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Out-of-home food selection behaviour in the presence and absence of price-based incentives in a virtual food delivery app: a randomised controlled trial

Amy Finlay [a,*], Andrew Jones [b], Martin O'Flaherty [c], Zoé Colombet [c], Nick Townsend [d], James Garbutt [d], Rebecca Evans [a], Zoi Toumpakari [d], Eric Robinson [a]

[a] Department of Psychology, University of Liverpool, UK
[b] School of Psychology, Liverpool John Moores University, UK
[c] Department of Public Health and Policy, University of Liverpool, UK
[d] School for Policy Studies, University of Bristol, UK

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ABSTRACT

Policies restricting price-based incentives in the out-of-home (OOH) food sector could influence food-related behaviours and improve population diet. In the present study we assessed the impact of removing price-based incentives on consumer food selection through a virtual, hypothetical, OOH delivery platform. Participants ordered a hypothetical meal for their household using a virtual ordering platform which presented the menu of a popular UK pizza chain restaurant/takeaway outlet. Participants were randomly allocated to one of 5 experimental conditions: control (all price-based incentives present), price reductions removed (e.g., 25 % off when you spend £10), value pricing removed (product size increase for a disproportionately small price increase), bulk-buy reductions removed (meal deals at discounted prices), and all price-based incentives removed. We examined the impact of removing each of the price-based incentives individually and simultaneously on hypothetical food purchases (energy selected (kcal) and money spent). There was a main effect of price-based incentive experimental condition on energy selected ($F(4, 1919) = 3.51$, $p = .007$) and money spent ($F(4,1919) = 163.48$, $p < .001$) and there was no evidence that effects of removing price-based incentives differed by participant characteristics. Participants in the control condition had a significantly lower hypothetical spend than all other conditions. Kcal selected tended to be lower in the all price-based incentives removed condition compared to the control condition (−7 %) and other conditions (average −8 %), although only the difference between all price-based incentives removed and value pricing removed conditions reached pre-specified statistical significance (−364 kcal; $p < .0125$; $d = 0.21$). Bayes Factors indicated that for all other pairwise comparisons the data did not provide strong evidence to support either the presence or absence of an effect. Therefore, further research is necessary to assess the impact of removing price-based incentives in OOH food settings.

1. Background

The price of food is a key barrier to consuming healthier food and drink (hereafter: food), particularly for those in more socioeconomically disadvantaged groups(Mayuree et al., 2013; Van der Velde et al., 2019; Zavala et al., 2022). A systematic review and meta-analysis of 27 studies, the majority from high-income countries, found that healthier diets were significantly more expensive than less healthy diets(Mayuree et al., 2013). On average, the healthiest diet cost US$500 more per person per year compared to the least healthy diet. A healthy diet can prevent the development of obesity and associated non-communicable diseases, both of which have a greater prevalence in groups of lower socioeconomic position (SEP)(Lago - Peñas et al., 2021).

Price-based incentives, such as temporary product price reductions (e.g., 20 % off) or volume-based deals (e.g. buy one get one free) are frequently used by food retailers in grocery settings to increase sales (Kaur et al., 2020). In the out-of-home (OOH) food sector (e.g. cafes, restaurants, takeaway food outlets), price-based incentives can include meal deals and bundles whereby a number of different products are offered together at an overall reduced price(Bleich et al., 2020; Looi

* Corresponding author.
E-mail address: amy.finlay@liverpool.ac.uk (A. Finlay).

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et al., 2022; Reeves, 2020), while temporary product price reductions can be implemented to specific products or a menu as a whole(Looi et al., 2022). Research conducted in Brazil identified that some of the most frequent price-based incentives used on OOH food delivery platforms were product price reductions and bulk-buy price reductions (i.e. meal deals) and these were more commonly seen for less healthy foods compared to healthier foods(Horta et al., 2022). Value pricing is another strategy used in the OOH food sector and promotes the selection of larger portion sizes for disproportionately small price increases(Haws & Winterich, 2013). A small number of studies have examined the impact of value pricing in the OOH food sector, with mixed findings of the extent that value pricing strategies prompt larger size choices(Finlay et al., 2023; Harnack et al., 2008; Vermeer et al., 2010). However, there is a lack of research on the extent to which other common types of price-based incentives in the OOH food sector impact on dietary choice.

The English government plans to implement restrictions to volume-based price promotions (e.g. buy one get one free) of foods high in fat, salt and sugar (HFSS) in grocery retail settings, both in-store and online (Gov.UK, 2020). This is due to existing evidence that price-based incentives are more frequently available for less healthy and larger packaged food products compared to healthier products(Powell et al., 2016). Moreover, a review by Backholer et al. (2019) concluded that consumers are more responsive to price-based incentives of unhealthy compared to healthy foods, and that such incentives are associated with impulse purchases, stockpiling and overconsumption(Backholer et al., 2019). Restrictions to price-based incentives in the OOH food sector have not been considered to date. Given that the OOH food sector now makes a significant contribution to UK diets(Garbutt et al., 2025), understanding the role of price-based incentives in the OOH food sector will now be important.

To guide public health policy, it will be important to understand the role that price-based incentives in the OOH food sector play in food purchasing, and whether the impacts of price-based incentives differ based on demographic characteristics. For example, evidence from questionnaire studies suggests that the effects of removing a price-based incentive are greater in individuals with a higher Body Mass Index (BMI) (Vermeer et al., 2010), but experimental studies have not replicated this effect(Finlay et al., 2023). There may also be differences in impact according to SEP, as individuals in lower SEP groups reportedly use price-based incentives more frequently(Davies et al., 2023). If lower SEP individuals are more influenced by price-based incentives (i.e. they prompt ordering in excess and greater spending), then banning the use of these types of price-based incentives for unhealthy food could have a greater impact on the diet of lower SEP consumers in the OOH food sector. Similarly, individual motivations related to food choice should be considered, as those who are more motivated by price when making food-related decisions would likely be more influenced by the removal of price-based incentives. Evidence suggests this may be the case for lower SEP individuals(Konttinen et al., 2021).

Given the range of price-based incentives that can be used by businesses in the OOH food sector, it is currently unclear what effect interventions to remove specific types of price-based incentives would have on consumer behaviour. In the present study we examine the most common types of price-based incentives used in the OOH food sector: product price reductions (e.g. money off selected product), bulk buy price reductions (e.g. save money when items are purchased together) and value pricing (e.g., order a larger sized item for a disproportionately small price increase). In the present study we examined hypothetical food selection in the context of an online food delivery platform. A recent review emphasised the importance of including food delivery platforms in new and existing nutrition-related policies, to ensure optimum health benefits(Jia et al., 2024). The number of people using food delivery platforms to order meals prepared outside of the home has increased yearly since 2017(Statista Research Department, 2024). In the UK, pizzas are one of the most popular food types ordered for home delivery(Statista Research Department, 2023).

Our primary objectives were to observe the effect of removing price-based incentives (product price reductions, bulk buy price reductions, value pricing) on food selection when using a virtual food delivery platform. We also explore how specific types of price-based incentives may influence ordering behaviour (e.g. through reducing the likelihood of a bulk-buy or larger portion size selection). Secondary objectives were to observe the effect of removing price-based incentives on hypothetical spending and to explore whether any effects of removing price-based incentives differ based on participant characteristics (BMI, SEP, food choice motives).

2. Methods

2.1. Study sample

Adult participants (final N = 1926) were recruited through the online research platform Prolific(Prolific, 2022) between 20th June and 28th October 2024. A consort flow diagram displaying the numbers of participants at each stage of the study is available in Fig. 1.

Eligibility criteria were: aged 18 yrs or older, reside in the UK, speak English fluently, frequently use food delivery platforms (e.g. at least once a month), frequently eat takeaway pizza (e.g. once every 2–3 months), and able to complete the study on a laptop or desktop. Participants were ineligible if they had any dietary restrictions. Participants were told they would be taking part in a study of food ordering, but were not aware of the study aims.

To obtain a sample diverse in SEP and balanced for other key demographics, recruitment was stratified to ensure a sample that had equivalent numbers of males vs. females that were representative of the UK population in terms of age group (36 % aged 18-39; 64 % aged 40+ (Office for National Statistics, 2023)) and household income. For household income, we obtained estimates of average household income in the UK across 10 deciles of deprivation from the Office for National Statistics(Andrews & Croal, 2023) to estimate income quintiles to use in recruitment. For stratification for household income, 20 % of the sample was made up of each of the following household income categories: £0-£19,999; £20,000-£29,999; £30,000-£49,999; £50,000-£80,999; £80,000+. When participants completed the study, they received monetary reimbursement equivalent to £8-£10/hour.

A total of N = 2098 participants completed the study. N = 95 participants were removed due to implausible orders (see Supplementary Material 1 for further detail). An additional N = 4 cases were removed for having an implausible BMI (>60 kg/m^2). N = 24 outliers were identified by calculating z-scores for kcal selected per household member. Any cases with a z-score greater than 3 were removed from the sample. Participants with missing data were removed (N = 4), as were participants who failed any attention checks (N = 45) resulting in a final sample of N = 1926 (in line with pre-registered power calculation, see Supplementary Material 2). See Fig. 1 for participant exclusion by condition.

2.2. Design

This was a randomised controlled trial pre-registered at the Open Science Framework (https://osf.io/fxc8q/) and Clinical Trials (ID: NCT06412276). Participants were randomly allocated to one of five conditions (Control, Product price reductions removed, Bulk buy price reductions removed, Value pricing removed, and All price-based incentives removed) and made a hypothetical evening meal order for their household from a virtual food delivery platform. Inquisit (Millisecond, n.d.) was used to create the virtual food delivery platform. The menu on the platform was based on a popular UK chain pizza restaurant and takeaway delivery service. Randomisation was automated through Inquisit using the <batch> and '/subjects' functions.

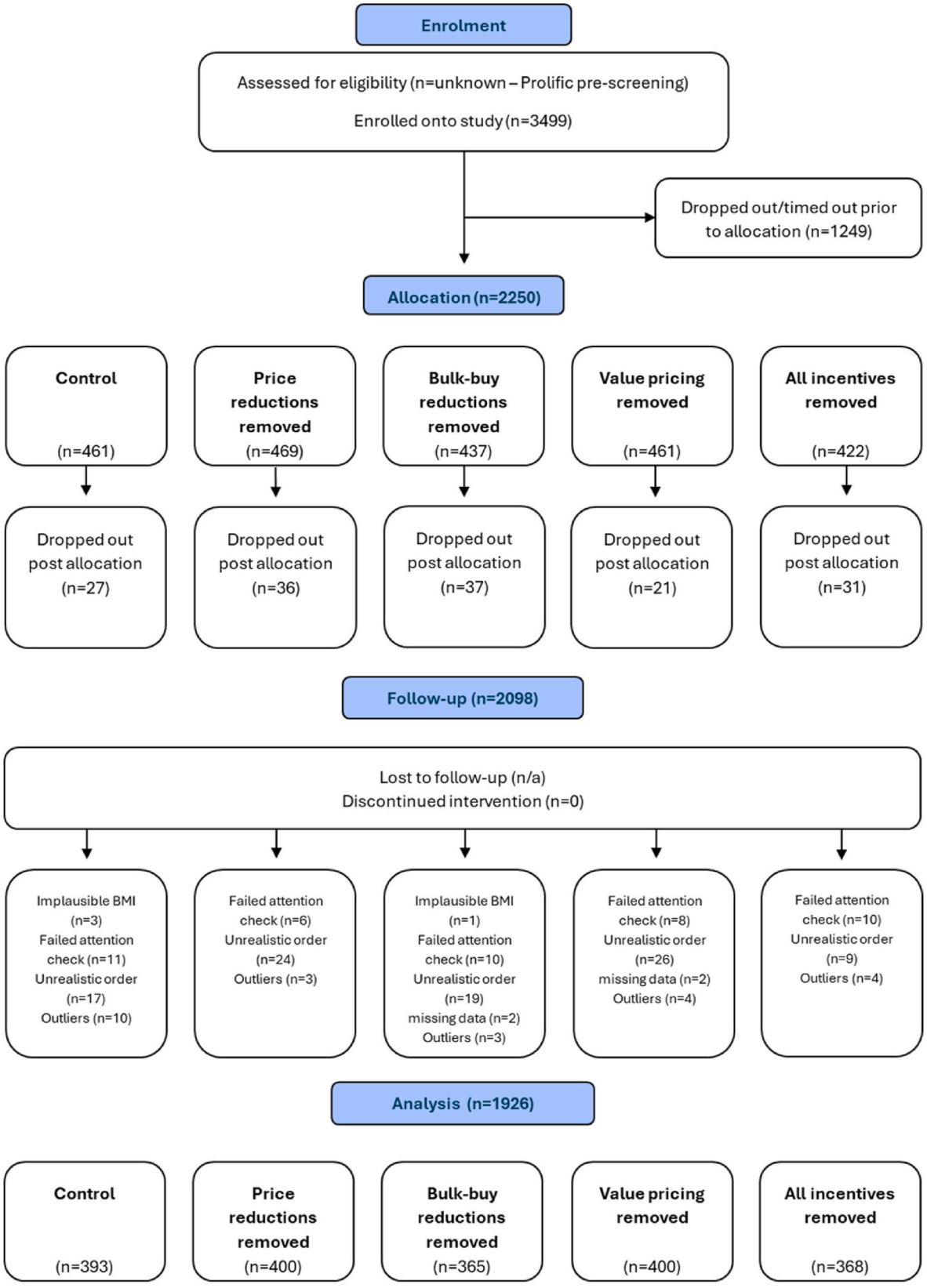

Fig. 1. Consort flow diagram.

2.3. Participant characteristics

Participants reported age, gender, ethnicity, SEP measures, height and weight. Three measures of SEP were collected. Participants selected their highest equivalent level of education from the six available options (less than high school, high school completion, college or foundation degree, bachelor's degree, master's degree, and doctoral or professional degree). Participants completed the MacArthur Scale of Subjective Social Status (Operario et al., 2004) which requires individuals to rank themselves from one to ten, visualised using a ladder, where the bottom rung of the ladder (1) represents those with the least money, least education and worst jobs/no job and the top rung of the ladder (10) represents those with the most money, most education and best jobs. Participants reported their household annual income (post-tax) and number of household members so equivalised household income could be calculated (reported household income divided by sum of household members: first adult = 1, additional adult or child over 14 years = 0.5, child aged 0–13 = 0.3)(Office for National Statistics, 2015).

2.4. Virtual food delivery platform

The virtual food delivery platform menu was based on a popular UK chain pizza restaurant which routinely offers three different price-based incentives:

1) Product price reductions (e.g. 20 % of all orders)
2) Bulk buy price reductions (e.g. meal deal for one person/family bundles)
3) Value pricing (e.g. larger sized item for a small price increase)

The items on offer and any price-based incentives were identical to those of the UK pizza chain during March–April 2024. See supplementary material 3 for item names, energy content and prices across all conditions. In short, there were n = 5 pizza melts (a thin, folded pizza), n = 20 pizzas (available as small, medium and large), n = 18 sides, n = 10 desserts, n = 14 drinks and n = 8 bulk-buy (meal deal/bundle) options. Food prices, kilocalorie (kcal) content and descriptions were taken from the outlet's UK website and food delivery platform Deliveroo.

In the control condition, all price-based incentives were present. All incentives, the products they apply to, the calculations made, and overall changes to item prices are shown in Table 1. Examples of how the menus were presented to participants are shown in Supplementary Material 4. Product price reductions were indicated by a message at the top of each menu page stating "25 % off all items, for orders over £10". All original prices over £10 were shown crossed out in red, with discounted prices next to them. Bulk-buy options were presented at the discounted prices used by the existing outlet. Value pricing was available for all pizzas. In the 'product price reductions removed' condition, only original prices were shown, with no message stating a reduction was available. In the 'bulk-buy price reductions removed' condition, bulk buy (meal deal and bundle) options were available but not at a discounted price. In the 'value pricing removed' condition, pizzas were priced proportionately (i.e. the change in price was proportionate to the change in size, based on the medium sized pizza). Finally, in the 'all price-based incentives removed' condition, all of the price-based incentives were removed.

2.5. Measures

The outcome variables of interest were food orders from the virtual food delivery platform, specifically:

- Total energy selected per household (kcal)
- Total hypothetical money spent per household (GBP)

After the food choice task, participants completed a Food Choice questionnaire(Steptoe et al., 1995) comprised of nine factors that may influence participants' food choices (health, mood, convenience, sensory appeal, natural content, price, weight control, familiarity & ethical concern). We calculated the relative importance of the three food choice motives most relevant to the study outcomes; price, health and weight control(Konttinen et al., 2013) by dividing the sum of each relevant motive scores by the mean score across all 9 items. Pre-order levels of hunger and thirst were obtained by using visual analogue scales ranging from 1 to 100 anchored by "not at all" and "extremely" respectively.

A number of follow-up questions were asked, with a required response of one of the following options: 'strongly disagree', 'disagree', 'slightly disagree', 'neither agree or disagree', 'slightly agree', 'agree', 'strongly agree'. Questions covered how participants felt about the removal of a range of price-based incentives, and whether they believed this would be a successful approach to improve eating habits in the OOH food sector (Supplementary Material 5). Participants were asked if they believed that they purchase more or less food and spend more or less money when they are offered a product price reduction, a bulk-buy price reduction and value pricing in the OOH food sector. Participants were asked if they believed that the virtual food delivery app was

Table 1
Table demonstrating how removal of price-based incentives impacted food prices.

Price-based incentive	Applied to	Calculation	Price change when incentive removed (compared to control)
Value pricing	Available on all pizzas which are available at small, medium and large sizes	The percentage increase/decrease in kcal was calculated with the medium pizza as the baseline. The observed % change in price was applied.	The price of large pizzas increased on average by £6.73 (37.82 %) The price of small pizzas decreased on average by -£2.53 (−17.78 %)
Product price reductions	All pizza and bulk-buy options on the menu; the full basket	A 25 % reduction in price was calculated and presented for all items over £10. In the online store basket, 25 % off the full basket price (i.e. using full price of all items) was calculated.	All items over £10 (pizzas and bulk-buy options) increased to "full" price. This equates to a 33.3 % increase.
Bulk-buy price reductions	All bulk-buy options:	The summed costs of all items included in bulk-buy options were calculated. Where multiple versions of an item were permitted (i.e. a large pizza/a classic side) the average cost of these items was used.	The price of bulk-buy options increased on average by £10.83 (54.08 %)
	Bulk-buy option name	*Description*	*Increase*
	Melts Meal Deal	*Any melt & Garlic Bread or Fries (serves 1)*	*£1.61 (19.5 %)*
	All for me	*Small pizza + garlic bread or fries + any*500 ml *drink*	*£8.55 (76.03 %)*
	Deal for one	*Medium pizza + a side + any*500 ml *drink*	*£7.81 (54.82 %)*
	Deal for two	*Sharing pizza + 1 side*	*£5.90 (39.34 %)*
	Deal for two+	*1 sharing pizza + 2 sides + 1.5L drink*	*£7.10 (36.41 %)*
	Deal for four	*2 sharing pizzas*	*£12.31 (52.95 %)*
	Deal for four+	*2 sharing pizzas + 2 sides + 1.5L drink*	*£18.81 (71.67 %)*
	Deal for more	*2 sharing pizzas + 2 sides + 2 desserts + 1.5L drink (serves 4-6)*	*£24.56 (81.89 %)*

representative of food delivery apps.

Participants were asked what they believed the aims of the study were. Two researchers coded awareness (Y/N) of study aims (e.g., 'influence of price-based incentives on food orders'). Disagreements were resolved through discussion.

2.6. Procedure

Participants were able to participate at the typical time for an evening meal in the UK during Monday-Friday (between 4pm and 8pm). All participants first completed measures on age, gender, SEP and current level of hunger and thirst and were randomly allocated to one of the five groups. All participants were asked to order a takeaway meal on behalf of their household, and to report the members of their household they were ordering for by reporting the number of adults (aged 14 and over) and the number of children (under the age of 14).

For the hypothetical ordering task, participants were able to browse the full menu and add items to their basket. The basket could be viewed and items removed before completing an order. In the basket, all items selected, item prices and total price were shown. Both original and discounted total price were shown in conditions with product price reductions present. After the food ordering task participants completed questions on food choice motives, price-based incentives, the representativeness of the food delivery platform and study aims. Participants were then debriefed and compensated for their time (equivalent to approximately £8 - £10 per hour).

2.7. Planned analysis

We followed a pre-registered analysis strategy (https://osf.io/fxc8q/). Minor deviations to the protocol are noted in the 'primary analyses' section. R Studio (version 2024.09.0 + 375) was used to conduct all analyses with the following packages: 'WRS2'(Mair & Wilcox, 2020) to conduct ANCOVAs, 'BayesFactor'(Morey & Rouder, 2024) to conduct Bayesian analysis, and 'ggplot2'(Wickham, 2016) and 'ggpubr'(Kassambara, 2023) to create graphs.

2.7.1. Primary analyses

A one-way between subjects Analysis of Covariance (ANCOVA) was used to compare the mean kcal selected per household across the five study conditions. Where significant main effects were identified, *post-hoc* pairwise comparisons were performed to identify whether differences existed between each of the experimental groups and the control group.

A range of characteristics were explored as potential moderators of effects of pricing. These participant characteristics were included as covariates in final models if they were associated with outcome but not condition: number of adults in the household and subjective social status (no other variables were associated with outcomes). The number of children in the household was associated with condition so we examined the inclusion of number of children in households as a covariate in models in sensitivity analyses and results were unchanged.

Additional analyses examined ordering behaviour for specific types of price-based incentives. Two binary logistic regressions (minor deviation – the pre-registered protocol stated multinomial logistic regressions) were performed to assess whether the removal of value pricing was associated with the likelihood of selecting a large or small sized pizza compared to the control condition. The same covariates were included as in the above models. A binary logistic regression was used to assess whether removal of bulk-buy price reductions was associated with the likelihood of selecting a bulk-buy option compared to the control condition. A linear regression was used to assess whether removal of product price reductions was associated with a change to the total number of items selected compared to the control condition.

2.7.2. Secondary analyses

Using the same methods as the primary ANCOVA and follow-up pairwise comparisons, we examined the effect of condition on monetary value of orders per household. To examine if the relationship between condition and total kcal selected was moderated by participant characteristics, interaction terms for participant characteristic variables (BMI, equivalised household income, education, subjective social status & relative food choice motives) were included in a second step of the ANCOVA outlined in the primary analyses. Follow-up questionnaire items were assessed using descriptive analysis.

Sensitivity analyses were conducted to test if results remained the same after removing any participants that correctly guessed the aims of the study (N = 53). Results remained the same. For primary analyses, main effects in the ANCOVA were considered significant at $p < .05$ and post-hoc tests (n = 4) at $p < .0125$ to account for multiple comparisons. For secondary analyses examining the impact of interventions on monetary value of orders, main effects were considered significant at $p < .05$ and post-hoc comparisons at $p < .0125$. For interaction analysis, to account for multiple comparisons (N = 7 interaction effects), results were considered significant at $p < .007$.

3. Results

N = 1926 participants were included in the final sample. The mean age of participants was 42 (±13) years. The sample was largely representative of the UK population in terms of gender (51 % women) and ethnicity (74 % White British). Households had a mean of 2.4 (±1.1) adults and 0.5 (±0.8) children. Overall, participants selected a mean of 3864 kcal for their household (mean range 3625–3989 kcal according to condition), with a value of £38.18 (mean range £29-£54 according to condition). For full details of participant characteristics overall and for each condition, see Tables 2 and 3.

A one-way between-subjects ANCOVA confirmed a significant effect of condition on total kcal selected after adjusting for socioeconomic position and number of adults in the household ($F(4, 1919) = 3.51$, $p = .007$). A boxplot of the total kcal selected across the five conditions is shown in Fig. 2. Follow-up pairwise comparisons were conducted between control and other conditions, but none were significant at $p < 0.0125$ (Control vs. Bulk-buy price reductions removed $p = .883$; Control vs. Product price reductions removed $p = .740$; Control vs. Value pricing removed $p = .375$; Control vs. all price-based incentives removed $p = .048$).

To better understand the significant effect observed in ANCOVA, further exploratory pairwise comparisons were conducted for all conditions (Supplementary Material 6). These analyses identified that kcal selection when all price-based incentives were removed was generally lower than in other conditions (average −7 %). However, only the difference between the all price-based incentives removed and value pricing removed conditions was significant at $p < .0125$ ($d = 0.21$). We therefore found some mixed evidence of between-condition differences in kcal selected which were seemingly driven by fewer kcal selected when all price-based incentives were removed. To better understand whether the significant and non-significant condition differences provide conclusive evidence for the presence and absence of effects, we computed Bayes Factors (BF10). Unlike frequentist statistics, Bayes Factors provide a quantitative measure of relative evidence by comparing the predictive accuracy of data (Heck et al., 2023), for example the probability of the alternative hypothesis over the null hypothesis. Bayes factors greater than 3 indicate support for the alternative hypothesis, and Bayes Factors less than 0.3 indicate support for the null hypothesis. Bayes Factors between 0.3 and 3 provide weak or anecdotal evidence (i.e. inconclusive), for either H1 or H0. These analyses were exploratory, and not pre-registered. See Table 4. Bayes factors indicated evidence was moderately in favour of the alternative hypothesis for all price-based incentives removed vs value pricing removed ($BF = 4.52$), but inconclusive for all other comparisons ($BF = 0.08–1.14$), suggesting

Table 2
Participant and household characteristics overall and for each condition (n(%) and mean(sd)).

	Control (N = 393)	Product price reductions removed (N = 400)	Bulk buy price reduction removed (N = 365)	Value pricing removed (N = 400)	All price-based incentives removed (N = 368)	Overall (N = 1926)
N(%)						
Gender						
Man	200 (51 %)	199 (50 %)	172 (47 %)	188 (47 %)	182 (49 %)	932 (48 %)
Woman	191 (49 %)	200 (50 %)	191 (52 %)	211 (53 %)	184 (50 %)	986 (51 %)
Other	2 (<1 %)	1 (<1 %)	2 (<1 %)	1 (<1 %)	2 (<1 %)	8 (<1 %)
Ethnicity						
White British	279 (71 %)	290 (73 %)	283 (78 %)	286 (72 %)	278 (76 %)	1416 (74 %)
Other	114 (29 %)	110 (27 %)	82 (22 %)	114 (28 %)	90 (24 %)	510 (26 %)
Education						
Less than High school	10 (3 %)	13 (3 %)	7 (2 %)	11 (3 %)	12 (3 %)	53 (3 %)
High school completion	60 (15 %)	49 (12 %)	58 (16 %)	40 (10 %)	57 (15 %)	264 (14 %)
College or foundation degree	88 (22 %)	81 (20 %)	83 (23 %)	80 (20 %)	86 (23 %)	418 (22 %)
Bachelor's Degree	151 (38 %)	175 (44 %)	134 (37 %)	176 (44 %)	134 (36 %)	770 (40 %)
Master's degree	74 (19 %)	64 (16 %)	63 (17 %)	78 (20 %)	65 (18 %)	344 (18 %)
Doctoral/ professional degree	10 (3 %)	18 (5 %)	20 (5 %)	15 (4 %)	14 (4 %)	77 (4 %)
Food delivery app use						
Not in the last year	19 (5 %)	20 (5 %)	14 (4 %)	13 (3 %)	23 (6 %)	88 (5 %)
Less than once per month	79 (20 %)	76 (19 %)	50 (14 %)	65 (16 %)	48 (13 %)	318 (17 %)
1-3 times per month	226 (58 %)	220 (55 %)	213 (58 %)	235 (59 %)	216 (59 %)	1110 (58 %)
1-2 times per week	61 (16 %)	76 (19 %)	83 (23 %)	78 (20 %)	68 (18 %)	366 (19 %)
3 times per week or more	9 (2 %)	8 (2 %)	5 (1 %)	9 (2 %)	13 (4 %)	44 (2 %)
Pizza outlet use						
Not in the last year	15 (4 %)	15 (4 %)	12 (3 %)	10 (3 %)	13 (4 %)	65 (3 %)
Less than once per month	128 (33 %)	129 (32 %)	100 (27 %)	109 (27 %)	116 (32 %)	582 (30 %)
1-3 times per month	225 (57 %)	227 (57 %)	215 (59 %)	247 (62 %)	205 (56 %)	1119 (58 %)
1-2 times per week	24 (6 %)	23 (6 %)	34 (9 %)	31 (8 %)	30 (8 %)	142 (7 %)
3 times per week or more	1 (<1 %)	6 (2 %)	4 (1 %)	3 (<1 %)	4 (1 %)	18 (<1 %)
Mean (SD)						
Age	41.96 (13.30)	42.04 (13.67)	42.10 (12.77)	40.42 (12.59)	43.12 (13.38)	41.91 (13.17)
Subjective social status [a]	5.36 (1.53)	5.45 (1.65)	5.36 (1.60)	5.41 (1.48)	5.39 (1.57)	5.39 (1.57)
Equivalised household income	28,405.00 (32,161.33)	26,314.00 (22,572.47)	28,534.00 (28,947.84)	28,081.00 (37,631.17)	28,873.50 (30,229.56)	28,018.00 (30,712.54)
BMI $(KG/M)^2$	27.12 (5.87)	27.00 (6.05)	27.90 (6.60)	27.01 (5.88)	27.54 (6.50)	27.30 (6.18)
Number of Adults	2.35 (1.12)	2.44 (1.04)	2.39 (1.09)	2.41 (1.11)	2.31 (1.06)	2.38 (1.09)
Number of Children	0.42 (0.74)	0.43 (0.75)	0.49 (0.88)	0.61 (0.94)	0.44 (0.83)	0.48 (0.83)
Relative price FCM [b]	3.46 (0.68)	3.51 (0.71)	3.49 (0.76)	3.51 (0.75)	3.50 (0.72)	3.50 (0.73)
Relative health FCM [b]	6.26 (1.17)	6.13 (1.13)	6.16 (1.16)	6.21 (1.10)	6.12 (1.12)	6.18 (1.14)
Relative weight FCM [b]	2.63 (0.66)	2.66 (0.68)	2.70 (0.66)	2.62 (0.65)	2.69 (0.68)	2.66 (0.67)

[a] Participants rated their subjective social status on a scale of 1–10 where 1 represents people with the least money, least education and worst jobs/no job and 10 represents people with the most money, most education and best jobs.
[b] Food Choice Motives: higher scores represent greater relative importance of motive.

a need for further research to determine support for effects of removing different forms of price-based incentives vs. control.

No significant individual effects of specific types of price-based incentives on specific ordering behaviours (e.g., removing bulk-buy promotions on the likelihood of selecting a bulk-buy promotion) were observed. See Table 5. A one-way between-subjects ANCOVA confirmed a significant difference in total hypothetical spend across conditions after adjusting for socioeconomic position and the number of adults in the household ($F(4,1919) = 163.48$, $p < .001$; Fig. 3). Participants in the control condition spent significantly less money than participants in the four experimental conditions ($p < .001$).

In a second step of the primary ANCOVA for kcal selected, no significant interactions were observed between condition and BMI ($p = .976$), equivalised household income ($p = .902$), education ($p = .167$), subjective social status ($p = .077$), relative price food choice motives ($p = .380$), relative health food choice motives ($p = .572$), and relative weight food choice motives ($p = .035$).

3.1. Questionnaire results

Overall, 87 % of participants agreed that the app was representative of existing food delivery apps and 90 % agreed that the food choices made were typical for their household. Almost 2/3 of the participants (64 %) agreed they were influenced by the prices of food options. Around half of the participants believed that the various price-based incentives saved money (from 48 to 58 %), led to the purchase of more unhealthy food (from 50 to 58 %), and agreed with the removal of such incentives in the OOH food sector (from 50 to 54 %). For full questionnaire responses, see Supplementary Material 5.

Table 3
Main outcomes overall and for each condition (mean(sd) and n(%)).

	Control (N = 393)	Product price reductions removed (N = 400)	Bulk buy price reduction removed (N = 365)	Value pricing removed (N = 400)	All price-based incentives removed (N = 368)	Overall (N = 1926)
Mean (sd)						
Hunger [a]	46.70 (28.63)	49.46 (28.46)	50.04 (26.67)	48.65 (27.60)	48.79 (28.45)	48.71 (27.98)
Thirst [a]	52.32 (24.30)	52.16 (23.32)	52.13 (23.88)	52.26 (4.13)	51.75 (24.41)	52.13 (23.98)
Total Spend	28.50 (13.29)	36.61 (15.66)	38.35 (17.06)	34.17 (14.65)	54.44 (24.52)	38.18 (19.35)
Total Kcal	3877.00 (1770.22)	3919.00 (1755.53)	3896.00 (1849.48)	3989.00 (1768.97)	3625.00 (1737.60)	3864 (1778.47)
Spend per HH member	11.43 (4.95)	13.96 (5.66)	14.74 (5.29)	12.58 (5.02)	21.03 (6.27)	14.66 (6.37)
Kcal per HH member	1485.00 (479.93)	1431.00 (471.48)	1456.70 (508.16)	1426.00 (473.93)	1394.00 (456.11)	1439.00 (478.51)
Number of items selected [b]	4.59 (2.26)	4.60 (2.18)	4.54 (2.33)	4.72 (2.07)	4.39 (2.13)	4.57 (2.19)
Number of small pizzas selected [c]	0.10 (038)	0.07 (0.33)	0.06 (0.28)	0.09 (0.35)	0.13 (0.43)	0.09 (0.36)
Number of medium pizzas selected [c]	0.15 (0.49)	0.16 (0.51)	0.17 (0.52)	0.18 (0.54)	0.29 (0.73)	0.19 (0.56)
Number of large pizzas selected [c]	0.13 (0.47)	0.15 (0.59)	0.18 (0.59)	0.12 (0.46)	0.13 (0.44)	0.14 (0.49)
Number of melts selected[c, d]	0.03 (0.26)	0.04 (0.19)	0.02 (0.14)	0.04 (0.25)	0.02 (0.13)	0.03 (0.20)
Number of sides selected [c]	0.31 (0.74)	0.44 (0.88)	0.48 (1.09)	0.46 (0.88)	0.47 (0.93)	0.43 (0.91)
Number of desserts selected [c]	0.30 (0.65)	0.22 (0.56)	0.29 (0.72)	0.27 (0.58)	0.29 (0.65)	0.27 (0.63)
Number of drinks selected [c]	0.31 (0.83)	0.30 (0.66)	0.28 (0.65)	0.34 (0.78)	0.30 (0.65)	0.30 (0.72)
Number of bulk-buy options selected [c]	0.96 (0.62)	0.93 (0.62)	0.95 (0.87)	0.91 (0.59)	0.84 (0.66)	0.92 (0.67)
N(%)						
Bulk-buy selection						
Y	321 (82 %)	324 (81 %)	286 (78 %)	319 (80 %)	264 (72 %)	1514 (79 %)
N	71 (18 %)	76 (19 %)	79 (22 %)	81 (20 %)	104 (28 %)	412 (21 %)
Small pizza selection [c]						
Y	28 (7 %)	22 (6 %)	18 (5 %)	27 (7 %)	34 (9 %)	129 (7 %)
N	365 (93 %)	378 (95 %)	347 (95 %)	373 (93 %)	334 (91 %)	1797 (93 %)
Med pizza selection [c]						
Y	41 (10 %)	41 (10 %)	46 (13 %)	50 (13 %)	66 (18 %)	244 (13 %)
N	352 (90 %)	359 (90 %)	319 (87 %)	350 (88 %)	302 (82 %)	1682 (87 %)
Large pizza selection [c]						
Y	36 (9 %)	39 (10 %)	42 (12 %)	33 (8 %)	35 (10 %)	185 (10 %)
N	357 (91 %)	361 (90 %)	323 (88 %)	367 (92 %)	333 (90 %)	1741 (90 %)

[a] Hunger and thirst are rated on a Likert scale anchored 1–100 (higher scores indicate greater hunger/thirst).
[b] Includes the number of items in bulk-buy options.
[c] Refers to selection of items outside of bulk-buy selections.
[d] Melts were the non-pizza main dish option available to select.

4. Discussion

In the present study removal of individual types of price-based incentives in isolation had minimal impact on energy selection from a hypothetical food delivery platform for a pizza outlet. Energy selected was lowest when all price-based incentives were removed simultaneously (7 % lower compared to when all price-based incentives were present). However, the tendency for energy selected in the all price-based incentives removed condition to be lower was only statistically significantly different to the value pricing removed condition after accounting for multiple comparisons. Bayes factors did not indicate convincing evidence for all other comparisons, suggesting further research is required before drawing firm conclusions on the effect of removing different forms of price-based incentives. The monetary value of orders was lowest for participants in the control condition (all price incentives present) compared to all other conditions. Monetary value of orders was significantly lower in the control condition compared to all other conditions. No significant interactions between pricing conditions and participant characteristics (SEP, food choice motives, BMI) on energy selected were observed, indicating a lack of evidence for moderation by participant characteristics of the effects of removing price-based incentives in a virtual food delivery setting.

When individual incentives were removed overall price increases may have been insufficient to cause significant changes to ordering behaviour and/or removal of individual incentives may have prompted switching to use of other remaining available price incentives. The observed main effect of condition on energy selection was driven by lower energy selection when all price-based incentives were removed. However, the difference was only statistically significant when compared to the value pricing removed condition. Findings suggest that the removal of one type of price-based incentive alone may have limited impact if applied to a real-world setting. When total energy selected was compared for control (all price-based incentives present) vs all price-based incentives removed, Bayes factors suggested 'anecdotal' (weak) evidence for lower energy purchased in the all price-based incentives removed vs. control condition, therefore the non-significant p-values should be interpreted with caution. It will therefore be important to further study whether removal of all price-based incentives in OOH food sector settings significantly reduces energy selected when compared to the presence of price-based incentives.

The intervention approach adopted and differences between experimental conditions in the present study did not allow for direct quantification of price elasticities, as has been estimated in previous research on food pricing (e.g.(Andreyeva et al., 2022)). However, the findings

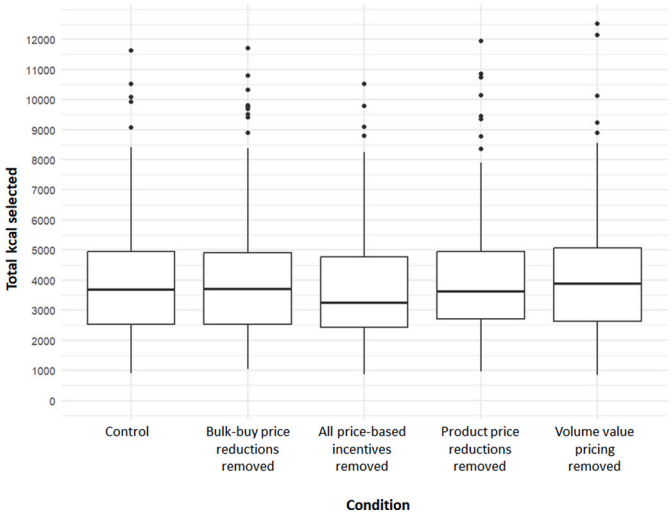

Fig. 2. Total energy (kcal) selected per household across the five conditions[1]
[1] In the control condition all forms of price-based incentives were present. Other condition names refer to which price-based incentives were removed in that condition.

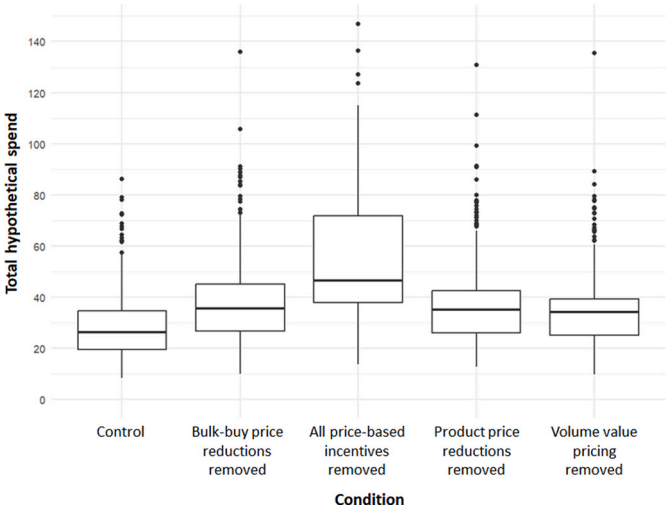

Fig. 3. Monetary value of orders (GBP) across the five conditions.[a]
[a] In the control condition all forms of price-based incentives were present. Other condition names refer to which price-based incentives were removed in that condition.

Table 4
Bayes Factor analyses for pairwise comparisons with the control and all price-based incentives removed conditions.

Comparison	Cohen's d	R	BF10[a]	Uncertainty
Control vs Value pricing removed	0.06	0.707	0.12	±0.17 %
Control vs bulk-buy price reductions removed	0.01	0.707	0.08	±0.23 %
Control vs Product price reductions removed	0.02	0.707	0.08	±0.23 %
All price-based incentives removed vs Control	0.14	0.707	0.55	±0.04 %
All price-based incentives removed vs Value pricing removed	0.21	0.707	4.52	±0.00 %
All price-based incentives removed vs Bulk-buy price reductions removed	0.15	0.707	0.64	±0.03 %
All price-based incentives removed vs Product price reductions removed	0.17	0.707	1.14	±0.02 %

[a] BF10: Bayes factor.

Table 5
Primary analyses exploring ordering behaviour for specific types of price-based incentives.

Model description	Estimate/ OR	95 % CI	P Value
[a] Removing value pricing on the likelihood of selecting a small sized pizza	0.95	0.55, 1.66	0.867
[a] Removing value pricing on the likelihood of selecting a large sized pizza	0.88	0.54, 1.45	0.619
[a] Removing bulk-buy price reductions on the likelihood of selecting a bulk-buy option	1.23	0.86, 1.77	0.247
[b] Removing product price reductions on the number of items selected	−0.07	−0.35, −0.21	0.618

[a] Binary logistic regression.
[b] Linear regression.

from this study are somewhat comparable to previous intervention research examining price-based interventions. For example, applying a tax-based intervention on energy dense foods (Batis et al., 2016), food products high in saturated fat (Jensen et al., 2016), and sugar-sweetened beverages (Teng et al., 2019) have been associated with reductions in purchase and consumption by between 4 and 10 %, which are comparable to the mean 7 % reduction observed in the present study. Previous research conducted in a restaurant setting found that the implementation of price reductions on healthier menu items intervention was associated with a non-significant reduction in energy selection of approximately 5 % (Witkam et al., 2025).

It may be important to consider whether different aspects of a price-based incentive result in consumers selecting higher energy options. Previous research suggests that changing the price of an item alone is not as effective in changing selection as informing consumers the price has been changed (Hoenink et al., 2020). The nuance in how price-based incentives are presented may be important to consider in future research and policy. Our findings would suggest that the complete removal of price-based incentives in the OOH food sector may cause modest (7 %) reductions in energy selected based on the present study, although potential effectiveness should now be examined in real-world environments. As this was a hypothetical selection and participants did not have to spend their own money, effects may be underestimated. The response to the removal of price-based incentives was of a smaller magnitude than anticipated and the present study was powered to detect small to medium effects of condition on energy selection based on previous research.

In the present study, removal of value pricing led to the increased price of large pizzas, and decreased price of small pizzas. Changes to the price of bulk-buy options (i.e. those that included small or large pizzas) were made accordingly. Previous research found that the removal of value pricing led to greater overall energy selected(Finlay et al., 2023) and this was due to increased selection of additional side dishes. The number of sides selected was somewhat higher in the four price-based incentive removal conditions (0.43–0.48) vs the control condition (0.31), suggesting that removal of price-based incentives may encourage purchasing of additional side dishes not subject to price-based incentives. Similarly, the observed significant difference in energy selection between the value pricing removed and all price-based incentives removed conditions may have been in part driven by the total numbers of items selected being somewhat higher (7 %) when value pricing was removed in isolation. These observations highlight the need for policies regarding pricing to not inadvertently increase the appeal of items outside of the scope of pricing interventions(Anderson et al., 2021).

The present study has shown that when ordering food from a takeaway pizza outlet for the household, an excessive amount of food is likely purchased (~1400 kcal per household member) which supports

the suggestion that OOH foods contribute to poor nutrition and high energy intake(Gesteiro et al., 2022; Robinson et al., 2018). In the present study, 21 % of participants reported using a food delivery app at least weekly and based on the public health guidance of 600 kcals per main meal(Public Health England, 2018), the present study results would equate to ordering of ~120 kcals per day over public health recommendations among regular food delivery app users.

In this study, hypothetical spend was lowest in the control condition and highest when all price-based incentives were removed. Changes to menu prices according to study conditions were calculated with the existing prices as a baseline. This may not be representative of changes in a real-world setting if price-based incentives were removed. Evidence suggests that consumer expectations of what they should pay for an item are informed by the promotion frequency and depth of promotion typical for the brand(Kalwani & Yim, 1992). Therefore, if an item is frequently promoted at a discounted price, consumers will be less willing to pay the full price. If this is the case, then we could expect businesses in the OOH sector to adapt to the removal of price-based incentives to provide lower prices across the full menu to ensure willingness of consumers to pay. The ability of the food industry to lessen the impact of a policy has been shown previously. For example, in Scotland when multi-buy promotions on alcohol were banned, retailers increased the use of price discounts(Nakamura et al., 2014). Future research could therefore consider the impact of providing items without an obvious price-based incentive whilst maintaining the standard 'discounted' value of the product (i.e. how we could expect menus to change if price-based incentives were banned).

Population interventions that aim to improve dietary quality at population level should ultimately strive to have a greater positive impact on lower SEP groups as a means of reducing health inequalities (Davey et al., 2022), as low dietary quality and obesity are most common in low SEP groups. In the present study, there was no significant interaction between condition and SEP on total energy selected. The average spend per household in the control condition was approximately £29, compared to £34-£54 in all other conditions. Making a OOH meal less affordable for lower SEP groups while also having little positive impact in terms of health could inadvertently widen socioeconomic inequalities (Darmon et al., 2016). Future research could seek to examine the impact of implementing price-based incentives or other forms of intervention on healthier food options to improve nutritional quality in the OOH food sector.

4.1. Limitations

As discussed, this was a study of hypothetical choice and therefore the effects of removing price-based incentives on energy selected may be underestimated. We examined selection behaviour in a specific type of OOH outlet and the types of price-based incentive it offers. Results will therefore not directly generalise to other OOH outlet types and individual businesses. For example, the outlet tested in this study offered very few options that could be considered healthier, and this would have prevented switching from expensive less healthy food options to less expensive healthier options upon removal of price-based incentives, as may be the case in other outlet types. Ensuring that affordable healthier options are available in OOH outlets could increase the likelihood of healthier ordering behaviour following price-based restrictions for less healthy food. Further research could explore the impact of removing price-based incentives in a wider range of settings, for example, different cuisines and independent businesses. A final limitation of this study is that the drop-out rate was fairly high (i.e. between signing up to the study and completing the study) and this increases the potential for bias in the findings. However, drop-out did not tend to differ by condition and occurred prior to intervention/control condition exposure.

5. Conclusion

The present study examined the effect on hypothetical food orders of removing different types of price-based incentives from a simulated food delivery platform. The presence of all incentives (control condition) was associated with a significantly lower hypothetical spend compared to conditions in which price-incentives were removed. Kcal selected tended to be lower in the all price-based incentives removed condition compared to the control condition (−7 %) and other conditions (average −8 %), although only the difference between all price-based incentives removed and the value pricing removed conditions reached pre-specified statistical significance (−364 kcal; $p < .0125$; $d = 0.21$). Bayes Factors indicated that for all other pairwise comparisons the data did not provide strong evidence to support either the presence or absence of an effect. Therefore, further research is needed assess the impact of removing price-based incentives in OOH food settings.

CRediT authorship contribution statement

Amy Finlay: Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Andrew Jones:** Writing – review & editing, Supervision, Software, Methodology, Funding acquisition, Conceptualization. **Martin O'Flaherty:** Writing – review & editing, Funding acquisition, Conceptualization. **Zoé Colombet:** Writing – review & editing, Funding acquisition, Conceptualization. **Nick Townsend:** Writing – review & editing, Funding acquisition, Conceptualization. **James Garbutt:** Writing – review & editing, Funding acquisition, Conceptualization. **Rebecca Evans:** Writing – review & editing, Validation. **Zoi Toumpakari:** Writing – review & editing, Funding acquisition. **Eric Robinson:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

Ethical approval

Ethical approval was granted by the University of Liverpool's Ethics Committee (Project ID: 14420) and all participants provided informed verbal consent.

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Declaration of competing interest

ER has previously received research funding from Unilever and the American Beverage Association for unrelated research projects. Other authors have no competing interests.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.appet.2025.108228.

Data availability

The full dataset is available on the Open Science Framework (https://osf.io/fxc8q/).

References

Anderson, P., O'Donnell, A., Kaner, E., Llopis, E. J., Manthey, J., & Rehm, J. (2021). Impact of minimum unit pricing on alcohol purchases in Scotland and Wales: Controlled interrupted time series analyses. *The Lancet Public Health, 6*(8), e557–e565.

Andrews, E., & Croal, P. (2023). *Household disposible income and inequality, UK: Financial year ending 2022* (the effects of taxes and benefits on houshold income, disposable income estimate, issue. https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/datasets/householddisposableincomeandinequality.

Andreyeva, T., Marple, K., Moore, T. E., & Powell, L. M. (2022). Evaluation of economic and health outcomes associated with food taxes and subsidies: A systematic review and meta-analysis. *JAMA Network Open, 5*(6), Article e2214371.

Backholer, K., Sacks, G., & Cameron, A. J. (2019). Food and beverage price promotions: An untapped policy target for improving population diets and health. *Current Nutrition Reports, 8*(3), 250–255. https://doi.org/10.1007/s13668-019-00287-z

Batis, C., Rivera, J. A., Popkin, B. M., & Taillie, L. S. (2016). First-year evaluation of Mexico's tax on nonessential energy-dense foods: An observational study. *PLoS Medicine, 13*(7), Article e1002057.

Bleich, S. N., Dunn, C. G., Frelier, J. M., Moran, A. J., & Vercammen, K. A. (2020). Nutrition composition of children's meals in twenty-six large US chain restaurants. *Public Health Nutrition, 23*(12), 2245–2252. https://doi.org/10.1017/S1368980019004907

Darmon, N., Lacroix, A., Muller, L., & Ruffieux, B. (2016). Food price policies may improve diet but increase socioeconomic inequalities in nutrition. *Hidden hunger, 115*, 36–45.

Davey, F., McGowan, V., Birch, J., Kuhn, I., Lahiri, A., Gkiouleka, A., Arora, A., Sowden, S., Bambra, C., & Ford, J. (2022). Levelling up health: A practical, evidence-based framework for reducing health inequalities. *Public Health in Practice, 4*, Article 100322. https://doi.org/10.1016/j.puhip.2022.100322

Davies, T., Coyle, D., Shahid, M., Pettigrew, S., Wu, J. H. Y., & Marklund, M. (2023). Packaged foods purchased on price promotion in Australia. *Appetite, 180*, Article 106352. https://doi.org/10.1016/j.appet.2022.106352

Finlay, A., Boyland, E., Jones, A., Witkam, R., & Robinson, E. (2023). The impact of calorie labelling and proportional pricing on out of home food orders: A randomised controlled trial study using a virtual food and drink delivery app. *International Journal of Behavioral Nutrition and Physical Activity, 20*(1), 112. https://doi.org/10.1186/s12966-023-01513-2

Gesteiro, E., García-Carro, A., Aparicio-Ugarriza, R., & González-Gross, M. (2022). Eating out of home: Influence on nutrition, health, and policies: A scoping review. *Nutrients, 14*(6), 1265. https://www.mdpi.com/2072-6643/14/6/1265.

Gov.UK. (2020). *Tackling obesity: Empowering adults and children to live healthier lives*. GOV.UK. https://www.gov.uk/government/publications/tackling-obesity-government-strategy/tackling-obesity-empowering-adults-and-children-to-live-healthier-lives.

Harnack, L. J., French, S. A., Oakes, J. M., Story, M. T., Jeffery, R. W., & Rydell, S. A. (2008). Effects of calorie labeling and value size pricing on fast food meal choices: Results from an experimental trial. *International Journal of Behavioral Nutrition and Physical Activity, 5*, 1–13.

Haws, K. L., & Winterich, K. P. (2013). When value trumps health in a supersized world. *Journal of Marketing, 77*(3), 48–64.

Heck, D. W., Boehm, U., Böing-Messing, F., Bürkner, P.-C., Derks, K., Dienes, Z., Fu, Q., Gu, X., Karimova, D., & Kiers, H. A. (2023). A review of applications of the Bayes factor in psychological research. *Psychological Methods, 28*(3), 558.

Hoenink, J. C., Mackenbach, J. D., Waterlander, W., Lakerveld, J., van der Laan, N., & Beulens, J. W. J. (2020). The effects of nudging and pricing on healthy food purchasing behavior in a virtual supermarket setting: A randomized experiment. *International Journal of Behavioral Nutrition and Physical Activity, 17*(1), 98. https://doi.org/10.1186/s12966-020-01005-7

Horta, P. M., Matos, J. D. P., & Mendes, L. L. (2022). Food promoted on an online food delivery platform in a Brazilian metropolis during the coronavirus disease (COVID-19) pandemic: A longitudinal analysis. *Public Health Nutrition, 25*(5), 1336–1345. https://doi.org/10.1017/S1368980022000489

Jensen, J. D., Smed, S., Aarup, L., & Nielsen, E. (2016). Effects of the Danish saturated fat tax on the demand for meat and dairy products. *Public Health Nutrition, 19*(17), 3085–3094. https://doi.org/10.1017/S1368980015002360

Jia, S. S., Todd, A. R., Vanderlee, L., Farrell, P., Allman-Farinelli, M., Sacks, G., Gibson, A. A., & Partridge, S. R. (2024). Offline to online: A systematic mapping review of evidence to inform nutrition-related policies applicable to online food delivery platforms. *BMC Medicine, 22*(1), 542. https://doi.org/10.1186/s12916-024-03747-8

Kalwani, M. U., & Yim, C. K. (1992). Consumer price and promotion expectations: An experimental study. *Journal of Marketing Research, 29*(1), 90–100. https://doi.org/10.1177/002224379202900108

Kassambara, A. (2023). Ggpubr: 'ggplot2' based publication ready plots. https://CRAN.R-project.org/package=ggpubr.

Kaur, A., Lewis, T., Lipkova, V., Fernando, S., Rayner, M., Harrington, R. A., Waterlander, W., & Scarborough, P. (2020). A systematic review, and meta-analysis, examining the prevalence of price promotions on foods and whether they are more likely to be found on less-healthy foods. *Public Health Nutrition, 23*(8), 1281–1296.

Konttinen, H., Halmesvaara, O., Fogelholm, M., Saarijärvi, H., Nevalainen, J., & Erkkola, M. (2021). Sociodemographic differences in motives for food selection: Results from the LoCard cross-sectional survey. *International Journal of Behavioral Nutrition and Physical Activity, 18*(1), 71. https://doi.org/10.1186/s12966-021-01139-2

Konttinen, H., Sarlio-Lähteenkorva, S., Silventoinen, K., Männistö, S., & Haukkala, A. (2013). Socio-economic disparities in the consumption of vegetables, fruit and energy-dense foods: The role of motive priorities. *Public Health Nutrition, 16*(5), 873–882.

Lago - Peñas, S., Rivera, B., Cantarero, D., Casal, B., Pascual, M., Blázquez-Fernández, C., & Reyes, F. (2021). The impact of socioeconomic position on non-communicable diseases: What do we know about it? *Perspectives in Public Health, 141*(3), 158–176. https://doi.org/10.1177/1757913920914952

Looi, E. S., Backholer, K., Cameron, A. J., Grigsby-Duffy, L., Orellana, L., & Sacks, G. (2022). Price promotions offered by quick service restaurants in Australia: Analysis from an obesity prevention perspective. *Public Health Nutrition, 25*(3), 513–527.

Mair, P., & Wilcox, R. (2020). Robust statistical methods in R using the WRS2 package. *Behaviour Research Methods, 52*, 464–488. https://doi.org/10.3758/s13428-019-01246-w

Mayuree, R., Ashkan, A., Gitanjali, S., & Dariush, M. (2013). Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis. *BMJ Open, 3*(12), Article e004277. https://doi.org/10.1136/bmjopen-2013-004277

Millisecond. (n.d.). Inquisit: Precision testing for psychological research https://www.millisecond.com/.

Morey, R. D., & Rouder, J. N. (2024). BayesFactor: Computation of bayes factors for common designs. https://CRAN.R-project.org/package=BayesFactor.

Nakamura, R., Suhrcke, M., Pechey, R., Morciano, M., Roland, M., & Marteau, T. M. (2014). Impact on alcohol purchasing of a ban on multi-buy promotions: A quasi-experimental evaluation comparing Scotland with England and Wales. *Addiction, 109*(4), 558–567. https://doi.org/10.1111/add.12419

Office for National Statistics. (2015). Chapter 3: Equivalised income. In *Compendium: Family spending in the UK*. https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/compendium/familyspending/2015/chapter3equivalisedincome.

Office for National Statistics. (2023). *Age groups*. GOV.UK. https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/age-groups.

Operario, D., Adler, N. E., & Williams, D. R. (2004). Subjective social status: Reliability and predictive utility for global health. *Psychology and Health, 19*(2), 237–246.

Powell, L. M., Kumanyika, S. K., Isgor, Z., Rimkus, L., Zenk, S. N., & Chaloupka, F. J. (2016). Price promotions for food and beverage products in a nationwide sample of food stores. *Preventive Medicine, 86*, 106–113. https://doi.org/10.1016/j.ypmed.2016.01.011

Prolific. (2022). Conduct your best research. Retrieved November 24 from https://www.prolific.co/researchers.

Public Health England. (2018). A quick guide to the government's healthy eating recommendations. https://assets.publishing.service.gov.uk/media/5ba8a087e5274a55c3407c38/A_quick_guide_to_govt_healthy_eating_update.pdf.

Reeves, S. (2020). Meal deals, combos and bundling: The impact on the nutrition composition of children's meals in restaurants. *Public Health Nutrition, 23*(12), 2253–2255. https://doi.org/10.1017/S1368980019005160

Robinson, E., Jones, A., Whitelock, V., Mead, B. R., & Haynes, A. (2018). (Over)eating out at major UK restaurant chains: Observational study of energy content of main meals. *BMJ, 363*, Article k4982. https://doi.org/10.1136/bmj.k4982

Statista Research Department. (2023). Leading foods ordered for delivery in the United Kingdom (UK) in 2017. https://www-statista-com.liverpool.idm.oclc.org/statistics/830633/leading-takeaway-cuisines-ordered-united-kingdom-uk/.

Statista Research Department. (2024). Number of users of the online food delivery market in the United Kingdom from 2017 to 2028, by segment. https://www-statista-com.liverpool.idm.oclc.org/forecasts/1405516/users-online-food-delivery-uk.

Steptoe, A., Pollard, T. M., & Wardle, J. (1995). Development of a measure of the motives underlying the selection of food: The food choice questionnaire. *Appetite, 25*(3), 267–284.

Teng, A. M., Jones, A. C., Mizdrak, A., Signal, L., Genç, M., & Wilson, N. (2019). Impact of sugar-sweetened beverage taxes on purchases and dietary intake: Systematic review and meta-analysis. *Obesity Reviews, 20*(9), 1187–1204. https://doi.org/10.1111/obr.12868

Van der Velde, L. A., Schuilenburg, L. A., Thrivikraman, J. K., Numans, M. E., & Kiefte-de Jong, J. C. (2019). Needs and perceptions regarding healthy eating among people at risk of food insecurity: A qualitative analysis. *International Journal for Equity in Health, 18*(1), 184. https://doi.org/10.1186/s12939-019-1077-0

Vermeer, W., Alting, E., Steenhuis, I., & Seidell, J. (2010). Value for money or making the healthy choice: The impact of proportional pricing on consumers' portion size choices. *The European Journal of Public Health, 20*(1), 65–69.

Wickham, H. (2016). *ggplot2: Elegant graphics for data analysis*. New York: Springer-Verlag. https://ggplot2.tidyverse.org.

Witkam, R., Brealey, J., Latham, R., Jones, A., & Robinson, E. (2025). The effect of healthier menu item price reductions in the out-of-home food sector on energy purchased and consumed: A restaurant-based pilot experiment. *BMC Public Health, 25*(1), 1893. https://doi.org/10.1186/s12889-025-21992-1

Zavala, G. A., Ainscough, T. S., & Jimenez-Moreno, A. C. (2022). Barriers to a healthy diet and physical activity in Mexican adults: Results from the Mexican health and nutrition survey. *Nutrition Bulletin, 47*(3), 298–306. https://doi.org/10.1111/nbu.12568