
# MENU LABELLING AND HEALTHY FOOD CHOICES: A RANDOMISED CONTROLLED TRIAL



| | |
|---|---|
| Journal: | *British Food Journal* |
| Manuscript ID | BFJ-04-2017-0248.R1 |
| Manuscript Type: | Research Paper |
| Keywords: | nutrition information, Restaurants, foodservice, food choices, Intervention |
| | |

# MENU LABELLING AND HEALTHY FOOD CHOICES: A RANDOMISED CONTROLLED TRIAL


## Abstract

**Purpose:** This~~e purpose of this~~ study ~~was to examine~~examined the effect of different menu labelling formats on healthy food choices in a real restaurant setting. **Design/methodology/approach:** This cross-sectional, randomised and controlled parallel-group trial was conducted in Brazil in 2013. 313 university students were randomly assigned to one of three parallel groups with different menu labelling formats. Of these, data from 233 students were analysed. The others did not attend and were excluded. Intervention group 1 (n=88) received information in the form of a traffic light ~~system~~ plus guideline daily amounts, while intervention group 2 (n=74) was presented with ~~an~~ ingredients list plus highlighted symbols. The control group (n=71) received a menu with no menu labelling. Data were collected on one weekday in a restaurant setting. Trial outcomes were assessed by healthy food choices. **Findings:** Healthy food choices ~~were significantly higher among~~of students who received the menu showing ~~an~~ ingredients list plus highlighted symbols were significantly higher when compared to the other groups. This~~e~~ same menu labelling format positively affected healthy food choices in women, not overweight participants and in participants who often ate out more than twice a week. **Originality/value:** M~~A m~~enu labelling format presenting~~that presented an~~ ingredients list and highlighted symbols was positively associated with healthy food choices among university students in Brazil. This type of labelling could be adopted in future legislation on menu labelling in Brazil and around the world.


**Keywords:** Nutrition information; Restaurants; Foodservice; Food choices; Intervention.

**Article Classification:** Research paper.

## Introduction

The term menu labelling can be used in different contexts, as a synonym for calorie information (Roberto *et al.,* 2013; Brochu and Dovidio, 2014;), for nutritional information (Yoon and George, 2012; Auchincloss *et al.*, 2013), for the coloured traffic light system (Gerlach, 2013; Morley *et al.,* 2013), or for food and nutritional information (Thunstrom and Nordstrom, 2011; Feldman *et al.*, 2013). For the purposes of the present study, menu labelling refers to –all calorie information, nutritional information (such as calories and nutrients), and food information (e.g. ingredients list, highlighted symbols to designate 'vegetarian' and phrases like 'contains gluten'), as well as the traffic light system plus guideline daily amounts.

Menu labelling is a public health strategy that is debated around the world as a way to help prevent obesity and other chronic diseases by informing consumers' choices (Bleich and Pollack, 2010; Malik *et al.*, 2013). However, only in the United States of America (USA) is it mandatory under federal law; there, restaurants and similar food service establishments that are part of a chain of 20 or more must provide calorie information on their menus (United States Of America, 2014). In other countries (e.g. Canada and Australia), menu labelling comes under local laws, but not federal law.

In Brazil, although there is no national legislation, menu labelling is being discussed by ANVISA (Brazilian Health Surveillance Agency). In some places there are local laws which require nutritional information to be presented on menus but there is no evidence of law enforcement and if this initiative is effective for consumer use (Oliveira *et al.*, 2012).

Consumers report wanting menu labelling to be available to help them make informed choices; this is especially so for those who have dietary restrictions related to health, such as allergies and intolerances, and those with religious or philosophical requirement (Oliveira *et al.*, 2012; Martinez *et al.*, 2013). Unfortunately, they often find it hard to read and understand the information, mostly because of the mathematically complex numeric information on calories and nutrients (Grunert and Wills, 2007; Blumenthal and Volpp, 2010; Tangari *et al.*, 2010; Lee *et al.*, 2013).

There is no a standard design to provide menu labelling in restaurants, and the way this information is made available varies substantially. According to the Food Standards Agency (FSA) in the United Kingdom (UK), consumers consider standardisation of menu labelling design important to allow

differentiation among dishes, and to facilitate their use and understanding of this information (United Kingdom, 2009).

Because of the lack of standardisation and definition on what is the best menu labelling design a variety of food and nutritional information formats for packaged food are being adapted for restaurant use, such as the traffic light system and nutrition table formats (Feldman *et al.*, 2013).

However, if the available information is not presented in a simple and easily understandable format, consumers may become confused (Thomas Jr and Mills, 2006). Authors report that consumers have difficulty understanding quantitative information such as calories, fat and sodium counts, but can easily recognise qualitative information about different dishes (Tangari *et al.*, 2010; Ellison *et al.*, 2014).

Studies have shown that providing only calorie information is insufficient to modify consumer behaviour in restaurants; this suggests that the inclusion of interpretative or descriptive menu labelling formats, besides calories, is required to influence food choices (Kiszko *et al.*, 2014; Schornack and Rozensher, 2014; Sinclair *et al.*, 2014; Fernandes *et al.*, 2016).

Studies have reported that qualitative information, such as healthy symbols and traffic light information, was most effective in promoting healthy food choices in restaurants (Thorndike *et al.*, 2012; Morley *et al.*, 2013; Lassen *et al.*, 2014; Fernandes *et al.*, 2016; Chen *et al.*, 2017). In addition, studies have showed that consumers prefer simple menu labelling formats (such as symbols) and are more likely to use menu labelling when the information is easy to understand and requires minimal effort (Lando and Labiner-Wolfe, 2007; Morley *et al.*, 2013).

Formatted: Font: Not Italic

A survey conducted in the USA among 487 university students has shown that ninety-six per cent of participants reported that they wanted menu labelling in canteens and eighty-eight per cent of university students said that menu labelling could affect their food choice at least sometimes. Respondents also indicated a preference for less information, focusing more on calories, ingredients and fat (Martinez *et al.*, 2013).

For many students, meals eaten in university restaurants or canteens are their main meals of the day (Hoefkens *et al.*, 2012); and often they describe menu labelling designs in these venues as confusing and difficult to follow (Hoefkens *et al.*, 2011).

The impact of providing menu labelling on food choices may differ depending on different factors, such as age, gender and weight. Young adults (18 to 24 years) (Dumanovsky *et al.*, 2010; Pulos and Leng, 2010), women (Bezerra and Sichieri, 2009; Bollinger *et al.*, 2011; Heathcote and Baic, 2011) and overweight people (Dowray *et al.*, 2013) tend to see and use menu labelling in their food choices.

Formatted: Font: Not Italic

In the same way, some studies have reported that consumers who follow special diets or have food-related illnesses would be more nutrient-conscious and would use more menu labelling (Stein *et al.*, 2010; Girz *et al.*, 2012; Ellison *et al.*, 2014) as well as people who often have lunch away from home (Fernandes *et al.*, 2015).

Therefore, the aim of this study was to examine the effect of different menu labelling formats on healthy food choices in a real restaurant setting. According to the results of a preliminary focus groups study to develop the tested formats (Oliveira *et al.*, 2017), we hypothesised that selected menu labelling formats could influence healthy food choices, especially qualitative information, as ingredients list plus symbols format and traffic light system, because they were the preferred formats reported in the focus groups study.

## Method

### *Study design*

A cross-sectional, parallel group cluster randomised controlled trial was undertaken in Brazil with university students in a restaurant setting in 2013. The participants were randomly assigned to three parallel groups with different menu formats: traffic light system plus guideline daily amounts (TLS+GDA); ingredients list plus highlighted symbols (IL+S); or a control group, with no menu labelling (C), to examine the effect on healthy food choices.

### *Menu labelling formats*

The tested menu formats were previously defined in five focus groups conducted with university students in 2013 (Oliveira *et al.*, 2017). Focus groups were conducted with 36 participants. Recruitment was discontinued once the same themes continued to emerge across groups. Themes originating from the content analysis were organised around four menu labelling formats: 1) numerical information of calories; 2) numerical information on calories and nutrients; 3) coloured traffic light system; 4) food information with list of ingredients and highlighted symbols (contains gluten, lactose, trans fat and/or genetically modified organisms; is suitable for vegetarian and/or organic). University students preferred a list of ingredients plus symbols format, which was considered more understandable and useful to make informed food choices. The traffic light system was considered the second preferred

menu labelling format. Numerical information of calories and nutrients as well as only calorie information formats were rejected by most focus group participants (Figure 1).

In this study, the traffic light system was used plus GDA (guideline daily amount) because consumers' feedback in our focus group study suggested that this information is considered more understandable than the traffic light system only. Malam *et al*. (2009) also showed a preference for the traffic light system plus GDA. Traffic light colours designated low (green), medium (amber) or high (red) levels of fat, saturated fat, sugar, salt and calories plus the percentage of the GDA of energy and the same nutrients (United Kingdom, 2007; European Food Information Council, 2015).

Food information with list of ingredients and highlighted symbols (contains gluten, lactose, trans fat and/or genetically modified organisms; is suitable for vegetarian and/or organic) was adapted from a previous study conducted by Feldman *et al*. (2013).

*Selected restaurant*

Selection of the location was intentional; we chose a restaurant located near a university campus in Brazil, with university students who agreed to participate in the study as consumers.

The restaurant offers a printed menu of the day serving a selection of 18 dishes per day similar a fast buffet setting (five salads, seven side dishes, six meat dishes). Nearly 500 meals are served daily between 11am until 2pm, Monday to Friday. Structure of the menu and recipes are standardised.

*Participants and recruitment*

To be eligible to participate, students had to be at least 20 years old, in accordance with the World Health Organisation adulthood definition [31] and be undergraduate students. To minimize self-selection bias, the participants were told that the study was a consumer survey in a restaurant. Menu labelling and the word nutrition were not mentioned in any recruitment material.

Subjects were all volunteers, recruited via social media and email messages. Online advertisements contained a link to the registration form, allowing eligible students to be contacted by the research team.

The selected restaurant could support an increase of approximately 250 people per day in addition to their usual 500 customers. Thus, sample calculation was based on 250 people plus 10% due to losses or refusals and 15 % due to confounders, giving a total of 313 volunteers.

Some 430 students signed up to participate in the study, from whom 375 volunteers were recruited having met the criteria of eligibility, 313 (83.4% response rate) were blindly allocated to the experimental condition. Of these, 233 students attended and participated in the one-day intervention.

This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Human Ethics Committee of Federal University of Santa Catarina (ethics number 484.782). All students who agreed to participate in the study signed an informed consent form.

*Random allocation and blinding*

The 313 volunteers recruited were randomly assigned to one of the three parallel groups corresponding to different menu formats: 1) no menu labelling (control group); 2) traffic light system plus GDA (TLS + GDA 3) ingredients list plus highlighted symbols (IL +S). Randomisation was stratified according to gender, BMI and dietary restrictions. Sixteen groups were formed to be randomised into one of three menu labelling formats proposed. Block randomisation was carried out with a computer-generated list of random numbers, using codes for the participants by an investigator with no involvement in the trial. A stratified blocked randomisation scheme was used to achieve comparability between the study groups.

Only investigators and staff were kept blind to the allocation.

*Study protocol*

Data were collected on a weekday during lunch time opening hours (11:00-14:00). All menu labelling formats were tested simultaneously. Upon arrival at the restaurant, each participant met individually with a study staff member and was provided with one of the printed menus having the labelling format corresponding to the group to which they had been randomly assigned. Participants were then asked to look at/ read the menu and order their meal annotating the chosen dishes on a separate tally sheet. Study staff guided this procedure.

Meals chosen by the participants were free. The aim of this stage was to analyse healthy food choices.

*Measures*

*Sample characteristics*

During recruitment, volunteers completed a brief online questionnaire about their age, gender, frequency of eating out, weight, height and dietary restrictions. Gender was categorised as male /

female, age was categorised as 20-30; 31-40; > 40 years old, frequency of eating out was categorised as ≤ twice a week; > twice a week, dietary restrictions was categorised as do not have; vegetarian/vegan; disease, allergy or intolerance.

*Body weight and height*

Body weight and height were self-reported by participants during recruitment of volunteers. Body Mass Index (BMI) was categorised as not overweight (< 25 kg/m²) and overweight (≥ 25 kg/m²), according to the World Health Organisation (1995).

*Healthy dishes*

Healthy foods were classified according to a public policy document, the Dietary Guidelines for the Brazilian Population (Brasil, 2008; Brazil, 2015), and also according to the Food Diversity Index for Assessment of Diets (Bernardo *et al*., 2015). Criteria to classify dishes as healthy were:

- Salads: raw and cooked vegetables (low-fat; boiled/steamed/roasted/grilled/braised) – without dressing.

-Side dishes: raw and cooked vegetables (low-fat; boiled/steamed/roasted/grilled/braised) – without sauce; cooked beans; cooked cereals, potatoes, roots (low-fat; boiled/steamed/roasted/grilled/braised).

-Main courses: beef, pork, chicken, turkey, fish and seafood (low-fat; boiled/steamed/roasted/grilled/braised).

According to the proposed classification method, ten of the eighteen dishes offered at the restaurant on the day of the study were classified as healthy (55, 6%):

- Salads: (three from five) lettuce and rocket, raw carrot and beet salad, boiled onion/aubergine/courgette mix;
- Side dishes (four from seven): boiled rice, boiled brown rice, boiled black beans, pasta without sauce;
- Main courses (three from six): roasted beef, roasted chicken, beef in tomato sauce.

Eight of the offered dishes (44, 4%) were classified as less healthy:

- Salad: pasta salad with mayo; boiled cauliflower with mayo (because of having mayonnaise sauce);
- Side dishes: potato chips, fried cassava flour (*farofa*), stewed cabbage with bacon (high fat dishes);
- Main courses: beef lasagne, fried chicken steak, and fried breaded fish (high fat dishes).

A typical Brazilian meal is composed of three or four types of salads (with vegetable oil, vinegar or lemon juice and salt as dressing), rice, beans, meat dishes, potatoes or other side dishes.

Healthy menu items are prepared based on fresh food, minimally processed food and cooking ingredients (such as salt) (BRAZIL, 2015). It was not considered the amount of salt, but the use of processed and ultra- processed food with high salt contents.

*Statistical analyses*

All analyses were conducted using STATA 11 statistical software (Statacorp, College Station, TX, USA) in 2014. A p-value of <0.05 was accepted as statistically significant. No participant was excluded from the analyses.

Sample characteristics reported as frequencies (%) were compared between groups using chi-square test (Hammond *et al.*, 2013; Morley *et al.*, 2013). ANOVA reported as mean and a 95% confidence interval (CI 95%) was used to examine cross-sectional associations between healthy food choices and each experimental condition and to examine associations by gender, BMI, dietary restrictions and frequency of eating out. When a significant difference was found, Bonferroni post hoc test was performed to determine differences between each pair of groups.

Formatted: Font: Not Italic

Formatted: Font: Not Italic

**Results**

*Recruitment and retention*

The flow of participants through the study is shown in Figure 2. From the 375 volunteers assessed for eligibility, 313 (83.4% response rate) were included and randomised as follows and 62 students were excluded in enrolment. 104 students were allocated to the control group, 103 to TLS + GDA and 106 IL +S. Of these, data from 233 students were analysed. The others did not attend and were excluded.

In the one-day intervention, there were 71 participants in the control group, 88 in the TLS + GDA group and 74 in the IL +S group.

*Overall characteristics of participants*

There were no significant differences in sample characteristics across experimental conditions (Table 1).

*Healthy food choices by experimental condition*

~~Considering t~~The total of 18 items on the restaurant menu, the mean of items chosen by participants in control group was 8.3 items, in TLS + GDA was 8.0 items and in the IL +S was 8.9 items. Considering the 12 healthy items on the restaurant menu, the mean of healthy items chosen by participants in control group was 5.6 items (67,6% of the chosen items), in TLS + GDA was 5.4 items (67,5% of the chosen items) and in the IL +S was 6.2 items (69,8% of the chosen items). The number of healthy food choices was significantly higher among students who received the IL+S menu ($p<0.05$) across experimental conditions. (Table 2).

The presence of IL+S information positively affected women's healthy food choices, not overweight participants and also the healthy food choices of those participants who ate out more than twice a week. As shown in Table 2, there were no significant differences in number of healthy food choices items chosen across individual dishes (salads, side dishes, main courses) and dietary restrictions in the different intervention groups.

TLS+GDA format had no significant effect on healthy food choices.

**Discussion**

The more qualitative menu labelling format (IL+S) was positively associated with healthy food choices. These results indicate that visual information on ingredients and components of dishes can quickly and effectively help consumers compare different options and select the healthier ones when deciding what to eat in a restaurant setting. A possible explanation for the effectiveness of this menu labelling format is the fact that it is a simple, easy to understand informative format which demands little time to be evaluated.

According to a systematic review (Fernandes *et al*., 2016), qualitative information may prove more effective in promoting healthy eating. In the UK, Alexander *et al*. (2010) investigated consumer attitudes towards menu labelling and found that they preferred qualitative menu labelling, without the presence of numbers to avoid confusion when using this information. Similarly, in the USA, other researchers also reported that simple menu labelling formats including the use of symbols are preferred by consumers, who are more likely to use menu labelling that requires minimal effort when compared to quantitative information (Lando and Labiner-Wolfe, 2007; Morley *et al*., 2013).

Traffic light labelling is also considered a simple menu labelling format and studies have shown a positive relationship between the traffic light system and healthier food choices (Heathcote and Baic, 2011; Morley *et al*., 2013; Thorndike *et al*., 2014; Yepes, 2014). In the present study however, this was

not the case, as the TLS+GDA format was not as effective as IL+S on influencing the choice of healthier foods. A possible explanation for this result is the fact that the menu of selected restaurant contains much more items than those of other studies, which may demand more time for reading and understanding when compared to the ingredients list plus symbols information besides being able to confuse the consumers when there are different colours' combinations in the many items of the menu, for example, are three yellow alerts better or worse than one green, one yellow and one red?

In our study, the IL+S labelling format positively affected healthy food choices by women. This is in accordance with other studies on the subject. Brazilian researchers suggested that Brazilian women indeed make healthier choices when eating out (Bezerra and Sichieri, 2009). Additionally, it has been reported that women are more likely to use menu labelling, and are more motivated to try to understanding it (Lando and Labiner-Wolfe, 2007; Driskell *et al*., 2008; Bates *et al*., 2009; Heathcote and Baic, 2011).

Although studies showed inconsistent association between menu labelling formats and weight status, the presence of IL+S information positively affected healthy food choices in not overweight participants (Harnack *et al*., 2008; Lee *et al*., 2016).

The presence of IL+S information also positively affected healthy food choices in participants who ate out more than twice a week. In this study, the restaurant selected is an everyday restaurant offering a menu with simple dishes. A possible explanation is that people who often have lunch away from home at everyday restaurants look for a healthy diet and simple dishes, making healthier food choices than people who almost never eat out or eat out at leisure restaurants looking for special and different dishes including unhealthy food (Fernandes *et al*., 2015).

Healthy food choices were not significantly different across dishes group and dietary restrictions for all menu labelling conditions. The significantly difference of healthy items was a result of the combination of different items selected, not across dishes group. Although associations between menu labelling conditions and dietary restrictions were not found, the provision of information on ingredients complemented by symbols does enable—— people who have health, religious or other related dietary restrictions to choose foods while respecting their habit, without having to ask the attendants the ingredients of each dish, which could be considered embarrassing or restricting the act of eating away from home because they did not have their food choices hampered.

Mandatory description of ingredients on restaurant menus could potentially lead to the revision of recipes by owners, in order to make them healthier and thus more attractive to consumers. The action could also result in a positive marketing campaign for the venue.

**Conclusions**

Results of this study indicated a menu labelling format presenting food information with ingredients list and highlighted symbols on the presence of gluten, lactose, trans fat, GMO, as well as on being organic, and/or suitable for vegetarians was positively associated with healthy food choices in a real setting.

By positively influencing healthy food choices, the provision of food information with a list of ingredients and highlighted symbols in restaurants menus could become part of a public policy designed as a strategy to empower consumers, promote health, and address the escalation of obesity and other chronic diseases. Food information with ingredients list and highlighted symbols could be adopted in future legislation on menu labelling in Brazil and around the world.

*Strengths and limitations*

The main strength of this study is the use of rigorous methods to conduct a randomised controlled trial in a real setting with concurrent control and intervention groups at the same place. The setting was a real place (a restaurant) in which ordering food and consumption naturally occurs. According to literature reviews (Kiszko *et al*., 2014; Sinclair *et al*., 2014; Long *et al*., 2015), most menu labelling studies have been conducted in artificial or laboratory settings, which is a limitation in itself to offer recommendations for practice or policy.

To the best of our knowledge, this is also the first randomised controlled trial to test menu labelling formats in a real setting presenting influence on healthier food choices as outcome.

However, this study has some limitations. The study involved a rather uniform group of university students, homogeneous in terms of age, educational, and behavioural aspects. University students are nevertheless important public health actors, and acquired behaviours during this period that can persist for all their lives (Nelson *et al*., 2008; Blichfeldt and Gram, 2013).

Another limitation concerns the fact that the intervention occurred during only one day at only one restaurant and it was not collected data on the amount of food that people consumed. Participants did not necessarily consume the food that was selected.

Generalizability of the findings to other restaurants and populations requires further research. Future studies should seek to confirm the trial findings with adults in the general population and in different types of restaurants.

**Acknowledgements**

We acknowledge the National Council for Scientific and Technological Development in Brazil – CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) for funding (485004/2012-7). We also acknowledge the Federal Agency for Support and Evaluation of Graduate Education in Brazil – CAPES (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior) for PhD scholarships granted, PhD international internship scholarship, as well as Senior international internship scholarship. Last, we acknowledge Science Without Borders program for the PhD internship scholarship granted and for the Postdoc international scholarship granted. We also thank the students for their participation.

**Financial Support**

The present study was supported by the National Council for Scientific and Technological Development in Brazil – CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) and the Federal Agency for Support and Evaluation of Graduate Education in Brazil – CAPES, Ministry of Education of Brazil, Brasilia, DF, Brazil.

**Conflict of interest**

The authors declare that there are no conflicts of interest.

**References**

Alexander M, O'Gorman K, Wood K (2010), "Nutritional labelling in restaurants: whose responsibility is it anyway?" *International Journal of Contemporary Hospitality Management***,** Vol.22, pp. 572-529.

Auchincloss AH, Mallya GG, Leonberg BL *et al.* (2013), "Customer responses to mandatory menu labeling at full-service restaurants", *American Journal of Preventive Medicine*, Vol. 45, pp.710-719.

Bates K, Burton S, Howlett E, Huggins K (2009), "The roles of gender and motivation as moderators of the effects of calorie and nutrient information provision on away-from-home foods", *Journal of Consumer Affairs*, Vol.43, pp.249-273.

Bernardo GL , Proença RPC, Calvo MCM *et al.* (2015), "Assessment of the healthy dietary diversity of a main meal in a self-service restaurant: a pilot study", *British Food Journal*, Vol.117, pp. 286 – 301.

Bezerra IN, Sichieri R (2009), Eating out of home and obesity: a Brazilian nationwide survey, *Public Health Nutrition*, Vol.12, pp.2037-2043.

Bleich SN, Pollack KM (2010), "The publics' understanding of daily caloric recommendations and their perceptions of calorie posting in chain restaurants", *BMC Public Health*, Vol.10, pp.1-10.

Blichfeldt BS, Gram M (2013), "Lost in transition? Student food consumption", *Higher Education*, Vol.65, pp.277-289.

Blumenthal K, Volpp KG (2010), "Enhancing the effectiveness of food labeling in restaurants". *Journal of the American Medicine Association*, Vol.303, pp.553-554.

Bollinger B, Leslie P, Sorensen A (2011), "Calorie posting in chain restaurants", *American Economic Journal*, Vol.3, pp.91-128.

Brasil. Ministério da Saúde (2008), *Guia alimentar para a população brasileira: promovendo a alimentação saudável,* Brasília, DF: Ministério da Saúde.

Brazil. Ministry of Healthy of Brazil (2015), *Dietary Guidelines for the Brazilian Population,* Translated by Carlos Augusto Monteiro – Brasília: Ministry of Health of Brazil.

Brochu PM, Dovidio JF (2014), "Would you like fries (380 calories) with that? Menu labeling mitigates the impact of weight-based stereotype threat on food choice", *Social Psychological and Personality Science*, Vol.5, pp.414-421.

Chen HJ, Weng SH, Cheng YY *et al.* (2017), "The application of traffic-light food labelling in a worksite canteen intervention in Taiwan", *Public Health*, Vol.150, pp.17-25.

Dowray S, Swartz JJ, Braxton D *et al.* (2013), "Potential effect of physical activity based menu labels on the calorie content of selected fast food meals", *Appetite*, Vol.62, pp.173-181.

Formatted: Font: Italic

Formatted: Font: Italic

Driskell JA, Schake MC, Detter HA (2008),"Using nutrition labeling as a potential tool for changing eating habits of university dining hall patrons", *Journal of the American Dietetic Association*, Vol.108, pp.2071-2076.

Dumanovsky T, Huang CY, Bassett MT *et al.* (2010), "Consumer awareness of fast-food calorie information in New York City after implementation of a menu labeling regulation", *American Journal of Public Health*, Vol.100, pp.2520-2525.

Ellison B, Lusk JL, Davis D (2014), "The effect of calorie labels on caloric intake and restaurant revenue: evidence from two full-service restaurants", *Journal of Agricultural and Applied Economics*, Vol.46, pp.173-191.

European Food Information Council (2015), *Global update on nutrition labelling,* Brussels: EUFIC.

Feldman C, Hartwell H, Brusca J (2013), "Using student opinion and design inputs to develop an informed university foodservice menu", *Appetite*, Vol.69, pp.80-88.

Fernandes AC, Oliveira RC, Rodrigues VM *et al.* (2015), "Perceptions of university students regarding calories, food healthiness, and the importance of calorie information in menu labelling", *Appetite*, Vol.91, pp.173-178.

Fernandes AC, Oliveira RC, Rodrigues VM *et al.* (2016), "Influence of menu labeling on food choices in real-life settings: a systematic review", *Nutrition Reviews*, Vol.74, pp.534-548.

Gerlach L (2013), "The effect of displaying traffic-light nutritional labels in a university cafeteria on students' food choice", *Plymouth Student Journal of Health and Social Work*, Vol.5, pp.13-29.

Girz L, Polivy J, Provencher V *et al.* (2013), "The four undergraduate years. Changes in weight, eating attitudes, and depression", *Appetite*, Vol. 69, pp. 145-150.

Formatted: Font: Italic

Formatted: Font: Italic

Grunert KG, Wills JM (2007), "A review of European research on consumer response to nutrition information on food labels", *Journal of Public Health*, Vol.15, pp.385-399.

Hammond D, Goodman S, Hanning R *et al* (2013), "A randomized trial of calorie labelling on menus", *Preventive Medicine*, Vol.57, pp.860-866.

Harnack LJ, French SA, Oakes JM *et al.* (2008), "Effects of calorie labeling and value size pricing on fast food meal choices: Results from an experimental trial", *International Journal of Behavioral Nutrition and Physical Activity*, available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2621234/ (accessed 12 October 2016).

Heathcote F, Baic S (2011), "The effectiveness and acceptability of a traffic light labelled menu with energy information to signpost customers towards healthier alternatives in a table service restaurant", *Journal of Human Nutrition and Dietetics*, Vol.24, pp. 375–407.

Hoefkens C, Lachat C, Kolsteren P *et al* (2011),"Posting point-of-purchase nutrition information in university canteens does not influence meal choice and nutrient intake", *American Journal of Clinical Nutrition*, Vol.94, pp.562-570.

Hoefkens C, Pieniak Z, Camp JV *et al* (2012), "Explaining the effects of a point-of-purchase nutrition information intervention in university canteens: a structural equation modelling analysis", *International Journal of Behavioral Nutrition and Physical Activity*, available at: https://ijbnpa.biomedcentral.com/articles/10.1186/1479-5868-9-111 (accessed 25 April 2015).

Kiszko KM, Martinez OD, Abrams C, Elbel B (2014), "The influence of calorie labeling on food orders and consumption: a review of the literature", *Journal of Community Health*, Vol.39, pp.1248-1269.

Lando AM, Labiner-Wolfe J (2007), "Helping consumers make more healthful food choices. Consumer views on modifying food labels and providing point-of purchase nutrition information at quick-service restaurants", *Journal of Nutrition Education and Behavior*, Vol.39, pp.157–163.

Lassen AD, Beck A, Leedo E *et al.*(2014), "Effectiveness of offering healthy labelled meals in improving the nutritional quality of lunch meals eaten in a worksite canteen", *Appetite*, Vol.75, pp.128-134.

Lee JWC, Shimizu M, Wansink B (2013), "You taste what you see: do organic labels bias taste perceptions?" *Food Quality and Preference*, Vol.29, pp.33-39.

Lee-Kwan SH, Pan L, Maynard LM, McGuire LC, Park S (2016), "Factors associated with self-reported menu-labeling usage among US adults", *Journal of the Academy of Nutrition and Dietetics*, Vol.116, pp.1127-1135.

~~Lando AM, Labiner-Wolfe J (2007), "Helping consumers make more healthful food choices. Consumer views on modifying food labels and providing point-of-purchase nutrition information at quick-service restaurants", *Journal of Nutrition Education and Behavior*, Vol.39, pp.157-163.~~

Long MW, Tobias DK, Cradock AL *et al.* (2015), "Systematic Review and Meta-analysis of the Impact of restaurant menu calorie labeling", *American Journal of Public Health*, Vol.105, pp.e11-e24.

Malam S, Clegg S, Kirwan S, Mcginigal S (2009), *Comprehension and use of UK nutrition signpost labeling schemes,* London: Food Standards Agency.

Malik VS, Willet WC, Hu FB (2013), "Global obesity: trends, risk factors and policy implications", *Nature Reviews Endocrinology*, Vol.9, pp.13–27.

Martinez O, Roberto C, Kim J *et al* (2013), "A Survey of undergraduate student perceptions and use of nutrition information labels in a university dining hall", *Health Education Journal*, Vol.72, pp.319-325.

Morley B, Scully M, Martin J *et al* (2013), "What types of nutrition menu labelling lead consumers to select less energy-dense fast food? An experimental study", *Appetite*, Vol.67, pp.8-15.

Nelson MC, Story M, Larson NI *et al.* (2008), "Emerging adulthood and college aged youth: an overlooked age for weight-related behavior change", *Obesity*, Vol.16, pp. 2205-2211.

Oliveira RC, Fernandes AC, Proença RPC *et al.* (2017), "Preferences for menu labelling formats of young adults in Brazil and in the United Kingdom", *Revista de Nutrição*, Vol.30, pp.321-332.

Oliveira RC, Proença- RPC, Salles RK (2012), "The right to food and nutrition information in restaurants: a review", *Demetra*, Vol.7, pp. 47-58.

Pulos E, Leng K (2010), "Evaluation of a voluntary menu-labeling program in full-service restaurants", *American Journal of Public Health*, Vol.100, pp.1035-1039.

Roberto CA, Haynos AF, Schwartz MB *et al.* (2013), "Calorie estimation accuracy and menu labeling perceptions among individuals with and without binge eating and/or purging disorders", *Eating Weight Disorders*, Vol.18, pp.255-261.

Schornack B, Rozensher S (2014), "The effects of menu calorie labeling on consumer food choice behaviour", *American Journal of Health Science*, Vol.5, pp.29-36.

Sinclair S, Cooper M, Mansfiels ED (2014), "The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis", *Journal of the Academy of Nutrition and Dietetics*, Vol.114, pp.1375-1388.

Stein K (2010), "A national approach to restaurant menu labeling: the Patient Protection and Affordable Health Care Act. Section 4205", *Journal of the American Dietetic Association*, Vol.110, pp.1288-1289.

Tangari AH, Burton S, Howlett E, Cho Y, Thyeoff A (2010), "Weighing in on fast food consumption: the effects of meal and calorie disclosures on consumer fast food evaluations", The *Journal of Consumer Affairs*, Vol.44, pp.431-462.

Formatted: Font: Italic

Formatted: Font: Italic

Thomas Jr L, Mills JE (2006), "Consumer knowledge and expectations of restaurant menus and their governing legislation: a qualitative assessment", *Journal of Foodservice*, Vol.17, pp.6-22.

Thorndike AN, Riis J, Sonnenberg LM, Levy DE (2014), "Traffic-light labels and choice architecture: promoting healthy food choices", *American Journal of Preventive Medicine*, Vol.46, pp.143-149.

Thunstrom L, Nordstrom J (2011). "Does easily accessible nutritional labelling increase consumption of healthy meals away from home? A field experiment measuring the impact of a point-of-purchase healthy symbol on lunch sales", *Acta Agriculturae Scandinavica*, Vol.8, pp.200-207.

United Kingdom. Food Standards Agency (2007), *Front-of-pack traffic light signpost labelling: technical guidance,* London: Navigator Research.

United Kingdom. Food Standards Agency. Central Office of Information on behalf (2009), Consumer *response to nutrition information available in catering outlets*, London, Navigator Research.

United States of America. Department of Health and Human Services.Food and Drug Administration (2014), Food Labeling: Nutrition Labeling of Standard Menu Items in Restaurants and Similar Retail Food Establishments. Final Regulatory Impact Analysis FDA–2011–F–0172, available at: http://www.fda.gov/downloads/Food/IngredientsPackagingLabeling/LabelingNutrition/UCM423985.pdf (accessed 21 August 2015).

World Health Organization (1995), *Physical status: the use and interpretation of anthropometry*, Geneva: WHO Technical Report Series nº 854.

Yepes MF (2014), "Mobile tablet menus: attractiveness and impact of nutrition labeling formats on millennials' food choices", *Cornell Hospitality Quartely*, Vol.56, pp. 58-67.

Yoon HJ, George T (2012), "Nutritional information disclosure on the menu: focusing on the roles of menu context, nutritional knowledge and motivation", *International Journal of Hospitality Management*, Vol.31, pp.1187-1194.

**Figures titles**

Fig1. Menu labelling formats tested by experimental condition.

Fig. 2. Participants flow diagram.

**Tables titles**

**Table 1**. Sample characteristics by experimental condition (n=233).

**Table 2.** Mean number of healthier food items chosen by experimental condition.

**Appendix 1 - CONSORT 2010 checklist of information to include when reporting a randomised trial**

**a) Traffic light system plus guideline daily amounts format**

**Fries**

| 1 serving (80g) contains | | | | |
|---|---|---|---|---|
| Energy 1264kJ/ 302kcal | Fat 19g | Saturates 2.5g | Sugars 0g | Salt 1g |
| 16% | 23% | 16% | 0% | 17% |
| Of the guideline daily amount* | | | | |

**a) Ingredients list and highlighted symbols**

**Fries** 

Ingredients: potato, hydrogenated fat, salt.

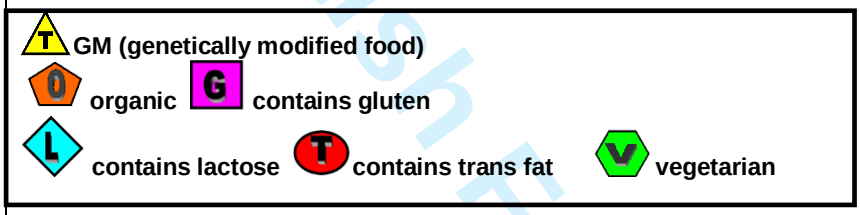


Fig1. Menu labelling formats tested by experimental condition.

**Table 1**. Sample characteristics by experimental condition (n=233).

| Variable | Control (n=71) | TLS+GDA (n= 88) | IL+S (n=74) |
|---|---|---|---|
| **Gender** | | | p= 0.786[a] |
| Male | 36 (50.7%) | 49 (55.7%) | 38 (51.4%) |
| Female | 35 (49.3%) | 39 (44.3%) | 36 (48.6%) |
| **Age** | | | p= 0.738[a] |
| 20-30 | 68 (95.8%) | 85 (96.6%) | 73 (98.6%) |
| 31-40 | 2 (2.8%) | 2 (2.3%) | 0 (0%) |
| >40 | 1 (1.4%) | 1 (1.1%) | 1 (1.4%) |
| **BMI** | | | p= 0.706[a] |
| Not overweight (< 25 kg/m²) | 55 (77.5%) | 72 (81.8%) | 57 (77.0%) |
| Overweight (≥ 25 kg/m²) | 16 (22.5%) | 16 (18.2%) | 17 (23.0%) |
| **Dietary restrictions** | | | p=0.885[a] |
| No dietary restriction | 60 (84.5%) | 70 (79.5%) | 58 (78.4%) |
| Vegetarian/vegan | 3 (4.2%) | 6 (6.8%) | 5 (6.8%) |
| Disease, allergy or intolerance | 2 (2.8%) | 6 (6.8%) | 5 (6.8%) |
| Dieting | 6 (8.5%) | 6 (6.8%) | 6 (8.1%) |
| **Frequency of eating out** | | | p= 0.653[a] |
| ≤ twice a week | 18 (25.4%) | 17 (19.3%) | 17 (23.0%) |
| > twice a week | 53 (74.6%) | 71 (80.7%) | 57 (77.0%) |

[a]Chi -square test

There were no significant differences in demographic and behavioural factors across experimental conditions

**Table 2.** Mean number of healthier food items chosen by experimental condition.

| Variable | Control (n=71) | | TLS+GDA (n=88) | | IL+S (n=74) | |
|---|---|---|---|---|---|---|
| | **Mean** | **CI 95%** | **Mean** | **CI 95%** | **Mean** | **CI 95%** |
| **Total** | 5.6 | 5.2-6.0 | 5.4 | 5.0-5.8 | 6.2* | 5.9-6.6 |
| **Healthy salads** | 2.3 | 2.0-2.6 | 2.1 | 1.8-2.4 | 2.6 | 2.3-2.9 |
| **Healthy side dishes** | 2.1 | 1.9-2.3 | 2.2 | 2.0-2.4 | 2.3 | 2.1-2.5 |
| **Healthy main courses** | 1.2 | 1.0-1.4 | 1.1 | 0.9-1.3 | 1.3 | 1.1-1.5 |
| **Gender** | | | | | | |
| Male | 6.0 | 5.5-6.6 | 5.9 | 5.3-6.4 | 6.3 | 5.8-6.9 |
| Female | 5.2 | 4.7-5.7 | 4.8 | 4.2-5.5 | 6.1* | 5.6-6.6 |
| **BMI** | | | | | | |
| Not overweight (<25kg/m²) | 5.8 | 5.3-6.2 | 5.2 | 4.8-5.7 | 6.4* | 6.0-6.7 |
| Overweight (≥25kg/m²) | 5.1 | 4.3-5.8 | 6.1 | 5.1-7.1 | 5.8 | 4.9-6.6 |
| **Dietary restrictions** | | | | | | |
| No | 5.6 | 5.1-6.0 | 5.3 | 4.8-5.8 | 6.1 | 5.7-6.5 |
| Yes | 5.9 | 5.0-6.9 | 5.7 | 4.9-6.5 | 6.6 | 6.0-7.2 |
| **Frequency of eating out** | | | | | | |
| ≤ twice a week | 6.1 | 5.2-6.9 | 5.6 | 4.3-6.8 | 5.8 | 5.0-6.6 |
| > twice a week | 5.5 | 5.0-5.9 | 5.4 | 4.9-5.8 | 6.3* | 5.9-6.7 |

* Significant p-values ($p<0.05$) - ANOVA post hoc Bonferroni.