthier choices.

These findings are timely as they provide support for government plans to restrict price and location-based promotions on less healthy foods, currently under consultation. Restricting price and location-based promotions on unhealthy foods could help shift behaviour towards healthier food purchasing - like all public health policies it should be thoroughly evaluated to measure its impact – but it is no silver bullet. Alongside these plans, governments must enact other measures set out in their obesity plans to reduce the obesogenic environment and improve public health.

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Executive Summary

Overweight and obesity is the second leading preventable cause of cancer in the UK[1], and is predicted to overtake smoking as the leading cause of cancer in women in around 25 years[6]. It is linked to at least 13 types of cancer, including bowel and breast, which are amongst the most common, and oesophageal and pancreatic, which are amongst the most difficult to treat[1]. Each year, it is estimated that overweight and obesity costs £5.1bn to the NHS[4] and £27bn to the wider UK economy[5].

Tackling this public health crisis requires a whole systems approach to improve the food environment and make the healthy choice the easy choice. National, population-level measures are a vital part of reducing obesity rates and the associated health inequalities.

The UK and devolved governments have published strategies to reduce obesity which include proposals to restrict location and volume-based price promotions on less healthy foods[15-17]. As evidence shows that less healthy foods are largely purchased on price promotion, and that promotions tend to increase the amount consumed, this may be an effective measure to reduce obesity[18,19].

This report uses data on take-home food and drink purchasing to investigate the influences of price promotions on shopping choices, overweight and obesity in Great Britain. It adds to existing evidence base that supports the restriction of price promotions on less healthy food and drink in the UK.

Around 3 in 10 food and drink items in supermarket baskets are bought on promotion in Great Britain
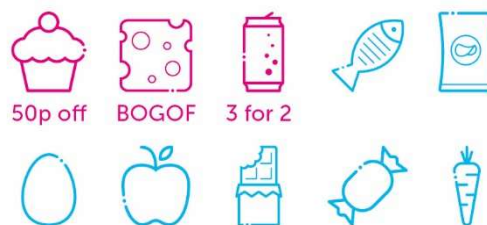
Key Findings

Around 3 in 10 food and drink items in supermarket baskets are bought on promotion in Great Britain

29% of food and drink items bought by the panel were purchased on promotion.

All studied demographic groups (region, life stage, income) made similar use of price promotions, suggesting that a promotions-based intervention could have influence across the British population.

Shoppers who buy more on promotion are more likely to be overweight or obese

High promotional shoppers[a] – the quarter of shoppers who buy the largest proportion of their basket on promotion – are 28% more likely to be obese than low promotional shoppers[b].

High promotional shoppers are also 13% more likely to be overweight (including obese) than low promotional purchasers.

The association between overweight and obesity and promotional purchasing was seen in all income groups, and was independent of age, life stage, and region.

The [a]upper and [b]lower quartiles of promotional purchasers.

Shoppers who buy more of their food and drink on promotion

Purchase more items high in fat, salt or sugar (HFSS)

...in greater volume

...and are more likely to be overweight or obese

50p off   BOGOF   3 for 2
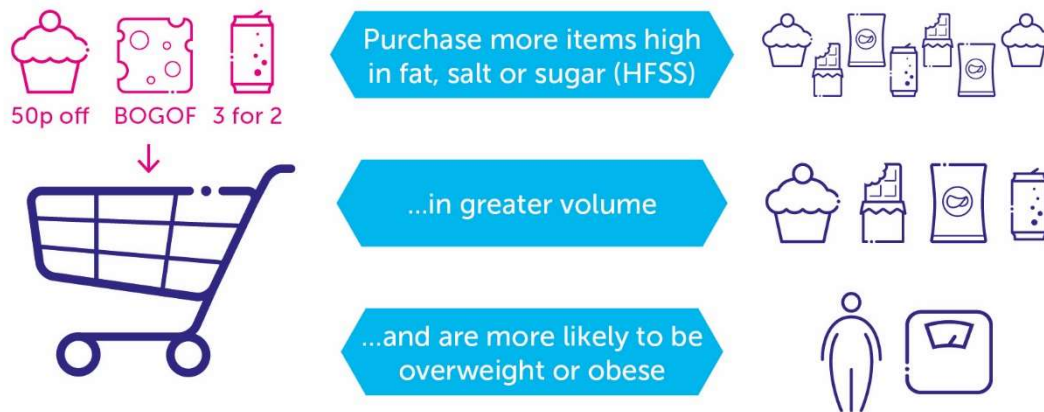
Shoppers who buy more on promotion buy greater amounts of less healthy food and drink

High promotional shoppers buy around a fifth more High in Fat, Salt or Sugar (HFSS) items than low promotional shoppers – in a 2 adult, 2 school-child household this equates to around 11 extra HFSS items a month.

High promotional shoppers also buy a quarter more HFSS volume than low promotional shoppers.

Promotional purchasing is associated with changes in overall nutrition

High promotional shoppers tend to buy a less healthy balance of nutrients. They purchase more sugar and less fibre than low promotional shoppers.

Promotional purchasing is skewed towards less healthy food categories

Overall, the food and drinks bought on promotion in Great Britain are biased towards less healthy categories. Staple foods like fruit and vegetables are underrepresented in the foods bought on price promotion.

Shoppers who buy more on promotion tend to buy less fruit and vegetables

High promotional shoppers buy more from typically less healthy food categories like cakes, confectionery, crisps, sugary drinks and puddings. This is at the expense of foods in healthier categories such as fruit, vegetables and unsweetened yoghurts.

What should government do?

The UK, Scottish, and Welsh Governments should:

1. Introduce restrictions on price promotions for less healthy food and drink items, focusing first on multi-buy offers. These policies should be as aligned as possible across nations.

2. Commit to reviewing the evidence base on other kinds of price promotions, including temporary price reductions, and take further action to restrict those if necessary.

3. Introduce restrictions on location-based promotions for less healthy foods to support restrictions on price promotions.

4. Fully implement other measures in their respective obesity strategies, to create a healthier food environment and support families to make healthier choices.

Methodology

Take-home food and drink purchasing and demographic data for a representative panel of British households were collected by Kantar Worldpanel and purchased by Cancer Research UK. Data for over 10,000 households were analysed using regression approaches to study associations between promotional purchasing, demographic factors, overweight/obesity, and food and drink quantities.

Contents

1 Introduction

Overweight and obesity is the biggest preventable cause of cancer in the UK after smoking, and is associated with more than 22,000 cancer cases a year (6% of all cancer cases in the UK)[1]. Being overweight or obese is linked to at least 13 types of cancer, including bowel and breast, which are amongst the most common, and oesophageal and pancreatic, which are amongst the most difficult to treat[1].

The problem of obesity and cancer is exacerbated by the country's rising obesity levels. Obesity prevalence in adults increased in England from 15% in 1993 to 29% in 2017[2], and in 2016/17 617,000 NHS hospital admissions were linked to obesity[3]. Annually it is estimated that overweight and obesity costs the NHS £5.1bn[4] and the wider UK economy £27bn[5]. Moreover, it has been estimated that, if trends continue, obesity will overtake smoking as the biggest cause of preventable cancer in UK women in around 25 years[6]. Reducing obesity levels is therefore a key priority in improving public health, protecting future generations and reducing the burden that it places on the NHS.

The obesity epidemic has the most adverse effects on the most vulnerable in society. People from more deprived areas are more likely to be obese than those in less deprived areas, and this divide is widening[2]. The obesity epidemic has had a large effect on children – one in five children in England enter primary school overweight or obese – and this rises to one in three when they leave[7]. Obese children are five times more likely to become obese as adults[8], increasing their risk of cancer and other obesity-related conditions.

A major contributor to the obesity epidemic is an unhealthy food environment[5,9]. A number of studies[10-13] have shown the role that food marketing can play on children's food preferences and choices, leading to overconsumption of less healthy foods and an increased risk of obesity.

In light of this, the UK and devolved governments have published several strategies to reduce obesity rates, including 'Childhood obesity: a plan for action'[14,15], 'A healthier future: Scotland's diet and healthy weight delivery plan'[16], and 'Healthy weight: healthy Wales'[17]. All propose the introduction of population-level measures to reduce the obesogenic food environment and to help people to make healthier choices. Among the proposed interventions is the restriction of volume-based price promotions on foods which are high in fat, salt or sugar (HFSS)[15], and belong to less healthy, discretionary food categories[16].

Several studies have supported the case for such restrictions on price promotions in the UK. A review of price promotions between 2010 and 2016 in Scotland[18] found that in 2016 price promotions contributed to 36% of calories, and that less healthy food tended to be more frequently purchased on promotion. In 2015 an analysis of British take-home shopping commissioned by Public Health England[19] found that promotions account for 40% of take-home food and drink expenditure, and it was estimated that approximately one fifth of promoted food and drink volumes bought was in addition to expected category purchasing levels. Moreover, they found little evidence to suggest

that increased purchasing of a higher sugar categories on promotion leads buyers to make compensatory reduction in other higher sugar categories.

2 Research aims and objectives

This study aims to build on previous price promotion studies in the UK by using recent (2017) household take-home food and drink purchasing data from across Great Britain to explore the following:

•   The prevalence of price promotions in take-home food and drink purchasing, and whether this differs between demographic groups
•   Whether use of price promotions is associated with shopper overweight / obesity
•   Whether use of price promotions is associated with overall food and drink purchasing quantities, particularly those of HFSS food and drink
•   Whether promotional purchasing is biased towards particular food and drink categories

Our general hypothesis is that promotional purchasing is associated with increased purchasing of unhealthy foods, and thus overweight and obesity, supporting the need for restrictions on promotions of less healthy food and drink products in the UK.

3 Methods

3.1 Data

3.1.1 Overview

Data on the take-home food and drink purchasing of a representative sample of 16,148 British households were purchased from Kantar Worldpanel.

The dataset, as purchased, included 4-week aggregated totals of purchases from individual households over the period of January 2017 to July 2017. 4-week totals were also split according to food/drink category, and classification as HFSS (High in Fat, Salt or Sugar, according to the Nutrient Profiling Model 2004/5[20]) or bought on price promotion. The data also included demographic information about each household.

To simplify analysis, we further aggregated the data for each household to cover the whole time period. The majority (68%) of households responded over all seven 4-week periods. Food and drink purchasing data were summed over all months for each household. Where monthly amounts were used, these sums were divided by the number of 4-week periods over which the household reported their food purchasing. Where daily amounts were used, this was further divided by 28. Aggregation of demographic data was dependent on the variable. For region, sex, social class, and life stage, the most frequent response for a household was taken to be the aggregated value. For main shopper height, weight, income, and number of adults and children, the mean was taken. For income, this was rounded to the nearest income bracket, whereas for adult/child number this was rounded to the nearest integer.

The key variables used in this this analysis are outlined in Table 1.

Table 1: Key variables used in this analysis

Categorical / discrete variables				
Variable	Possible values (frequency n, %)	Total n = 16,148	Possible values (frequency n, %) [minus retirees]	Total n = 12,678
Adults	1 (3621, 22.4%)	2 (9298, 57.6%)	1 (2447, 19.3%)	2 (7003, 55.2%)
	3 (2122, 13.1%)	4 (904, 5.6%)	3 (2121, 16.7%)	4 (904, 7.1%)
	5 (164, 1.0%)	6 (34, 0.2%)	5 (164, 1.3%)	6 (34, 0.3%)
		7 (5, 0.0%)		7 (5, 0.0%)
Children	0 (11670, 72.3%)	1 (2109, 13.1%)	0 (8201, 64.7%)	1 (2109, 16.6%)
	2 (1811, 11.2%)	3 (432, 2.7%)	2 (1811, 14.3%)	3 (431, 3.4%)
	4 (99, 0.6%)	5 (23, 0.1%)	4 (99, 0.8%)	5 (23, 0.2%)
		6 (4, 0.0%)		6 (4, 0.0%)

Region	East (1423, 8.8%)	East (1121, 8.8%)
	Lancashire (1801, 11.2%)	Lancashire (1413, 11.1%)
	London (2396, 14.8%)	London (1982, 15.6%)
	Midlands (2360, 14.6%)	Midlands (1877, 14.8%)
	North East (806, 5.0%)	North East (619, 4.9%)
	South West (603, 3.7%)	South West (440, 3.5%)
	Scotland (1537, 9.5%)	Scotland (1221, 9.6%)
	South (1740, 10.8%)	South (1306, 10.3%)
	Wales (774, 4.8%)	Wales (589, 4.6%)
	West (650, 4.0%)	West (498, 3.9%)
	Yorkshire (2058, 12.7%)	Yorkshire (1612, 12.7%)
Shopper Sex	Female (11729, 72.6%)	Female (9397, 74.1%)
	Male (4419, 27.4%)	Male (3281, 25.9%)
Social Class	Class AB (3508, 21.7%)	Class AB (2719, 21.4%)
	Class C1 (6620, 41.0%)	Class C1 (5262, 41.5%)
	Class C2 (2660, 16.5%)	Class C2 (2143, 16.9%)
	Class D (2072, 12.8%)	Class D (1694, 13.4%)
	Class E (1286, 8.0%)	Class E (858, 6.8%)
Income Group	£0 - £9,999 p.a. (1017, 6.3%)	£0 - £9,999 p.a. (743, 5.9%)
	£10,000 - £29,999 p.a. (6560, 40.6%)	£10,000 - £29,999 p.a. (4597, 36.3%)
	£30,000 - £49,999 p.a. (3975, 24.6%)	£30,000 - £49,999 p.a. (3461, 27.3%)
	£50,000 - £69,999 p.a. (1687, 10.4%)	£50,000 - £69,999 p.a. (1596, 12.6%)
	£70,000+ p.a. (851, 5.3%)	£70,000+ p.a. (817, 6.4%)
	Undisclosed (2058, 12.7%)	Undisclosed (1464, 11.5%)
Life Stage	Empty Nesters (4407, 27.3%)	Empty Nesters (4407, 34.8%)
	Family (10+) (1296, 8.0%)	Family (10+) (1296, 10.2%)
	Middle Family (5-9) (1304, 8.1%)	Middle Family (5-9) (1304, 10.3%)
	Older Dependents (2015, 12.5%)	Older Dependents (2015, 15.9%)
	Pre-Family (1782, 11.0%)	Pre-Family (1782, 14.1%)
	Retired (3467, 21.5%)	Young Family (0-4) (1874, 14.8%)
	Young Family (0-4) (1874, 11.6%)	
Household Structure	N/A	See Appendix 8.1.
Promotional Group	N/A	Low (3170, 25.0%)
		Medium (6338, 50.0%)
		High (3170, 25.0%)

Numeric variables		
Variable	Median (interquartile range)	Median (interquartile range) [minus retirees]
Shopper Age	52.7 (42.0 – 64.0)	48.1 (39.0 – 56.4)
Shopper BMI (adjusted)	27.6 (24.5 – 31.7) [unavailable = 2188, 13.5%]	27.3 (24.2 – 31.6) [unavailable = 1980, 15.6%]
% volume	27.4 (18.5 - 36.4)	28.0 (18.6 - 37.1)

bought on promotion		
% items bought on promotion	28.9 (20.6 – 37.1)	29.6 (21.0 – 38.0)
Total volume / month	112.3 (75.3 - 159.7)	114.6 (76.2 - 166.4)
Total items / month	140.4 (96.0 - 193.0)	142.5 (96.1 - 198.8)
Total calories / day	3014 (1993 - 4198)	3064 (2010 - 4379)
Total carbohydrates / day	344.4 g (226.4 - 489.5 g)	351.1 g (228.9 - 513.9 g)
Total sugar / day	155.4 g (102.1 - 223.9 g)	155.2 g (101.3 - 229.9 g)
Total fat / day	120.2 g (79.0 - 171.5 g)	122.5 g (79.5 - 177.1 g)
Total saturated fat / day	46.0 g (29.8 - 65.8 g)	46.2 g (29.5 - 67.5 g)
Total protein / day	106.7 g (69.4 - 150.9 g)	109.8 g (70.8 - 158.0 g)
Total salt / day	9.0 g (5.7 - 13.2 g)	9.2 g (5.8 - 13.6 g)
Total fibre / day	27.1 g (18.0 - 37.9 g)	27.6 g (18.1 - 39.3 g)
Total HFSS volume / month	25.8 (15.2 - 42.2)	26.0 (15.1 - 43.2)
Total HFSS items / month	41.7 (27.4 - 60.5)	42.8 (27.7 - 63.3)
Category monthly quantities		Available on request

3.1.2 Demographic data

Household demographic data included number of adults / children (where the latter is any individual younger than 16 years of age), geographical region, social class, income group, life stage, and shopper sex, age, and body mass index (BMI).

Geographic regions included London, Midlands, South, South West, West, East, Yorkshire, North East, Lancashire, Scotland and Wales.

Social class was based on National Readership Survey (NRS) social grade and was one of Class AB (Upper Middle and Middle Class), Class C1 (Low Middle Class), Class C2 (Skilled Working Class), Class D (Working Class) or Class E (Non-Working).

Household income was reported in the original dataset as £10,000 brackets from £0 - £9,999 per annum (p.a.) to £70,000+ p.a., with the option to refuse a response. As a compromise between granularity and sample size, for analysis these were recoded into five bands of £0 - £9,999 p.a., £10,000 - £29,999 p.a., £30,000 - £49,999 p.a., £50,000 - £69,999 p.a. and £70,000+ p.a.

Life stage is a classification of households according to its adult and child constituents. Life stages with children include "Young Family (0 – 4)" (a family where the youngest child is younger than 5), "Middle Family (5 – 9)" (a family where the youngest child is aged between 5 and 9), and "Family (10+)" (a family where the youngest child is aged between 10 and 15). Life stages without children include "Pre-Family" (the main shopper is younger than 45), "Older Dependents" (the main shopper is 45 or older in a household with at least 3 adults), "Empty Nesters" (the main shopper is aged 45 – 64 in a household with fewer than 3 adults), and "Retired" (the main shopper is 65 or older in a household with fewer than 3 adults). To focus the analyses on households with children and childless households of similar age (keeping this work relevant to the UK's Childhood obesity plan), households where life stage was labelled as "retired" were excluded from all regression analyses.

For some regression models, number of adults and children and life stage were recoded into a new variable called "household structure" to account for differing nutritional demands of a household's constituents. This categorical variable took into account number of adults, number of school-age children (in "Middle Family" and "Family (10+)" households) or children ("Young Family" households).

Body Mass Index (BMI) was calculated based on shopper self-reported weight and height. Prior to calculation of BMI, heights and weights were adjusted to account for self-reporting bias according to a method developed by Public Health England[21]. Adjusted height/weight was subsequently used to calculate BMI using the formula $BMI = \frac{weig \quad (kg)}{(heig \quad (m))^2}$

3.1.3 Food and drink data
Food and drink purchases were summarised both by category and as a household total. In both cases, variables included nutritional volume, number of items, number of calories, volume of various nutrients (protein, fat, saturated fat, sugar, salt, fibre, and carbohydrates), items and nutritional volume bought on promotion, and items and nutritional volume classed as HFSS.

3.1.4 Food and drink categories
The 24 food and drink categories included in this dataset are shown in Table 2.

Categories were selected where possible to match the PHE sugar reformulation plan and the Soft Drinks Industry Levy[22].

Alcoholic drinks (category "Total Alcohol") were excluded from category analyses, but were included in overall food and drink quantities (e.g. volume, items) and overall nutritional quantities (e.g. carbohydrates, sugars, etc.)

Table 2: Food and drink categories

Category name [further detail]	% of panel		% category volume
	Calories	Sugar	HFSS
Cakes, Pastries & Morning Goods	4.0	5.2	55.3
Cereals	4.7	3.7	40.2
Confectionery – Chocolates	3.0	5.9	99.3
Confectionery – Sweets	1.1	3.4	93.2
Crisps, Savoury Snacks & Popcorn	2.1	0.2	88.4
Dairy Drinks (> 10 g sugar / 100 ml)	< 0.1	0.1	65.5
Diet Drinks	< 0.1	< 0.1	3.9
Energy Drinks	0.1	0.4	37.6
Fried Potato	1.9	0.2	2.4
Fruit	3.5	14.3	2.2
Ice Cream, Ice Lollies & Sorbets	1.9	3.6	92.4
Puddings	1.1	1.9	68.9
Pure Juices	0.5	1.8	< 0.1
Ready Meals	3.5	1.0	19.0
Sugary Drinks (> 8 g sugar / 100 ml)	1.0	4.2	62.9
Sugary Drinks (5 – 8 g sugar / 100 ml)	0.1	0.6	71.3
Sweet Biscuits	5.2	6.6	98.5
Sweet Spreads and Preserves	0.9	1.9	89.4
Sweetened Yoghurts	1.1	2.6	17.5
Vegetables	5.2	4.5	0.2
Other Yoghurt [Non-sweetened yoghurt]	0.4	0.6	20.0
Other Drinks [All other drinks, including sugary drinks (< 5 g sugar / 100 ml), milk, water, milk drinks (< 10 g sugar / 100 ml), fruit squash, etc.]	5.9	11.2	11.3
Other Food [All other food. Main contributors include eggs, bread, ambient cakes/pastries, meats, cheese, baked beans, tomato products, sugar, rice noodles, margarine, sugar, soup, chilled prepared fruit and vegetables.]	50.3	24.4	20.2
Total Alcohol	2.5	1.5	12.1
All food and drink	100.0	100.0	25.9

3.1.5 Promotional purchasing groups

Following removal of retirees (households where life stage is "retired"), households were assigned a promotional purchasing group (also referred to here as "promo group") according to their percentage of items bought on promotion:

- "Low" promo buyers form the lower quartile of the population.

- "Medium" promo buyers form the second and third quartiles of the population.

- "High" promo buyers form the upper quartile of the population.

3.2 Analysis

Data were analysed in R Version 3.4.0[23]

3.2.1 Determinants of promotional purchasing

To investigate which demographic factors, if any, are influential in the purchasing of items on price promotion, a beta regression model was fitted using the R package `betareg`, in the form $Proportion\ Promo \sim Region + Life\ Stage + Main\ Shopper\ Age + Income\ Band$. Spline regression was used when incorporating age into the model, with knots set at 12.5-centiles (ages 34, 39, 44, 48, 52, 56, and 61) as a compromise between granularity in age and sample size (~1400 samples per spline). To avoid 0 values (which cannot be fitted using beta regression), the dependent variable $Proportion\ Promo$ was transformed according to Smithson and Verkuilen[24], using the equation $y = \frac{y \cdot (n-1) + 0.5}{n}$ where y is the dependent variable and n is the input sample size.

Age spline coefficients are available on request.

3.2.2 Promotional purchasing and overweight/obesity

To investigate the link between promotional purchasing and shopper overweight/obesity, logistic regression was performed using the R function `glm`. The model fitted was a binomial family model (logit link function) in the form $y \sim Household\ Structure + Region + Age + Income\ Band + Promo\ Group$ where y is a binary outcome (i.e. obese or not, overweight including obese or not, where obesity is defined as a BMI $\geq$ 30, and overweight including obese is defined as a BMI $\geq$ 25). Spline regression was used when incorporating age into the model, with knots set at 12.5-centiles as a compromise between granularity in age and sample size.

Fitted regression coefficients are available on request.

Percentage changes in odds ratio were calculated from parameter estimates using the formula $Percentage\ Change = (e^{\beta} - 1) \times 100$, where β is the fitted coefficient.

3.2.3 Promotional purchasing and food/drink quantities

To investigate the link between promotional purchasing group and overall shopping basket quantities (e.g. food volumes, item counts, nutrient volumes), as well as quantities of particular food/drink categories, a number of generalised linear regression models were fitted using the R function `glm`. These were quasipoisson family models taking the form $y \sim Household\ Structure + Region + Main\ Shooper\ Age + Income\ Band + Promo\ Group$ where y is the food and drink quantity of interest. Spline regression was used when incorporating age into the model, with knots set at 12.5-centiles as a compromise between granularity in age and sample size.

Fitted regression coefficients are available on request.

Additionally, to control for potential differences in BMI with promotional purchasing group, each model was subsequently rerun in the form $y \sim Household\ Structure + Region + Main\ Shooper\ Age + Income\ Band + Promo\ Group + BMI$ where BMI was a spline term with knots at 12.5-centiles. These results were generally qualitatively similar

to the previous results and can be found in Appendix 8.5.

Percentage changes in quantities were calculated from parameter estimates using the formula $Percentage\ Change = (e^{\beta} - 1) \times 100$, where β is the fitted coefficient.

To assess whether differences between promotional purchasing groups represented directional trends, a Cuzick trend analysis was performed for each regression (see Appendix 8.4).

To estimate absolute food/drink quantity changes in a hypothetical 2 adult, 2 school-age child household, the fitted generalised linear regression model was used to make predictions in a 2 adult, 2 school-age child subpopulation of the original data where promotional group was set to one of "low", "medium" or "high" (and other demographic factors were fixed as originally in this subpopulation), and a mean was taken for each of these promotional groups.

4 Results

4.1 Overview of promotional purchasing

During the period January to July 2017, 28.5% of food and drink volume, and 29.2% of items, were bought on promotion. In England, Wales, and Scotland, this was 29.2%, 28.5%, and 30.4% of items, respectively.

Figure 1 shows how the proportion of items bought on promotion varied between households. This proportion varies considerably, with the average household purchasing 29.0% of take-home food and drink items on promotion, and ~4% of the sampled population purchasing the majority (> 50%) of their take-home food and drink items on promotion, and ~5% of households purchasing less than 10% of items on promotion.
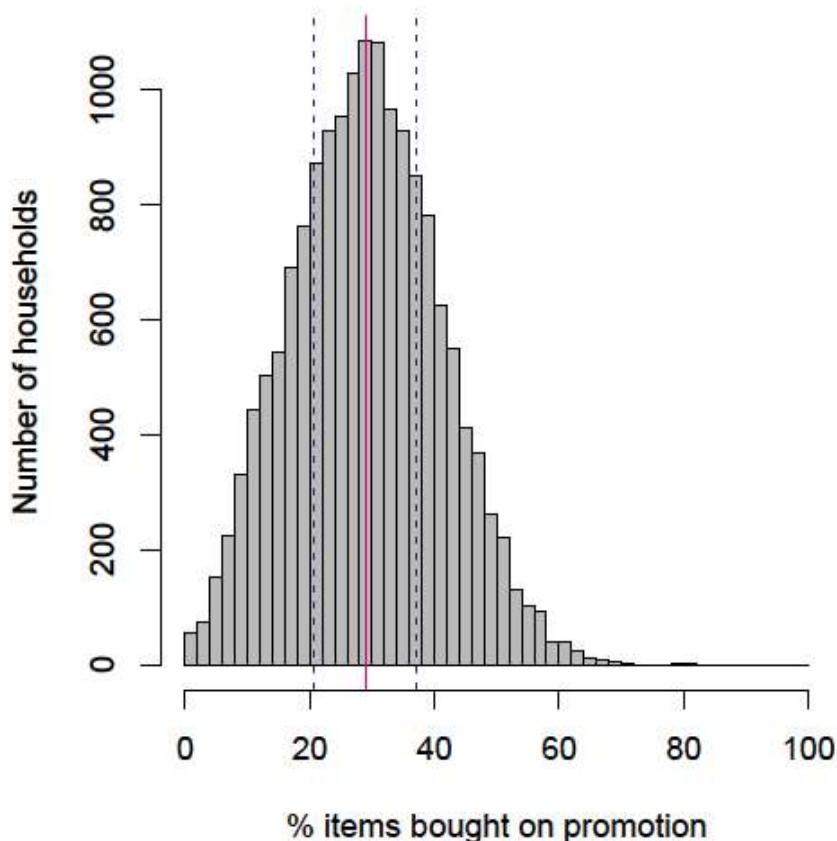

Figure 1: Distribution of households according to percentage of items bought on promotion

Pink line = median. Purple dashed line = 1st and 3rd quartiles.

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4.2 Determinants of promotional purchasing

Results from the beta regression model are shown in Table 3.

Table 3: The influence of household demographic factors on promotional purchasing

		Group mean	Fitted coefficient [log odds ratio] (p-value)*
Region			
	East (Reference)	30.9%	0
	Lancashire	27.4%	**-0.188 (< 0.001)**
	London	30.3%	-0.023 (0.356)
	Midlands	28.9%	**-0.077 (0.002)**
	North East	28.5%	**-0.075 (0.021)**
	South West	30.4%	-0.003 (0.936)
	Scotland	30.7%	-0.010 (0.719)
	South	30.2%	-0.003 (0.921)
	Wales	29.4%	-0.031 (0.350)
	West	30.6%	0.044 (0.208)
	Yorkshire	29.3%	**-0.078 (0.002)**
Life stage			
	Empty Nesters (Reference)	29.1%	0
	Family 10+ Years	31.4%	**0.059 (0.015)**
	Middle Family 5-9 Years	30.3%	0.002 (0.934)
	Older Dependents	30.2%	**0.049 (0.008)**
	Pre-Family	29.3%	-0.020 (0.524)
	Young Family 0-4 Years	28.8%	-0.009 (0.780)
Income band			
	£0 - £9,999 p.a. (Reference)	28.4%	0
	£10,000 - £29,999 p.a.	28.9%	0.034 (0.168)
	£30,000 - £49,999 p.a.	29.7%	**0.082 (0.001)**
	£50,000 - £69,999 p.a.	30.5%	**0.093 (< 0.001)**
	£70,000+ p.a.	31.6%	**0.134 (< 0.001)**

Values in bold are statistically significant ($p \leq 0.05$).

4.2.1 Region

Regional mean household promotional purchasing varied from 27.4% items in Lancashire, to 30.9% items in East England. The regression model, factoring in other demographic variables, showed promotional purchasing to be significantly lower in Lancashire, the Midlands, North East England and Yorkshire, than in the baseline region East England, although these differences were small.

4.2.2 Life stage

Mean household promotional purchasing showed little difference between life stage groups, varying from 28.8% in young families (youngest child 0 – 4 years) to 31.4% in families (youngest child 10 – 15 years). This is reflected in the regression model showed where only families (youngest child 10 – 15 years) and households with older dependents (16+ years) showed significantly higher promotional purchasing than the baseline life stage "empty nesters".

4.2.3 Income

Mean household promotional purchasing varied from 28.4% of items in households with income less than £10,000 p.a., to 31.6% of items in households with income greater than £70,000. Consistent with this, the three highest income bands – £30,000 - £49,999 p.a., £50,000 - £69,999 p.a., and £70,000+ p.a. – each showed significantly higher promotional purchasing in the regression model when compared with a baseline of £0 - £9,999 p.a.

To investigate if social class had a similar effect, a new model was fitted with social class in place of income band (social class was originally excluded to avoid collinearity with income) (Appendix 8.3). This provided no such evidence for a change in promotional purchasing with social class.

4.3 Promotional purchasing groups

To streamline analysis of the link between promotional purchasing, overweight/obesity, and take-home food and drink quantities, the sample population was split into 3 broad groups according to their percentage of items bought on promotion (Figure 2):

- "Low" promotional purchasers form the bottom quartile of the sample population, purchasing 0 to 20.9797% of items on promotion.
- "Medium" promotional purchasers form the middle two quartiles of the population, purchasing 20.9798 to 37.989% of items on promotion.
- "High" promotional purchasing form the top quartile of the population, purchasing 37.991% to 81.9% of items on promotion.
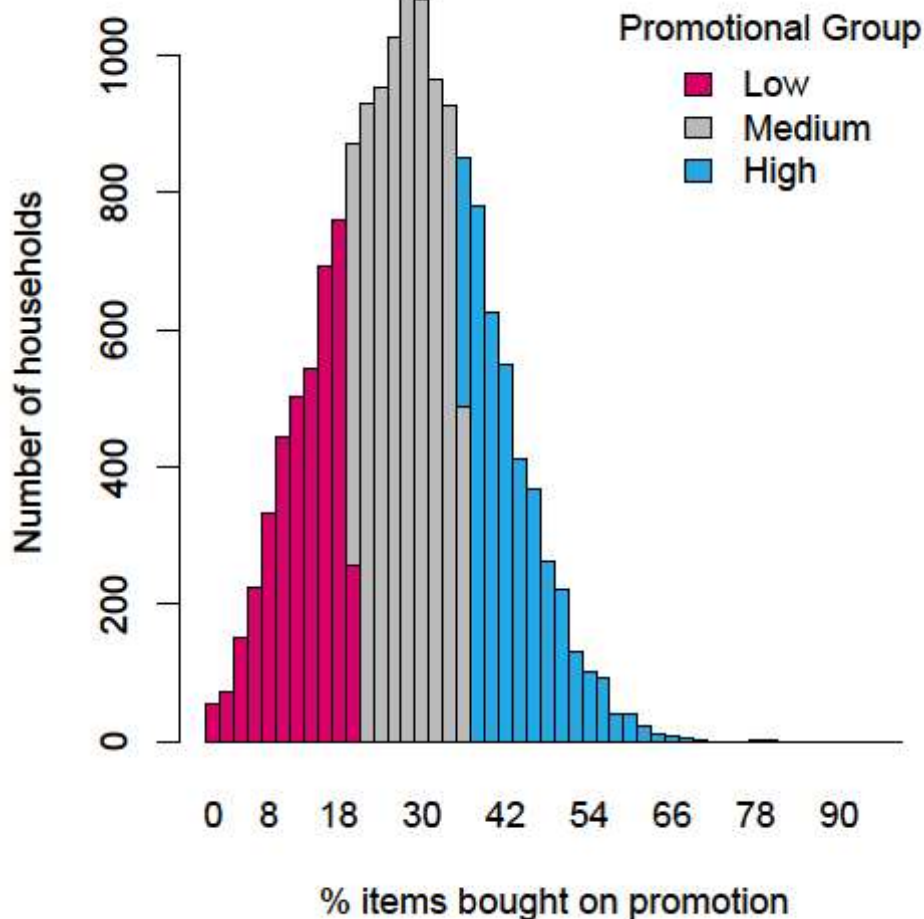

Figure 2: Distribution of households of different promotional groups, according to percentage of items bought on promotion

4.4 Promotional purchasing and overweight/obesity

At the sample population level, prevalence of main shopper overweight including obesity (BMI $\geq$ 25) and obesity (BMI $\geq$ 30) both appeared to increase with increasing promotional purchasing group (Figure 3) – in the low promo group, 64% of shoppers were overweight including obese, and 28% were obese, compared with 72% and 36% in the high promo group. These represent 13% and 28% increases in overweight and obesity prevalence, respectively.

Figure 3: Prevalence of overweight (BMI $\geq$ 25 and < 30) and obesity (BMI $\geq$30) in main shoppers by household promotional purchasing group

This trend was maintained when splitting the sample population by income band (Figure 4).

To further this analysis by taking multiple demographic factors into account, logistic regression models were fitted with overweight including obesity, and obesity, as outcomes (Table 4). Consistent with Figures 3 and 4, we found that medium and high promotional purchasers each showed significantly higher odds both of being overweight, and obese, than low promotional purchasers.
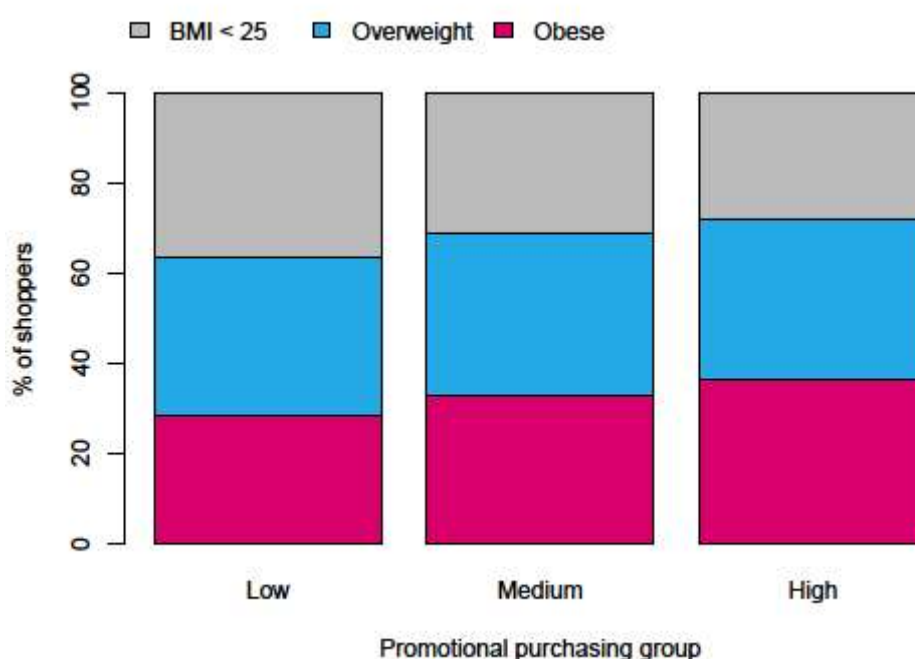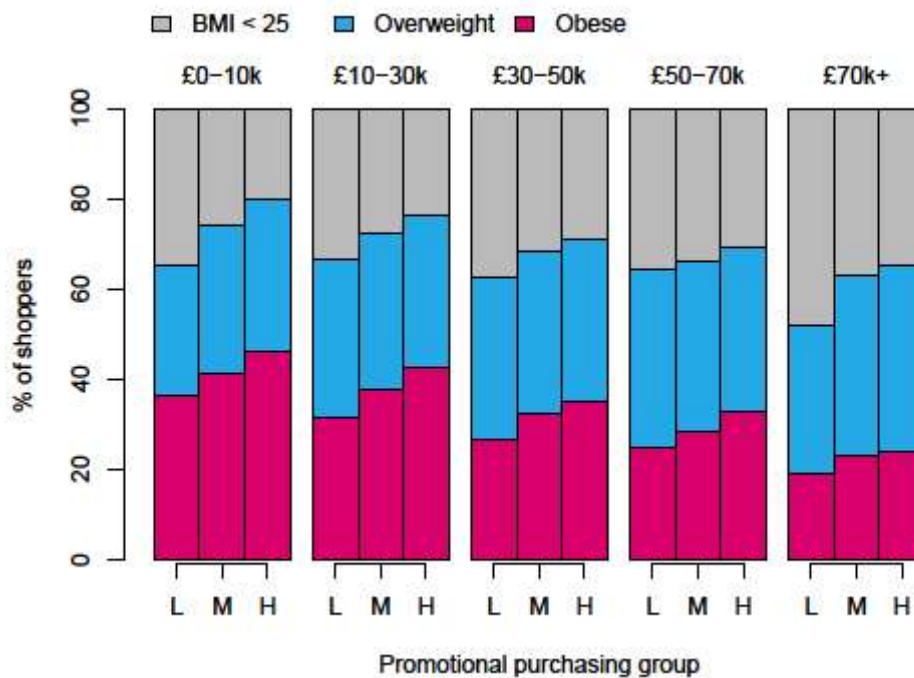
Figure 4: Prevalence of overweight (BMI ≥ 25 and < 30) and obesity (BMI ≥30) in main shoppers by household promotional purchasing group and household income

Income brackets: "£0-10k" (£0 - £9,999 p.a.), "£10-30k" (£10,000 - £29,999 p.a.), "£30-50k" (£30,000 - £49,999 p.a.), "£50-70k" (£50,000 - £69,999), "£70k+" (£70,000+)
Promotional purchasing: "L" (low), "M" (medium), "H" (high)

Table 4: Changes in main shopper overweight and obesity prevalence with promotional purchasing group

Measure		Fitted coefficient [log odds ratio] (*p*-value)*	% change in odds
Overweight including obese			
Promo Group	Low	0	-
	Medium	**0.230 (< 0.001)**	+25.8%
	High	**0.427 (< 0.001)**	+53.3%
Obese			
Promo Group	Low	0	-
	Medium	**0.228 (< 0.001)**	+25.7%
	High	**0.432 (< 0.001)**	+54.0%

"Low" is the reference group in all models.
* Values in bold are statistically significant (p ≤ 0.05).

4.5 Promotional purchasing and food and drink quantities

Results from the Generalised Linear Models for basket quantities can be found in Table 5.

Table 5: Changes in overall take-home food and drink purchasing with promotional purchasing group

Measure			Fitted coefficient (*p*-value)*	Expected change (%)	Expected value (2 adults, 2 school-age children)
Total calories / day					
Promo group	Low		0	-	4476 kcal
	Medium		**0.020 (0.040)**	+2.0%	+98 kcal
	High		0.021 (0.058)	+2.1%	+104 kcal
Total volume / month					
Promo group	Low		0	-	170.7
	Medium		**0.038 (< 0.001)**	+3.9%	+6.6
	High		**0.074 (< 0.001)**	+7.7%	+13.1
Total items / month					
Promo group	Low		0	-	202.4
	Medium		-0.002 (0.824)	-0.2%	-0.4
	High		-0.020 (0.071)	-2.0%	-4.1
HFSS volume / month					
Promo group	Low		0	-	41.7
	Medium		**0.092 (< 0.001)**	+9.7%	+4.0
	High		**0.224 (< 0.001)**	+25.2%	+10.5
HFSS items / month					
Promo group	Low		0	-	61.8
	Medium		**0.076 (< 0.001)**	+7.9%	+4.9
	High		**0.162 (< 0.001)**	+17.6%	+10.9
Carbohydrates / day					
Promo group	Low		0	-	586.0 g
	Medium		**0.022 (0.038)**	+2.2%	+12.8 g
	High		**0.036 (0.002)**	+3.7%	+21.5 g
Sugar / day					
Promo group	Low		0	-	260.1 g
	Medium		**0.025 (0.038)**	+2.5%	+6.5 g
	High		**0.048 (< 0.001)**	+5.0%	+12.9 g
Fat / day					
Promo group	Low		0	-	193.8 g
	Medium		0.016 (0.120)	+1.7%	+3.2 g
	High		0.009 (0.463)	+0.9%	+1.7 g

Saturated fat / day				
Promo group	Low	0	-	73.7 g
	Medium	0.020 (0.065)	+2.1%	+1.5 g
	High	**0.030 (0.016)**	+3.1%	+2.3 g
Salt / day				
Promo group	Low	0	-	14.4 g
	Medium	**0.029 (0.020)**	+2.9%	+0.4 g
	High	0.023 (0.114)	+2.3%	+0.3 g
Protein / day				
Promo group	Low	0	-	176.6 g
	Medium	-0.016 (0.105)	-1.6%	-2.9 g
	High	**-0.043 (< 0.001)**	-4.2%	-7.5 g
Fibre / day				
Promo group	Low	0	-	45.1 g
	Medium	-0.019 (0.059)	-1.9%	-0.8 g
	High	**-0.077 (< 0.001)**	-7.4%	-3.3 g

"Low" is the reference group in all models.

* Values in bold are statistically significant ($p \leq 0.05$).

4.5.1 Calories, volume and items

The total food and drink volume purchased per month was higher in those who bought more items on promotion, with high promotional purchasing associated with a 7.7% increase in monthly volume over low promotional purchasing (Table 5).

Daily calorie purchasing also appeared to increase with promotional purchasing group, albeit more modestly. High promotional purchasing was associated with a 2.1% increase in calories when compared with low promotional purchasing – although this marginally missed a significant threshold of $p \leq 0.05$. Nonetheless, a Cuzick trend analysis supported an upwards trend in daily calories with increasing promotional purchase group (p = 0.025, Appendix 8.4). However, when accounting for shopper BMI, these observations were lost (Appendix 8.5).

We did not observe a statistically significant change in total items / month with promotional purchasing group.

In short, increased promotional purchasing was associated with a significant increase in food and drink volume purchased, but only a marginal (and BMI-dependent) increase in calorie purchasing, and no significant change in item number.

4.5.2 HFSS purchasing

HFSS purchasing, in terms of both volume per month and items per month, increased substantially with promotional purchasing group. High promotional purchasing was associated with a 25.2% increase in HFSS volume, and a 17.6% increase in HFSS items, when compared with low promotional purchasing (Table 5).

4.5.3 Nutrients

Daily carbohydrate, sugar, and saturated fat purchasing increased significantly with promotional purchasing group. Sugar purchasing was 5% higher in high promotional purchasers than low promotional purchasers – representing approximately 13 g (~ 3 teaspoons) extra sugar per day in an average 2 adult, 2 school child household.

Daily protein and fibre both significantly decreased with promotional purchasing group, with high promotional purchasers buying 7.4% less fibre than low promotional purchasers.

Fat and salt purchasing did not show any clear trends with promotional purchasing group, although salt purchasing was significantly different between the medium and low promo groups.

N.B. a significant increase in saturated fat with promotional purchasing group was not seen in the model accounting for BMI (Appendix 8.5).

4.6 Promotional purchasing and food and drink categories

4.6.1 Overview

Table 6 shows, category-by-category, the percentage of items and volume that were bought on promotion by the panel. By items this varies almost four-fold from 64.4% of Dairy Drinks (> 10 g sugar / 100 ml) bought on promotion, to 16.6% of Sweet Spreads and Preserves, indicating that use of price promotions is more prevalent in a subset of categories. Notably, fruit and vegetables show low promotional purchasing incidence (21.6% and 20.3% of items, respectively).

Table 6: Percentage of categories bought on promotion

Category	% of category bought on promotion (items / volume)
Dairy Drinks (> 10 g sugar / 100 ml)	64.4 / 59.0
Sweetened Yoghurts	55.5 / 56.1
Pure Juices	52.3 / 49.7
Confectionery – Chocolates	48.7 / 49.1
Crisps, Savoury Snacks & Popcorn	47.8 / 45.2
Sugary Drinks (5 – 8 g sugar / 100 ml)	45.7 / 47.8
Energy Drinks	44.7 / 52.6
Diet Drinks	44.6 / 35.2
Ice Cream, Ice Lollies & Sorbets	43.5 / 35.9
Puddings	42.4 / 38.4
Sweet Biscuits	42.2 / 40.0
Cereals	37.2 / 35.9
Ready Meals	36.7 / 35.6
Sugary Drinks (> 8g sugar / 100 ml)	36.1 / 41.4
Confectionery – Sweets	35.3 / 31.5
Cakes, Pastries & Morning Goods	33.8 / 39.2
Other Food	29.2 / 24.4
Fried Potato	27.1 / 26.5
Other Drinks	25.2 / 23.6
Fruit	21.6 / 24.9
Vegetables	20.3 / 20.0
Other Yoghurt	16.8 / 15.3
Sweet Spreads and Preserves	16.6 / 15.8

Additional statistics on category contribution to overall promotional and non-promotional shopping totals, and promotion-exclusive category purchasing, are presented in Appendix 8.2.

4.6.2 Promotional purchasing group and category volumes

Results from the Generalised Linear Models for category volumes can be found in Tables 7 and 8.

Categories where purchase volume increased with promotional purchasing group

Categories where purchase volume increased with promotional purchasing group include Cakes, Pastries & Morning Goods, Confectionery – Chocolates, Confectionery – Sweets, Crisps, Savoury Snacks & Popcorn, Dairy Drinks (> 10 g sugar / 100 ml), Diet Drinks, Energy Drinks, Fried Potato, Ice Cream, Ice Lollies & Sorbets, Puddings, Pure Juices, Ready Meals, Sugary Drinks (> 8 g sugar / 100 ml), Sugary Drinks (5 – 8 g sugar / 100 ml), Sweet Biscuits, Sweetened Yoghurts, and Other Drinks (Table 7).

Notably, many of these categories show disproportionately high levels of HFSS purchasing (Table 2, 10 out of 17 categories are > 50% HFSS), as consistent with the previous observation that HFSS purchasing increases with promotional purchasing group. Many categories are also discretionary (that is, high in calories/sugar/fat/salt, but low in nutritional value and not required for health[25]) and overlap with the Scottish consultation's target discretionary categories of confectionery, sweet biscuits, crisps, pastries, puddings, and soft drinks with added sugar[16]. Moreover, many of these categories overlap with foods recommended to eat less often in The Eatwell Guide[26].

All drinks categories showed increased purchasing with promotional purchasing. This, together with the observation that drinks are the items most bought exclusively on promotion (Appendix 8.2.2), suggests that promotions may be influencing the discretionary consumption of a range of drink products.

Table 7: Increases in monthly food and drink category purchasing with promotional purchasing group

Measure		Fitted coefficient (p-value)*	Expected change (%)	Expected value (2 adults, 2 school-age children)
Cakes, Pastries & Morning Goods				
Promo group	Low	0	-	30.2 servings
	Medium	**0.195 (< 0.001)**	+21.5%	+6.5 servings
	High	**0.384 (< 0.001)**	+46.9%	+14.2 servings
Confectionery – Chocolates				
Promo group	Low	0	-	0.67 kg
	Medium	**0.171 (< 0.001)**	+18.7%	+0.12 kg
	High	**0.376 (< 0.001)**	+45.6%	+0.30 kg
Confectionery – Sweets				
Promo group	Low	0	-	0.39 kg
	Medium	0.041 (0.243)	+4.2%	+0.02 kg
	High	**0.195 (< 0.001)**	+21.5%	+0.08 kg
Crisps, Savoury Snacks & Popcorn				
Promo group	Low	0	-	0.51 kg
	Medium	**0.078 (0.002)**	+8.1%	+0.04 kg
	High	**0.199 (< 0.001)**	+22.1%	+0.11 kg
Dairy Drinks (> 10 g sugar / 100 ml)				
Promo group	Low	0	-	0.04 l
	Medium	**0.630 (< 0.001)**	+87.7%	+0.03 l
	High	**1.351 (< 0.001)**	+286.2%	+0.11 l
Diet Drinks				
Promo group	Low	0	-	0.03 l
	Medium	**0.554 (< 0.001)**	+74.0%	+0.03 l
	High	**0.915 (< 0.001)**	+149.6%	+0.05 l
Energy Drinks				
Promo group	Low	0	-	0.33 l
	Medium	**0.353 (< 0.001)**	+42.4%	+0.14 l
	High	**0.823 (< 0.001)**	+127.7%	+0.42 l
Fried Potato				
Promo group	Low	0	-	1.63 kg
	Medium	**0.097 (< 0.001)**	+10.2%	+0.17 kg
	High	**0.237 (< 0.001)**	+26.7%	+0.44 kg
Ice Cream, Ice Lollies & Sorbets				
Promo group	Low	0	-	1.16 kg
	Medium	**0.078 (0.013)**	+8.1%	+0.09 kg
	High	**0.254 (< 0.001)**	+29.0%	+0.34 kg

Puddings				
Promo group	Low	0	-	0.58 kg
	Medium	**0.165 (< 0.001)**	+17.9%	+0.10 kg
	High	**0.354 (< 0.001)**	+42.5%	+0.25 kg
Pure Juices				
Promo group	Low	0	-	1.16 l
	Medium	**0.324 (< 0.001)**	+38.3%	+0.45 l
	High	**0.511 (< 0.001)**	+66.7%	+0.78 l
Ready Meals				
Promo group	Low	0	-	2.06 kg
	Medium	**0.176 (< 0.001)**	+19.3%	+0.40 kg
	High	**0.375 (< 0.001)**	+45.6%	+0.94 kg
Sugary Drinks (> 8 g sugar / 100 ml)				
Promo group	Low	0	-	3.52 l
	Medium	0.058 (0.192)	+6.0%	+0.21 l
	High	**0.234 (< 0.001)**	+26.3%	+0.93 l
Sugary Drinks (5 – 8 sugar / 100 ml)				
Promo group	Low	0	-	0.34 l
	Medium	**0.583 (< 0.001)**	+79.1%	+0.27 l
	High	**0.702 (< 0.001)**	+101.7%	+0.34 l
Sweet Biscuits				
Promo group	Low	0	-	1.59kg
	Medium	**0.068 (0.002)**	+7.0%	+0.11kg
	High	**0.209 (< 0.001)**	+23.3%	+0.37kg
Sweetened Yoghurts				
Promo group	Low	0	-	1.67kg
	Medium	**0.092 (0.002)**	+9.6%	+0.16kg
	High	**0.263 (< 0.001)**	+30.1%	+0.50kg
Other Drinks				
Promo group	Low	0	-	25.40 l
	Medium	**0.068 (< 0.001)**	+7.1%	+1.79 l
	High	**0.152 (< 0.001)**	+16.4%	+4.16 l

"Low" is the reference group in all models.

* Values in bold are statistically significant ($p \leq 0.05$).

Categories where purchase volume decreased with promotional purchasing group

Categories where purchase volume decreased with promotional purchasing group include Cereals, Fruit, Sweet Spreads and Preserves, Vegetables, Other Yoghurt, and Other Food (Table 8). Notably this list contains more staple foods (Other Food, Fruit, Vegetables) and healthier options (Fruit, Vegetables, Other Yoghurt, and potentially some Other Food) than the list of categories which increased in volume with promotional purchasing. Only one of these food categories contained a majority of HFSS food (Sweet Spread and Preserves, 89.4% HFSS, Table 2).

High promo households were predicted to purchase 30.1% less Fruit, and 22.8% less Vegetables, than equivalent low promo households – in a household of 2 adults and 2 school-age children, this would be equivalent to a difference of 1.37 kg fruit (14 large apples) and 2.86 kg vegetables (47 medium-sized carrots) per month. This emphasises that, not only is high use of promotions associated with a skew towards less healthy, discretionary food categories, but this is at the cost of healthier, more nutritionally valuable foods.

Table 8: Decreases in monthly food and drink category purchasing with promotional purchasing group

Measure			Fitted coefficient (*p*-value)*	Expected change (%)	Expected value (2 adults, 2 school-age children)
Cereals					
Promo group	Low		0	-	2.12 kg
	Medium		**-0.052 (0.014)**	-5.1%	-0.11 kg
	High		**-0.082 (< 0.001)**	-7.9%	-0.17 kg
Fruit					
Promo group	Low		0	-	9.49 kg
	Medium		**-0.156 (< 0.001)**	-14.4%	-1.37 kg
	High		**-0.358 (< 0.001)**	-30.1%	-2.85 kg
Sweet Spreads and Preserves					
Promo group	Low		0	-	0.34kg
	Medium		**-0.104 (0.001)**	-9.9%	-0.03kg
	High		**-0.304 (< 0.001)**	-26.2%	-0.09kg
Vegetables					
Promo group	Low		0	-	12.56 kg
	Medium		**-0.082 (< 0.001)**	-7.9%	-0.99 kg
	High		**-0.258 (< 0.001)**	-22.8%	-2.86 kg
Other Yoghurt					
Promo group	Low		0	-	0.68 kg
	Medium		**-0.229 (< 0.001)**	-20.5%	-0.14 kg
	High		**-0.594 (< 0.001)**	-44.8%	-0.31 kg
Other Food					
Promo group	Low		0	-	69.54 kg
	Medium		-0.014 (0.255)	-1.4%	-1.00 kg
	High		**-0.051 (< 0.001)**	-5.0%	-3.45 kg

"Low" is the reference group in all models.

* Values in bold are statistically significant ($p \leq 0.05$).

5 Discussion

This report used British take-home food and drink purchasing data to investigate the link between price promotions, obesity, and food and drink purchasing trends. It found that price promotions are prominent in British take-home food and drink shopping and are being used at broadly similar levels by all demographic groups. Increased promotional purchasing was associated with higher prevalence of both overweight and obesity, and substantial changes in overall shopping basket and category purchasing.

This study found that 29.2% of food and drink items, and 28.5% of volume, was bought on promotion. This is slightly lower than recent findings from Food Standards Scotland, who in 2016 reported that 33% of take-home food and drink volume was bought on promotion in Scotland[18], and Public Health England, who reported around 40% of volume in Great Britain in 2015[19]. This is potentially due to changes in market trends and the rise of discount retailers. None the less, price promotions are still prominent in Great Britain, and promotional purchasing is among the highest in Europe[19].

Although promotional purchase varied largely household-by-household, little of this variation could be attributed to known demographic factors. Slight regional variation is likely due to different distribution of retailers across regions, and minimal differences were found between life stages or social class – a finding consistent with previous observations[19]. Notably, use of price promotions appeared to increase with income, as previously observed in Scotland[18]. Although this increase was small, it does suggest that lower income households will not be disproportionately and detrimentally affected by any policy that restricts price promotions. Together, these observations suggest that a promotions-based intervention could have a positive influence on all demographic groups.

Shoppers who bought more items on promotion were more likely to be overweight or obese. Prevalence of obesity (BMI $\geq$ 30) was almost 30% higher in the top quartile of promotional purchasing households (high promotional purchasers) than the bottom quartile (low promotional purchasers). This trend was still seen when taking demographic factors (age, income, region, household structure) into account, demonstrating an association between high promotional purchasing and shopper obesity.

Promotional purchasing behaviour was associated with changes to the overall shopping basket. Previous research has suggested that 22% of food/drink volume purchased on promotion is bought in addition to expected purchase amounts[19]. Consistent with this, we found that high promotional purchasing was associated with an increase in purchased food and drink volume. We did not find an association between promotional purchasing and number of food items, indicating that on average, volume per item typically increases. A potential explanation is that consumers may be conscious of the total number of items in their food basket, and thus try to stay within a certain number of items. One limitation of the analysis was that our measure of promotional shopping was calculated using item number, which may affect the interpretation of the regression where item number was an outcome.

Although we observed an increase in calorie purchasing with promotional purchasing, these changes were modest and dependent on shopper BMI. As many factors may influence calorie purchasing, such as differences in out-of-home purchasing and food waste, it could be that the study did not have to power to detect changes in calorie purchasing with price promotions.

Promotional purchasing was associated with a substantial increase in purchasing of HFSS food and drink, with high promotional purchasers buying 17.6% more HFSS items, and 25.2% more HFSS volume, than low promotional purchasers. This demonstrates that, regardless of total volume or calories purchased, households which use price promotions more are generally purchasing more unhealthy food. Changes in nutritional content of baskets with promotional purchasing were consistent with this observation – high promotional purchasers typically bought more carbohydrates and sugar than low promotion purchasers, but less protein and fibre. This is important considering that 87% of adults in the UK are exceeding their recommended sugar intake, whereas 91% are under-consuming fibre[27].

Finally, this report investigated whether promotional purchasing was skewed towards particular food and drink categories, and whether increased promotional purchasing was associated with a shift in categorical purchasing. It was found that price promotions were unevenly distributed across food and drink categories: many discretionary categories are bought disproportionately on promotion (e.g. Confectionery – Chocolates [48.7%], Crisps, Savoury Snacks & Popcorn [47.8%], Sugary Drinks (5 – 8 g sugar / 100 ml) [45.7%], Table 6). This is consistent with previous findings from PHE and FSS[18,19].

Furthermore, promotional purchasing group was associated with significant changes in purchasing of all 23 food and drink categories studied. Categories which increased with promotional purchasing included Cakes, Pastries & Morning Goods, Confectionery, Crisps, Savoury Snacks & Popcorn, Puddings, and all drinks categories, amongst others. Notably, many of these categories contain a disproportionately high number of HFSS items, and/or are discretionary. Many are included in PHE's sugar reduction programme[22], or are among the foods that the Eatwell Guide recommends should be eaten less often[26]. Conversely, Fruit, Vegetables, and Other Food decreased with promotional purchasing group, suggesting that increased purchasing of less healthy food and drink in high promotional purchasers causes shoppers to purchase fewer healthier items.

Despite the link between promotional purchasing and increased purchasing of HFSS items and disproportionately HFSS and discretionary categories, the majority of food and drink items bought on promotion are Other Food, Fruit or Vegetables (with Fruit and Vegetables collectively representing ~20% of all promotional items, Appendix 8.2.2). This is reassuring as it suggests that price promotions can aid in making healthier purchasing choices. While the current promotion environment favours the purchasing of less healthy foods, new policies could see promotions shifting more towards healthier items. Targeting restrictions on food and drinks which are deemed HFSS or discretionary could encourage households which typically make great use of price promotions to make healthier choices.

Together, these findings support the general hypothesis that promotional purchasing is associated with increased purchasing of less healthy foods, overweight and obesity. It underpins the recommendation that UK government should restrict price promotions on less healthy foods to encourage healthier purchases and in attempt to reduce obesity.

Strengths and limitations

This report has a number of strengths. The Kantar Worldpanel data represents real-world purchases, allowing direct study of the association between price promotions and food and drink purchasing. Provision of demographic data including income, social class, shopper age, and household structure, has allowed not only study into the influence of these factors on promotional purchasing, but adjustment for these factors when considering the effects of price promotions on a population level. Moreover, the broad scope of the dataset, covering a representative sample of thousands of British households, allows population-level conclusions to be drawn.

There are some limitations in the use of take-home food and drink purchasing data. Although data represent real-world purchases, panellists may still under-report, leading to underestimation of food and drink volumes. Moreover, this analysis does not capture food and drink purchased for out-of-home consumption. The extent to which out-of-home consumption contributes to a household's diet is like to vary significantly from household to household. Conversely, panellists may not consume all that they purchased, potentially leading to overestimation – this is probably more likely for perishable items such as fresh fruit and vegetables. Additionally, these data were collected prior to the Soft Drinks Industry Levy, and thus trends in sugar-sweetened beverages may not accurately reflect current trends. Finally, these data and analysis allow the investigation of associations between high promotional purchasing, overweight/obesity, and food/drink quantities, but the analysis does not confirm any direct causal link between these factors.

Future research

This study has demonstrated an association between high use of price promotions, overweight/obesity, and increases in purchasing of HFSS and less healthy food and drink categories at the cost of healthier food and drink. Although this adds to the building evidence on the population-level association between price promotions and unhealthy eating, future work should aim to demonstrate any direct causal effect of price promotions on consumer decision-making in a controlled setting. Further research should investigate not only how price promotions alter short term decision making, but what effect, if any, they have on long-term purchasing habits regardless of current price promotions. Moreover, further research could look at whether price promotions have a differential effect on healthy vs. less healthy foods.

Current evidence is generally limited to the take-home sector. Further studies could potentially look at how price promotions influence the purchasing and consumption of foods out-of-home, to provide a more complete picture of the effects of price promotions on overall diets.

Further research could also explore the role of different kinds of price promotions, such as multi-buy versus temporary price reductions, on consumer purchasing behaviour to build the case for extending Government regulations in future.

Finally, more work is needed to understand how price promotions, location-based promotions, and marketing collectively interact with our environmental factors to influence food/drink consumption, and ultimately, obesity. A holistic, systems-based approach to understanding these factors is fundamental to developing effective policy and interventions to improve health in the UK.

Policy discussion

Cancer Research UK welcomes the UK and Scottish Governments' consultations on restricting the promotion of less healthy food and drink, and early indications that the Welsh Government will follow suit. This is a positive step towards reducing the UK's obesity rate, improving health outcomes, and reducing the number of preventable cancers. It is vital that eventual regulation is as aligned as possible, to ensure ease of implementation and enforcement across the UK. The findings of this report provide further evidence for the importance of the proposed measures and the significant impact they could have.

We agree that mandatory measures to restrict the promotion and marketing of food and drink high in fat, sugar and salt (HFSS) should be implemented across retail and out of home settings. Regulation would allow for a UK-wide impact, while also creating a level playing field for industry; no business seeking to improve public health in the UK should be subject to reduced market share because others won't follow. Previous voluntary measures have not achieved the desired impact and are not sufficient to address the scale of obesity and excess weight in the UK.

We agree with the UK and Scottish Governments' decisions to recommend restricting multi-buy price promotions on less healthy food and drink, and support this as a priority across the UK. We also ask the UK Government to commit to review how this change affects in-store promotional activity and, at that stage, to consider the case for introducing restrictions on 'temporary' price promotions on less healthy food and drink.

Beyond price promotions, we are also supportive of restricting location-based promotions (end of aisle, checkouts, store entrances etc.) due to their prevalence and influence on consumer purchasing[28,29]. These restrictions would re-stack the odds of eating more healthily back in favour of the consumer: making it easier to avoid impulse purchases of HFSS food and drink products when shopping for other items and helping parents to avoid pester power from their children.

The food industry drives purchasing of their products through a range of marketing techniques. To ensure that restrictions on HFSS price promotions have the intended impact, they must be one of a comprehensive package of measures to discourage brands simply switching to other media and marketing tactics.

Population-wide measures are central to creating a healthier food environment and supporting families to make healthier choices. To achieve this, the UK Government should implement a comprehensive 9pm watershed on junk food marketing on television and across all digital media, along with other measures proposed in the

Childhood Obesity Plan Chapter 2. Devolved governments should also implement the policies set out in their own strategies. We would like all governments in the UK to seek to align their policies, to create consistency across nations and make implementation and enforcement of proposed measures as straightforward as possible.

Implementing these measures is even more vital for those in lower socio-economic groups, who have higher rates of obesity and diet-related ill-health. Reducing the marketing and promotion of less healthy food is a core component of addressing such health inequalities and must be implemented alongside other measures to improve food access and food security, and to provide sustainable funding for local and NHS prevention work.

Decisive action in these areas by governments will be vital to ensuring all nations achieve their ambitions of reducing childhood obesity, and health inequalities, in the coming decades.

Further discussion of policy implementation

We are supportive of the majority of proposals put forward by the UK and Scottish Governments and would like to offer further thoughts on how these can be most effectively implemented.

Widening health inequalities are of great concern to the public health community. The findings of this report indicate that restricting HFSS promotions would not disadvantage people from lower socioeconomic backgrounds, which is consistent with previous research. Promotions encourage impulse purchasing[30] and generally cause people to buy more[19], while promoting overconsumption rather than sensible planning[31]. Furthermore, the proposed restrictions would target discretionary purchases and the least healthy foods that bring the biggest health harms, and which are more likely to be bought on promotion, rather than staple foods such as bread, eggs, fruit and vegetables.

The report also finds that the proportion of baskets bought on promotion is broadly similar across all English regions and between England, Wales and Scotland. This indicates that no region would be disproportionately affected by restrictions.

Whilst this report focuses on the impact of price promotions in retail settings, the out of home sector must be included in the scope of the restrictions as it accounts for an ever-growing proportion of food consumed, and healthier choices should be incentivised wherever people eat. These restrictions should also apply to online grocery shopping, to ensure the creation of a level playing field across retailer environments.

Finally, the Nutrient Profile Model (NPM) should be used as the basis for identifying the food and drinks that could be sold using price or location-based promotions. The 2004/5 NPM is an established, evidence-based tool to define 'less healthy' food and drinks high in fat, sugar or salt based on their nutritional composition. Some manufacturers have been quick to argue the flaws of the NPM yet continue to block the implementation of a revised model, which better reflects the Government's latest nutrition advice to increase fibre intake and reduce free sugar intake.

Inconsistencies in industry's approach, and the limited success of voluntary measures thus far, further highlight the need for mandatory restrictions. This would help ensure an even playing field where businesses committed to improving public health are not penalised for their efforts.

Policy Recommendations

The UK, Scottish, and Welsh Governments should:

1   Introduce restrictions on price promotions for less healthy food and drink items, focusing first on multi-buy offers. These policies should be as aligned as possible across nations.
2   Commit to reviewing the evidence base on other kinds of price promotions, including temporary price reductions, and take further action to restrict those if necessary.
3   Introduce restrictions on location-based promotions for less healthy foods to support restrictions on price promotions.
4   Fully implement other measures in their respective obesity strategies, to create a healthier food environment and support families to make healthier choices.

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6 Glossary

Price promotion	Temporary price reduction (TPR), multibuy, Y for £X, meal deal, extra free, and other temporary alterations of retail price.
Discretionary food/drink	Food and drink which are high in calories, sugar, fat, or salt, but low in nutritional value and are not required for our health, including confectionery, sweet biscuits, savoury snacks, cakes, pastries, puddings and sugary drinks[25].
HFSS	High in Fat, Salt, or Sugar, as determined by the Nutrient Profiling Model 2004/5[20].
Nutrition volume	A volume of food, with units dependent on the food category:

Units	Categories
Kilograms (kg)	Cereals Confectionery – Chocolates Confectionery – Sweets Crisps, Savoury Snacks & Popcorn Fried Potato Fruit Ice Cream, Ice Lollies & Sorbets Puddings Ready Meals Sweet Biscuits Sweet Spreads and Preserves Sweetened Yoghurts Vegetables Other Yoghurt Other Food*
Litres (l)	Dairy Drinks (> 10 g sugar / 100 ml) Diet Drinks Energy Drinks Pure Juices Sugary Drinks (> 8 g sugar / 100 ml) Sugary Drinks (5 – 8 g sugar / 100 ml) Total Alcohol Other Drinks
Servings	Cakes, Pastries & Morning Goods Other Food*

* Note that as "Other Food" is a compound of several food categories with several volume units, units cannot be assigned to this category.

Main shopper	The individual reported to perform most of the take-home shopping for a household.
BMI	Body Mass Index
Social class	National Readership Survey (NRS) social grade. One of: • Class AB (Upper Middle and Middle Class) • Class C1 (Low Middle Class) • Class C2 (Skilled Working Class)

	• Class D (Working Class) • Class E (Non-Working)
Adult	An individual 16 years of age or older.
Child	An individual 15 years of age or younger.
Life stage	A classification of a household according to its adult and child constituents. Life stages include: | Life stage	Description
Pre-Family	The main shopper is younger than 45 in a household with no children.
Young Family (0 – 4)	A family where the youngest child is younger than 5.
Middle Family (5 – 9)	A family where the youngest child is aged between 5 and 9.
Family (10+)	A family where the youngest child is aged between 10 and 15.
Older Dependents	The main shopper is 45 or older in a household with at least 3 adults and no children.
Empty Nesters	The main shopper is aged 45 – 64 in a household with fewer than 3 adults, and no children.
Retired	The main shopper is 65 or older in a household with fewer than 3 adults and no children.	
Household structure	A categorisation of households according to the number of adults and school-age children (in "Middle Family" and "Family 10+" households) or children (all other households).

7 Appendices

7.1 Key variables

7.1.1 Household structure

Household structure was calculated after removing households labelled "retired".

Table: Household structure and possible values

Name	# Adults	# Children	Child age group*	n, %
A1C0	1	0	N/A	2035, 16.1%
A1C1	1	1	C	40, 0.3%
A1C2	1	2	C	38, 0.3%
A1C3	1	3	C	13, 0.1%
A1C4	1	4	C	4, < 0.1%
A1C5	1	5	C	1, < 0.1%
A1SC1	1	1	SC	193, 1.5%
A1SC2	1	2	SC	98, 0.8%
A1SC3	1	3	SC	22, 0.2%
A1SC4	1	4	SC	3, 0.0%
A2C0	2	0	N/A	3853, 30.4%
A2C1	2	1	C	627, 4.9%
A2C2	2	2	C	692, 5.5%
A2C3	2	3	C	195, 1.5%
A2C4	2	4	C	61, 0.5%
A2C5	2	5	C	12, < 0.1%
A2C6	2	6	C	1, < 0.1%
A2SC1	2	1	SC	656, 5.2%
A2SC2	2	2	SC	734, 5.8%
A2SC3	2	3	SC	149, 1.2%
A2SC4	2	4	SC	19, 0.1%
A2SC5	2	5	SC	4, < 0.1%
A3C0	3	0	N/A	1477, 11.7%
A3C1	3	1	C	60, 0.5%
A3C2	3	2	C	43, 0.3%
A3C3	3	3	C	15, < 0.1%
A3C4	3	4	C	3, < 0.1%
A3C5	3	5	C	3, < 0.1%
A3C6	3	6	C	2, < 0.1%
A3SC1	3	1	SC	349, 2.8%
A3SC2	3	2	SC	139, 1.1%
A3SC3	3	3	SC	23, 0.2%
A3SC4	3	4	SC	6, < 0.1%

A3SC5	3	5	SC	1, < 0.1%
A4C0	4	0	N/A	692, 5.5%
A4C1	4	1	C	19, 0.1%
A4C2	4	2	C	17, 0.1%
A4C3	4	3	C	6, < 0.1%
A4C4	4	4	C	1, < 0.1%
A4C5	4	5	C	1, < 0.1%
A4C6	4	6	C	1, < 0.1%
A4SC1	4	1	SC	129, 1.0%
A4SC2	4	2	SC	32, 0.3%
A4SC3	4	3	SC	4, < 0.1%
A4SC4	4	4	SC	2, < 0.1%
A5C0	5	0	N/A	117, 0.9%
A5C1	5	1	C	10, < 0.1%
A5C2	5	2	C	6, < 0.1%
A5C5	5	5	C	1, < 0.1%
A5SC1	5	1	SC	19, 0.1%
A5SC2	5	2	SC	8, < 0.1%
A5SC3	5	3	SC	3, < 0.1%
A6C0	6	0	C	25, 0.2%
A6C1	6	1	C	1, < 0.1%
A6C2	6	2	C	3, < 0.1%
A6C3	6	3	C	1, < 0.1%
A6SC1	6	1	SC	3, < 0.1%
A6SC2	6	2	SC	1, < 0.1%
A7C0	7	0	C	2, < 0.1%
A7SC1	7	1	SC	3, < 0.1%

N/A = not applicable.

* SC = school child. Youngest child is aged 5 to 15 (i.e. life stage is "Middle Family (5 - 9)" or "Family (10+)"). C = child. Youngest child is aged 0 -4 (i.e. life stage is "Young Family (0 – 4)").

7.2 Category statistics

Note: these statistics were calculated excluding retirees.

7.2.1 Contribution of categories to promotional and non-promotional item totals

Table: Contribution of food categories to promotional and non-promotional item totals

Rank (% of all promo items)	Category name	% of all promo items	% of all non-promo items	Rank (% of all non-promo items)
1	Other Food	37.1	37.8	1
2	Fruit	12.9	19.6	2
3	Vegetables	7.5	12.4	3
4	Other Drinks	6.8	8.5	4
5	Sweet Biscuits	4.8	2.8	6
6	Confectionery – Chocolates	4.7	2.1	8
7	Ready Meals	4.3	3.1	5
8	Sweetened Yoghurts	4.1	1.4	11
9	Cakes, Pastries & Morning Goods	3.2	2.6	7
10	Crisps, Savoury Snacks & Popcorn	2.4	1.1	13
11	Puddings	2	1.1	12
12	Cereals	2	1.4	10
13	Confectionery – Sweets	1.8	1.4	9
14	Sugary Drinks (> 8 g sugar / 100 ml)	1.4	1.1	14
15	Ice Cream, Ice Lollies & Sorbets	1.4	0.8	16
16	Pure Juices	1.2	0.4	18
17	Fried Potato	0.8	0.9	15
18	Sugary Drinks (5 – 8 g sugar / 100 ml)	0.5	0.2	21
19	Energy Drinks	0.5	0.2	20
20	Other Yoghurt	0.3	0.6	17
21	Sweet Spreads and Preserves	0.2	0.4	19
22	Dairy Drinks (> 10 g sugar / 100 ml)	0.1	< 0.1	22
23	Diet Drinks	< 0.1	< 0.1	23

7.2.2 Promotion-exclusive category purchasing
Table: Categories most bought exclusively on promotion

Rank	Category name	% households which bought category exclusively on promotion	
		of households which bought the category	of all households
1	Dairy Drinks (> 10 g sugar / 100 ml)	48.2	6.4
2	Diet Drinks	36.4	3.6
3	Energy Drinks	28.9	8.7
4	Sugary Drinks (5 – 8 g sugar / 100 ml)	25.2	12.3
5	Pure Juices	18.6	10
6	Sugary Drinks (> 8 g sugar / 100 ml)	12.1	9
7	Ice Cream, Ice Lollies & Sorbets	12	9.9
8	Sweetened Yoghurts	11.8	9.8
9	Crisps, Savoury Snacks & Popcorn	9.8	8.8
10	Puddings	8.2	7
11	Confectionery – Sweets	6.6	5.5
12	Confectionery – Chocolates	6.4	6
13	Sweet Spreads and Preserves	6.1	4.4
14	Other Yoghurt	5.9	3.5
15	Fried Potato	5.8	4.7
16	Cereals	5.3	4.8
17	Sweet Biscuits	4.3	4.1
18	Cakes, Pastries & Morning Goods	2.5	2.4
19	Ready Meals	2.4	2.3
20	Fruit	0.6	0.6
21	Other Drinks	0.1	0.1
22	Vegetables	0.1	0.1
23	Other Food	< 0.1	< 0.1

7.3 Determinants of promotional purchasing – social class model

Table: The influence of household demographic factors on promotional purchasing (including social class)

		Group mean	Fitted coefficient (*p-value*)
Region			
	East (Reference)	30.90%	0
	Lancashire	27.40%	**-0.181 (< 0.001)**
	London	30.30%	-0.023 (0.317)
	Midlands	28.90%	**-0.088 (< 0.001)**
	North East	28.50%	**-0.112 (< 0.001)**
	S.West	30.40%	-0.007 (0.829)
	Scotland	30.70%	-0.009 (0.732)
	South	30.20%	-0.018 (0.460)
	Wales	29.40%	-0.052 (0.095)
	West	30.60%	0.029 (0.374)
	Yorkshire	29.30%	**-0.077 (0.001)**
Life stage			
	Empty Nesters (Reference)	29.10%	0
	Family 10+ Years	31.40%	**0.057 (0.011)**
	Middle Family 5-9 Years	30.30%	0.007 (0.803)
	Older Dependents	30.20%	**0.065 (0.001)**
	Pre-Family	29.30%	-0.010 (0.741)
	Young Family 0-4 Years	28.80%	-0.016 (0.576)
Social class			
	Class AB (Reference)	29.90%	0
	Class C1	29.70%	0.015 (0.296)
	Class C2	29.60%	0.012 (0.507)
	Class D	29.30%	-0.014 (0.452)
	Class E	29.00%	-0.042 (0.085)

* Values in bold are statistically significant ($p \leq 0.05$).

7.4 Trend analyses

7.4.1 Methods

Cuzick tests to study the directional effect of promotional purchasing group on various outcomes were performed using function `cuzickTest` in R package `PMCMRplus`. A Cuzick test was applied to promo group / residual scores (representing the promotional purchasing group and residual variation) which were calculated by subtracting measured outcomes from predictions where promotional group was fixed as the reference value ("Low").

7.4.2 Results

Table: Cuzick test results for the directional effect of promotional purchasing group on various measures

Measure	Z statistic (p-value)*
Total calories / day	2.24 (0.025)
Total volume / month	5.51 (< 0.001)
Total items / month	-1.88 (0.059)
HFSS volume / month	13.36 (< 0.001)
HFSS items / month	13.04 (< 0.001)
Carbohydrates / day	3.52 (< 0.001)
Sugar / day	4.61 (< 0.001)
Fat / day	1.35 (0.177)
Saturated fat / day	3.21 (0.001)
Salt / day	1.92 (0.055)
Protein / day	-3.02 (0.003)
Fibre / day	-6.50 (< 0.001)
Cakes, Pastries & Morning Goods (monthly volume)	16.29 (< 0.001)
Cereals (monthly volume)	-2.22 (0.026)
Confectionery – Chocolates (monthly volume)	14.68 (< 0.001)
Confectionery – Sweets (monthly volume)	7.86 (< 0.001)
Crisps, Savoury Snacks & Popcorn (monthly volume)	9.46 (< 0.001)
Dairy Drinks (> 10 g sugar / 100 ml) (monthly volume)	7.19 (< 0.001)
Diet Drinks (monthly volume)	4.14 (< 0.001)
Energy Drinks (monthly volume)	10.72 (< 0.001)
Fried Potato (monthly volume)	9.70 (< 0.001)
Fruit (monthly volume)	-16.08 (< 0.001)
Ice Cream, Ice Lollies & Sorbets (monthly volume)	10.37 (< 0.001)
Puddings (monthly volume)	13.52 (< 0.001)
Pure Juices (monthly volume)	11.16 (< 0.001)
Ready Meals (monthly volume)	16.43 (< 0.001)
Sugary Drinks (> 8 g sugar / 100 ml) (monthly volume)	5.89 (< 0.001)

Sugary Drinks (5 – 8 g sugar / 100 ml) (monthly volume)	11.60 (< 0.001)
Sweet Biscuits (monthly volume)	11.16 (< 0.001)
Sweet Spreads and Preserves (monthly volume)	-7.32 (< 0.001)
Sweetened Yoghurt (monthly volume)	11.98 (< 0.001)
Vegetables (monthly volume)	-15.77 (< 0.001)
Other Yoghurt (monthly volume)	-11.63 (< 0.001)
Other Drinks (monthly volume)	9.28 (< 0.001)
Other Food (monthly volume)	-3.53 (< 0.001)

Values in bold are statistically significant ($p \leq 0.05$).

7.5 Models incorporating shopper BMI

7.5.1 Promotional purchasing and overall food and drink quantities and nutrition

Table: Changes in overall take-home food and drink purchasing with promotional purchasing group

Measure		Fitted coefficient (*p*-value)*	Expected change (%)	Expected value (2 adults, 2 school-age children)
Total calories / day				
Promo group	Low	0	-	4886 kcal
	Medium	0.016 (0.125)	+1.6%	+78 kcal
	High	0.015 (0.208)	+1.5%	+74 kcal
Total volume / month				
Promo group	Low	0	-	171.1
	Medium	**0.034 (0.003)**	+3.5%	+6
	High	**0.067 (< 0.001)**	+6.9%	+11.8
Total packs / month				
Promo group	Low	0	-	203.9
	Medium	-0.007 (0.508)	-0.7%	-1.4
	High	**-0.025 (0.035)**	-2.5%	-5.1
HFSS volume / month				
Promo group	Low	0	-	42.4
	Medium	**0.083 (< 0.001)**	+8.7%	+3.7
	High	**0.214 (< 0.001)**	+23.9%	+10.1
HFSS packs / month				
Promo group	Low	0	-	62.5
	Medium	**0.067 (< 0.001)**	+7.0%	+4.4
	High	**0.149 (< 0.001)**	+16.0%	+10.0
Carbohydrates / day				
Promo group	Low	0	-	586.9 g
	Medium	0.017 (0.135)	+1.7%	+9.8 g
	High	**0.032 (0.013)**	+3.2%	+18.9 g
Sugar / day				
Promo group	Low	0	-	261.0 g
	Medium	0.019 (0.131)	+1.9%	+5.1 g
	High	**0.046 (0.002)**	+4.7%	+12.2 g
Fat / day				
Promo group	Low	0	-	194.6 g
	Medium	0.013 (0.235)	+1.3%	+2.6 g
	High	0.001 (0.953)	+0.1%	+0.2 g
Saturated fat / day				
Promo group	Low	0	-	74.2 g

	Medium	0.017 (0.152)	+1.7%	+1.3 g
	High	0.021 (0.118)	+2.1%	+1.6 g
Salt / day				
Promo group	Low	0	-	14.4 g
	Medium	0.023 (0.083)	+2.3%	+0.3 g
	High	0.013 (0.400)	+1.3%	+0.2 g
Protein / day				
Promo group	Low	0	-	176.9 g
	Medium	**-0.022 (0.041)**	-2.2%	-3.8 g
	High	**-0.051 (< 0.001)**	-5.0%	-8.8 g
Fibre / day				
Promo group	Low	0	-	45.1 g
	Medium	-0.020 (0.054)	-2.0%	-0.9 g
	High	**-0.079 (< 0.001)**	-7.6%	-3.4 g

"Low" is the reference group in all models.

* Values in bold are statistically significant (p ≤ 0.05).

7.5.2 Promotional purchasing and category volumes

Table: Changes in monthly food and drink category purchasing with promotional purchasing group

Measure		Fitted coefficient (*p*-value)*	Expected change (%)	Expected value (2 adults, 2 school-age children)
Cakes, Pastries & Morning Goods				
Promo group	Low	0	-	30.8 servings
	Medium	**0.182 (< 0.001)**	+20.0%	6.2 servings
	High	**0.374 (< 0.001)**	+45.4%	14.0 servings
Cereals				
Promo group	Low	0	-	2.10 kg
	Medium	**-0.045 (0.046)**	-4.4%	-0.09 kg
	High	**-0.063 (0.017)**	-6.1%	-0.13 kg
Confectionery – Chocolates				
Promo group	Low	0	-	0.68 kg
	Medium	**0.161 (< 0.001)**	+17.5%	+0.12 kg
	High	**0.354 (< 0.001)**	+42.5%	+0.29 kg
Confectionery – Sweets				
Promo group	Low	0	-	0.40 kg
	Medium	0.036 (0.340)	+3.7%	+0.01 kg
	High	**0.179 (< 0.001)**	+19.6%	+0.08 kg
Crisps, Savoury Snacks & Popcorn				
Promo group	Low	0	-	0.50 kg
	Medium	**0.081 (0.002)**	+8.4%	+0.04 kg

	High	**0.199 (< 0.001)**	+22.0%	+0.11 kg
Dairy Drinks (> 10 g sugar / 100 ml)				
Promo group	Low	0	-	0.04 l
	Medium	**0.622 (< 0.001)**	+86.3%	+0.03 l
	High	**1.288 (< 0.001)**	+262.6%	+0.10 l
Diet Drinks				
Promo group	Low	0	-	0.04 l
	Medium	**0.563 (0.001)**	+75.6%	+0.03 l
	High	**0.885 (< 0.001)**	+142.2%	+0.05 l
Energy Drinks				
Promo group	Low	0	-	0.30 l
	Medium	**0.380 (< 0.001)**	+46.2%	+0.14 l
	High	**0.826 (< 0.001)**	+128.4%	+0.39 l
Fried Potato				
Promo group	Low	0	-	1.63 kg
	Medium	**0.100 (< 0.001)**	+10.5%	+0.17 kg
	High	**0.227 (< 0.001)**	+25.5%	+0.42 kg
Fruit				
Promo group	Low	0	-	9.54 kg
	Medium	**-0.151 (< 0.001)**	-14.0%	-1.34 kg
	High	**-0.349 (< 0.001)**	-29.5%	-2.81 kg
Ice Cream, Ice Lollies & Sorbets				
Promo group	Low	0	-	1.18 kg
	Medium	**0.065 (0.044)**	+6.7%	+0.08 kg
	High	**0.229 (< 0.001)**	+25.7%	+0.30 kg
Other Drinks				
Promo group	Low	0	-	25.61 l
	Medium	**0.067 (< 0.001)**	+6.9%	+1.76 l
	High	**0.133 (< 0.001)**	+14.2%	+3.63 l
Other Food				
Promo group	Low	0	-	69.03 kg
	Medium	-0.016 (0.226)	-1.6%	-1.12 kg
	High	**-0.056 (< 0.001)**	-5.4%	-3.73 kg
Other Yoghurt				
Promo group	Low	0	-	0.69 kg
	Medium	**-0.232 (< 0.001)**	-20.7%	-0.14 kg
	High	**-0.602 (< 0.001)**	-45.2%	-0.31 kg
Puddings				
Promo group	Low	0	-	0.60 kg
	Medium	**0.136 (< 0.001)**	+14.5%	+0.09 kg
	High	**0.325 (< 0.001)**	+38.5%	+0.23 kg
Pure Juices				
Promo group	Low	0	-	1.14 l
	Medium	**0.346 (< 0.001)**	+41.3%	+0.47 l
	High	**0.501 (< 0.001)**	+65.1%	+0.74 l

Ready Meals				
Promo group	Low	0	-	2.11 kg
	Medium	**0.178 (< 0.001)**	+19.4%	+0.41 kg
	High	**0.362 (< 0.001)**	+43.6%	+0.92 kg
Sugary Drinks (> 8g sugar / 100 ml)				
Promo group	Low	0	-	3.57 l
	Medium	0.035 (0.458)	+3.6%	+0.13 l
	High	**0.238 (< 0.001)**	+26.9%	+0.96 l
Sugary Drinks (5 − 8 g sugar / 100 ml)				
Promo group	Low	0	-	0.38 l
	Medium	**0.528 (< 0.001)**	+69.6%	+0.27 l
	High	**0.636 (< 0.001)**	+88.9%	+0.34 l
Sweet Biscuits				
Promo group	Low	0	-	1.60 kg
	Medium	**0.060 (0.011)**	+6.2%	+0.10 kg
	High	**0.198 (< 0.001)**	+21.9%	+0.35 kg
Sweet Spreads and Preserves				
Promo group	Low	0	-	0.34 kg
	Medium	**-0.093 (0.006)**	-8.9%	-0.03 kg
	High	**-0.284 (< 0.001)**	-24.7%	-0.08 kg
Sweetened Yoghurts				
Promo group	Low	0	-	1.71 kg
	Medium	**0.070 (0.024)**	+7.3%	+0.12 kg
	High	**0.248 (< 0.001)**	+28.1%	+0.48 kg
Vegetables				
Promo group	Low	0	-	12.45 kg
	Medium	**-0.083 (< 0.001)**	-8.0%	-0.99 kg
	High	**-0.255 (< 0.001)**	-22.5%	-2.80 kg

"Low" is the reference group in all models.

* Values in bold are statistically significant (p $\leq$ 0.05).