What is the impact of increasing the prominence of calorie labelling? A stepped wedge randomised controlled pilot trial in worksite cafeterias

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Abstract

Background: Calorie labelling may help to reduce energy consumption, but few well-controlled experimental studies have been conducted in real world settings. In a previous randomised controlled pilot trial we did not observe an effect of calorie labelling on energy purchased in worksite cafeterias. In the present study we sought to enhance the effect by making the labels more prominent, and to address the operational challenges reported previously by worksites.

Methods: Three worksite cafeterias were randomised in a stepped wedge design to start the intervention at one of three fortnightly periods between March and July 2018. The intervention comprised introducing prominent calorie labelling for all cafeteria products for which calorie information was available (on average 87% of products offered across the three sites were labelled). Calorie content was displayed in bold capitalised Verdana typeface with a minimum font size of 14 *e.g.* **120 CALORIES**. Feasibility and acceptability were assessed using post-intervention surveys with cafeteria patrons and semi-structured interviews with managers. Effectiveness was assessed using total daily energy (kcal) purchased from intervention items across the three sites, analysed using semi-parametric GAMLSS models.

Results: Recruitment and retention of worksite cafeterias proved feasible: all three randomised sites successfully completed the study. Post-intervention feedback suggested high levels of intervention acceptability: 87% of responding patrons wanted calorie labelling to remain in place. No effect of the intervention on daily energy purchased was observed: -0.6% (95%CI -2.5 to 1.2, p=.487). By-site analyses showed similar null effects at each of the three sites, all ps>.110.

Conclusions: There was no evidence that prominent calorie labelling changed daily energy purchased across three English-based worksite cafeterias. The intervention was feasible to implement and acceptable to patrons and managers.

Keywords: choice architecture; nudging; stepped wedge trial; randomised controlled trial; workplace interventions; calorie labelling

Background

Excess energy intake and poor diet quality leading to obesity are the leading causes of the rising incidence of non-communicable diseases and excess mortality in England and worldwide [1-4]. Interventions aimed at reducing energy intake and/or improving diet quality are therefore key to improving the health of populations [5]. Recent evidence suggests that interventions that change aspects of the physical environment or 'choice architecture' may be more effective at changing dietary behaviour including reducing energy intake than more traditional interventions requiring conscious engagement, such as educational campaigns [6-9].

One potential promising choice architecture intervention that alters environmental cues that are temporally and physically proximal to the point of choice is calorie labelling [9, 10]. In the USA, calorie labelling for all food products sold in out-of-home food retail environments has been mandatory since 2010 [11]. In England the government is considering implementing similar legislation to make calorie labelling mandatory for the out-of-home sector [12].

Though potentially impactful and overwhelmingly desired by customers, the estimated effect size of calorie labelling on energy purchased has been found to vary across studies, with a paucity of experimental evidence, particularly in field settings amongst general population samples. The evidence from a recent Cochrane review of nutritional labelling suggests that if calorie labels were added to menus or put next to foods in restaurants, coffee shops and cafeterias this could reduce energy purchased by about 47 calories (7.8%) per meal on average [13]. The synthesised evidence was, however, derived from three studies, all conducted in the USA and assessed as being of low quality using the GRADE assessment tool due to very serious risk of bias.

Another recent systematic review synthesised evidence from 186 mainly US-based studies. These included both experimental and non-experimental studies, conducted in laboratory or field settings. This synthesis led to an estimated smaller effect of calorie labelling – amounting to a reduction of approximately 27 calories (4.6%) per meal [10]. This systematic review also accounted for study heterogeneity, showing that the effect size of calorie labelling was larger in laboratory (hypothetical-choice) studies, and larger amongst women and those who were overweight.

A third recent systematic review provided evidence that calorie labelling may be more effective amongst those of higher socio-economic position (SEP), though these conclusions derived from narrative and not quantitative synthesis of a small number of studies measuring the impact of calorie labelling across different SEP groups [14]. Finally, a fourth systematic review conducted by Shangguan and colleagues estimated that calorie labelling could reduce total energy intake by 5.8% per meal [15]. In this systematic review, the impact of nutrient content labelling *vs.* calorie labelling was examined, but there was no sufficient evidence to conclude that one of these types of labelling is more effective in lowering energy intake, mainly due to the small number of studies available for these moderation analyses. In sum, these recent systematic reviews suggest that there remains considerable uncertainty about the potential impact of calorie labelling and that calorie labelling may have differential impacts amongst different groups, and may be dependent on the intervention setting.

In a recent study, we sought to build on these heterogeneous findings by examining the impact of calorie labelling upon energy purchased using an experimental design across six worksite cafeterias in England [16, 17]. We found that, although highly acceptable to cafeteria patrons and managers, the calorie labelling intervention had no effect upon energy purchased across the six sites. At one of the six sites, there was a statistically significant

reduction in total calories purchased, with an estimated reduction of 6.6% [95% CI -12.9% to -0.3%], which diminished over time.

There were several possible explanations for the lack of an observed effect in five out of the six worksites in this study. The calorie labels were designed to be visible to the customer at the point of choice, and were therefore presented in the same font style and size as the product price. This design may, however, have inadvertently decreased the impact of the intervention by making the calorie information less distinguishable from the other information on the label. There were also some operational difficulties in collecting the primary outcome measure which limited the precision of the data collected in the initial trial. For example, four of the six sites recorded a small number of their food/drink items – such as sales of different carbonated drinks - under the same till button, thus preventing full disaggregation of sales of products with different energy content.

In the current replication and extension study we therefore sought to use visually-enhanced calorie labels designed to communicate more prominently the energy content. In addition, we aimed to work closely with the catering teams and others in the participating sites to improve their till systems for data capture, and accordingly, to improve the estimates of the potential impact of calorie labelling on energy purchased.

The aims of the present study are:

(1) to assess the feasibility of recruiting eligible worksites, and identify potential barriers to the feasibility and acceptability of implementing prominent calorie labelling; and

(2) to estimate the impact of prominent calorie labelling designed to clearly communicate energy content upon energy purchased in worksite cafeterias.

Methods

Sample

Three worksite cafeterias in England were recruited to take part in the study via a collaboration with the Institute of Grocery Distribution (IGD) [18]. Worksites were eligible if they were based in England, employed more than 300 employees and had the ability to provide data on daily sales of individual items and their energy content. Due to the pilot nature of the study, a sample size of three sites was selected prior to enrolment as a pragmatic number with which to address the study aims within available resources.

We approached the managers of four sites that were part of a Healthy Eating in the Workplace Advisory Group organised by IGD and had already expressed interest in participating in studies. Sites were then screened for eligibility. All four sites were deemed eligible on the criteria reported above. Of the four sites approached, three agreed to participate in this pilot study and were therefore randomised to the time at which to implement the intervention. Enrolment of sites into the study was conducted by two members of the research team (MV and GF). The flow of participating sites through the pilot trial is shown in the CONSORT diagram in Figure 1. The demographic characteristics of employees at the three sites are summarised in Table 1 (these data were provided by the worksite Human Resource departments with all data points provided in aggregate form as they appear in the table). The baseline characteristics of intervention items across the three sites are summarised in Table 2.

========== PLACE FIGURE 1 HERE ==========

========== PLACE TABLE 1 HERE ==========

========== PLACE TABLE 2 HERE ==========

Design and Procedure

The study used a stepped wedge randomised controlled trial design [19-21]. This design was chosen since it allows the intervention to be tested across all eligible sites thus maximising study power; as well as allowing a more robust control of unexpected events over time since the roll out of the intervention occurs sequentially across the different sites. Between March and July 2018 three worksite cafeterias were sequentially randomised to receive the intervention after an initial baseline period of at least six weeks (see Figure 2). Sites were randomised to implement the intervention at one of three, two-weekly intervals. The randomisation of sites to the intervention sequence was performed by a statistician (MP) using computer-generated random numbers (the statistician was blinded to the identity of sites throughout the randomisation process). The protocol for this pilot trial was prospectively registered [ISRCTN20474205] (for more details see http://www.isrctn.com/ISRCTN20474205).

During the 6-week pre-intervention period, routine cafeteria service continued while information was collected on the energy content of food available and on the sales each day. The intervention periods were planned to be at least equal in length to the pre-intervention period – *i.e.* the third site implementing the intervention for at least six weeks – so that a best estimate of intervention impact could be obtained. Two further intervention weeks were run at the end of the trial for all three sites. Accordingly, the period of intervention lasted between eight to twelve weeks, depending on randomisation sequence within the stepped wedge design. It was not possible to blind the caterers who implemented the intervention to intervention assignment. Patrons of the cafeterias were not informed that the introduction of prominent calorie labelling was being evaluated as part of a study.

The research team trained and instructed the catering teams across the three worksites on how to implement the intervention prior to the study start date and worked closely with the

catering managers during intervention implementation. Prior to the commencement of the study, till systems were discussed and all worksites were instructed to use individual till buttons for each individual product in their cafeterias. Where this was not practically possible (*e.g.,* due to a large product offering as in Site 1), a few till buttons were reprogrammed to capture a few products of the same category that were similar in energy content (with the difference in energy ranging between ±30 kcal). Compliance with intervention implementation was measured by one member of the research team who conducted fortnightly visits to the worksites and recorded any deviations from the study protocol. Sales data were collected from all three sites over the period 6th March to 9th July 2018. The catering teams provided the research team with data on the energy content of food and drink items as well as till records of the sales data for each day throughout the study period.

========== PLACE FIGURE 2 HERE ==========

Intervention

The intervention comprised labelling all cafeteria products for which calorie information was available with their energy content *e.g.,* **120 CALORIES**. Following evaluation of the impact of the labelling intervention in our previous study [17], we aimed to enhance the presentation of calorie information by displaying this information more prominently in the current study. A literature review provided the basis for design features to make the labels more prominent.

The findings from the review suggested that typefaces such as Verdana [22-24] increased readability compared to Times New Roman and Arial, with bolded [25], larger fonts [25-28], and uppercase letters [29] also aiding readability. Increasing white space around a message and using high contrasts such as black text on a white background could

also enhance readability [30, 31]. In order to maximise effectiveness of the labelling, the extant literature suggested combining these features [28, 32]. For more information on how we incorporated these findings from the extant literature in the design of the new prominent calorie labels see the Calorie Labelling Manual document in Online Supplementary Materials.

As in our previous study, the labels were designed to be visible and legible to the customer from where they would be standing at the point of choice. Labels also contained calorie information by product portion size by denoting 'per slice', 'per ladle', or 'per average bowl/serving'. Salad bars, deli bars, hot drinks, and vending machine items were excluded from the intervention because of challenges in reliably implementing calorie labelling for these items (see the Calorie Labelling Manual document in Online Supplementary Materials for more details).

In the present study calorie information was provided in one of four different places:

(1) On products (see Figure 3a);

(2) Along shelf edging at point of choice (see Figure 3b);

(3) On tent cards placed next to products (see Figure 3c); and

(4) On menus (printed or electronic via email or screens; see Figure 3d).

========== PLACE FIGURE 3 HERE ==========

Measures

Feasibility and acceptability

The feasibility and acceptability of the intervention implementation in the present study were captured using the following indicators:

(1) *Feasibility of recruiting and retaining eligible worksites*. This was assessed by examining recruitment and drop-out rates;

(2) *Feasibility of implementing the assigned intervention.* This was assessed after initial visits to worksite cafeterias by the research team, in discussions and formal interviews with worksite managers and catering teams, and through examination of the sites' sales data;

(3) *Acceptability of the intervention.* This was measured via surveys distributed to cafeteria patrons, and qualitative interviews with worksite managers/caterers. In the surveys cafeteria patrons were asked: "*How did you feel about the introduction of calorie labels?"* (rated on a five-point scale from *Very unhappy* to *Very happy* with an additional option of choosing *Didn't notice the labels*); and *"Would you like calorie labels to remain in place permanently?"* (rated on a five-point scale from *No, definitely not* to *Yes, definitely*); and

(4) *Compliance with the study protocol.* Compliance visits were conducted at each of the three sites on the first day of intervention when non-compliant items, *i.e.* unlabelled products, were noted. Thereafter, fortnightly compliance visits were carried out at each site; protocol violations were recorded and rectified in discussion with the cafeterias' management teams.

Intervention impact

Primary outcome

Total energy (kcal) purchased daily from intervention items, controlling for the total transactions as measured from daily sales records.

Secondary outcome

Number of items purchased daily from (a) intervention items, and (b) non-intervention items, controlling for the total transactions.

Other measures

Covariates recorded in the study and considered in analyses: total number of transactions per day (to control for daily footfall in each site); day of week; and weather conditions (daily average temperature).

Data Analysis

Feasibility and acceptability

Feasibility and acceptability indicators were summarised using descriptive statistics. Qualitative assessments gathered via semi-structured interviews with worksite managers and caterers were coded and summarised narratively.

Intervention impact

Analyses were conducted in R.3.4.2. Our protocol and trial registration pre-specified that we would use generalised linear mixed models (GLMM) to examine the impact on total energy (kcal) purchased per day from intervention items controlling for the total transactions, adjusted for time trends (using day relative to the intervention start date as a random slope per site) and with random effects for worksite. However, an examination of the data showed considerable heterogeneity in variances between the three sites. Various variance-stabilising transformations - including logarithmic and square-root transformations - were investigated but none proved adequate. Therefore, due to heteroscedasticity, both the mean and variance of parameters were included (using identity and log links respectively) in the more general analysis framework of a Generalized Additive Model for Location, Scale and Shape

(GAMLSS) mixed model [33, 34]. This allowed explicit parameters for site-variances to take different values.

Uncharacteristic days, such as days showing large changes in energy purchased due to special events at the worksites, were included as dummy variables to allow for an unbiased estimate of the intervention effect (more details on this can be found in the Results section). Site was fitted as a random effect as per protocol. We also fitted parameters when necessary for separate variances: (i) on different weekdays; and (ii) different sites. The model diagnostics ranged from acceptable to good. Additional sensitivity analyses were conducted to explore whether partial compliance with the intervention affected the obtained results.

Results

Feasibility and acceptability

Of the four worksites approached, all were eligible to participate. Three sites were recruited and received the labelling intervention. All three recruited worksite cafeterias successfully completed the baseline and intervention periods (attrition rate of 0%), attesting to the feasibility of retaining eligible worksites (see also Figure 1 CONSORT diagram).

Implementation of the intervention proved feasible, with the proportion of items that were labelled being above 80%: 83% at Site 1, 94% at Site 2, and 85% at Site 3.

Cafeteria patrons who took part in the post-study survey strongly supported the intervention. The survey was completed by 250 employees, approximately 8.5% of the total number of employees based at the three worksites. A large proportion of respondents (83%) were either happy or very happy about the introduction of calorie labelling, 12% were neither happy nor unhappy, 1% were unhappy or very unhappy, whilst 2% reported not noticing any changes in labelling. Furthermore, the vast majority of surveyed employees (87%) reported that they would like calorie labelling to remain in place permanently, answering either *Yes,*

309 *definitely* or *Yes, probably*, 10% didn't mind, whilst only 1% objected to calorie labelling
310 remaining in place permanently, answering either *No, probably not* or *No, definitely not*.
311 The Box in the Online Supplementary Materials summarises the themes identified in
312 the thematic analysis of the post-intervention interviews conducted with worksite managers.
313 As in the previous study [17], worksite managers were receptive and supportive of the
314 intervention, seeing the calorie labels as a positive addition to the cafeteria, rather than taking
315 something away from patrons. In the current study, managers again commented that the
316 initial implementation of calorie labelling was labour-intensive and time-consuming, but once
317 this was done the intervention was simple to maintain. Managers reported positive feedback
318 from their patrons and, in contrast to our previous study, the managers also noted that patrons
319 commented on the clarity of the visual display of the energy content on the labels used for
320 this study, demonstrating that at least for the employees who took part in the post-study
321 survey, the labelling intervention tested in this study was more prominent and more
322 noteworthy when compared to the calorie labelling intervention used in the prior study.
323 Managers also reported that patrons expressed mixed feelings towards the presentation of
324 calorie information. Some patrons thought this made their food choices easier, whereas others
325 felt that additional nutritional information may be needed to help them make more informed
326 dietary choices [see also 35]. Furthermore, managers also highlighted the benefits of setting
327 up calorie labelling in their cafeterias with the view of aiding their employees' dietary
328 choices. Finally, managers hoped that the independent evaluation of the calorie labelling
329 intervention would help them to set-up calorie labelling initiatives which may, at some point
330 in the future, be mandated through government policy [12].
331 Compliance with the study protocol varied across sites and products. A detailed
332 record of items that were non-compliant at each site and the dates when these were then
333 labelled as per protocol can be seen in Table S1 in Online Supplementary Materials.

Sensitivity analyses were performed to check for differences in the effects of the intervention between days when all items were compliant and when they were not.

Intervention Impact

An examination of the plots for total energy purchased from intervention items and the number of transactions at each site showed different underlying trends at different sites (see Figures 4 and 5). The graphical presentation of the data in Figures 4 and 5 uses best fit lines based on loess curves, making minimal assumptions about the data. As can be seen in Figures 4 and 5 there were: (i) strong weekday effects with, for example, at all sites more energy being purchased on Thursdays, and at Site 1 less energy purchased across fewer transactions on Fridays; and (ii) special features in some of the sites that had to be accounted for by dummy variables. For example, at Site 3 there were three days on which a free buffet was available in the cafeteria, one day with a free BBQ on offer, and one day with a non-free BBQ for which employees had to purchase a ticket. A dummy variable indicating these five special events was included as a control variable in the statistical modelling of the primary outcome.

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Given the small number of sites, there was limited scope to include explanatory terms in the modelling. The final model included the following covariates: number of transactions, time relative to the intervention, week-day, daily average temperature, and a dummy variable denoting the five special events at Site 3. Model diagnostics - *i.e.*, residual plots,

autocorrelation – ranged from acceptable to good. Alternative models were also examined (see sensitivity analysis below).

Primary outcome

Pooling the data across the three sites showed no significant effect of prominent calorie labelling on daily energy purchased: -0.6% [95%CI -2.5 to 1.2, p = .487, M = -2410.2 (SD = 5992.6) total daily calories]. By-site analyses showed similar null effects at each of the three sites: Site 1 (-0.4% [95%CI -1.2% to 0.4%, p = .299, M = -3896.2 (SD = 6482.3) total daily calories]); Site 2 (0.3% [95%CI -4.5% to 5.1%, p = .890, M = 444.3 (SD = 5543.2) total daily calories]); and Site 3 (-7.4% [95%CI -16.5% to 1.7%, p = .110, M = -4891.8 (SD = 5287.4) total daily calories]). The model estimates are shown in Table 3. A sensitivity check where we excluded the dummy variable for special events replicated these results.

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Sensitivity analysis

A sensitivity analysis was conducted in which all items non-compliant with the labelling intervention at any point during the intervention phase were excluded from the calculation of the total calories per day. This led to the removal of 44 (9.8%), 5 (1.7%) and 30 (10.1%) products at Sites 1, 2 and 3, respectively. Similar results were obtained to those using the primary models: there was no overall effect of the intervention -1.2% [95%CI -3.2% to 0.8%, p = .240, M = -4079.4 (SD =5992.1) total daily calories]. Unlike in the primary analysis, the impact of the calorie labelling intervention on energy purchased was statisticially significant at Site 3 when compliance was accounted for: -29.0% [95%CI -47.7% to -10.2%, p = .003, M = -12958.8 (SD = 7410.9) total daily calories]. These estimates should be considered with caution due to the particularly large confidence intervals obtained for energy purchased at Site 3. The impact of the prominent calorie labelling was not

statistically significant in the other two sites when taking into consideration the non-compliant items: Site 1 (-1.5% [95%CI -5.8% to 2.7%, p = .481, M = -12933.2 (SD = 31705.3) total daily calories]; Site 2 (-0.5% [95%CI -6.1% to 5.0%, p = .851, M = -685.6 (SD = 6315.5) total daily calories]).

Secondary outcome

Our secondary outcome consisted of modelling the total number of (a) intervention items, and (b) non-intervention items sold per day since it was not possible to model the total daily energy for non-intervention items separately. Daily number of transactions, day of the week, and daily average temperature served as covariates as in the primary outcome models.

Intervention items only

There was no overall effect of labelling on total sales of intervention items per day [15.2 items (SD = 35.7) (95%CI -25.2 to 55.6), p = .460]. There was also no impact on total sales of intervention items per day in the individual sites.

Non-Intervention items only

There was no overall effect of the intervention on total sales of non-intervention items per day [0.5 items (SD = 5.0) (95%CI -5.2 to 6.1), p = .867]. The by-site analysis showed a statistically significant decrease in daily sales of non-intervention items following the introduction of calorie labelling at Site 1 [-44.8 items (SD = 29.3) (95%CI -77.9 to -11.7), p = .009]. The other two sites did not demonstrate a statistically significant effect of the intervention on daily sales of non-intervention items: Site 2 [2.8 items (SD = 5.2) (95%CI -3.1 to 8.7), p = .358]; Site 3 [-4.5 items (SD = 5.7) (95%CI -10.9 to 2.0), p = .174]).

Discussion

Recruitment and retention of worksite cafeterias in the present pilot trial proved feasible. Post-intervention feedback suggested high levels of intervention acceptability

amongst both patrons and catering staff, with 87% of cafeteria patrons wanting the prominent calorie labelling to remain in place. In terms of intervention effectiveness, pooling the data across the three sites showed no effect of the intervention on daily energy purchased: -0.6% [-2.5%, 1.2%]. Modelling the impact of the intervention at each individual site showed similar null effects.

The overall non-significant effect found across sites (-0.6%) replicates the overall size of effect of calorie labelling obtained in our prior pilot trial (-0.4%) [17]. Together, these results suggest that the synthesised effect size estimates of the potential impact of calorie labelling in recent systematic reviews [10, 13] may be an overestimate of the true effect found in general populations in real world settings. The estimated effect size of -7.8% from calorie labelling on menus presented in the recent Cochrane Review was based on three US-based experimental studies, two of which were conducted in the same university cafeteria [13]. This evidence was rated of low quality using GRADE assessment criteria, meaning that the estimated effect size is likely to change with more evidence [13]. The estimate of -4.6% provided in the larger systematic review by Zlatevska and colleagues [10] was based mainly on studies conducted in the USA, often carried out in university establishments and testing the effects of calorie labelling amongst university staff and students, often under controlled laboratory settings. The effect of calorie labelling in Zlatevska's review was shown to be larger in laboratory settings than in field studies [10]. Furthermore, a narrative synthesis of evidence suggests that calorie labelling may generate larger effects amongst those in higher socio-economic positions (SEPs) [14], the populations on which much of the evidence in the Cochrane Review and Zlatevska's review is based.

Post-hoc power analyses suggest that our present study was powered to detect an effect size of 5.23% (two-tailed). We were therefore powered to detect an effect of the size suggested by the recent Cochrane systematic review [13], which is arguably the closest

estimate of effect size relevant for the current study given the synthesised effect was based solely on randomised experimental evidence in field settings. An as yet unexplored moderator of these effects is the country in which studies were conducted. Our two field cafeteria experiments – conducted in England – have thus far yielded smaller and statistically non-significant effects in contrast to field cafeteria experiments conducted in the USA.

Within-site analyses in both the present and our previous studies [17] suggest that calorie labelling has heterogeneous effects in different worksite establishments which may reflect differences in participants' characteristics. However, due to the small number of sites in both the previous and current studies (n = 9), we were not able to formally examine demographic characteristics of participants at each site as a potential moderator of the effects of calorie labelling.

Decisions about the introduction of calorie labelling may rest upon considerations other than evidence of effectiveness to reduce energy purchased or consumed. The high levels of acceptability of the prominent calorie labelling and high levels of support for its continuation amongst worksite managers, catering staff, and cafeteria patrons are in line with evidence showing that the public consider information provision or education as acceptable interventions to change dietary behaviour [36]. This is consistent with growing demands from consumers for information about their food, whether about nutritional content, allergens, or provenance [37]. A further indirect effect of calorie labelling – not assessed in the current study – is its potential impact on reformulation of products or the range of menu options provided. An additional analysis by Zlatevska and colleagues of 41 studies that measured the impact of mandatory calorie labelling on retailers' food offering, estimated that after the introduction of calorie labelling, retailers offered 15 calories less per meal [10]. In the context of randomised controlled trials such as those reported here, these effects are excluded by careful manipulation only of the labelling itself and not the product range. Thus, even though

460 the direct impact of calorie labelling on consumer purchasing may be smaller than previously
461 estimated, there may be additional indirect effects if implemented in routine practice, which
462 may result in a reduction in the energy content of foods offered for purchase and
463 consumption. Reformulation of products or changes in menu options may also lead to
464 improvements in the nutritional quality of the foods available, through reductions in saturated
465 fat, free sugars or sodium and/or increases in fruit and vegetable content, bringing additional
466 beneficial health impacts [see 4, 15, 35].

467 **Strengths and Limitations**

468 One notable strength of the present study is the use of prominent calorie labels
469 designed to maximise readability following a scoping literature review. Furthermore, in the
470 present study we worked closely with the three worksite catering teams in order to improve
471 their data-capture methods prior to study commencement. We also carried out fortnightly
472 fidelity checks at all sites, which enabled us to rectify any issues with intervention
473 implementation and data capture in a timelier fashion than was possible in our previous study
474 [17]. These changes to the protocol and intervention design resulted in higher quality data,
475 lending greater confidence in any conclusions that could be drawn from the present study.

476 The above strengths notwithstanding, the study was limited in several respects. The
477 most notable limitation was the small number of participating sites and their heterogeneity.
478 Since this was a pilot trial, we tested the prominent calorie labels and improved protocol
479 amongst three sites, which was the maximum number of sites that we could realistically
480 recruit and set-up the intervention in the given time period. Another limitation of this pilot
481 study was that we were only able to recruit the required three sites by approaching four
482 worksites, which were members of a Healthy Eating in the Workplace Advisory Group. The
483 feasibility of recruiting a larger number of potentially more diverse worksite cafeterias for a
484 larger trial is unknown. However our other feasibility measures show that when workplaces

485 are willing to try this intervention it is possible to deliver the intervention successfully and
486 collect the data necessary for evaluation. The study was further limited by using energy
487 purchased as a proxy for consumption. Purchasing does not take into account possible food
488 waste, food bought and consumed from other establishments, and food freely available at the
489 worksites. However, this is likely to apply equally to both intervention and control periods
490 and should therefore not impact the estimates of energy purchased across different study
491 periods. Future studies could improve estimates of food consumption by measuring food
492 waste and establishing a protocol to measure and control for consumption of food obtained
493 from outside the worksite cafeteria setting.

494 **Future Research Directions**

495 Although recent systematic reviews suggest that calorie labelling has an impact on
496 energy selected or purchased [10, 13, 15], they each highlight the paucity of well-controlled
497 experimental studies in field settings, with one review suggesting that the effect of calorie
498 labelling is weaker in field compared with laboratory settings [10]. Future research should
499 therefore aim to estimate the impact on selection and consumption of calorie labelling in field
500 settings in robust studies using experimental designs. Aside from the current study, all other
501 existing experimental field studies have been conducted in the US. More studies outside of
502 the US are therefore needed to examine the generalisability of calorie labelling effects
503 beyond the US.

504 Even though recent reviews by Zlatevska [10] and Shanguann [15] have found no
505 significant difference between simple calorie labels *vs.* enhanced labels – such as physical
506 activity calorie equivalents [PACE] labels or pictorial warning labels - these supplementary
507 analyses were based on limited evidence generated in laboratory settings. Further research is
508 warranted to test such enhanced calorie labelling using robust experimental designs in field

settings to estimate the potential for such labels to reduce the energy of food selected or consumed.

Diet-related disease is linked both to overconsumption of energy and to the nutrient composition of the diet. The recent systematic review by Shanguann and colleagues [15] found no significant difference in the impact on consumption of calorie labelling *vs.* nutritional labelling of specific nutrients. However, the moderation analyses were based on a limited number of studies, suggesting that the estimate of this effect may change when there is a larger evidence base to probe this difference. Future studies could also consider whether additional labelling of specific nutrients has greater impact on food consumption than calorie labelling alone.

Policy Implications

While studies to date do not provide a reliable population level estimate of the potential for calorie labelling to reduce energy purchased out-of-home, any decision to introduce, or even mandate, calorie labelling should take into consideration a range of other factors. First, such information is valued by consumers [37]. Second, there is some evidence that mandatory calorie labelling could have positive supply-side effects through product and menu reformulation [10]. Given that increasing the availability of lower energy foods in worksite cafeterias can reduce energy purchased [38] this could be an effective route through which calorie labelling could contribute to tackling obesity.

Conclusions

There was no evidence that prominent calorie labelling changed daily energy purchased across three English-based worksite cafeterias. The intervention was feasible to implement and acceptable to patrons and managers.

Declarations

Ethics Approval: Approved by the Psychology Research Ethics Committee of the University of Cambridge (Reference Number: PRE.2016.035).

Availability of data and materials: The data are commercially sensitive, provided by the participating worksites on condition that they are not shared beyond the research team.

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: All authors collaborated in designing the study. MV and GF coordinated the intervention implementation and data collection. MP performed the data analyses. MV drafted the manuscript, GF, MP, GJH, RP, SAJ, and TMM provided critical revisions to the manuscript. All authors read and approved the final manuscript.

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References:

1. Steel N, Ford JA, Newton JN, et al. Changes in health in the countries of the UK and 150 English Local Authority areas 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet. 2018;392:1647-61. doi:10.1016/S0140-6736(18)32207-4
2. Gakidou E, Afshin A, Abajobir AA, et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2016: a systematic analysis for the global burden of disease study 2016. Lancet. 2017;390:1345–422. doi:10.1016/S0140-6736(17)32366-8
3. Naghavi M, Abajobir AA, Abbafati C, et al. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: systematic analysis for the global burden of disease study 2016. Lancet. 2017;390:1151–210. doi:10.1016/S0140-6736(17)32152-9
4. Swinburn BA, Kraak VI, Allender S, et al. The global syndemic of obesity, undernutrition, and climate change: The Lancet Commission report. Lancet. 2019;393:791-846. doi:10.1016/S0140-6736(18)32822-8
5. Swinburn B, Kraak V, Rutter H, Vandevijvere S, Lobstein T, Sacks G, Gomes F, Marsh T, Magnusson R. Strengthening of accountability systems to create healthy food environments and reduce global obesity. Lancet. 2015;385:2534-45. doi:10.1016/S0140-6736(14)61747-5
6. Thaler RH, Sunstein CR. Nudge: Improving decisions about health, wealth and happiness. 2nd ed. London, UK: Penguin, 2008.
7. Hollands GJ, Marteau TM, Fletcher PC. Non-conscious processes in changing health-related behaviour: a conceptual analysis and framework. Health Psychol Rev. 2016;10:381-94. doi:10.1080/17437199.2015.1138093
8. Marteau TM, Hollands GJ, Fletcher PC. Changing human behavior to prevent disease: the importance of targeting automatic processes. Science. 2012;337:1492-5. doi:10.1126/science.1226918
9. Hollands GJ, Bignardi G, Johnston M, Kelly MP, Ogilvie D, Petticrew M, Prestwich A, Shemilt I, Sutton S, Marteau TM. The TIPPME intervention typology for changing environments to change behaviour. Nat Hum Behav. 2017;1:1-9. doi:10.1038/s41562-017-0140
10. Zlatevska N, Neumann N, Dubelaar C. Mandatory Calorie Disclosure: A Comprehensive Analysis of Its Effect on Consumers and Retailers. J Retailing. 2018;94:89-101. doi:10.1016/j.jretai.2017.09.007
11. FDA. Food Labeling: Nutrition Labeling of Standard Menu Items in Restaurants and Similar Retail Food Establishments Final Regulatory Impact Analysis FDA–2011–F–0172 (2014). https://www.fda.gov/downloads/Food/IngredientsPackagingLabeling/LabelingNutrition/UCM423985.pdf Accessed on 4th October 2018.
12. Department of Health and Social Care. Consultation on mandating calorie labelling in the out-of-home sector (2018). https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/740545/consultation-on-calorie-labelling-outside-of-the-home.pdf Accessed on 4th October 2018.
13. Crockett RA, King SE, Marteau TM, Prevost AT, Bignardi G, Roberts NW, Stubbs B, Hollands GJ, Jebb SA. Nutritional labelling for healthier food or non-alcoholic drink

purchasing and consumption. Cochrane Database Syst Rev. 2018;2. Art. No.: CD009315. doi:10.1002/14651858.CD009315.pub2
14. Sarink D, Peeters A, Freak-Poli R, Beauchamp A, Woods J, Ball K, Backholer K. The impact of menu energy labelling across socioeconomic groups: A systematic review. Appetite. 2016;99:59-75. doi:10.1016/j.appet.2015.12.022
15. Shangguan S, Afshin A, Shulkin M, et al. A meta-analysis of food labeling effects on consumer diet behaviors and industry practices. Am J Prev Med. 2019;56:300. doi:10.1016/j.amepre.2018.09.024
16. Vasiljevic M, Cartwright E, Pechey R, Hollands GJ, Couturier DL, Jebb SA, Marteau TM. Physical micro-environment interventions for healthier eating in the workplace: protocol for a stepped wedge randomised controlled pilot trial. Pilot Feasibility Stud. 2017;3:27. doi:10.1186/s40814-017-0141-z
17. Vasiljevic M, Cartwright E, Pilling M, Lee MM, Bignardi G, Pechey R, Hollands GJ, Jebb SA, Marteau TM. Impact of calorie labelling in worksite cafeterias: a stepped wedge randomised controlled pilot trial. Int J Behav Nutr Phys Act. 2018;15:41. doi:10.1186/s12966-018-0671-7
18. Institute of Grocery Distribution. https://www.igd.com/. Accessed 4th October 2018.
19. Brown CA, Lilford RJ. The stepped wedge trial design: a systematic review. BMC Med Res Methodol. 2006;6:54. doi:10.1186/1471-2288-6-54
20. Hughes JP. Stepped wedge design. Wiley Encyclopedia of Clinical Trials. 2007:1-8. doi:10.1002/9780471462422.eoct449
21. Hemming K, Haines TP, Chilton PJ, Girling AJ, Lilford RJ. The stepped wedge cluster randomised trial: rationale, design, analysis, and reporting. BMJ. 2015; 350:h391. doi:10.1136/bmj.h391
22. Josephson S. Keeping your readers' eyes on the screen: An eye-tracking study comparing sans serif and serif typefaces. Visual Communication Quarterly. 2008;15:67-79. doi:10.1080/15551390801914595
23. Franken G, Podlesek A, Možina K. Eye-tracking study of reading speed from LCD displays: influence of type style and type size. J Eye Mov Res. 2015;8. doi:10.16910/jemr.8.1.3
24. Chaparro BS, Shaikh AD, Chaparro A, Merkle EC. Comparing the legibility of six ClearType typefaces to Verdana and Times New Roman. Information Design Journal. 2010;18:36-49. doi:10.1075/idj.18.1.04cha
25. Silver NC, Braun CC. Perceived readability of warning labels with varied font sizes and styles. Safety Sci. 1993;16:615-25. doi:10.1016/0925-7535(93)90026-A
26. Silver NC, Kline PB, Braun CC. Type form variables: differences in perceived readability and perceived hazardousness. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting 1994 Oct (Vol. 38, No. 14, pp. 821-825). Sage CA: Los Angeles, CA: SAGE Publications.
27. Wogalter MS, Vigilante WJ. Effects of label format on knowledge acquisition and perceived readability by younger and older adults. Ergonomics. 2003;46:327-44. doi:10.1080/0014013021000048006
28. Vigilante Jr WJ, Wogalter MS. Over-the-counter (OTC) drug labeling: format preferences. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting 1999 Sep (Vol. 43, No. 2, pp. 103-107). Sage CA: Los Angeles, CA: SAGE Publications.
29. Ohyama J, Sagawa K. The effects of letter design features and aging on legibility. Perception. 2016;45:642-56. doi:10.1177/0301006616629036
30. Arditi A, Cho J. Letter case and text legibility in normal and low vision. Vision Res. 2007;47:2499-505. doi:10.1016/j.visres.2007.06.010

655 31. Rousek JB, Hallbeck MS. Improving and analyzing signage within a healthcare
656 setting. Appl Ergon. 2011;42:771-84. doi:10.1016/j.apergo.2010.12.004
657 32. Laughery KR, Young SL, Vaubel KP, Brelsford Jr JW. The noticeability of warnings
658 on alcoholic beverage containers. J Public Policy Mark. 1993:38-56.
659 doi:jstor.org/stable/30000110
660 33. Rigby RA, Stasinopoulos DM. Generalized additive models for location, scale and
661 shape. J R Stat Soc C-Appl. 2005;54:507-54. doi:10.1111/j.1467-9876.2005.00510.x
662 34. Stasinopoulos DM, Rigby RA. Generalized additive models for location scale and
663 shape (GAMLSS). R J Stat Softw. 2007;23:1-46.
664 35. Mozaffarian D. Foods, obesity, and diabetes—are all calories created equal?. Nutr
665 Rev. 2017;75(suppl_1):19-31. doi:10.1093/nutrit/nuw024
666 36. Diepeveen S, Ling T, Suhrcke M, Roland M, Marteau TM. Public acceptability of
667 government intervention to change health-related behaviours: a systematic review and
668 narrative synthesis. BMC Public Health. 2013;13:756. doi:10.1186/1471-2458-13-756
669 37. Roberto CA, Schwartz MB, Brownell KD. Rationale and evidence for menu-labeling
670 legislation. Am J Prev Med. 2009;37:546-51. doi:10.1016/j.amepre.2009.07.015
671 38. Pechey R, Cartwright E, Pilling M, Hollands GJ, Vasiljevic M, Jebb SA, Marteau
672 TM. Impact of increasing the proportion of healthier foods available on energy
673 purchased in worksite cafeterias: A stepped wedge randomized controlled pilot trial.
674 Appetite. 2018. doi:10.1016/j.appet.2018.11.013
675

676 Table 1.

677 *Staff demographic characteristics across the three sites.*

Categories	Site 1 (*n* = 2205)	Site 2 (*n* = 337)	Site 3 (*n* = 405)
Employment Type (*n*/%)			
Full Time	2011 (91%)	335 (99%)	245 (60%)
Part Time	132 (6%)	2 (1%)	20 (5%)
Temporary	62 (3%)	0	140 (35%)
Gender (*n*/%)			
Male	824 (37%)	278 (82%)	243 (60%)
Female	1381 (63%)	59 (18%)	162 (40%)
Age (*n*/%)			
18 – 24	164 (7%)	42 (12%)	41 (10%)
25 – 34	884 (40%)	148 (44%)	101 (25%)
35 – 44	572 (26%)	96 (28%)	142 (35%)
45 – 54	416 (19%)	36 (11%)	73 (18%)
55 – 64	165 (7%)	15 (4%)	36 (9%)
65+	4 (0.2%)	0	12 (3%)
Role Type (*n*/%)			
Higher Managerial	25 (1%)	1 (0.3%)	20 (5%)
Intermediate Managerial	240 (11%)	8 (2%)	81 (20%)
Supervisory or Clerical / Junior Managerial Skilled	622 (28%)	20 (6%)	170 (42%)
Manual Worker	1125 (51%)	50 (15%)	114 (28%)
Semi or Unskilled Worker	193 (9%)	228 (68%)	20 (5%)
Other	0	11 (3%)	0

Note. Sites 1 and 3 did not have any staff in the 'other' category (e.g., students). Site 2 did not have any temporary employees or anyone over the age of 65 years old.

678

Table 2.

Baseline sales data of intervention items across the three sites.

Categories	Site 1 (*n* = 2205)	Site 2 (*n* = 337)	Site 3 (*n* = 405)
Number of Daily Transactions [Mean (SD)]	2365.6 (222.2)	226.5 (21.2)	159.2 (24.9)
Main Meal Kcal [Mean [SD] (min, max)]	418.4 [387.3] (95, 1614)	415.0 [162.4] (154, 829)	542.0 [238.5] (144, 1025)
Drink Kcal [Mean [SD] (min, max)]	71.0 [58.9] (0, 216)	121.2 [67.0] (0, 366)	81.2 [57.5] (0,240)
Snack Kcal [Mean [SD] (min, max)]	163.2 [166.4] (27, 657)	243.1 [126.0] (35, 770)	207.8 [107.1] (21, 576)
Mean Cost of Main Meal (£) [Mean [SD] (min, max)]	1.51 [0.89] (0.80, 3.90)	2.69 [0.67] (0.60, 3.90)	2.89 [0.53] (1.99, 3.95)

Note. Sales of main meals at Site 3 are recorded with side dishes as the default option. At Site 3, employees must request if they do not want a particular side to be automatically included with their main meal.

683 Table 3.

684 *Primary analysis of total daily energy purchased.*

	Calories M (SD)	95%CI	p	Pre-Intervention Mean Daily Calories	% Change Post-intervention	95% CI
Overall model						
Modelling of the mean (identity link):						
(Intercept)	43742.9 (8625.1)	(33982.9, 53502.9)	<0.0001			
Day relative to intervention	125.0 (107.9)	(2.9, 247.1)	0.0458			
Transactions	376.7 (7.0)	(368.8, 384.5)	<0.0001			
Week day (Ref=Monday)		(-2213.9, 8462.6)				
Tuesday	3124.4 (4717.5)		0.2525			
Wednesday	-4084.109 (4443.1)	(-9111.9, 943.7)	0.1127			
Thursday	8091.4 (4652.6)	(2826.5, 13356.2)	0.0029			
Friday	4721.3 (5865.9)	(-1916.5, 11359.1)	0.1646			
Temperature	-1524.5 (585.5)	(-2187.0, -862.0)	<0.0001			
Special Event	-18313.4 (12497.0)	(-32454.8, -4171.9)	0.0118			
Intervention	-2410.2 (5992.6)	(-9191.3, 4371.0)	0.4867	374551.9	-0.6%	(-2.5%, 1.2%)
Modelling of the variance (log link):						
(Intercept)	11.155 (0.198)	(10.931, 11.379)	<0.0001			
Week day (Ref=Monday)						
Tuesday	0.092 (0.239)	(-0.179, 0.363)	0.5052			
Wednesday	-0.015 (0.181)	(-0.220, 0.189)	0.8842			
Thursday	0.017 (0.225)	(-0.237, 0.272)	0.8934			
Friday	0.359 (0.259)	(0.066, 0.652)	0.0172			
Site (Ref=Site 1)						
Site 2	-2.114 (0.201)	(-2.342, -1.886)	<0.0001			
Site 3	-1.532 (0.213)	(-1.772, -1.291)	<0.0001			

By-site

Modelling of the mean (identity link):						
(Intercept)	39965.7 (4569.9)	(29612.6, 50318.9)	<0.0001			
Day relative to intervention	73.0 (64.5)	(-44.6, 190.6)	0.224766			
Transactions	376.9 (8.0)	(363.1, 390.7)	<0.0001			
Week day (Ref=Monday)						
Tuesday	2320.3 (1498.1)	(-3148.7, 7789.4)	0.406505			
Wednesday	-4615.0 (3340.7)	(-9762.9, 532.9)	0.080204			
Thursday	7701.1 (10391.2)	(2267.7, 13134.5)	0.005912			
Friday	4342.4 (2886.6)	(-2439.8, 11124.6)	0.210756			
Temperature	-1287.7 (364.1)	(-1975.8, -599.6)	0.000303			
Special Event	-13141.4 (717572.0)	(-28184.6, 1901.9)	0.088184			
Intervention:						
Site 1	-3896.2 (6482.3)	(-38047.7, 30255.3)	0.29893	927358.1	-0.4%	(-1.2%, 0.4%)
Site 2	444.3 (5543.2)	(-6244.5, 7133.1)	0.88971	130320.0	0.3%	(-4.5%, 5.1%)
Site 3	-4891.8 (5287.4)	(-13340.6, 3557.1)	0.11040	65977.7	-7.4%	(-16.5%, 1.7%)
Modelling of the variance (log link):						
(Intercept)	11.264 (0.293)	(10.959, 11.569)	<0.0001			
Week day (Ref=Monday)						
Tuesday	0.131 (0.269)	(-0.144, 0.407)	0.351			
Wednesday	-0.016 (0.253)	(-0.327, 0.294)	0.918			
Thursday	0.037 (0.314)	(-0.240, 0.314)	0.794			
Friday	0.339 (0.296)	(0.029, 0.649)	0.033			
Intervention :						
Site 1	-0.194 (0.285)	(-0.515, 0.127)	0.238			
Site 2	-0.046 (0.278)	(-0.411, 0.318)	0.803			
Site 3	0.057 (0.284)	(-0.290, 0.404)	0.748			
Site (Ref=Site 1)						

Site 2	-2.202 (0.354)	(-2.586, -1.818)	<0.0001
Site 3	-1.674 (0.321)	(-2.035, -1.312)	<0.0001

Note. 95%CI based on the likelihood ratio test.

686 **Figure Captions**

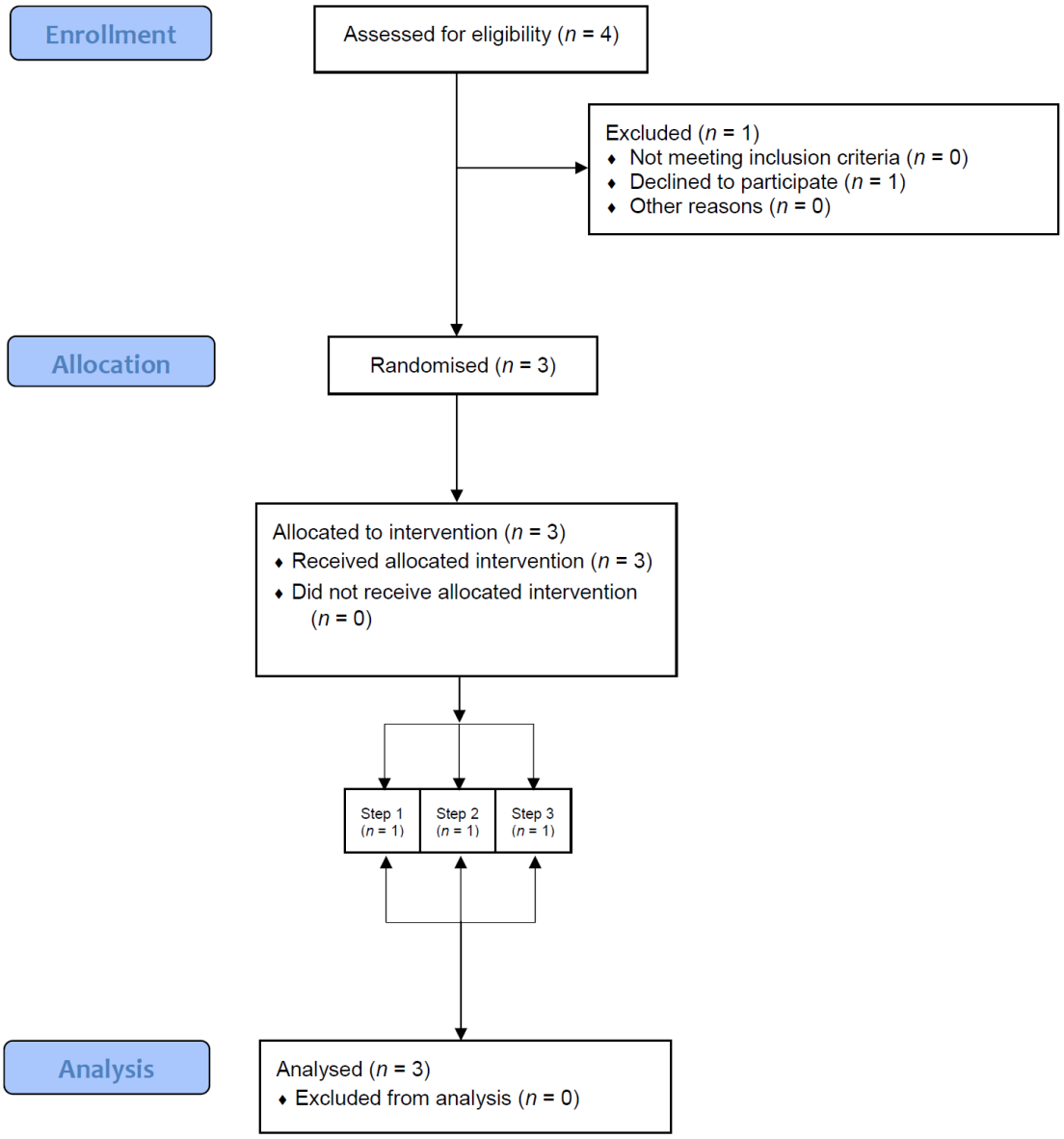
687 ***Figure 1.*** CONSORT diagram of participant flow through the study.

688 ***Figure 2.*** A graphical presentation of the study's stepped wedge design**.**

689 ***Figure 3.*** Examples of calorie labelling: a) on a product; b) along shelf-edging; c) on a tent
690 card; and d) on a menu.

691 ***Figure 4***. Total energy sold per day for intervention items across the three sites with
692 information displayed for day of the week.

693 ***Figure 5***. Transactions per day for intervention items across the three sites with information
694 displayed for day of the week.

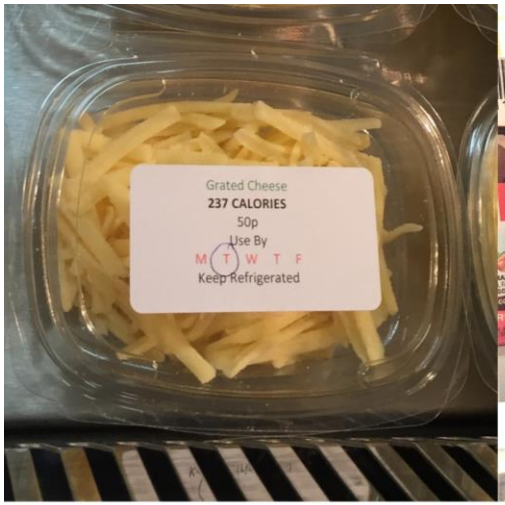

Enrollment
Assessed for eligibility (n = 4)
Excluded (n = 1)
♦ Not meeting inclusion criteria (n = 0)
♦ Declined to participate (n = 1)
♦ Other reasons (n = 0)
Allocation
Randomised (n = 3)
Allocated to intervention (n = 3)
♦ Received allocated intervention (n = 3)
♦ Did not receive allocated intervention (n = 0)
Step 1 (n = 1)
Step 2 (n = 1)
Step 3 (n = 1)
Analysis
Analysed (n = 3)
♦ Excluded from analysis (n = 0)

Site	Baseline 06.03.18 - 16.04.18	Period 1 17.04.18	Period 2 24.04.18	Period 3 01.05.18	Period 4 08.05.18	Period 5 15.05.18	Period 6 22.05.18	Period 7 29.05.18	Period 8 05.06.18	Period 9 12.06.18	Period 10 19.06.18	Extra Period 11† 26.06.18	Extra Period 12† 03.07.18
1													
2													
3													

Baseline - no intervention (6 weeks)

Control - no intervention (period represents 1 week)

Intervention (period represents 1 week; † two extra periods lasting 1 week each were captured at the end of the study)

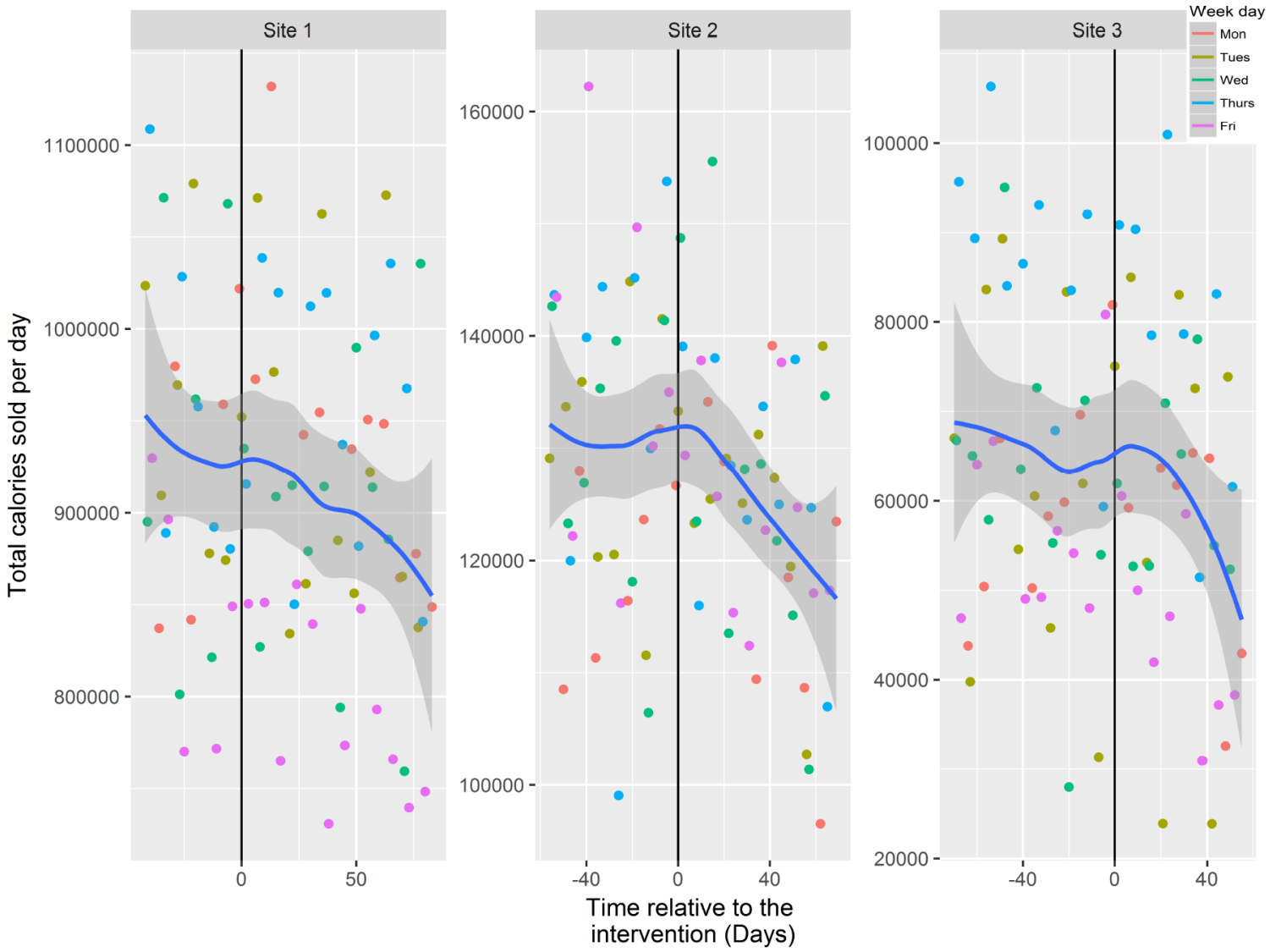


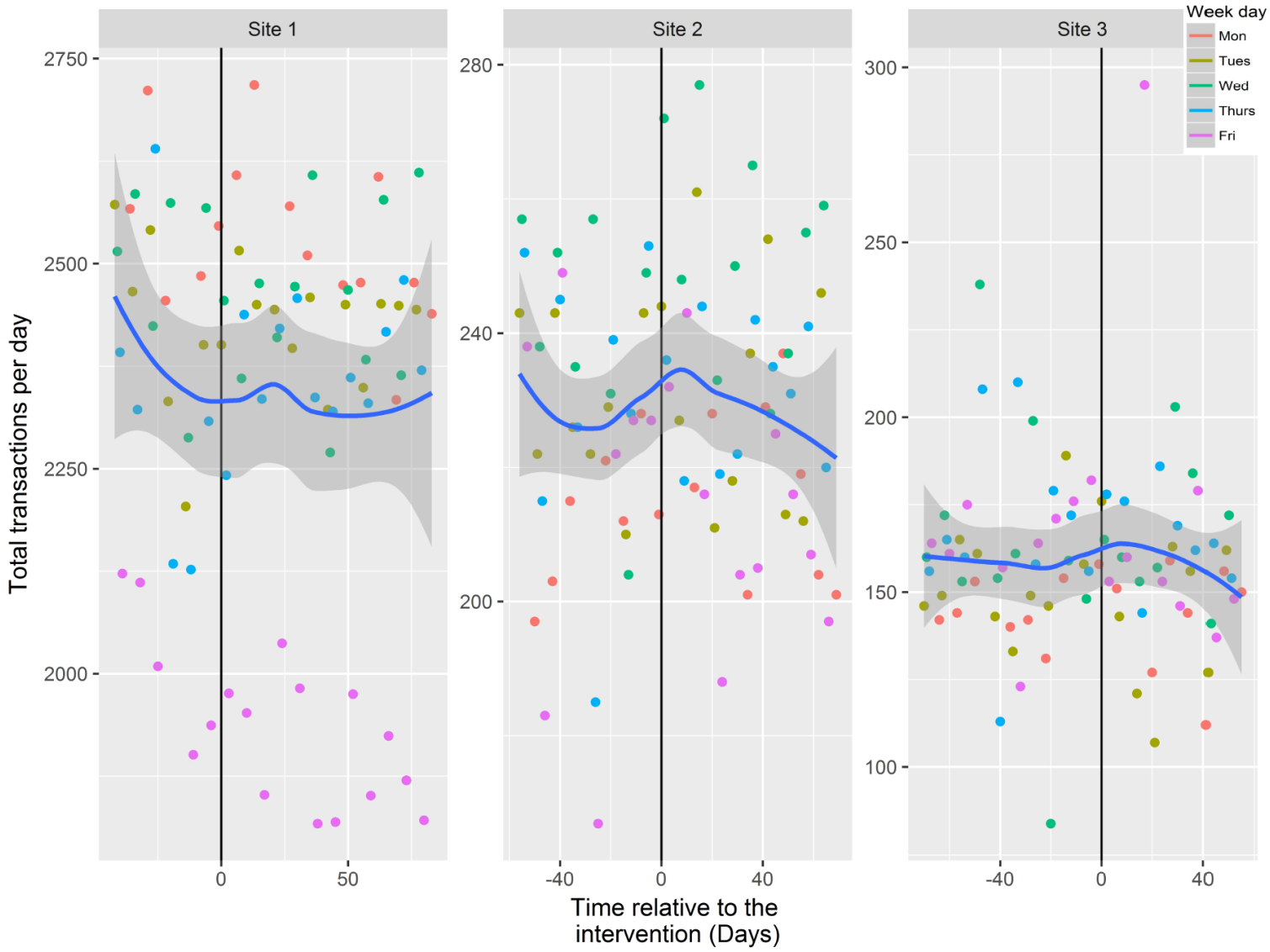
(a) On a product

(b) Along shelf-edging

(c) On a tent card

(d) On a menu


Site 1
Site 2
Site 3
Week day
Mon
Tues
Wed
Thurs
Fri
Total calories sold per day
1100000
1000000
900000
800000
160000
140000
120000
100000
100000
80000
60000
40000
20000
0
50
-40
0
40
-40
0
40
Time relative to the intervention (Days)


Site 1
Site 2
Site 3
Week day
Mon
Tues
Wed
Thurs
Fri
Total transactions per day
2750
2500
2250
2000
280
240
200
300
250
200
150
100
0
50
-40
0
40
Time relative to the intervention (Days)

Online Supplementary Materials

What is the impact of increasing the prominence of calorie labelling? A stepped wedge randomised controlled pilot trial in worksite cafeterias

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Calorie Labelling: How to design your labels

Background

Thank you for participating in IGD's Healthy Eating programme. This document is prepared by the University of Cambridge (UoC) and provides instructions for displaying calorie labels in your cafeteria. Please use this to prepare your labels containing calorie information for all products at point of choice.

You will introduce calorie labels from [DATE]

Ahead of implementation, we will be in touch to arrange a convenient time to view these labels before they are finalised. In the meantime, please get in touch if you have any questions.

Contact details

Georgia Fuller
Research Assistant
Behaviour and Health Research Unit
University of Cambridge

Email: [email here]
Telephone: [telephone here]

Where to put labels

Calorie information should be directly above, below or beside the product. Where this is not possible please inform UoC to discuss and agree a solution.

- Labels on products – see Figures 1A and 1B
- Shelf-edging at point of choice – see Figure 2
- Tent cards next to products – see Figure 3
- Menus (printed or electronic via email or screens) – see Figures 4 and 5

Which products to label

All products within the cafeteria should be labelled with calorie information, including:

- Main meals (including side dishes)
- Snacks (including all confectionery, crisps, sandwiches, protein pots etc.)
- Breakfast selection (both hot and cold options)
- Cold drinks
- Condiments (portioned)

Salad bars, hot drinks and vending are **excluded** from the study and do not need additional labelling. However, please note you will still need to send daily sales information for salad bars to UoC.

Other areas where calorie labelling may be difficult (such as deli bars) will be dealt with case-by-case by UoC.

Label Content

The label should include:

- Name of food or drink item
- Calorie content written as 'XXX CALORIES'
- Portion size if relevant (e.g. per slice, per ladle, per average bowl/serving if pre-portioned or served to the customer)
- Price

*The label should **not** include:*

- Any additional information such as Reference Intakes, which should be removed
- Any alternative terms to 'calories' – e.g. do not use 'kcal' or 'kJ'

If applicable, allergen information should continue to be provided as usual.

Label Design

Labels should be legible and prominent to the customer (from where they will be standing at point of choice). To ensure this, the calorie content, e.g. '**120 CALORIES**', should be:

- Bolded
- Written in uppercase
- Written in Verdana typeface
- Written in:
    a) minimum font size 14 for product labels, shelf-edging and tent cards
    b) minimum font size 18 for A4 daily menus (please note, weekly menus will be designed on a case-by-case basis)
- Written two font sizes larger than the rest of the font on the label (calorie information should appear larger than the product name, price and portion size)
- Written in black typeface on a white background (if coloured backgrounds are used, please contact us to discuss options)
- Written horizontally on the label with as much white space around the text as possible

Please see the Appendix to find examples (Figures 1A, 1B, 2, 3, 4 and 5).

Appendix

Figure 1A - *Example of a calorie label on a product:*

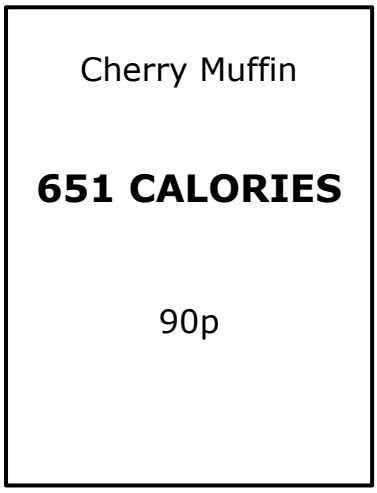
This is not correct as full Reference Intake (RI) information is

This is correct.

Figure 1B - *Example of a calorie label on a product:*

N.B. to demonstrate what labels may look like if allergen information would usually be present, this has been included in one of the example product labels below. For the purposes of this study, if allergen information is not already on your labels, please do not include it.

Option 1. *Calorie label without allergen advice*



Option 2. *Calorie label with allergen advice*

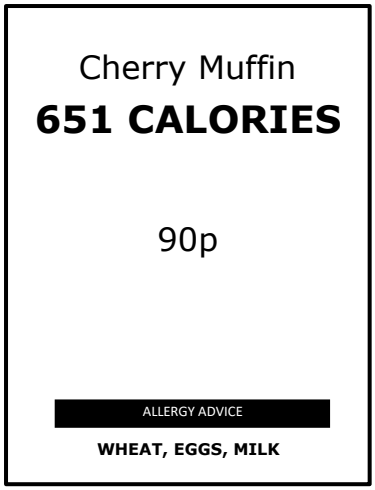


Figure 2 - *Example of a calorie label on shelf-edging:*

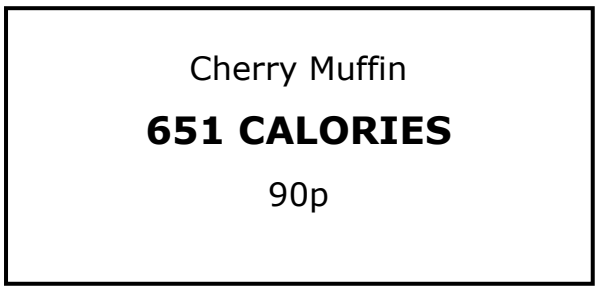


Figure 3 - *Example of a calorie label on a tent card:*

Figure 4 - *Example of calorie labelling on a daily menu:*

Monday's Menu

Cumberland Sausages	**150 CALORIES**	£2.95
Cajun Chicken	**208 CALORIES**	£2.95
Cheese & Onion Pasties	**433 CALORIES**	£1.60
Leek & Potato Soup	**193 CALORIES**	£0.80
Sweetcorn	**95 CALORIES**	£0.50
Side Salad	**11 CALORIES**	£0.50

Figure 5 - *Example of calorie labelling on a weekly menu:*

	Monday	Tuesday	Wednesday	Thursday	Friday
House Soup	Carrot & Coriander (v) **104 CALORIES**	Tomato and Basil (v) **112 CALORIES**	Leek & Potato (v) **137 CALORIES**	Tomato (v) **98 CALORIES**	Cauliflower (v) **108 CALORIES**
'Real' Soup	Seafood Broth **240 CALORIES**	Chicken and Mushroom **129 CALORIES**	Spicy Chickpea (v) **217 CALORIES**	Cream of Vegetable (v) **217 CALORIES**	Minestrone (v) **194 CALORIES**
Our 'made to order' Pizza Menu is available every day					
Al Forno	Pork Chop **249 CALORIES**	Spicy Bean Burger with Cheese (v) **580 CALORIES**	Goats Cheese & Red Onion Tart (v) **275 CALORIES**	Chicken & Egg Fried Rice Pot **390 CALORIES**	Beef Chilli with Wedges **410 CALORIES**
Nutritional Selection	Chickpea Curry & Naan (v) **240 CALORIES**	Kedgeree **404 CALORIES**	Sardines with Tomato Stew **244 CALORIES**	Vegetable Pasta Bake (v) **290 CALORIES**	Feta, Roast Vegetable & Quinoa Pot (v) **191 CALORIES**
Main Course	Chicken Supreme & Gravy **228 CALORIES**	Cumberland Pie with Mash **400 CALORIES**	Beef & Guinness Pie **332 CALORIES**	Roast Lamb & Gravy **294 CALORIES**	Battered Haddock Fillet **326 CALORIES**
Sides Starch Veg	Chips **260 CALORIES** Steamed Carrots **41 CALORIES** Corn on the Cob **155 CALORIES**	Chips **260 CALORIES** Cauliflower Cheese **138 CALORIES** Green Beans **31 CALORIES**	Patatas Bravas **184 CALORIES** Peas & Corn **65 CALORIES** Steamed Broccoli **31 CALORIES**	Roast Potatoes **149 CALORIES** Parsnips **179 CALORIES** Cabbage **27 CALORIES**	Chips **260 CALORIES** Peas **81 CALORIES** Vegetable Medley **50 CALORIES**
Hot Dessert	Coffee Sponge **230 CALORIES** Custard **190 CALORIES**	Rice Pudding **111 CALORIES** Jam Sauce **75 CALORIES**	Bread Pudding **360 CALORIES** Custard **122 CALORIES**	Orange Cake **198 CALORIES** Custard **122 CALORIES**	Ginger Sponge **355 CALORIES** Toffee Sauce **132 CALORIES**

Box: Themes identified from semi-structured interviews with worksite managers.

Themes	Subthemes	Comments
Information provided	Clear Information† (2 of 3 sites)	*"It was very clear, big, bold writing"*
		"Just the calories, rather than doing the whole thing, the fat, the protein, the carbs. It just gives a very clear message"
		"The previous ones we put calories and kilojoules …I think everybody is more aware of calories so it was a clearer message"
	Missing Information† (2 of 3 sites)	*"Some people question about the fact whether we should just be saying about calories, whether we should be giving more dietary information around ingredients"*
		"There's been a few suggestions around whether it is productive towards a...balanced diet, talking about just calories"
		"…and then there's the sugar as well because some of the things that have low calorie have higher sugar"
	Eye-catching Design (2 of 3 sites)	*"I think it is probably more effective than previous ones I've been involved in, in terms of it being a little more bolder than the previous times which I think is useful"*
		"If it was much smaller people probably wouldn't pay attention (to) what's on the label where it was quite big and bold so you can see, it is one of the first things that you can see when you look at the label so that was good"
		"I understand that part of the study was for (the labelling) to be so big; I think from a customer point of view it looked a bit ridiculous if I'm honest"
	Awareness of Information (2 of 3 sites)	*"People were talking about it so they definitely noticed the difference"*
Implementation	Time-consuming† (3 of 3 sites)	*"It was more work at the beginning getting all the labelling done"*
		"It was hard work obviously but…it's not (a) major change to my everyday tasks"
		"There was quite a lot of work for (the catering team) first off but once that was done then…it was all there."
	Overcoming challenges (3 of 3 sites)	*"We had to get extra information from the supplier and if the supplier didn't have it we had to go...to the actual manufacturer"*
		"Some things were challenging for us in terms of getting some of the information from suppliers"
	Feeling Supported (3 of 3 sites)	*"(The University of Cambridge has) been very helpful with it, you've smoothed over where there's times where the managers would have been a bit more stressed if they didn't have your support"*
		"You guys (did) a lot of work actually, you helped me a lot and for me it was just making sure that everything was in place really."
		"What I felt was really good this time was that there was a continual visitation to site from (University of Cambridge). That, I think, helped keep the impetus and also helped in terms of potentially going off-piste"

	Rationale (2 of 3 sites)	*"We wanted to do it so that we can learn from the experience of doing it so if it does become [law] later on...we've trialled it in our own area and got a better understanding of it"* *"It's something that's helped be a foundation of our health and well-being ambitions and drives within the business so it's been good"* *"...it surprises me that more people aren't interested in the nutritional value of what they're putting into their bodies. I think it's great that we've offered that information..."*
Feedback in Cafeteria	Reactions to Calorie Content (2 of 3 sites)	*"Most people were quite surprised to see the amount in calories in certain foods"* *"From the beginning people were a little bit surprised with the amount of calories actually in the food, which is a bit of an eye opener, which is good"* *"There were people going 'oh there's calories on here, oh I didn't know that', 'that's surprising'"*
	Positive Impact (3 of 3 sites)	*"The actual concept itself has worked very well, the fact that people do want more information I think it shows"* *"I actually went for a different type of food because of the amount of calories that was in the ones that I actually wanted to go for"* *"It went very well and the response that we've had is overwhelming (that) it's gone very well and was a real success which is brilliant"*
	Indifference to Information (3 of 3 sites)	*"If somebody wants a cake they're going to have a cake because they fancy cake"* *"I have had comments that they don't really care about it"* *" I think there's times where you think 'right I'm just going to ignore it because I really want this'"*

Note. Sub-themes marked with † are recurring themes that were identified in the present study and our prior pilot study carried out across six worksite cafeterias.

Table S1: List of non-compliant items

Site	Product	Date non-compliant
Site 1	CalypOrange	17.04.18
	CalypOrange	18.06.18
	CalypApple	18.06.18
	CalypApple	17.04.18
	Butter/Flora	17.04.18
	Philadelphia	17.04.18
	Cornetto Flav	17.04.18
	Cornetto	17.04.18
	FreshWholeFruit	17.04.18
	CRISPS	17.04.18
	GFChickenSldSW	17.04.18
	Muller Cornr	17.04.18
	DoughnutCaramel	17.04.18
	Doughnutsprinkl	17.04.18
	BreadPudding	17.04.18
	muffblueberry	17.04.18
	mufflemonpoppy	17.04.18
	muffdblchoc	17.04.18
	GateauxCarrot	17.04.18
	GateauxVictoria	17.04.18
	TrayBrownie	17.04.18
	TrayChoCarShort	17.04.18
	TrayRockyRoad	17.04.18
	TrayMalteser	17.04.18
	TrayCranbYog	17.04.18
	Coco Pops	17.04.18
	BranFlakes	17.04.18
	Corn Flakes	17.04.18
	Crunchy Nut	17.04.18
	FruitNFibre	17.04.18
	Rice Crispies	17.04.18
	Special K	17.04.18
	Weetabix	17.04.18
	Alpen Original	17.04.18
	InstantPorridge	17.04.18
	Jaffa cake	17.04.18
	ChocChipCookie	17.04.18
	Spotty Cookie	17.04.18
	WT Choc Cookie	17.04.18
	Ryvita	17.04.18
	Flapjack	17.04.18

	Preserve	01.05.18
	Preserve	02.05.18
	Marmite	01.05.18
	Marmite	02.05.18
	Nutella	02.05.18
	Nutella	01.05.18
	Water 40	11.05.18
	Water 40	14.05.18
	GateauxVictoria	11.05.18
	GateauxVictoria	14.05.18
	GateauxCarrot	11.05.18
	GateauxCarrot	14.05.18
	WB Diet Coke	01.06.18
Site 2	CSS CRISPS WALK CHSE ONION STD.	16.05.18
	CSS CRISPS WALK PRAWN CKTAIL STD	16.05.18
	CSS CRISPS WALK READY SALTED STD.	16.05.18
	CSS CRISPS WALK SALT VINEGAR STD.	16.05.18
	CONF WINE GUMS MAYNARDS TUBE	29.05.18
Site 3	DELI SLICED HAM	15.05.18
	DELI SLICED HAM	16.05.18
	DELI SLICED HAM	17.05.18
	JACKET POTATO	15.05.18
	JACKET POTATO	16.05.18
	JACKET POTATO	17.05.18
	BEEF BOLOGANISE JKT FILLING	16.05.18
	VEGETABLE CASSROLE JKT FILLING	17.05.18
	CHILLI HAKE	15.05.18
	CHIPS	15.05.18
	CHIPS	16.05.18
	CHIPS	17.05.18
	ROAST TURKEY	15.05.18
	ROAST TURKEY BAGUETTE	15.05.18
	SAUSAGE GRILL	15.05.18
	SIDE SALAD	15.05.18
	SIDE SALAD	16.05.18
	SIDE SALAD	17.05.18
	CORNISH PASTRY	16.05.18
	SAUSAGE GRILL	16.05.18
	SAUSAGE GRILL	17.05.18
	SEASONAL VEGETABLES	16.05.18
	DAILY POTATOES	17.05.18
	PIRI CHICKEN	17.05.18
	PORK MEATBALLS	17.05.18
	SEASONAL VEGETABLES	17.05.18
	SPECIALITY MEATBALL BAGUETTE	17.05.18
	BREAD ROLL	15.05.18

	BREAD ROLL	16.05.18
	BREAD ROLL	17.05.18
	BROWN BREAD	15.05.18
	BROWN BREAD	16.05.18
	BROWN BREAD	17.05.18
	THICK WHITE BREAD SLICE	15.05.18
	THICK WHITE BREAD SLICE	16.05.18
	THICK WHITE BREAD SLICE	17.05.18
	BAGUETTE	15.05.18
	BAGUETTE	16.05.18
	BAGUETTE	17.05.18
	BOILED EGG	15.05.18
	BOILED EGG	16.05.18
	BOILED EGG	17.05.18
	GRATED CHEESE PORTION	15.05.18
	GRATED CHEESE PORTION	16.05.18
	GRATED CHEESE PORTION	17.05.18
	SALAD POT TUNA MAYONNAISE	15.05.18
	SALAD POT TUNA MAYONNAISE	17.05.18
	DELI SANDWICH A	15.05.18
	DELI SANDWICH B	16.05.18
	DELI SANDWICH B	17.05.18
	DELI SANDWICH C	15.05.18
	DELI SANDWICH D	15.05.18
	DELI SANDWICH D	16.05.18
	DELI SANDWICH D	17.05.18
	DELI SANDWICH E	15.05.18
	DELI SANDWICH F	17.05.18
	SNACKING ESSENTIALS YOG COATED PEANUTS	01.06.18