Investigating the Effect of Restaurant Menu Labelling on Consumer Food Choices Using a Field Experiment

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1. Introduction

Obesity and overeating are causing a global public health crisis (Pomeranz, 2011; Arno and Thomas, 2016; Crockett *et al.*, 2018; Fitzgerald *et al.*, 2018). This phenomenon is costly to healthcare systems worldwide, with the prevalence of obesity and the complications that result from poor dietary choices expected to rise (Wootan and Osborn, 2006; Wootan, Osborn and Malloy, 2006). Many developed countries have seen an increase in out-of-home eating, which has been linked to an increase in obesity and diet-related morbidities (S. N. Bleich *et al.*, 2017; Bleich, Moran and Jarlenski, 2018; Kerins *et al.*, 2018). There is a heated debate over whether governments or the food industry should spearhead new strategies to combat these issues (Almanza, Nelson, and Chai, 1997; Alexander, O'Gorman, and Woods, 2010; Fitzgerald *et al.*, 2018). Many high-income countries have voluntary government-led initiatives with varying levels of private-sector participation (Bleich, Moran and Jarlenski, 2018). Currently, in the UK and the EU, packaged food labelling is mandatory, but restaurant menu labelling is not. This is a common situation in countries that have evaluated the use of menu labelling legislation (Almanza, Nelson and Chai, 1997; Vandevijvere and Vanderlee, 2019).

A substantial amount of research has been conducted to determine what type of labelling most effectively promotes positive behaviour change toward healthy food choice and consumption. This is especially pertinent given the current political debate in the United Kingdom, Europe, and North America over whether the policy is required to address nutritional labelling on restaurant menus (Britt *et al.*, 2011; Mah *et al.*, 2013; Geaney *et al.*, 2015; Arno and Thomas, 2016). Menu labelling has gained public and legislative support (Mah *et al.*, 2013; Sinclair, Cooper, and Mansfield, 2014; Reale, Flint, and Capehorn, 2015), with many workplaces and healthcare organisations developing and implementing menu labelling policies on their own at both the national and local authority levels (Kerins *et al.*, 2018). One UK policy initiative is the public consultation launched by the Scottish Government to understand the barriers and motivators for restaurant menu labelling in Scotland (Food Standards Scotland, 2018).

Several studies have found widespread support for calorie labelling on menus (Kuo *et al.*, 2009; Mackison, Wrieden and Anderson, 2009; Kerins *et al.*, 2018). While there is public support for calorie labelling, policy issues include how to implement this labelling. In Scotland and Northern Ireland, this is accomplished by using MenuCal, an online tool that assists businesses in calculating the calorie content of menu items. Food Standards Scotland (FSS) is currently offering MenuCal as a tool for businesses to label their menus without incurring high costs (Geaney *et al.*, 2015; Fitzgerald *et al.*, 2018; Kerins *et al.*, 2018). Its goal is to encourage healthier food choices by informing people about the nutritional details of foods, specifically the calorie content and allergen content. This is especially important given the higher proportion of people who eat out of the house on a regular basis, as well as the fact that meals eaten out of the house are often higher in calories and certain nutrients, such as salt and fats, than those cooked at home (Orfanos *et al*., 2009; Kerins *et al*., 2018). While research on menu labelling shows that calorie labelling has benefits, there is no agreed-upon form of labelling and its potential impact on consumer choices.

This research adds to the literature by investigating the effect of menu labelling on consumers' actual meal purchases in a real-world setting using a field experiment at a restaurant. In addition, we are doing something different with the menu labels. We use a combination of traffic-light colour coding and a pictogram to help consumers understand the levels of nutrients and calorie content, respectively. Although several studies have looked into menu labelling on options, with the main focus being primarily on calorie labelling, how to communicate calories and other nutrient information on menu labels has been overlooked, particularly because real-world research in this area is limited. Thus, in this study, we contribute to a better understanding of the impact of menu labelling on actual meal purchases, as well as the best way to communicate calorie and nutrient information to consumers, and we share our experience designing a field experiment with a restaurateur for future research.

The rest of the paper is organised as follows. Section 2 provides a brief review of menu labelling. Section 3 presents the study design, data and analysis. Section 4 reports the main results of the field experiment. Section 5 discusses the findings and limitations. Finally, Section 6 concludes and suggests avenues for further research.

2. Menu Labelling

2.1. Benefits of Menu Labelling

The proponents of menu labelling highlight two potential sources of improvement in public health as a result of menu labelling. The first is that people will make healthier choices and consume fewer calories on average (Bassett *et al*., 2008; S. N. Bleich *et al*., 2017; Crockett *et al*., 2018). While menu labelling has been shown to nudge consumers to make healthier choices (Arno and Thomas, 2016; Cawley, Susskind, and Willage, 2020), not all studies have produced statistically significant results to support this claim (Sinclair, Cooper, and Mansfield, 2014). There is frequently a small decrease in the mean number of calories ordered before and after menu labels are introduced. However, this could still result in significant reductions in healthcare spending (Bassett *et al*., 2008; Thomas, 2015). There is growing evidence in the Republic of Ireland that introducing a menu labelling initiative can influence consumer choice to promote healthier options (Food Safety Authority of Ireland, 2012; Kelly *et al*., 2014). Many studies have shown that a sizable percentage of people would use menu labelling at least some of the time (Auchincloss *et al*., 2013; Hammond *et al*., 2013; Geaney *et al*., 2015).

Another effect of calorie menu labelling would be that restaurants would redesign their menus to include healthier options (Auchincloss et al., 2014; Condrasky *et al.*, 2015; Crockett *et al*., 2018; Vandevijvere and Vanderlee, 2019; Cawley, Susskind and Willage, 2020). There is a lot of evidence to support the idea that businesses self-regulate and reformulate menu items to reduce calories in products after menu labelling is implemented (Bruemmer *et al*., 2012; Bleich, Moran and Jarlenski, 2018). Across studies on restaurateurs' behaviour, there is a consistent trend indicating that they offer products with fewer calories on menus (Harnack and French, 2008; Restrepo, 2017). Large chain restaurants appeared to be part of this trend, although 'core' items did not change calorie count over time, but newly introduced items appeared to have lower calories than the items they replaced (Bleich, Wolfson and Jarlenski, 2016). This caveat was discovered when studies found no changes in median calorie content while also seeing a decrease in average calorie content, indicating that there may still be room to improve the healthy options available (Bleich, Moran and Jarlenski, 2018).

Some evidence suggests that businesses are not averse to reshaping menu items (Obbagy *et al*., 2011). In England, the Responsibility Deal emphasised that taking voluntary responsibility to reformulate menu items could be part of a strategy to reduce high-calorie consumption outside the home (Nikolaou, Lean and Hankey, 2014). While it was acknowledged that reformulation alone is unlikely to have a significant impact on public health, it is critical to any public health diet strategy (Crockett *et al*., 2018; Kerins *et al*., 2018). According to studies from the United States, where menu labelling is required, many restaurants reduced their mean calorie count due to reformulation (Bruemmer *et al*., 2012; S. N. Bleich et al., 2017). While there is mixed evidence from the Responsibility Deal in England regarding voluntarily providing menu labels, growing evidence suggests that a voluntary policy measure may not be sufficient (Geaney *et al*., 2015; Knai *et al*., 2015).

2.2. Barriers to Menu labelling

While labelling policies exist in the food processing and manufacturing industries, the restaurant industry faces unique operational challenges when it comes to implementing menu labels. The cost to the industry is one such barrier. According to the British Hospitality Association, menu labelling would benefit public health little while posing high costs to businesses, which could be passed on to consumers (Thomas, 2015). Another common barrier mentioned in the literature is that restaurant owners and employees do not believe they have the necessary skills or knowledge to accurately measure the calories of menu items (Obbagy *et al*., 2011; Kerins *et al*., 2018). This contributes to the cost of implementing calorie labelling on restaurant menus, as outside companies are frequently hired to provide this service (Geaney *et al*., 2015; Kerins *et al*., 2018). Without the expertise required to accurately calculate calorie counts, menu item innovation and creation may be stifled. This is especially problematic for small or independent restaurants that cannot afford to pay for accurate calorie information for new menu items on a regular basis (Condrasky *et al*., 2015; Thomas, 2015). Other practical issues for menu labelling include a lack of menu space and thus difficulty in designing aesthetically pleasing menus, a lack of standardised cooking methods in some restaurants, which could lead to inconsistent portion sizes and, as a result, misleading menu label information, and offering no menus or portion control at buffet-style dining (Alexander, O'Gorman, and Woods, 2010; Auchincloss *et al.*, 2013; Yepes, 2015).

The desire to avoid information overload for customers on the menu, as well as the fear of accidentally proving misleading information on menus, have been cited as reasons why many restaurants in the UK have not participated in menu labelling initiatives (Knai *et al*., 2015; Fitzgerald *et al*., 2018). According to research, more information about the benefits of menu labelling should be provided to restaurant owners, as well as practical assistance in nutritional analysis, nutrition training for staff, and menu design from public health practitioners and academics (Almanza, Nelson and Chai, 1997; Fitzgerald *et al*., 2018).

2.3. Menu Labels Used

One aspect of the debate over nutritional labelling on restaurant menus that is frequently overlooked is what format of menu labelling would be most beneficial. While the Scottish Government considers whether to require calorie labelling on menus, some research suggests that different variations of menu labelling can have varying levels of usefulness for consumers. A recent Cochrane review (Crockett, 2018) highlighted a variety of menu labelling interventions, ranging from simply requiring the labelling of calorie content (Bollinger, Leslie, and Sorensen, 2011) and requiring a statement of recommended calorie intake (Girz *et al*., 2012) to the labelling of other nutritional information such as fat, salt, and sugar content, as well as the calorie content of each menu (Hammond *et al*., 2013). There are very few examples of mandatory nutritional labels other than calorie labelling. Menu boards in New York, USA, for example, are required to display the sodium content of each item (Vandevijvere and Vanderlee, 2019). Various menu labelling interventions have also been used in studies to compare a variety of possible outcomes, such as calories provided as numbers and calories represented with traffic-light codes for low, medium, and high contents (Hammond *et al*., 2013). However, the results between different menu-labelling practices can be inconclusive (Ellison, Lusk, and Davis, 2013; Liu *et al*., 2012), with some evidence of symbolic labels being beneficial (Holmes *et al*., 2013; Antonelli and Viera, 2015).

In our study, we design and implement a new menu label that communicates calorie content and nutrients (fat, saturated fat, sugars, and salt) using traffic-light colour coding and a pictogram. The traffic light colour coding helps explain nutrient levels (low, medium, and high), while the pictogram aids understanding of calorie information by providing walking minutes to burn associated calories. Previous research has found that physical-activity equivalent calorie labelling may influence food choices by promoting healthy options or decreasing intentions to consume unhealthy options (Antonelli and Viera, 2015; Robinson, Smith and Jones, 2021). Furthermore, a previous study indicates that colour-coding plays an important role in people's decision-making processes. Colour-coding, in particular, may improve analytical thinking rather than the quick and emotional thinking process, leading to healthier choices (Cecchini and Warin, 2016; Fenko, Nicolaas, and Galetzka, 2018). While many studies have been conducted on the use of colour-coding on front-of-pack labelling (e.g., Sacks et al., 2011; Mhurchu et al., 2018; Fenko, Nicolaas, and Galetzka, 2018; Erdem and Campbell, 2019; Hagmann and Siegrist, 2020), the use on menu labelling has gone unnoticed.

3. Materials and Method

3.1. Study design

We devised a field experiment in a natural eating environment at a restaurant in Stirling to investigate the effect of restaurant menu labelling on consumers' meal choices and attitudes toward the use of nutritional labels on menus. The restaurant is located in a hotel on campus and is open to the public and students seven days a week. The experiment consisted of a control condition in which no menu labels were included on the restaurant menu and a treatment condition in which nutritional labels were included on the same menu used in the control group. The labels were placed next to the menu items and contained information about the dish's calorie and nutritional content (see Figure 1). The chefs provided us with the recipes they used during the experiment, and we calculated the calorie content of each dish using McCane and Widdowson's Composition of Foods Integrated Dataset (2006). This is a database that is frequently used in calorie calculations and on which the MenuCal software is based. We cross-validated our calculations with an expert dietitian at the company that provided catering services to the restaurant after determining the calories and nutritional contents of the restaurant's starters, main dishes, and desserts during the study period. We designed new menu labels after calculating the calories and nutritional content of each dish.

In accordance with the standard practice used in front-of-pack labelling, the menu labels included information about the calorie content of the entire portion and 100 grams of the dish (see Figure 1). The labels also included information about the dishes' fat, saturated fat, sugars, and salt content. We communicated nutrient content using traffic light coding and qualitative descriptors for their levels, such as low, medium, and high, as found on food product front-of-pack labelling. These classifications are based on the guidelines for developing front-of-pack nutritional labelling for pre-packaged foods sold in retail outlets (Department of Health, 2016). For example, if an item is coded with green, it indicates a low level of that nutrient in 100 grams of that dish; amber indicates a medium level of nutrients in 100 grams of the dish; and red indicates a high level of nutrients in 100 grams of the dish. On the labels, the total portion size of the dish was also specified.

FIGURE 1 HERE

Another essential feature of the menu labels we created was how we communicated the calories per 100 grams of food to the participants. We included the average amount of walking time required to burn calories from the dish's consumption. The walking time is calculated using the data from the BUPA calorie calculator[1] and cross-checked against other sources such as the British Heart Foundation[2] and the NHS[3]. It is based on an adult who weighs 75 kg and walks at a moderate pace (3 miles per hour). Appendix A contains the menu with labels (intervention). The menu in the control condition is identical to the one in the treatment condition, but it lacks nutritional labels.

The experiment began by giving participants either the standard menu (control) or the same menu with labels (treatment), depending on whether they were in the control or treatment group. Following their meal, the waiting staff handed them a postcard with five quick questions about their previous experience with nutritional labelling, perceived usefulness and influence of nutritional labels on food choices made, gender, and food items ordered from the menu. We were limited to using postcards with short questions due to the restaurateur's

[1] https://www.bupa.co.uk/health-information/tools-calculators/calories-calculator

[2] https://www.bhf.org.uk/informationsupport/support/healthy-living/staying-active/exercise-calorie-calculator

[3] https://www.nhs.uk/live-well/healthy-weight/understanding-calories/

concern about influencing their customers' dining experience with a standard follow-up questionnaire. As a result, we were unable to investigate other factors that could have aided in the investigation of food choice in greater depth.

We asked the control group if they were *familiar with nutritional labelling for foods*, if they *would find nutritional information useful when selecting meals from a menu*, and if *this information would influence what they chose*. The response options for these questions ranged from "very familiar/very much agree" to "very unfamiliar/very much disagree" on a five-point Likert scale. In addition to these three opinion questions, we asked participants about their gender and the meals they ordered (starter, main, and dessert).

We asked the treatment group similar questions, but because the restaurant menu included nutritional labels, our questions reflected this and sought more details on their opinions. We inquired about their level of *familiarity with the labelling prior to visiting the restaurant, whether the nutritional labelling influenced what they ordered, the most and least useful information on the label*, their gender, and the meals they chose. While the response options for label familiarity and influence were mirroring those in the control questionnaire, the usefulness of labelling information included *calories, walking minutes, fat, saturates, sugars, and salt contents*.

The items in the mini-questionnaires were chosen based on our review of the literature and discussions with the restaurateur and local policymakers. Appendix B contains a copy of the mini-questionnaires for the control and intervention groups. The University's Ethics Panel approved the study protocol. Furthermore, before they were fielded, the mini questionnaires were piloted with a small sample from the campus.

3.2. Data

In 2017, we collected data from 197 consumers. Participants in the study were neither recruited nor chosen. They were restaurant patrons who chose to eat there on the spur of the moment, unaware of the experiment. The treatment group had 108 participants, compared to 89 in the control group. From March to July, we began collecting data from the control group. The new menus were then labelled, and treatment data was collected from July to December.

The participant profiles in the control and intervention groups are very similar. As shown in Table 1, the proportion of males in each group is similar (45% control, 44% treatment), with more people in the control group not reporting their gender and a slightly higher proportion of females in the treatment group. Statistically speaking, there are no gender differences between the control and treatment groups (Pearson $\chi^2(2) = 0.50$ with p-value = 0.77).

TABLE 1 HERE

It is critical for these types of natural experiments to have similar demographics for each group in order to control for any unobservable variable biases within the analysis. There is a slight difference in the male-to-female ratio between the groups, but this is not unusual given the small sample size.

3.3. Analysis

The empirical evidence presented in the paper is based on descriptive and inferential statistical analyses to compare and test differences between and within the control and treatment conditions, and ordered logistic regression to investigate what predicts the likelihood of labels perceived influential on food choices.

The inferential analysis is performed using Pearson's χ^2 to determine whether familiarity with nutritional labelling, perception of the usefulness of menu labels, and the influence of labels on food choices differ significantly between and within groups.

The ordered logistic regression allows us to predict the probability of labels as influential on food choices using the perceived usefulness of calorie labels, familiarity with them, and gender. Statistically, we can present the model as follows:

$$\log \frac{P(Y \leq j)}{P(Y \geq j)} = \beta_j + \beta X \quad j \,\epsilon\, [\,1, J-1], \qquad \text{eq 1}$$

where $j \,\epsilon\, [\,1, J-1]$ are the levels of the ordinal outcome variable Y, agreement on the influence of nutritional labels on food choices [disagree, neutral, agree][4]. This outcome variable is derived from a question on the control and treatment questionnaires that asks participants' opinions on the influence of nutritional information on their food choices on a five-point Likert-based scale[5]. The ordinal outcomes are distinguished by the $J-1$ intercepts β_j. The benchmark level is J. βs are coefficients for X covariates: gender, perceived usefulness of the labels and familiarity with the nutritional labelling.

By a simple algebraic manipulation, we can formulate the probability of observing an outcome at a level *j* by:

$$p(Y \leq j) = \frac{\exp(\beta_j + \beta X)}{1 + \exp(\beta_j + \beta X)} \qquad \text{eq 2}$$

This probability expression in eq 2 takes the following forms for the control (p_{ctrl}) and treatment (p_{tr}) :

[4] We note a slight difference in the meaning of the dependant variable for the control and treatment conditions. The response to "influence" question in the control condition refers to how information on labels *would* influence participant's food choice if they were provided. However, the treatment group made their food choices using menus with labels, and therefore, we asked them whether information on labels *actually* influenced their food choices.

[5] Due to the small sample size, few responses were given to each level of Likert scale. For this reason, we decided to derive a variable with three levels, rather than using all five levels.

$$p_{ctrl} = \frac{\exp\,(\beta_j + \beta_1 X_{female} + \beta_{2-3} X_{familiar} + \beta_{4-5} X_{useful})}{1 + \exp\,(\beta_j + \beta_1 X_{female} + \beta_{2-3} X_{familiar} + \beta_{4-5} X_{useful}} \qquad \text{eq 3}$$

$$p_{tr} = \frac{\exp\,(\beta_j + \beta_1 X_{female} + \beta_{2-3} X_{familiar} + \beta_4 X_{usefulcal} + \beta_5 X_{usefulwalk})}{1 + \exp\,(\beta_j + \beta_1 X_{female} + \beta_{2-3} X_{familiar} + \beta_4 X_{usefulcal} + \beta_5 X_{usefulwalk})}, \qquad \text{eq 4}$$

where female is defined as a binary variable, familiarity is a categorical variable with three levels (unfamiliar, neutral, familiar), "neutral" being the baseline level. The "usefulness" variables are defined differently in control and treatment. It asks the level of agreement on whether nutritional labels are useful on food choices in the control condition (disagree, neutral, agree); in the treatment condition, it asks the most and least useful information on nutritional labels. We created two dummy variables from the treatment questionnaire that were related to the usefulness of calorie ("usefulcal") and walking minute ("usefulwalk").

We then use maximum likelihood estimation to estimate the β coefficients that maximise the log-likelihood function.

$$\sum_{i=1}^{N} \left[Y_i * \ln\left(P_{Y_i}\right) + (1 - Y_i) * \ln\,(1 - P_{Y_i}) \right], \qquad \text{eq 5}$$

where N is the number of participants.

4. Findings

4.2. Exploratory Data Analysis:

The data provided information on the gender of the participants, their familiarity with nutritional labels, their opinions on how much the menu labels influence their food choices, and their actual menu choices. This section presents descriptive statistics and the results of statistical tests performed between and within groups, as shown in Table 1.

TABLE 1 HERE

Our exploratory analysis shows that control and treatment samples are not statistically significantly different in gender distribution (Pearson $\chi^2(2) = 3.71$, p-value = 0.15). There are, however, some significant differences in terms of familiarity with the nutritional labels (Pearson $\chi^2(4) = 7.67$, p-value = 0.10) and the perceived influence of labels on actual food choices from the menu (Pearson $\chi^2(4) = 12.81$, p-value = 0.01). We see that the control has a slightly higher proportion of individuals more familiar with nutritional labelling (68%) than individuals in the treatment group (56%). When we further investigate the familiarity within each sample, we see no significant association with gender (control: Pearson $\chi^2(8) = 10.99$, p-value = 0.20; treatment: Pearson $\chi^2(8) = 7.52$, p-value = 0.48). However, we see a significant association between the perceived usefulness and familiarity with labels in the control condition (Pearson $\chi^2(8) = 17.72$, p-value = 0.001).

Regarding the influence the nutritional labels have on individuals' meal choices, we find significant differences in views between the control and the treatment groups (Pearson $\chi^2(4) = 12.81$ with p-value = 0.01). While 23% of the control group disagreed that the nutritional labelling influenced what they chose from the menu, this was 43% for the treatment group, who were actually presented with menus including labels. Nearly equal proportions of the samples agreed (c.40%) that nutritional labels influenced their choices. This indicates that more people are neutral in their opinion in the control group than in the treatment. This could be due to the uncertainty or unfamiliarity about how actual nutritional labels would look like on restaurant menus. When we reviewed the feedback participants left over the survey card, a few participants mentioned that the nutritional labels on the menu "spoiled their dining experience" as they did not want to know the nutritional details of their meals (a phenomenon called strategic self-ignorance (Thunström *et al.*, 2016)). These findings are consistent with other studies that found a similar proportion of individuals would not use nutritional labels on menus or not find them influential (Burton *et al.*, 2006; Harnack and French, 2008; Liu *et al.*, 2012; McCann *et al.*, 2013; Nikolaou, Lean and Hankey, 2014).

Looking at which information on the label is viewed as the most influential in the treatment group's decision-making process, we find that both calorie information and walking minutes to burn calories are most influential in making choices, as shown in Figure 2 below. Nutrient information (such as salt, fat, saturates, and sugar) ranked low in terms of usefulness in decision-making. Participants who believe nutrients are the most useful information on labels also believe walking minutes are the least useful. This could be due to a lack of familiarity with the measure. When we explore if the usefulness of certain information on labels varies by gender, we find no significant differences.

FIGURE 2 HERE

Using the data provided by the survey respondents[6], we calculate the average calories ordered by the control and treatment group for each course. As shown in Table 1, the differences between average calories for starter, main dish, and desserts are very small and statistically insignificant, as evident from the result of the t-tests. Furthermore, although the average total calories in the treatment group are less than the average total calories in the control group, this difference is not statistically significant, either ($t(170) = 0.36$, $p = 0.72$). This is consistent with findings from Cawley, Susskind and Willage (2020) study on calorie labelling of restaurant menus.

4.2. Regression Analysis

We conducted an ordered logistic regression to determine how nutritional labelling of menus affects actual food choices and what predicts the probability of labels being influential on meal choice. The dependent variable is an ordinal variable with three levels: disagreement, neutral opinion, and agreement on the influence of nutritional labels on food choices[7].

[6] Not all participants provided details on what they ordered from the menu.

[7] We explored various regression models, such as multinomial logit model using food choices as outcome variable, OLS using total calorie consumption as the outcome variable, and logistic regression using a binary

The usefulness of nutritional labels was measured on a Likert-based scale, and we recoded it in this regression analysis using three ordinal levels: disagreeing on the usefulness of labels, neutral, and agreeing on the usefulness of labels. However, because the treatment groups had already encountered the nutritional labels during the experiment, we asked them which aspects (i.e., calorie content, walking minutes, nutrient contents) they found most useful and which they found least useful. Because of this nuance, there is no direct comparison of the perceived usefulness of the labels between control and treatment.

According to the results, familiarity with nutritional labels has no significant effect on the labels' likelihood of influencing food choices in both control and treatment groups. On the other hand, the perceived usefulness of the labels has some significant effect on the likelihood of labels being influential during food choices.

In the control group, keeping all variables constant, if participants agree with the usefulness of the labels, they are 3.29 (odds ratio) times more likely to find the nutritional labels influential on their meal choices if they were provided with a menu with nutritional labels (relative to the participants who neither agree nor disagree with it). In the treatment group, if calorie information is believed to be the most useful aspect of the menu label, participants are 3.51 (odd ratio) times more likely to find the nutritional labels influential when making meal choices from a menu with labels (compared to a case where nutrient contents are considered as the most useful aspect). Walking minutes, on the other hand, is not statistically significant in predicting the likelihood of influence on food choices (compared to nutrient details).

In terms of gender, females in the control group are 3.34 times (odds ratio) more likely to find nutritional labels persuasive. However, in the treatment group, we found no significant gender effect on the likelihood of nutritional labels being viewed as important on food choices.

TABLE 2 HERE

5. Discussion

This research used a field experiment at a restaurant to investigate the effect of nutritional labelling on restaurant menus on actual meal purchases in a real-world setting. While it does not seek to add conclusive weight to the policy debate, it does provide empirical evidence on the impact of menu labels on meal choices at restaurants and how consumers perceive them. Several studies on nutritional labelling have had equivocal results (Restrepo, 2017; S. Bleich *et al.*, 2017; S. N. Bleich *et al.*, 2017; Kerins *et al.*, 2018). This paper also did not find conclusive evidence that menu calorie labelling is effective. This discovery can be attributed to a number of factors. To begin with, while field experiments are useful for gathering real-life data without influencing participants and so have higher ecological validity than lab-based studies, they also have certain flaws that may explain our rather poor results. These include (i) taking

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outcome variable representing if calorie consumption is over the sample mean or median calorie consumption. However, we did not find significant effects to report (these are available from the author upon request).

more time to collect data, which reduces the sample size of a study; (ii) having no control over variables, which causes replicability and generalisability issues (external validity); and (iii) having no control over attrition, which results in unbalanced/missing data in the analysis. The amount of data collected is also determined by the restauranteur's desire to provide room for data gathering after their customers' eating experience. In our situation, we agreed with the company to ask a modest number of opinion questions to elicit the important features of menu labelling use. As a result, the lack of rich data was not surprising, as many systematic reviews in the literature have noted (Sinclair, Cooper, and Mansfield, 2014; Arno and Thomas, 2016; Crockett *et al*., 2018). Despite these limitations, this paper is useful for researchers and others who want to design a study investigating the impact of menu labelling on food choices in a real-world setting.

One of the goals of this study is to demonstrate the importance of information disclosure on restaurant menus. We discovered that disclosing nutritional and calorie content information on restaurant menus increased participants' perceptions of labels as influential on food choices. There is evidence that menu labelling information can have varying levels of importance to consumers, and the more useful the information is to consumers, the more likely they will be influenced by it (Breck *et al*., 2014). Because calories are useful to some people, healthy choices are often made when people are knowledgeable about calories and can use the information on labels (Girz *et al*., 2012; Ni Mhurchu *et al*., 2018). We wanted to show that visual cues like pictograms and colour coding would result in more easily accessible and, as a result, effective menu labelling in our study. We discovered that a higher proportion of people found the pictogram to be the most useful part of the menu labelling. This is because of the visual presentation with a familiar activity aids in translating and thus understanding numeric calorie information. Including contextual information, such as colour coding or infographics, on menu labels, according to studies, is more effective than just displaying calorie content (Liu *et al*., 2012; Morley *et al*., 2013; Antonelli and Viera, 2015).

However, when the actual calories of meals ordered are compared to perceived influence, there are no significant differences between the control and treatment groups. This indicated that participants in the treatment condition believed nutritional labels had an impact on their decisions; however, their actual purchased calories were not statistically significantly lower than those in the control conditions. We should point out that we only observed the orders and not the consumption. As a result, it is possible that participants respond to nutritional labels by changing the amount they consume rather than changing their orders. Unfortunately, we cannot prove this claim, but it would be useful if future studies could test how labels influence consumption.

Females are more likely than males to be familiar with nutritional menu labels, which is consistent with previous studies (Breck *et al*., 2014; Nikolaou, Lean, and Hankey, 2014). However, a higher level of familiarity does not always imply comprehension or use of these labels.

Our findings indicate that the “perceived” usefulness of labels appears to be related to whether labels are thought to influence meal choices. This is a significant finding. As Spinks and Mortimer (2015) point out, the use of pictograms and colour-coded nutritional information, including calorie content, may be some ways to contextualise difficult-to-understand information on menu labels, and thus, might be influencing the perceived "usefulness" of labels.

While most studies on menu labelling have focused on the consumer's point of view (Din, Zahari, and Shariff, 2012; Restrepo, 2017), a few studies have looked at business impacts (Fitzgerald *et al*., 2018). While this study focuses on consumer responses to menu labelling, we collected informal feedback from the restaurateur during the field experiment's design and implementation. Many of the barriers to menu labelling implementation identified by restaurateurs have been extensively discussed in the literature. For example, measuring calories was difficult due to a lack of knowledge, expertise, and equipment. This problem was exacerbated by variations in cooking methods and recipe changes that altered the calorie and nutritional content of meals. While most of the barriers were related to implementing menu labelling and how it affected how the kitchen ran, potentially stifling chef experimentation and increasing difficulty infrequently changing menu items (Obbagy *et al*., 2011; Condrasky *et al*., 2015), which could lead to potential profit loss. There was also concern that, in order to implement menu labelling, restaurant staff would need to be trained and able to answer questions about these labels, similar to findings in other studies (e.g., Thomas, 2015). This could be difficult due to a lack of resources and time for training, as well as potential issues with waiting staff turnover.

While there were concerns and barriers to implementing menu labelling at the restaurant, there was a genuine desire to provide customers with more information to help them make healthy choices. However, this information had to be balanced against the risk of overwhelming the customer and negatively impacting their dining experience (Hodgkins *et al.,* 2012).

Another interesting observation from this study was that the restaurant decided to reformulate a few items on their menu when designing the labels. This involved reducing the portion sizes to have a lower level of fat and sugar content. This reformulation is often credited as a potential benefit of menu labelling (Bleich *et al*., 2017; Vandevijvere and Vanderlee, 2019).

There are several important directions for future research. First, field experiments should be conducted in restaurants varying in size, location, customer base, and menu offerings. Second, the actual consumption data should also be collected to test the effect of menu labels on meal consumption.

6. Concluding remarks

This paper presents empirical evidence on the effect of menu labelling on actual meal purchases by consumers in a real-world setting. While the findings do not add conclusive weight to the policy debate, they do add to the literature by providing empirical evidence from a field experiment and sharing experiences from the study's design and implementation. More research is needed, however, to address the limitations highlighted in this study. The requirement for useful menu labelling necessitates the testing of various labelling interventions and formats. A more in-depth study could reveal whether different menu labelling formats can reduce calorie purchase, as well as consumption. However, more engagement with businesses of various sizes and sectors of the restaurant industry is required before any policy recommendation on menu labelling implementation can be made.

Acknowledgements

To be added.

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Table 1: Results of exploratory data analysis

	Control	*Treatment*	*Test Statistics*
Gender			
Male	48 (54%)	48 (47%)	Pearson $\chi^2(2) = 3.71$ p-value = 0.15
Female	34 (39%)	47 (46%)	
Prefer not to say	6 (7%)	8 (7%)	
N	88	103	
Familiarity with labels			
Very unfamiliar	3 (3%)	13 (13%)	Pearson $\chi^2(4) = 7.67$ p-value = 0.10
Somewhat unfamiliar	14 (16%)	13 (13%)	
Neutral	11 (13%)	19 (18%)	
Somewhat familiar	39 (44%)	35 (34%)	
Very familiar	21 (24%)	22 (22%)	
N/A	0 (%)	1 (1%)	
N	88	103	
Influence of labels on food choice			
Very much disagree	9 (10%)	28 (27%)	Pearson $\chi^2(4) = 12.81$ p-value = 0.01
Somewhat disagree	11 (13%)	16 (16%)	
Neutral	29 (33%)	18 (17%)	
Somewhat agree	30 (34%)	29 (28%)	
Very much agree	8 (9%)	12 (12%)	
N/A	1 (1%)	0 (0%)	
N	88	103	
Average calories of foods purchased (Kcal)			
Starter	281 (sd = 122)	275 (sd = 141)	t(149) = 0.25, p = 0.80
Main	666 (sd = 145)	670 (sd = 125)	t(168) = -0.19, p = 0.85
Dessert	456 (sd = 175)	424 (sd = 167)	t(127) = 1.04, p = 0.30
Total calories	1242 (sd = 314)	1224 (sd = 319)	t(170) = 0.36, p = 0.72
N	70	102	

Table 2. Ordered logistic regression result

Dep var = influence (ordinal) (*1=Disagree, 2 = Neutral, 3= Agree)*	**Control**		**Treatment**	
	Coef.	**Odd Ratio (OR)**	**Coef.**	**Odd Ratio (OR)**
Coefficients:				
Familiarity: unfamiliar	0.52 (0.79)	1.68 (0.79)	0.30 (0.62)	1.35 (0.62)
Familiarity: neutral	Baseline			
Familiarity: familiar	-0.02 (0.72)	0.97 (0.72)	0.30 (0.54)	1.35 (0.54)
Usefulness: disagree	-2.63*** (0.77)	0.08*** (0.77)		
Usefulness: neutral	Baseline			
Usefulness: agree	1.19** (0.59)	3.29** (0.59)		
Most useful: calories			1.25** (0.56)	3.51** (0.56)
Most useful: walking minutes			0.77 (0.51)	2.17 (0.51)
Most useful: nutrient contents	Baseline			
Female	1.21*** (0.49)	3.34*** (0.49)	0.12 (0.42)	1.12 (0.42)
Intercepts:				
Disagree|unsure	-1.07 (0.67)		0.59 (0.62)	
Unsure|agree	1.23* (0.66)		1.31** (0.63)	
N	81		89	
Log-likelihood	-65.70		-88.45	

***, **,* indicate significance at the 1%, 5%, and 10% levels, respectively.
Standard errors are in parentheses.

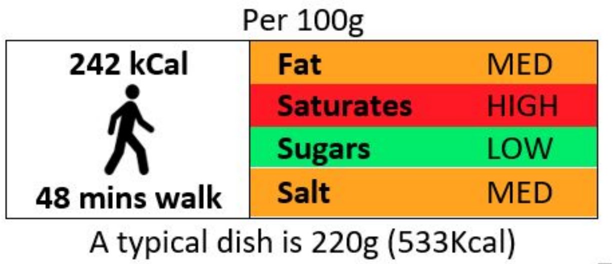

Figure 1. An example of a nutritional label used in the experiment

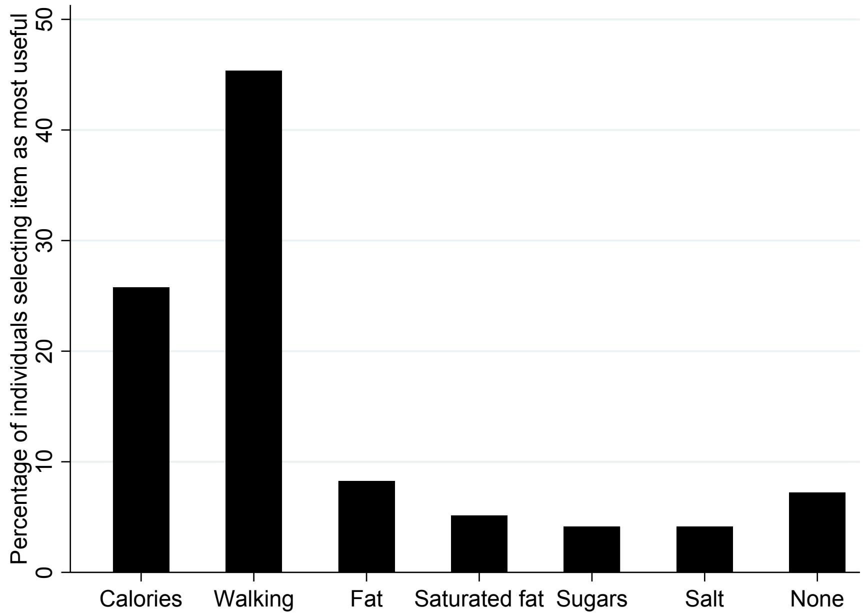

Figure 2. Most useful information on the nutritional labelling

Appendix A: Labelled Menu

STARTERS

Seasonal soup of the day 4.25

Crispy Stornoway black pudding and confit pork sandwich
with celeriac slaw, truffled spinach,
caramelised apples and sage jus 6.75

Per 100g

242 kCal	Fat	MED
	Saturates	HIGH
	Sugars	LOW
48 mins walk	Salt	MED

A typical dish is 220g (533Kcal)

Hot oaked-roast Scottish salmon and herb mousse
avocado, lemon and shallot dressing 6.50

Per 100g

148 kCal	Fat	MED
	Saturates	MED
	Sugars	LOW
30 mins walk	Salt	MED

A typical dish is 135g (200Kcal)

Terrine of chicken liver and port parfait
house chutney, Earl Grey soaked sultanas, brioche bun 6.50

Per 100g

258 kCal	Fat	MED
	Saturates	HIGH
	Sugars	MED
52 mins walk	Salt	MED

A typical dish is 127g (327Kcal)

Crispy Inverloch Goat's Cheese
Balsamic, locally sourced honey-roasted garden beetroot,
rocket leaves 6.00

Per 100g

281 kCal	Fat	HIGH
	Saturates	HIGH
	Sugars	MED
56 mins walk	Salt	MED

Typical dish is 105g (295Kcal)

Crown of seasonal melon
exotic fruits and Arran mango sorbet 5.65

Per 100g

37 kCal	Fat	LOW
	Saturates	LOW
	Sugars	MED
7 mins walk	Salt	LOW

A typical dish is 258g (95Kcal)

MAIN COURSE

Roast rump of Perthshire lamb
braised lentils, button onions, pancetta, apple and elderflower chutney, wilted greens, madeira jus 16.95

Per 100g

185 kCal	Fat	MED
	Saturates	MED
	Sugars	LOW
37 mins walk	Salt	MED

A typical dish is 345g (638Kcal)

Poached smoked Scottish haddock
asparagus, leek and Arran mustard potatoes, soft poached egg, sauce hollandaise 14.95

Per 100g

105 kCal	Fat	MED
	Saturates	MED
	Sugars	LOW
21 mins walk	Salt	MED

A typical dish is 375g (394Kcal)

Slow cooked daube of highland beef
horseradish mash, wild mushrooms, fine beans, Bordelaise sauce 15.25

Per 100g

157 kCal	Fat	MED
	Saturates	MED
	Sugars	LOW
31 mins walk	Salt	LOW

A typical dish is 350g (550Kcal)

Grilled fillet of Scottish salmon
lemon and soft herb risotto, crisp Parma ham, pesto dressing 14.50

Per 100g

267 kCal	Fat	MED
	Saturates	MED
	Sugars	LOW
53 mins walk	Salt	MED

A typical dish is 300g (801Kcal)

Wild mushroom and asparagus filo parcel
spinach, braised rice and a sweet chilli dressing 13.50

Per 100g

234 kCal	Fat	MED
	Saturates	MED
	Sugars	LOW
47 mins walk	Salt	MED

Typical dish is 303g (708Kcal)

8oz Buccleuch chargrilled sirloin steak
fries, flat cap mushroom, roasted plum tomato, garlic and herb butter 19.95

Per 100g

199 kCal	Fat	MED
	Saturates	HIGH
	Sugars	LOW
40 mins walk	Salt	MED

A typical dish is 422g (840Kcal)

Chef's seasonal dish of the day 14.50
Ask your server for details

**Nutritional details and calories are average values for a typical dish. The walking time is for an average adult walking at a moderate pace.

DESSERTS

Baked Bramley apple crumble
Arran vanilla bean ice cream, spiced red wine syrup 4.50

Per 100g

200 kCal	Fat	MED
	Saturates	HIGH
	Sugars	MED
40 mins walk	Salt	LOW

A typical dish is 138g (276Kcal)

Lemon and meringue
lemon curd mousse, fluffy meringue, white chocolate sauce 5.95

Per 100g

335 kCal	Fat	MED
	Saturates	HIGH
	Sugars	HIGH
67 mins walk	Salt	MED

A typical dish is 115g (385Kcal)

Hazelnut delice
Arran peanut butter ice cream, dulce de leche 6.50

Per 100g

344 kCal	Fat	HIGH
	Saturates	HIGH
	Sugars	HIGH
69 mins walk	Salt	LOW

A typical dish is 148g (509Kcal)

Classic chocolate fondant,
poached sour cherries, vanilla mascarpone, pistachio wafer 5.75

Per 100g

382 kCal	Fat	HIGH
	Saturates	HIGH
	Sugars	MED
76 mins walk	Salt	LOW

A typical dish is 190g (727Kcal)

Selection of Scottish cheeses,
house chutney, celery, frozen grapes, biscuits 7.25

Per 100g

296 kCal	Fat	HIGH
	Saturates	HIGH
	Sugars	LOW
59 mins walk	Salt	MED

A typical dish is 115g (340Kcal)

Chef's dessert of the day 5.95
Ask your server for details

Appendix B: Menu Questionnaires

Control Questionnaire

Please take a few moments to fill out the following questions…

1. **How familiar are you with nutritional labelling for foods?**

Very familiar	Somewhat familiar	Neither familiar nor unfamiliar	Somewhat unfamiliar	Very unfamiliar
☐	☐	☐	☐	☐

2. **Would you find nutritional information (e.g., calories, fat, sugar, salt) useful when choosing your meal?**

Very much agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Very much disagree
☐	☐	☐	☐	☐

3. **Would this information influence what you choose from a menu?**

Very much agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Very much disagree
☐	☐	☐	☐	☐

4. **What is your gender?**

Male ☐ Female ☐ Prefer not to say ☐

5. **Please briefly indicate which dishes you ordered (leave blank if N/A).**

Starter	
Main	
Dessert	

Thank you!

Treatment Questionnaire

Please take a few moments to fill out this short questionnaire…

1. How familiar were you with nutritional labelling before coming to the restaurant?

Very familiar	Somewhat familiar	Neither familiar nor unfamiliar	Somewhat unfamiliar	Very unfamiliar
☐	☐	☐	☐	☐

2. Nutritional labelling influenced what I ordered from the menu.

Very much agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Very much disagree
☐	☐	☐	☐	☐

3. Which information on labels did you find MOST useful when ordering your meal? (*tick ONE*)

Calories	Walking mins	Fat	Saturated fats	Sugars	Salt
☐	☐	☐	☐	☐	☐

4. Which information on labels did you find LEAST useful when ordering your meal? (*tick ONE*)

Calories	Walking mins	Fat	Saturated fats	Sugars	Salt
☐	☐	☐	☐	☐	☐

5. What is your gender?

Male ☐ Female ☐ Prefer not to say ☐

6. Please briefly indicate which dishes you ordered (leave blank if not ordered).

Starter	
Main	
Dessert	

Thank you!