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1 **Impact of a targeted direct marketing price promotion intervention (Buywell) on food**
2 **purchasing behaviour by low income consumers: a randomised controlled trial**

3

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23 **Authors' contributions**

24 MS was the PI and took the lead in writing the paper which was revised by all authors. AMM
25 contributed to study design and data analysis, and led the consumer survey.

26 AF and LS conducted the EPOS analysis.

27 ASA and KB developed the intervention recipes and advised on selection of promotion foods and
28 identification of target group.

29 DE conducted the consumer research and contributed to study design.

30

31 **Keywords:** Public health, nutrition, diet, health inequalities, marketing, promotion.

32

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34 **Abstract**

35 **Background**

36 Price promotions are a promising intervention for encouraging healthier food purchasing. We
37 sought to assess the impact of a targeted direct marketing price promotion combined with healthy
38 eating advice and recipe suggestions on purchase of selected healthier foods by low income
39 consumers.

40 **Methodology**

41 We conducted a randomised controlled trial (n=53,367) of a direct marketing price promotion
42 (Buywell) combined with healthy eating advice and recipe suggestions for low income consumers
43 identified as 'less healthy' shoppers. Impact was assessed using electronic point of sale data for UK
44 low income shoppers before, during and after the promotion.

45 **Results**

46 The proportion of customers buying promoted products in the intervention month increased by
47 between 1.4% and 2.8% for four of the five products. There was significantly higher uptake in the
48 promotion month ($p<0.001$), for the intervention group, than would have been expected on the basis
49 of average uptake in the other months. When product switching was examined for semi-
50 skimmed/skimmed milk, a modest increase (1%) was found in the intervention month of customers
51 switching from full fat to low fat milk. This represented 8% of customers who previously bought
52 only full fat milk. Effects were generally not sustained after the promotion period.

53 **Principal conclusions**

54 Short-term direct marketing price promotions combined with healthy eating advice and recipe
55 suggestions targeted at low income consumers are feasible and can have a modest impact on short
56 term food purchasing behaviour but further approaches are needed to help sustain these changes.

57

58 Introduction

59 Diet is a major modifiable risk factor for many cancers ⁽¹⁾ and circulatory diseases ^(2,3). Obesity is a
60 significant contributor to cardiovascular disease, diabetes and cancer, and continues to rise
61 internationally ⁽⁴⁾ and in the UK ⁽⁵⁾. Of particular concern are persistent inequalities in obesity, diet
62 and health-related outcomes ^(6,7). Low income consumers in the UK and other European countries
63 tend to have *lower* intakes of fruit, vegetables, wholegrain bread and cereals, fruit juice and oil-rich
64 fish, and *higher* intakes of sugar, whole milk and processed meats compared to higher income
65 consumers ⁽⁸⁻¹⁰⁾.

66 Increasingly, attention has focussed on system-level interventions which modify the social
67 environment in which food choices are made ⁽¹¹⁻¹³⁾ and make healthier choices easier ⁽¹⁴⁾. Access
68 and price have been identified as barriers to healthier eating for some low income consumers ⁽¹⁵⁻¹⁹⁾,
69 and the World Health Organization and various national governments have called for improved
70 access to affordable healthy food for vulnerable groups ⁽²⁰⁻²²⁾. If inequalities in diet are to be
71 narrowed, it may be important to target prevention interventions primarily or specifically at these
72 groups ⁽²³⁾.

73 Recent healthy diet strategies ^(21, 24-25) have recommended harnessing marketing levers such as
74 product development, labelling and pricing in support of ‘behaviour that builds health’, and
75 working with retail businesses which have the marketing expertise to engage with customers and
76 encourage specific behaviours. Various studies suggest that interventions using point-of-sale
77 promotions, pricing, in-store signposting and product labelling, singly or in combination, are
78 feasible to implement and have the potential to impact on customer purchasing behaviour ⁽²⁶⁻²⁹⁾.

79 Recent debate has focussed on financial incentives as a motivator to initiate change in health
80 behaviours ^(11, 30-32), although this approach has not yet been demonstrated to produce consistently
81 positive results in diet-related behaviours such as weight loss ⁽³³⁾. Financial incentives comprise
82 food price promotions, subsidies, and rewards, and a recent review found that “*retail price*
83 *promotions can influence purchasing patterns and promote overall greater consumption of the*
84 *product, but this is highly dependent on the nature of the promotion (e.g. the depth of the discount,*
85 *the shopper, and the specific food*” (p10) ⁽³⁴⁾. Recent studies in New Zealand and the Netherlands
86 have demonstrated, using randomised controlled trial (RCT) methods, that price discounts for
87 healthier foods can have a significant and sustained effect on food purchasing ⁽³⁵⁾ and on fruit and
88 vegetable purchases ⁽³⁶⁾. Although effects tend to be smaller than those obtained in more intensive

89 interventions ⁽³⁷⁾, price promotion interventions potentially have a much wider reach and are
90 relatively cost-effective ⁽³⁸⁾. This suggests that price promotions can make a useful contribution
91 towards promoting healthy diets, as part of a portfolio of approaches which might also include
92 health education, availability and fiscal measures.

93 Price promotions have been extensively applied and studied in retailing ⁽³⁹⁾. Technological
94 developments have given rise to new and more targeted strategies, such as using data linked to
95 loyalty schemes ^(40, 41) and customers' history of purchasing to develop promotions targeted at
96 individual customers ⁽⁴²⁾. Likewise, technology such as electronic point of sales (EPOS) systems
97 offers a unique opportunity for assessing household food purchases which do not rely on
98 participants' memory or literacy, is not subject to recall or social bias, and places no direct burden
99 on participants ^(43, 44). The ability to develop and deliver promotions targeted at groups of customers
100 on the basis of previous purchasing behaviour and other characteristics makes this a particularly
101 promising, although underexplored, route for addressing health inequalities associated with food
102 purchasing behaviour.

103 This study sought to assess the feasibility and impact of a targeted direct marketing price promotion
104 intervention (Buywell) on food purchases by low income customers known not to be purchasing
105 'healthy' products at the time of the intervention.

106

107 **Methods**

108 **Overview**

109 The intervention comprised a direct marketing (i.e. mailed out to customers' homes) price
110 promotion combined with healthy eating advice and recipe suggestions. Working with a major UK
111 food retailing group, we developed a price-based promotion combined with healthy eating advice
112 and recipe suggestions for selected healthier products which was mailed to regular low income
113 customers in May 2007. The impact was assessed by examining data on actual food purchases,
114 using EPOS technology, for intervention (37,034) and control group (16,333) customers for two
115 months before, one month during and three months after the intervention. A consumer survey was
116 also conducted post-intervention with 3,706 customers to examine their awareness of and reactions
117 to the intervention; a brief summary of findings is reported elsewhere ⁽⁴⁵⁾. Ethical approval for the
118 study was provided by University of Stirling Research Ethics Committee.

119 Identification, selection and randomisation of sample

120 Information held by the retailer from membership card data and linked EPOS transaction data was
121 used to identify and select the study sample. The first step was to identify consumers who used the
122 retailer for their main food shopping, defined by possession of a loyalty/membership card,
123 proximity to a store in a town with few other major food retailers, and being categorised as in either
124 of the top two customer spending categories, based on frequency of shopping and average number
125 of items purchased per month.

126 The second step was to identify low income customers. Membership data held by the retailing
127 group did not record individual income or socio-economic status. However, based on their postcode
128 and other data, all customers were assigned to a category within MosaicUK, a widely used geo-
129 demographic classification scheme⁽⁴⁶⁾. Three Mosaic categories including primarily disadvantaged
130 customers were identified as the core target for the intervention.

131 The final step was to identify consumers whose current food purchasing behaviour had the potential
132 to be shifted in a 'healthier' direction. The most practicable strategy was to identify those who
133 could currently be defined as purchasers of 'healthier' foods and exclude them from the sample. All
134 food product categories stocked by the retailing group were examined, and 90 were identified which
135 were low in fat, sugar and sodium according to the UK Food Standards Agency 'traffic lights'
136 scheme⁽⁴⁷⁾. From these, 20 of the most commonly purchased product categories were identified to
137 serve as indicators of 'healthier' shopping. The indicators were based on the 35 item healthy eating
138 indicator shopping basket tool (HEISB)⁽⁴⁸⁾. These included low fat dairy products (milk, yoghurt,
139 spreading fats) and wholegrain products (brown and wholemeal breads, wholegrain breakfast
140 cereals, wholegrain rice and pasta, beans and peas). Fresh vegetables and fruits (n=15) included in
141 the HEISB were not used because formative work indicated they were not a reliable indicator of
142 purchasing patterns from the retailing group because these items were occasionally bought
143 elsewhere (e.g. produce markets). 'Healthier' purchasers were arbitrarily defined as those who had
144 bought a wide selection of these items, defined as at least 8 (40%), of the healthy eating indicator
145 foods within the last week, and these were removed from the sample.

146 The retailing group applied the three criteria of regular food shopping, low income Mosaic group
147 and less-healthy purchasing to its customer database for the time period immediately prior to the
148 intervention. This yielded a sample group of 53,367 adults aged 31-65 which was then randomised
149 on a 70:30 allocation ratio to intervention (n=37,034) or control group (n=16,333). The rationale

150 for the 70:30 split was to reach as large a customer group as the retailing group could afford (the
151 costs of price promotions being borne by the retailer in reduced profits), whilst ensuring a
152 sufficiently large control group. The randomisation was carried out by the retailer's own in-house
153 data team, using procedures which were not disclosed to the academic research team.

154 **The intervention**

155 Formative focus group research (six focus groups, n=34) was conducted with a sample of target
156 group consumers to inform the intervention design. Findings suggested that older and female
157 shoppers were more likely to use price promotions, and that although customers were fairly
158 conservative in their shopping habits, they felt their meals sometimes lacked variety. This suggested
159 that there was potential for a promotion comprising offers on basic food products which could be
160 combined to make a meal, especially if linked to recipe ideas and if separate coupons were provided
161 to maximise choice and minimise waste. Informed by this research, a direct mail price promotion
162 was developed. This comprised a flyer with two offers. The first was a Healthy Meal Deal, which
163 comprised healthy eating advice, two suggested recipes (one based on mince, vegetables and a
164 sauce, and one based on chicken, vegetables and a sauce), and discount coupons worth £2.50 in
165 total for the ingredients of the two recipes. The recipes were analysed for nutritional content and
166 piloted by nutritionists before being included in the offer. The second offer was a Low Fat Milk
167 Repeat Purchase offer, which comprised healthy eating advice on the value of calcium to teeth and
168 bone development, and six discount coupons for retailer brand skimmed and semiskimmed milk in
169 two sizes (Figure 1). In summary, the five products on which price promotions were offered were
170 low fat beef mince, skinless chicken, any fresh vegetables, ready-to-eat sauce (two different
171 flavours, both assessed as meeting health criteria), and skimmed/semi-skimmed milk (Figure 1).
172 Intervention group customers could use the discount by presenting the flyer at the till. The control
173 group did not receive the flyer and would not have been aware of the promotion.

174

175 The promotion was mailed from 7th-28th May, 2007. The time of the year was chosen to avoid other
176 key periods of promotional activity such as Christmas and Easter.

177 **EPOS data analysis**

178 The primary outcome of the study was the purchase of the promoted products, using EPOS data.
179 The outcome measures of interest were uptake of the promotion for each of the promotion products
180 and product switching. Anonymised EPOS data were supplied from March to August (with May as
181 the promotion month) by the retailer by transaction. Recorded purchases of the promoted products

182 were the primary outcome measure. Data were aggregated by customer membership card number to
183 give customer-based data and 'basket' combination data which were compared from month to
184 month. EPOS data are classified by a sequence of main and sub-categories, with every individual
185 product of a given size having a unique code. There were more than 150,000 products on the
186 retailer's product list, although this included non-food items and items not currently on sale. Codes
187 were obtained for the promotion products and entered to identify purchase of these products.

188 Uptake of the promoted products was analysed in terms of the number and proportion of customers
189 buying each of the products, compared with the control group. Chi-square tests were used to test
190 whether uptake of products, by the intervention group in the promotion month, could have occurred
191 by chance. Two tests were conducted for all promotion products. Firstly, differences between
192 control and intervention groups were tested. Secondly, differences were examined between
193 transactions in the promotion month (May) and the average uptake for each product for the months
194 excluding the promotion. This accounts for seasonal variation in uptake of products.

195 Product switching is an important part of the uptake of any promotion⁽⁴⁹⁾ and can have different
196 dimensions: health switching (e.g. from full fat to semi-skimmed milk), brand switching (e.g. from
197 a branded product to retailer brand), and pack size switching (from the size usually bought to the
198 size included in the offer). In public health terms, only the first form of switching, from a less to
199 more healthy variant, is meaningful⁽⁵⁰⁾. Within this paper, information on switching is presented for
200 milk, where less healthy variants could be clearly identified within the data. Because of the way
201 products were categorised by the retailer in the EPOS data, it was more difficult to identify less
202 healthy variants for the meat products included in the promotion.

203 **Results**

204 Over 4 million transactions per month were recorded on the retailer-supplied database. Nearly all
205 (99.6%) of the study group made purchases with the retailing group at the start of the study, falling
206 slightly to 92.6% still making purchases with the retailing group by the end of the six month study
207 period. The mean number of items purchased per customer over the study period ranged between 83
208 and 92 (Table 1).

209 **Uptake**

210 Figure 2 illustrates uptake of the promoted products by both groups over the study period. There
211 was wide variation in the proportions regularly buying each product. Whilst over 60% bought
212 vegetables, the other four products were less commonly purchased. For example, only around 40%

213 regularly bought skinless chicken and fewer than 5% bought ready-to-eat sauce. For four of the five
214 promoted products, there was a small upward spike, ranging from 1.4% to 2.8%, in the proportion
215 of intervention customers purchasing the product in May, the intervention month (Figure 2A): semi-
216 skimmed/skimmed milk (33.2% to 34.6%), lean steak mince (9.7% to 12.5%), skinless chicken
217 breasts (6.3% to 8.2%), and ready-to-eat sauce (1.4% to 2.8%). Figure 2B illustrates that the
218 proportion of control customers purchasing each of the five promoted products remained consistent
219 in the month of the intervention, reflecting the constancy of purchasing patterns for most shoppers.
220 Vegetable purchases increased by only 0.2% among intervention customers in May, but decreased
221 by 0.8% among control group customers; following the promotion, vegetable purchases decreased
222 in both the intervention and the control group, perhaps reflecting seasonality. For each of the five
223 products, the promotion month showed a significantly higher ($p<0.001$) value, for the intervention
224 group, than would have been expected on the basis of average uptake in the other months.
225 Similarly, when compared with the control sample, the promotion values for each of the products
226 were significantly higher ($p<0.001$) than expected values. The exception was skimmed and semi-
227 skimmed milk, significant at $p<0.05$. No significant difference was found between the control and
228 intervention groups for the other months. The increase in the proportion of intervention customers
229 purchasing four of the promoted products was generally not sustained beyond the intervention, with
230 the number of customers purchasing each product reverting to pre-intervention levels or lower from
231 June onwards, again perhaps reflecting seasonal patterns in purchasing.

232 Further analyses were conducted to explore whether the promotion widened the customer base for
233 the promoted products, as the data above suggest, or simply encouraged existing customers for the
234 products to buy more than usual. Analysis of the mean number of promoted products purchased per
235 customer each month indicated that this did not tend to vary over the study period (for example, the
236 mean number of low fat beef mince items bought per customer was between 1.28 and 1.30 per
237 month, including May). This suggests that the increase in uptake was explained primarily by a
238 widening of the customer base – i.e. introducing new customers to the promoted products – rather
239 than by existing customers buying more of a product than they would usually. Overall, the data
240 indicate that the intervention month was associated with an increase in the customer base for most
241 of the promoted products.

242 **Product switching**

243 Table 2 profiles the intervention customers, who purchased the promoted milk in May, in terms of
244 continuing customers, new customers and customers who switched brand or switched to lower fat

245 milk. Pack-size switching was not relevant because the promotion was not restricted to specific
246 pack sizes. One third (n=12,399, 33%) of all intervention customers bought the promoted
247 skimmed/semi-skimmed retailer brand milk during the promotion period. Most of these (n=10,072,
248 81%) were continuing customers who had purchased skimmed/semi-skimmed retailer brand milk in
249 the month prior to the intervention, while almost a fifth (n=2,327, 19%) were customers who had
250 switched from buying full fat only, switched from a different brand or were new to purchasing milk
251 at the retailing group. As a proportion of all intervention customers, the numbers taking up the
252 promoted milk, either as a result of switching or new purchases, appear small, representing 1%
253 (n=464) switching to healthier milk, 1% (n=262) switching brand and 4% (n=1,601) new
254 customers. However, from a health perspective, the key target group for the milk promotion is
255 customers who previously purchased only the full fat variety of milk. The EPOS analysis showed
256 that 6,034 intervention customers purchased only the full fat milk in April i.e. before the
257 intervention. Therefore, the 464 customers who switched to a healthier variety of milk during the
258 intervention month represent 8% of the target group.

259 Table 3 shows that only 36% (n=169) of those who had switched to a healthier variety of milk
260 continued to purchase the skimmed/semi-skimmed variety in the month immediately after the
261 promotion ended. Retention of the healthier purchase behaviour continued to decline in subsequent
262 months. Only 17% (n=81) of those who switched to the healthier milk sustained their healthier milk
263 purchasing in each of the three months after the promotion completed; these customers represent
264 1% of the target group of 6,034 intervention customers who had purchased only full-fat milk in
265 April prior to the intervention. Retention declined similarly among those who switched brand of
266 milk and among new customers, with 23% (n=61) of brand switchers and 22% (n=348) of new
267 customers continuing to purchase the skimmed/semi-skimmed retailer brand milk in each of the
268 three months after the promotion.

269 **Discussion**

270 This large randomised trial shows that it is feasible to develop and implement a direct marketing
271 price promotion intervention targeted at low income consumers not currently buying healthy food.
272 Customers who lived in disadvantaged postcode areas and with less 'healthy' current food
273 purchasing patterns were able to be identified by matching EPOS data and customer membership
274 data. These customers were then targeted with price promotion offers, combined with healthy eating
275 advice and recipe suggestions, informed by consumer research insights into their shopping habits
276 and preferences. If nutrition interventions are to have an impact on dietary inequalities, more

277 intensive and targeted efforts directed at those most in need of support are required. Technological
278 innovations and the development of sophisticated marketing databases provide a means not only of
279 identifying the customers most in need of support but also of developing, delivering and evaluating
280 interventions specifically for them.

281 Two key findings emerge from our results. Firstly, there appears to have been a modest and short-
282 lived impact of the intervention on uptake of the promoted products, with the increase in
283 intervention customers buying products in the intervention month ranging from 1.4% to 2.8% for
284 four of the five products. Increased uptake was accounted for primarily by a widening of the
285 customer base rather than by an increased number of purchases by existing customers. If the
286 intervention had only encouraged additional purchasing of the promoted items by customers who
287 already bought them, the contribution to influencing purchasing behaviour in a healthier direction
288 would have been of less significance.

289 Secondly, the intervention appears to have been associated with a small increase in health switching
290 for milk. This increase in lower fat milk was modest, 1% of all intervention customers. However,
291 among the key target group for the milk promotion from a health perspective, 8% switched to a
292 healthier variant of milk in the intervention month, suggesting that price promotions can encourage
293 trial of healthy variants. This is an important target food given the higher consumption of full fat
294 milk by low income groups (⁵¹). Just over a third of customers who switched to purchasing
295 healthier milk, 36%, continued to do so immediately after the promotion ended, and 17% of
296 switchers continued to purchase healthier milk in each of the three months after the promotion
297 completed (1% of the target group). It should be noted that the intervention targeted two different
298 behaviours: the milk promotion targeted switching (from one variant of a regularly-purchased
299 product to a healthier variant of the same product), while the Healthy Meal Deal promotion was
300 focused on encouraging uptake of products which customers had potentially not bought before. The
301 milk switching promotion was potentially simpler, both in terms of the communication and the
302 intended behavioural response, than the meal deal promotion. The short-lived impact of both
303 promotions, particularly the meal deal uptake promotion, is in line with short-term effects reported
304 in retailing studies (⁵²).

305 One of the main strengths of the study was its size, over 50,000 low income customers across the
306 UK. There was a low risk of ‘contamination’ in the control group, as control group customers
307 would not have been aware of the intervention and there were no in-store indicators that it was
308 taking place. The large sample and geographical spread mean that the results are potentially

309 generalisable to the wider UK low income population, although not necessarily to more affluent UK
310 populations or to low income shoppers in other countries. The commitment and support of the
311 retailing group enabled the research team to access large numbers of customers and to profile them
312 in terms of postcode level of disadvantage and food purchasing behaviour, enabling those most 'at
313 risk' to be identified for participation in the intervention. However, it should be noted that the way
314 in which low income consumers were selected, on the basis of MOSAIC geo-demographic
315 classifications, may have resulted in the inclusion of some higher income customers who were
316 living in lower income areas.

317 Collaborations between retailers and academic researchers are potentially challenging for both sides
318 because of different working practices and priorities. Working with this retailer involved building
319 and maintaining relationships with key contacts, providing reassurance of the impartiality of the
320 researchers, agreeing an intervention approach which did not require in-store adjustments and
321 maintenance of an open working relationship, including sharing of results. The retailing group
322 allowed the research team direct access to the EPOS data, rather than, as is the case in some studies,
323 having the research team dependent on the retailer or a third party to conduct the analysis.
324 Analysing the EPOS dataset was challenging because of the vast amount of data generated and
325 because products were not necessarily categorised within the database on the basis of nutrition
326 attributes but according to criteria such as shelf order, making it time-consuming to locate all
327 products of interest for analysis. Another challenge was that the price promotion covered several
328 product categories spread across the retail outlet. While price promotion effects have been
329 extensively studied in the retail literature, the challenge of a promotion such as the current one
330 which links products placed at different locations of the store has been less well researched.
331 Findings from disparate studies suggest that product categorisation is important in shaping the
332 likelihood of healthy food purchasing⁽⁵³⁾ and that location of the products in their correct categories
333 promotes greater likelihood of purchase⁽⁵⁴⁾.

334 Since the survey was carried out, considerable expertise and familiarity with 'Big Data' has been
335 gained and its usefulness much more widely recognised. Using loyalty card data linked to EPOS
336 transactions requires customers to remember to use their identifier each time they buy in the store.
337 However, as noted in the Introduction, EPOS analysis has a number of advantages for evaluation
338 purposes in that it is not subject to recall or social bias and places no direct burden on participants
339 ^(43, 44). This makes it a particularly useful method for evaluating outcomes among obese
340 populations, among whom there is a particular problem of giving socially desirable responses in

341 dietary research (^{55, 56}), and among populations with varying levels of literacy (⁴³). Given the
342 complexity and cost of conducting large-scale dietary and consumer behaviour surveys, EPOS data
343 analysis provides a cost-effective means of evaluating population-level interventions and policies
344 (⁴⁴).

345 Purchase behaviour does not necessarily reflect actual dietary intake; we do not know the extent to
346 which individuals in a household consumed the purchased products. However, Eyles and colleagues
347 (⁴³) found that, when electronic sales data were compared with repeated 24-hour dietary intake
348 recalls, modest correlations were observed between household purchases and individual intakes for
349 percentage energy from saturated and total fat, carbohydrate, protein and sugar, and that purchase
350 data were a reasonably reliable surrogate measure for certain nutrient intakes. In other words, sales
351 data can serve as a useful proxy for dietary impact. The type of effect found in the Buywell study, if
352 enlarged to a wider product range (for example, main sources of saturated fat), could make an
353 important contribution to changes in disease risk. Current modelling data at population level suggest
354 that even modest changes in diet are important. For example, Flores-Mateo and colleagues (⁵⁷)
355 suggest that reducing salt consumption by one g/day, reducing saturated fat and trans fat by 1% and
356 0.5% of energy intake respectively, and increasing fruit and vegetable intake by one portion per day
357 could result in approximately 13,850 fewer UK CVD deaths per year, while it has been estimated
358 that reducing dietary salt intake by 3g per day would prevent 30,000 cardiovascular events with
359 savings worth at least £40 million a year in the UK (⁵⁸).

360 The positive changes in food purchasing behaviour reported here are generally modest in scale.
361 That the impact was restricted to the intervention period was not surprising; it might have been
362 expected that sustained changes in purchasing behaviour could not be achieved with such a short
363 intervention, and reported effects are generally short lived in retailing studies (⁵²). However, it is
364 encouraging that a short-term and relatively small-scale promotion – a one-off price promotion
365 combined with healthy eating advice and recipe suggestions - was nonetheless able to trigger
366 changes in purchasing behaviour in a small proportion of the target group. This suggests that a
367 longer-term and more multi-faceted intervention may be capable of producing more lasting effects.
368 Hawkes (³⁴) suggests that healthy eating interventions based on financial incentives may be most
369 effective when implemented as part of a wider and integrated package of mutually-reinforcing
370 activities rather than in isolation. A review of financial incentives in the USA noted that financial
371 incentives might be more effective when combined with nutrition education (as the current study
372 has done, although the information/education element was limited in our study to brief messages

373 about the value of calcium to teeth and bone development and guidance regarding young children
374 and milk consumption), and also with components to address access (⁵⁹).

375 Overall, the study demonstrates that it is possible for public health researchers and nutritionists to
376 engage with food retailers to develop and implement healthy eating interventions in real world
377 settings. We have shown that a direct marketing intervention targeted at individual consumers on
378 the basis of past purchasing behaviour and other characteristics can have a short-term and modest
379 impact on uptake of healthier food products. We have also shown that it is possible to engage with
380 and stimulate change, albeit of short duration, among low-income consumers experiencing dietary
381 inequalities. Future studies could test the acceptability and sustainability of price promotion
382 interventions longer term, and could examine how the effects of price promotion interventions
383 could be reinforced by longer-term and more multi-faceted approaches.

384 **List of abbreviations**

385 RCT - randomised controlled trial

386 EPOS - electronic point of sale

387 HEISB - healthy eating indicator shopping basket tool

388

389 **Transparency Declaration**

390 The lead author affirms that this manuscript is an honest, accurate, and transparent account of the
391 study being reported, that no important aspects of the study have been omitted and that any
392 discrepancies from the study as planned (and registered with) have been explained. The reporting of
393 this work is compliant with CONSORT1/STROBE2/PRISMA3 guidelines.

394 **Competing Interests**

395 All authors declare that they have no competing interests.

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408 **Figure Legends:**

409 Figure 1 Content of the promotion

410 Figure 2

411 Changes in proportions of customers buying the promoted products

412

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565 **Figures**

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569 **Tables**

570 customers who switched to the promoted milk or were new to the promoted milk in May.