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REVIEW

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Qualitative menu labelling in university restaurants and its influence on food choices: A systematic review and synthesis without meta-analysis

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Abstract

Qualitative menu labelling can be defined as descriptive or non-numerical interpretive labels (e.g. traffic light labelling, healthy food symbols, messages or ingredient lists). Qualitative information seems to have a positive influence on consumers' food choices, particularly in institutional food service establishments, such as in universities. The aim of this systematic review was to assess the influence of different formats of qualitative menu labelling on food choices in university restaurants. This systematic review was guided by the Preferred Reported Items for Systematic Reviews and Meta-Analyses (PRISMA) and Synthesis Without Meta-Analysis (SWiM) and conducted vote counting of studies based on the direction of effect. Studies were retrieved from Cochrane Library, Scopus, MEDLINE, LILACS, SciELO and Web of Science databases and reference lists of selected articles. Experimental and quasi-experimental studies were included. Two independent researchers searched and extracted the data and assessed the methodological quality using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies. From the initial search (460 records), four papers were selected, plus one paper identified in a previous study and a further six from an update search, totalling 11 included studies, reporting 14 different interventions (n = 499 174). Types of interventions included the use of symbols and the inclusion of traffic light labelling. Outcomes of interest were food choice, expressed as mean, median or percent healthy food choices or purchases. Qualitative menu labels increased healthy food choices and/or purchase behaviour, with 10 of 12 interventions favouring the intervention (83%; 95%CI 55–95%; p = 0.0386). Most of the studies favouring the intervention used healthy food symbols for healthier foods or food components, alone or in association with another intervention and were of moderate and weak quality. These findings may serve as a basis for the implementation of nutrition information policies in university restaurants.

KEYWORDS
college, food labelling, food selection, healthy choices, nutrition information, nutrition labelling

INTRODUCTION

The out-of-home food environment is conducive to the implementation of health promotion initiatives (Beltrán & Romero, 2019; McGuffin et al., 2013; Wright & Bragge, 2018). A strategy widely adopted by restaurants to promote healthy eating is the provision of nutrition information (menu labelling) (McGuffin et al., 2013). Menu labelling could be defined as quantitative menu labelling (e.g. number of calories, nutrient content,

proportion of calories from fat) or qualitative menu labelling (descriptive or non-numerical interpretive label, e.g. traffic light labelling, healthy food symbols, messages or ingredients lists) of meals and/or drinks, visibly displayed at points of selection (e.g. on menus, table displays or menu boards, or besides food items at buffets, and counters) (Fernandes et al., 2016). Although the adjective 'qualitative' is usually applied to a research method, authors have adopted the term 'qualitative menu label' to refer to descriptive or non-numerical interpretive labels in out-of-home settings (Basak et al., 2018; Brindal et al., 2021; Fernandes et al., 2019; Fly, 2017; Hanssen et al., 2021; Kerins et al., 2018; Oliveira et al., 2018; Schneider et al., 2022; Warner et al., 2022).

Menu labelling in restaurants that cater for university students has been suggested as an important strategy to guide informed food choices (Nikolaou et al., 2014). It should be noted that university students generally transition from eating at their parents and/or buying snacks at school to having to plan and prepare their meals and/or have their main meals in the university environment (Martinez et al., 2013). Such changes in the daily routine often result in changes in eating habits, including high intake of fast foods, snacks, sweets and carbonated beverages and low intakes of fruits, vegetables, fish, whole grains and legumes, as concluded in a review paper (Bernardo et al., 2017). Low intake of fruits and vegetables was also prevalent in other studies in students (Bede et al., 2020; Kremmyda et al., 2008; Pinillos-Patiño et al., 2022; Small et al., 2013; Yun et al., 2018). A review found that most university students do not consume vegetables at the frequency the World Health Organization recommends and that their vegetable intake is below the recommendations of other relevant guidelines (Rodrigues et al., 2019). Also, a systematic review found evidence of weight gain among university students after entering university (Prado et al., 2019).

Despite the efforts to provide energy labelling (kcal or kJ) in out-of-home environments, systematic reviews of the literature showed that this kind of information did not yield the expected results in real-life restaurant settings (Bleich et al., 2017; Cantu-Jungles et al., 2017; Fernandes et al., 2016; Kiszko et al., 2014; Long et al., 2015; Sinclair et al., 2014; Swartz et al., 2011). Studies indicating positive effects of energy menu labelling were conducted, for the most part, in hypothetical environments, such as laboratory simulations and online or classroom surveys (Bleich et al., 2017; Cantu-Jungles et al., 2017; Kiszko et al., 2014; Long et al., 2015; Sinclair et al., 2014; Swartz et al., 2011). To our knowledge, two systematic reviews with meta-analyses show a positive influence of energy menu labelling on food choices based on a meta-analysis of real-world data (Agarwal et al., 2022; Littlewood et al., 2016). The forest plot of Littlewood et al. (2016) showed that one strong study (Vanderlee & Hammond, 2013) was mainly responsible for the positive effects of energy labelling (mean change in energy ordered = −127.5 kcal) in studies conducted in real-world settings (mean difference in energy ordered of pooled studies = −83.1 kcal), but the energy labelling was associated with the reformulation of 'healthier' options, which were also identified with a symbol.

A systematic review evaluating different nutrition information formats (both quantitative and qualitative) in real restaurant settings only concluded that menu labelling is more effective in institutional restaurants (such as university, hospital and workplace cafeterias) than in commercial restaurants, being particularly ineffective in fast food outlets (Fernandes et al., 2016). The most effective formats were those that contained qualitative information (healthy food symbols and/or traffic light labels). It was also found that the most commonly available information was the ingredients list and that calorie labelling did not lead to healthier food choices in restaurants (Fernandes et al., 2016). These findings corroborate those of two other qualitative studies held with university students in Brazil and the United Kingdom (Fernandes et al., 2015; Oliveira et al., 2017). Focus groups discussion showed that their rejection of quantitative calorie information (Fernandes et al., 2015; Oliveira et al., 2017) was because they attributed greater importance to food composition than to energy content (Fernandes et al., 2015) and that their preference for ingredients lists and symbols to communicate food components was because they considered them easier to understand and more useful for making informed food choices (Fernandes et al., 2015; Oliveira et al., 2017).

The same authors (Oliveira et al., 2018) also conducted a parallel-group randomised controlled trial to assess the food choices of 233 university students in a real-life restaurant setting. The authors compared a control menu without nutrition information with two menu labelling interventions: (i) traffic light labels plus percent daily value and (ii) ingredient lists plus highlighted symbols to communicate food components. Students in the second intervention group chose a greater number of healthy food items than those in the other groups. This influence was mainly observed among women, non-overweight participants and those who ate away from home more than twice a week.

Some systematic reviews on menu labelling for university students can be found in the literature (Christoph & An, 2018; Fernandes et al., 2016; Roy et al., 2015), but, so far, no review has specifically examined the effect of qualitative menu labelling in promoting healthy food choices in the real environment of university restaurants. Fernandes et al. (2016) focused on the influence of diverse menu labelling formats on food choices in real-life settings in general, with one of the settings being the university setting. Christoph and An (2018) studied specific university settings, seeking to examine and quantify the effect of nutrition labels on

diet quality in college students. The authors included real-life settings, hypothetical settings and vending machines in their analysis. The study by Roy et al. (2015) is not menu label specific, and the authors analysed different food environment interventions, such as menu labels, portion size control and changing catering practices. The aim of this systematic review was to identify and examine studies specifically on the influence of qualitative menu labelling on food choices in real-life university settings.

MATERIALS AND METHODS

This systematic review was conducted according to the Cochrane Handbook for Systematic Reviews of Interventions (Higgins & Green, 2011), the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021) and Synthesis Without Meta-Analysis (SWiM) reporting guidelines (Campbell et al., 2020). This review was not registered in any systematic review database.

The guiding question of this study was 'What is the influence of different formats of qualitative menu labelling on consumers' food choices in university restaurants?'. University restaurants are here understood as all food service establishments located in the university environment, regardless of whether they are referred to as restaurants or cafeterias and whether they serve main meals (such as lunch and dinner) or sell snacks. Environments with vending machines only were not included. The focus of this study was not front-of-pack labels or packaged food.

Eligibility criteria

Study eligibility was assessed according to PICOTS (population, intervention, comparison, outcome, type of study and setting) elements and other criteria, as described in Table 1.

TABLE 1 PICOTS and other criteria used for inclusion of studies.

Parameter	Criteria
Population (P)	University students and/or individuals who eat at university restaurants
Intervention (I)	Qualitative menu labelling (descriptive or non-numerical interpretive label, e.g. traffic light labelling, healthy food symbols, messages, ingredients list) of meals and/or drinks, visibly displayed at the point of selection (e.g. on menus, table displays or besides food items at buffets and counters)
Comparison (C)	Control restaurants or consumers, non-exposed or pre-intervention groups (in AB studies), menus without nutrition information or not changed by the intervention
Outcome (O)	Sales, purchases or choice of target items (e.g. food items with qualitative labelling), purchased or chosen on site
Type of study (T)	Experiments (randomised trials), quasi-experiments (controlled trials or pre-post experiments [AB studies] with or without control groups), case series, pre-post observational studies based on natural experiments with or without controls (nonexposed group) and cross-sectional studies with exposed and non-exposed groups
Setting (S)	Restaurants run by universities or located on campus that cater primarily to students and serve meals or ready-to-eat foods
Data source	Sales data, sales receipts, food order records and observed food choices
Type of paper	Original articles
Language	English, Portuguese, Spanish, French and Italian

Search strategy and study selection

Keywords related to the intervention (e.g. menu label, nutrition information) were combined with those related to the outcome (e.g. food selection, meal choice, eating behaviour), to the setting (e.g. restaurant, catering) and to the population (e.g. college, university). Keywords and a complete description of the search strategy are presented in Table 2.

Searches were performed in Cochrane Library, Scopus, MEDLINE, LILACS, SciELO and Web of Science databases in November 2018. An update of the literature search was carried out in July 2022. Articles were also identified by searching the reference list of selected studies for potentially relevant articles.

One researcher (N.F.) identified and removed duplicate studies using reference management software (EndNote). Two researchers (A.C.F. and N.F.) independently screened titles, abstracts and full articles for eligibility. Differences were resolved through discussions between the two researchers.

The uniterms used for this search were the same as those used by Fernandes et al. (2016) in their systematic review which focused on menu labelling studies conducted in real restaurant environments without restricting the type of information (quantitative or qualitative) nor the population (e.g. college, university). Thirty-eight articles published before June 2015 were found in this previous research (Fernandes et al., 2016). Of these articles, two tested qualitative information in university settings and one was included in the current review. The other study was excluded because the

TABLE 2 Search strategy used in Scopus, Web of Science, LILACS, PubMed, Cochrane and SciELO databases to retrieve articles assessing the influence of qualitative nutritional information displayed in university restaurants on students' food choices. Source: adapted from Fernandes et al. (2016).

Intervention
• ("nutri* facts" or "energy posting" or "calori* posting" or "joule* posting" or "menu label*" or "menu information" or "nutrition labeling" or "food labeling") OR
• (nutrition* W/1 (content* or sign* or symbol* or tag* or ticket* or sticker* or claim* or icon*)) OR (health* W/1 (content* or sign* or symbol* or tag* or ticket* or sticker* or claim* or icon*)) OR
• (label* W/3 (food* or fat* or sugar* or salt or diet* or health* or energy or calori* or joule* or nutrition* or "guideline daily amount*" or "recommended daily amount*" or "nutrient reference value*" or "nutrient daily value*" or "traffic light" or numeric or symbolic)) OR
• (information* W/3 (food* or fat* or sugar* or salt or diet* or health* or energy or calori* or joule* or nutrition* or "guideline daily amount*" or "recommended daily amount*" or "nutrient reference value*" or "nutrient daily value*" or "traffic light" or numeric or symbolic)) OR
• (menu W/3 (content* or sign* or symbol* or tag* or ticket* or sticker* or claim* or icon* or fat* or sugar* or salt or diet* or health* or energy or calori* or joule$ or nutrition* or "guideline daily amount*" or "recommended daily amount*" or "nutrient reference"))
AND
Outcome
• ("health* Food" or "eat* behavior" or "food preference" or "food habits" or "food selection" or "health* choice" or "meal choice") OR
• (Food W/3 (purchas* or sale* or sell* or select* or pick* or consum* or order or intention or intake)) OR
• (Meal W/3 (purchas* or sale* or sell* or select* or pick* or consum* or order or intention or intake))
AND
Setting
• (restaurant* or "food service*" or "fast? food" or "convenience food" or "ready prepared food" or "ready to eat meal" or "food away from home" or "eat* out" or Catering or "point of selection" or "point of purchase" or menu or café* or canteen* or cafeteria* or "dinner hall*" or "dining area*" or "dining room*" or refector* or eatery or buffet or bistro* or "eating place*")
AND
Population
• (college or university or "young adult" or "tertiary education")

qualitative label (description of sandwiches as classic, plain, simple, special or healthy) also included a quantitative label (calorie information). Thus, searches performed exclusively for the current review included articles published from 2015 until 2022.

Assessment of study quality

The methodological quality of selected studies was assessed using the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies, as recommended by the Guidelines for Systematic Reviews in Health Promotion and Public Health Taskforce (Armstrong et al., 2007) and the Cochrane Public Health Review Group (Armstrong et al., 2011). This tool can be applied to all types of quantitative studies. It comprises six components rated as strong, moderate or weak and provides a global quality rating for each study based on the number of weak ratings.

Study quality assessment was performed independently by two researchers (N.F. and A.D.S.), and any discrepancies were discussed with a third researcher (A.C.F.) until a consensus was reached. EPHPP criteria, which were designed for epidemiological studies having the individual as the unit of analysis, were adapted to the studies included in this review according to the procedures described by Fernandes et al. (2016).

Data extraction

The following information was obtained from the selected articles: authors, country and year of publication, study design, intervention and control groups, menu labelling format, menu labelling description and criteria, food choice outcomes and main findings. Data were extracted half and half by two researchers (N.F. and A.D.S.). Subsequently, each researcher revised the data extracted by their colleague, and a third researcher (A.C.F.) reviewed all the extracted data.

The outcome of interest was food choice, expressed as mean, median or percent healthy food choices or purchases compared between intervention and control groups or between pre- and post-intervention conditions. Methods used to measure these outcomes included direct observation of choices, analysis of receipts or sales records. We did not consider indirect measures such as interviews/surveys because they are reported choices, not the choices themselves, and may be inaccurate.

Data synthesis and analysis

It was not possible to conduct a meta-analysis since the included studies did not have methodological and clinical homogeneity and presented different effect measures. Thus, the data synthesis was performed using vote counting based on the direction of the effect, following the Synthesis Without Meta-Analysis (SWiM) reporting guidelines (Campbell et al., 2020). This methodology for data synthesis is recommended when there is inconsistency in the effect measures or data reported across studies (McKenzie & Brennan, 2019), for example, to combine data from diverse but related outcome measures. The confidence interval was calculated by Wilson interval methods

(Brown et al., 2001) and the *p*-value was calculated from the binomial probability test, as recommended by McKenzie and Brennan (2019). The effect direction plot summarising the direction of menu label influence was elaborated following Boon & Thomson (2020).

Outcomes were classified into three theoretical outcome categories by direction of effect. The categories were positive effect (≥70% outcomes report beneficial direction of effect of menu labelling on food choices or purchases, for example, increase in healthy food choices or purchases); mixed effects (>30% and <70% outcomes report beneficial direction of effect of menu labelling on food choices or purchases); and negative effect (≥70% outcomes report adverse direction of effect of menu label influence on food choices or purchases, for example, decrease in healthy food choices/purchases). Studies with an inconsistent (i.e. mixed) effect direction for a given outcome were excluded from the vote counting as they cannot be said to represent either a positive or a negative effect direction (McKenzie & Brennan, 2019). Included studies were grouped by menu label format (Traffic Light Labelling, Symbol, Text Message) for vote counting and by study quality in a table for qualitative synthesis. Data on the influence of menu labelling on food choices and study quality were synthesised and used to generate recommendations on the best qualitative labelling format to assist university students and/or individuals who eat at university restaurants in making healthy food choices.

RESULTS

A total of 460 studies were retrieved in the first literature search in November 2018. Following duplicate removal (n = 68), 392 studies were screened by title and abstract, resulting in 19 studies. One study from the search prior to 2015 was included in this step (Cinciripini, 1984). After full-text reading, 15 articles were excluded for not meeting the inclusion criteria, and four studies were included. No new eligible studies were found through analysis of the reference list of systematic review studies on related topics and included studies. The update of the literature search identified six studies meeting the inclusion criteria. In total, 11 studies (Biden et al., 2018; Cerezo-Prieto & Frutos-Esteban, 2021; Cinciripini, 1984; Feldman et al., 2015; Migliavada et al., 2022; Mora-García et al., 2019; Oliveira et al., 2018; Roy & Alassadi, 2020; Seward et al., 2016; Sogari et al., 2019; Vermote et al., 2020) were included. Three studies reported the results from two different interventions, giving a total of 14 interventions. Figure 1 shows the number of studies found in each database and the main reasons for exclusion as well as an overview of the selection procedures.

Of the included studies, four were conducted in the United States (Cinciripini, 1984; Feldman et al., 2015; Seward et al., 2016; Sogari et al., 2019), one in Brazil (Oliveira et al., 2018), one in Colombia (Mora-García et al., 2019), one in Canada (Biden et al., 2018), one in Belgium (Vermote et al., 2020), one in New Zealand (Roy & Alassadi, 2020), one in Italy (Migliavada et al., 2022) and one in Spain (Cerezo-Prieto & Frutos-Esteban, 2021) (Table 3). Thus, the results of this review mainly reflect the behaviours of university students in North and South America and Europe. Only one study adopted a randomised clinical trial design; the others were quasi-experiments. The outcomes evaluated were food choices (n = 5) and purchase behaviour (n = 6). The food choices outcomes evaluated the choice of target items (e.g. food items with qualitative labelling indicating they are healthy) and purchase

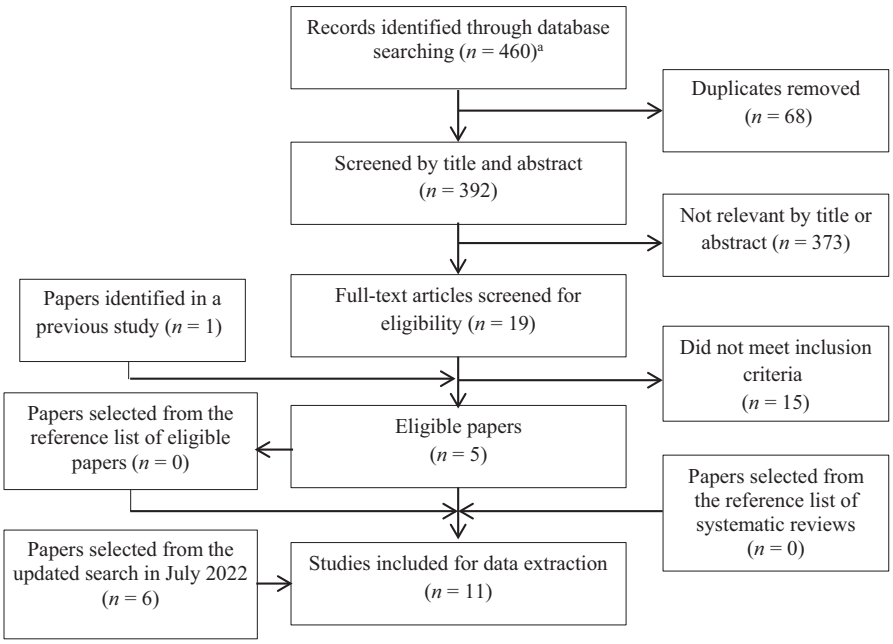


FIGURE 1 Flow diagram for selection of studies investigating the influence of nutritional information labeling on food choices in university restaurants and cafeterias. Records were retrieved from the following databases: Scopus (368), Web of Science (63), Cochrane Library (16), MEDLINE (13), LILACS (0), and SciELO (0) (a). Paper identified in a previous study (Fernandes et al., 2016) (b). The basis for exclusion of papers (15) was as follows: study setting (n=5), type of intervention (*n*=6), overlapping of interventions (*n*=1) and outcome (*n*=3) (c).

TABLE 3 Summary of studies included in the systematic review of the influence of menu labelling on healthy food choices in university restaurants under real-life conditions, stratified by study quality.

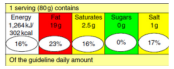
Reference, country	Study design	Intervention and control groups	Menu labelling format	Criteria and description	Outcomes related to food choices	Number of subjects, receipts or meals	Main findings	Direction of effect	Study quality [†]
Oliveira et al. (2018), Brazil	Randomised controlled trial	1. Traffic light labelling + recommended daily values 2. Ingredients list + food component symbols 3. Control	 Contains gluten Contains genetically modified organisms Organic Contains lactose Contains trans fat Vegetarian	Traffic light labels indicating low (green), medium (amber) and high (red) amounts of total fat, saturated fat, sugar, salt and calories	Healthy food choices (mean and percentage values of healthy food choices)	233 subjects	1. Traffic light labelling + recommended daily values (mean 5.4 items) decreased healthy food choices compared with the control (mean 5.6 items) 2. Ingredients list + food component symbols (mean 6.2 items) increased healthy food choices compared with the control (mean 5.6 items) ($p < 0.05$)	1. Negative 2. Positive	Strong
Cerezo-Prieto and Frutos-Esteban (2021), Spain	Quasi-experiment (AB)	1. Traffic light labelling + nutritional properties buffet label with emoji symbol 2. Baseline		Traffic light labels indicating low (green), medium (amber) and high (red) amounts of total fat, saturated fat, sugar, salt and calories	Food choice shares (% of selected foods types)	1101 meals	Choices of legumes (C:36.6%; I:54.8%), salad (C:9.3%; I:13.5%), white meat (C:45%; I:57.8%), fish (C: 9%; I:16.6%), fruit (C:30.4%; I:38.9%) and yogurt (C:40.4%; I:44.3%). There were statistically significant differences in all dishes: side dish ($p < 0.05$), first dish ($p < 0.001$), second dish ($p < 0.001$) and dessert ($p < 0.001$).	Positive	Moderate

TABLE 3 (Continued)

Reference, country	Study design	Intervention and control groups	Menu labelling format	Criteria and description	Outcomes related to food choices	Number of subjects, receipts or meals	Main findings	Direction of effect	Study quality [†]
Roy and Alassadi (2020), New Zealand	Quasi-experiment (ABBC)	1. ✓ Tick symbol + banner explain the symbol and survey (intervention period) 2. ✓ Tick symbol (post-intervention period) 3. Comparison outlet		The New Zealand National Healthy Food and Drink Policy Vegetables and/or fruit; meals prepared with at least 50% healthy category items or ingredients	Purchase behaviour (sales of targeted foods as a percentage of total food sales)	12 420 meals	(i) The sales of targeted food items increased at the experimental outlet between intervention period (1) (55.55%) and the post-intervention period (2) (60.78%) (+5.23%; $p = 0.0002$). (ii) A 5.04% increase in targeted items was also observed between the baseline (55.74%) and the post-intervention period (2) (60.78%) ($p = 0.0004$). (iii)A 0.19% decrease in targeted items was observed between the baseline (55.74%) and intervention period (1) (55.55%). (iv) At the comparison outlet, there was a decrease in the sale of targeted items between the baseline (22.37%) and the intervention period (1) (14.11%) (−8.26%; $p < 0.0001$).	Positive	Moderate
Vermote et al. (2020), Belgium	Quasi-experiment (ABBBBBBB)	1. Intervention I: posters showing the Flemish food triangle 2. Intervention I + green heart icon (for the healthiest food choice) 3. Intervention II + substitution message stimulating the consumption of fruits instead of desserts 4. Intervention III + message showing the percentage of customers who chose fruit for dessert in the previous week 5. Baseline	  	Flemish food triangle (Flemish Institute for Healthy Living) Inverted triangle, divided into four zones + outer circle. Blue zone (base): 'drink mostly water'; dark green zone: 'consume more', (vegetables, fruits, whole grains, potatoes, legumes, nuts and seeds, vegetable oils); light green zone (moderate intake): fish, yogurt, milk, cheese, poultry and eggs; orange zone (top): 'consume less butter and red meat'. Red circle: 'as little as possible': ultra-processed products and alcoholic beverages.	Fruit purchase patterns (% of fruits sold for dessert)	33 836 meals	Intervention (2) increased fruit purchase among students compared with the control (+2.8%, $p < 0.003$). Intervention (3) increased fruit purchase among students compared with the control (+2.8%, $p < 0.003$).	1. Positive 2. Positive	Moderate

(Continues)

TABLE 3 (Continued)

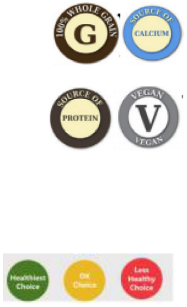
Reference, country	Study design	Intervention and control groups	Menu labelling format	Criteria and description	Outcomes related to food choices	Number of subjects, receipts or meals	Main findings	Direction of effect	Study quality [†]
Migliavada et al. (2022), Italy	Quasi-experiment	1. Local label 2. Organic label 3. Organic &local label 4. Standard	1. Local label: Green salad (0 km), Cooked vegetables (0 km), Slow food presidia pulses 2. Organic label: Organic green salad, Cooked organic vegetables, Organic pulses 3. Organic & local label: Organic green salad (0 km), cooked organic vegetables (0 km), organic & slow food presidia pulses 4. (4) Standard: green salad, cooked vegetables, pulses salad	Vegetable plates sold at lunch (green salad, cooked vegetables and pulses salad)	Purchase behaviour (% and OR of vegetable plates sold)	2208 meals	The odds of purchasing at least one vegetable plate were estimated to be 17% lower (OR: 0.83) when the vegetable plates were labelled as organic than for the standard case (credible interval: 95%: 0.53; 1.26).	Negative	Moderate
Feldman et al. (2015), USA	Quasi-experiment (non-randomised controlled trial)	1. Baseline 2. Intervention: menu labelled with nutrient icons and traffic lights		Energy value, total fat, trans fat, sodium and sugar contents, presence/absence of vitamins A and C, iron, calcium, protein and fibres Green label for the healthiest choice, yellow label for ok choice and red label for less healthy choices.	Healthy food choices (total number, percentage and odds ratio)	426 subjects	Healthiest food choice: Intervention: $n = 84$ (39.6%) Control: $n = 70$ (32.7%) ($p = 0.16$) Odds ratio (95% confidence interval): 1.42 (0.92–2.21)	Positive	Moderate

TABLE 3 (Continued)

Reference, country	Study design	Intervention and control groups	Menu labelling format	Criteria and description	Outcomes related to food choices	Number of subjects, receipts or meals	Main findings	Direction of effect	Study quality [†]
Sogari et al. (2019), United States of America (USA)	Quasi-experiment (ABABAB)	1. Baseline 2. Health message about fibre intake (FM) 3. Health message about vitamin B complex (VM)	(1) Extended message 'EAT WHOLE GRAIN PASTA. Whole grains are rich in fibre, which will make you feel more full. Feeling fuller will help you maintain a healthy weight!' Short message 'Whole grains are rich in fibre, which will make you feel more full.' (2) Extended message 'EAT WHOLE GRAIN PASTA. Whole grains are rich in B vitamins, which help to reduce fatigue. A reduction in fatigue will help you be more alert!' Short message 'Whole grains are rich in B vitamins, which help to reduce fatigue.'	2015–2020 USDA Dietary Guidelines for Americans Recommendations to focus on whole, minimally processed foods; and consume at least half of the grains in the diet in whole form.	Food choice shares (% of diners choosing whole grain pasta)	3734 meals	The choice probability of whole grain penne is higher than for the other pasta types when vitamin message or fibre message were included (constant: −1.771; VM: 0.497; FB: 0.137). The choice probability of whole grain penne is higher among the total of penne meals when vitamin message or fibre message were included (constant: −0.409; VM: 0.528; FB: 0.036). Whole grain pasta has lower choice probability compared with other pasta types (constant term significant at $p < 0.001$), but the probability increases ($p < 0.011$) in the presence of a vitamin benefit message.	1. Positive 2. Positive	Weak
Mora-García et al. (2019), Colombia	Quasi-experiment (ABBC)	1. Baseline 2. Intervention 1: Nutri-Score + information placard about processed food consumption in Latin America 3. Intervention 2: Nutri-Score + information placard about processed food consumption in Latin America + information on the Nutri-Score system		Nutri-score points (0 to 10) are calculated from the energy, total sugar, saturated fat, and sodium contents of foods. Foods containing fruits, plant fibres, oily seeds and proteins are worth negative points (0 to −5). Products are then assigned a label colour and a final score, as follows: 5, green (−15 to −2 points); 4, yellow (−3 to 3 points); 3, orange (4–11 points); 2, pink (12–16 points); and 1, red (>17 points).	Purchase behaviour (total money spent by label colour)	485 receipts	Mean expenditure was higher in the intervention group (US$1.59) than in the control (US$1.40). The mean expenditure on green, light green and red products were higher in intervention group than in control. The mean expenditure on orange and pink products were lower in intervention group than in control.	Mixed	Weak

(Continues)

TABLE 3 (Continued)

Reference, country	Study design	Intervention and control groups	Menu labelling format	Criteria and description	Outcomes related to food choices	Number of subjects, receipts or meals	Main findings	Direction of effect	Study quality [†]
Cinciripini (1984), USA	Quasi-experiment (ABABAB, only 1 AB evaluated)	1. Baseline 2. Intervention: green triangle icon for healthy food choices		Healthy food choices: Foods low in fat and calories (VFSD = vegetables (all non-starchy), soups, fruits, low-fat dairy; SALADS; CFT = chicken, fish, turkey without sauces or gravies). Non-healthy: FDS = foods high in fat, desserts, sauces; RED MEAT; DIARY = regular dairy; CARB = carbohydrates (potatoes, other starchy vegetables and white breads)	Food preferences (% of chosen foods)	5542 meals	Healthy food choices: there were decreases in the choice of VFSD (–1%) and SALADS (–2.4%). There was an increase in the choice of CFT (+0.1%). Non-healthy: There were increases in the choice of FDS (+5.2%) and RED MEAT (+3%). The was a decrease in the choice of CARB (–5.8%).	Mixed	Weak
Biden et al. (2018), Canada	Quasi-experiment (ABBB)	1. Baseline 2. Intervention: eggplant icon for healthy food choices		FRESH approved label for healthy foods. Items were assessed using the Eat Smart!® Choices Calculator.	Purchase behaviour (median number of FRESH approved items sold)	4564 subjects (mean of residents between 2011 and 2015)	No significant differences were observed in the first year of intervention. In the following years, FRESH approved items sold more than non-approved items. Median number of items sold in the pre-intervention phase (2011–2012): FRESH approved, 1520; non-FRESH approved, 3624. Median number of items sold in the post-intervention phases: FRESH approved, 1779; non-FRESH approved, 3178 (2012–2013); FRESH approved, 1937; non-FRESH approved, 1302 (2013–2014); and FRESH approved, 1832; non-FRESH approved, 993 (2014–2015).	Positive	Weak

TABLE 3 (Continued)

Reference, country	Study design	Intervention and control groups	Menu labelling format	Criteria and description	Outcomes related to food choices	Number of subjects, receipts or meals	Main findings	Direction of effect	Study quality [†]
Seward et al. (2016), USA	Quasi-experiment (non-randomised controlled trial)	1. Control 2. Choice architecture 3. Traffic light symbols + healthy plate stickers + choice architecture	Traffic light symbols + healthy plate stickers	Traffic lights: 5 positive criteria (fruits, vegetables, whole grains, lean proteins and low-fat dairy products) and 6 negative criteria (saturated fat, refined starch, added sugars, high sugar, high sodium and red meat). Food items with positive scores were labelled green, those with neutral scores were labelled yellow and those with negative scores were labelled red. Water, tea and coffee were labelled green. Choice architecture: healthier foods moved to the beginning of the buffet line and the addition of fruit-infused water.	Purchase behaviour (% of healthy food sales)	434 625 meals	There were changes in the sales of ref foods (−0.8%/week, $p = 0.199$), yellow foods (−0.1% change/week; $p = 0.940$) and green foods (+ 1.1% change/week; $p = 0.400$) compared with the control site.	Positive	Weak

Abbreviations: AB, pre–post-intervention study; AAB, 2 pre- and 1 post-intervention measures; ABB, 1 pre- and 2 post-intervention measures; ABA, pre–post-intervention plus another baseline measure without intervention; ABABA, multiple baselines and interventions; C, control group; FRESH, Food Resources and Education for Student Health; I, intervention group; OR = Odds Ratio; USDA, United States Department of Agriculture.

[a]Classified according to the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies.

Study	Study design	Healthy food choices/ Purchase behaviour	Menu labelling format
Oliveira et al. (2018) (1)	RCT	▼	TLL + RDA
Oliveira et al. (2018) (2)	RCT	▲	Symbol + ingredients list
Cerezo-Prieto & Frutos-Esteban (2021)	QES	▲	TLL + Symbol
Roy & Alassadi (2020)	QES	▲	Symbol
Vermote et al. (2020) (1)	QES	▲	Flemish food triangle + Symbol
Vermote et al. (2020) (2)	QES	▲	Flemish food triangle + Symbol + text message
Migliavada et al. (2022)	QES	▼	Text message
Feldman et al. (2015)	QES	▲	TLL + Symbol
Sogari et al. (2019) (1)	QES	▲	Text message
Sogari et al. (2019) (2)	QES	▲	Text message
Mora-Garcia et al. (2019)	QES	◄►	Nutri-Score
Cinciripini (1984)	QES	◄►	Symbol
Biden et al. (2018)	QES	▲	Symbol
Seward et al. (2016)	QES	▲	TLL

FIGURE 2 Effect direction plot summarizing direction of menu label influence. Effect direction: upward arrow ▲ = positive health impact, downward arrow ▼ = negative health impact, sideways arrow ◄► = no change/mixed effects/conflicting findings. Sample size: Final sample size: Large arrow ▲ >300; medium arrow ▲ 50-300; small arrow ▲ <50. Study quality: denoted by row colour: green = high quality; amber = moderate quality; red = weak quality. (1) Fibre message, (2) Vitamin message. Sogari et al. (2019). RCT, randomise controlled trial; QES, quasi-experiment; TLL, traffic light labelling; RDA, recommended daily values.

behaviour evaluated sales (e.g. food items/groups sold or money spent to buy healthy food items).

Study quality assessment

Only one study had a strong quality (Oliveira et al., 2018) (n = 1; 9%) and five had moderate quality (Cerezo-Prieto & Frutos-Esteban, 2021; Feldman et al., 2015; Migliavada et al., 2022; Roy & Alassadi, 2020; Vermote et al., 2020) (n = 5; 45.5%). All other studies were classified as having weak quality (Biden et al., 2018; Cinciripini, 1984; Mora-García et al., 2019; Seward et al., 2016; Sogari et al., 2019) (n = 5; 45.5%). Studies were classified as having weak or moderate quality mainly because of their before-and-after nature and lack of control group, blinding, randomisation and identification of confounding variables.

Results of included studies

There was evidence that qualitative menu labels were effective for promoting healthy food choices and/or purchase behaviour, with 10 of 12 interventions favouring the intervention (83%; 95% CI 55–95%; p = 0.0386). The effect direction plot summarising the direction of menu label influence is represented in Figure 2. When considering only significant changes, the effects varied from a 2.14% increase in the consumption of vegetables, soups, fruits and low-fat dairy products by women with obesity (Cinciripini, 1984), to a 20.5% increase in the overall sales of healthy food items (Biden et al., 2018). The following narrative analysis is stratified by study quality (strong, moderate and weak).

Strong quality

The only study which had strong quality was carried out by Oliveira et al. (2018). In a randomised controlled study, the authors evaluated the use of daily intake values plus traffic light labelling (to identify low (green), medium (amber) and high (red) levels of total fat, saturated fat, sugar, salt and calories in food items) and ingredients lists plus highlighted symbols (to communicate food components, such as gluten, lactose, *trans* fat, genetically modified organisms, organic and vegetarian meals) in comparison with the absence of labelling (control). Due to two different interventions being compared to the control, the direction of effect

was analysed for each separately. The mean choice share of healthier foods was higher ($p < 0.05$) among participants who received the menu containing ingredient lists and highlighted symbols (6.2) compared with the control (5.4), indicating a positive direction of effect. The group which received a menu containing daily intake values plus traffic light labelling had a lower mean choice share of healthier foods (5.2) compared with the control (5.4), indicating a negative direction of effect.

Moderate quality

Four of five studies had a positive direction of effect on food choices or purchase behaviour. One of the studies applied traffic light labelling plus nutritional properties message with an emoji sad (red), neutral (yellow) or happy (green), at the same time on a buffet line in a quasi-experiment (Cerezo-Prieto & Frutos-Esteban, 2021). The authors observed an improvement in healthy food choices between control (C) and intervention (I). There was an increase in the choice of legumes (C:36.6%; I:54.8%), salad (C:9.3%; I:13.5%), white meat (C:45%; I:57.8%), fish (C: 9%; I:16.6%), fruit (C:30.4%; I:38.9%) and yogurt (C:40.4%; I:44.3%). There were statistically significant differences in all dishes: side dish ($p < 0.05$), first dish ($p < 0.001$), second dish ($p < 0.001$) and dessert ($p < 0.001$) (Cerezo-Prieto & Frutos-Esteban, 2021).

The other study that found a positive direction of effect used a tick symbol to target healthier foods (Roy & Alassadi, 2020). The purchase behaviour was observed in two takeout food outlets where one operated as the experimental outlet and the other as the comparison outlet. The sales of targeted food items increased at the experimental outlet between the intervention period (55.55%) and the post-intervention period (60.78%) (+5.23%; $p = 0{\cdot}0002$). A 5.04% increase in targeted items was also observed between the baseline (55.74%) and the post-intervention period (60.78%) ($p = 0{\cdot}0004$). At the comparison outlet, there was a decrease in the sale of targeted items between the baseline (22.37%) and the intervention period (14.11%) (–8.26%; $p < 0{\cdot}0001$), showing that the intervention worked (Roy & Alassadi, 2020).

Vermote et al. (2020) had four different interventions reporting six outcomes. For our analyses, only two interventions were considered as being qualitative menu labels (green heart icon and a message suggesting substitution of other desserts for fruits), so only those two interventions were analysed. The interventions were carried out sequentially and cumulatively, aiming to encourage the choice of fruit for dessert. In the control week (week 0), no interventions were performed. In the next weeks, the restaurant received one additional intervention per week: posters of the Flemish food triangle; a green heart icon above the available fruits; a message suggesting the substitution of other desserts for fruits and a message about the frequency of fruit consumption among cafeteria customers respectively. All interventions were maintained until the end of the study. A significant increase in fruit purchases was observed after the second intervention (green heart icon) (+2.8%, $p < 0.003$) and after the third intervention (message suggesting substitution of other desserts for fruits) (+2.8%, $p < 0.003$).

In the study of Feldman et al. (2015), menu labelling interventions indicated a positive direction of effect. Students were presented with two university restaurant menus containing seven healthy foods and seven unhealthy foods. Menus were either unlabelled (control) or labelled with traffic lights and nutrient icons (iron, calcium, fibre, protein, whole grain and vegan). Healthy choices were made by 39.6% of participants in the intervention group and 32.7% of participants in the control group. Students in the intervention group had higher odds of selecting healthy food than students in the control group (OR: 1.42; $p = 0.16$). In a cluster crossover quasi-experiment, Migliavada et al. (2022) tested whether labelling vegetable items as organic, local or both tends to be associated with higher odds of purchasing at least one vegetable item for a lunch meal in a university canteen versus standard labelling (simple food plate name). For our analyses, only the organic label was considered as menu labelling, because this information refers to something intrinsic to the food. The odds of purchasing at least one vegetable plate were estimated to be 17% lower (OR: 0.83) when the vegetable plates were labelled as organic than for the unlabelled case, indicating a negative direction of effect.

Weak quality

Three of five studies had a positive direction of effect on food choices or purchase behaviour. Sogari et al. (2019) investigated consumers' preference for whole grain pasta among university diners. The two interventions included posters and a short message in front of the whole grain pasta about the benefits of fibre or B vitamins. Due to the two different interventions being compared to baseline, the direction of effect was analysed separately. The choice probability of whole grain penne was higher than for the other pasta types when a vitamin message or fibre message was included (constant: –1.771; vitamin message: 0.497; fibre message: 0.137). Also, the choice probability of whole grain penne was higher among the total of penne meals when vitamin message or fibre message was included (constant: –0.409; vitamin message: 0.528; fibre message: 0.036). Both interventions had a positive direction of effect.

Biden et al. (2018) labelled healthier food items with an eggplant icon. The authors analysed the sales records of 322 food items with logos and another 736 without them in university dining halls from 2011 to 2015. No significant differences in sales records were

observed in the year following logo implementation. However, in subsequent years, there was an increase in the sales of healthier foods, even in years when healthier food items re-occurred less frequently on menus. Whereas the median number of healthier items sold in the pre-intervention period was 1520 (Percentile25, 830; Percentile75, 7415), the median number of healthier food items sold in the second year of intervention (when a significant difference from baseline was observed) was 1937 (Percentile25, 526; Percentile75, 4793). Although the study obtained positive long-term results, indicating a positive direction of effect, it was not possible to conclude that the increase in sales of healthier foods was directly influenced by the menu labelling provided because, in addition to the study not having a control group, healthier food items were sold at a lower price.

Seward et al. (2016) evaluated the frequency of healthy food purchases in six university cafeterias: two control cafeterias, two cafeterias with a choice architecture intervention and two cafeterias with choice architecture plus traffic light labelling (and healthy plate stickers, not considered menu labelling), based on the Nutri-Score, with green labels for positive scores, yellow for neutral scores and red for negative scores. Results of meals served during the study period showed positive changes in the purchase of red foods (variation of −0.8%/week; $p = 0.199$), yellow foods (−0.1% change/week; $p = 0.940$) and green foods (+ 1.1% change/week; $p = 0.400$) compared with the control, indicating a positive direction of effect.

Mora-García et al. (2019) reported that qualitative menu labelling, in the form of the Nutri-Score, had a mixed effect on expenditure in a real university environment. The Nutri-Score system is based on the computation of calories, simple sugars, fatty acids, saturated fat, sodium, fibre, protein and the percentage of fruits and vegetables per 100 g of food. The label provides the nutritional score (scale of 1–5) combined with a colour (pink, orange, light green and green, respectively), ranked in ascending order according to nutritional quality. In the intervention group, there were posters with an explanation of the Nutri-Score system. Purchasing behaviour was assessed by analysing sale receipts and by determining the mean amount spent on foods from each category. The mean expenditure on green, light green and red products was higher in the intervention group than in the control. The mean expenditure on orange and pink products was lower in the intervention group than in the control.

Cinciripini (1984) also reported a mixed effect when investigating the use of a healthy food symbol (green triangle) on low-calorie, low-fat foods in a university restaurant. Food choices, gender and BMI (obese, lean or normal) of diners were collected by direct observation during baseline (control) and intervention periods. The effect of displaying menu labelling was desirable. The authors observed a decrease in the choice of two of three groups of healthy food: vegetables, soups, fruits and low-fat dairy (–1%) and salads (–2.4%), and an increase in chicken, fish and turkey choices (+0.1%). The foods classified as non-healthy had an increase in two of the three groups. The choice of foods high in fat, desserts, sauces (+5.2%) and red meat (+3%) increased, and the choice of carbohydrates (potatoes, other starchy vegetables and white breads) decreased (–5.8%).

Comparison of qualitative menu labels formats

One of the two interventions that reported a negative direction of effect of menu labelling used daily intake values plus traffic light labelling (Oliveira et al., 2018) and the other used organic labels (Migliavada et al., 2022). Studies that did observe significant positive effects (Biden et al., 2018; Cerezo-Prieto & Frutos-Esteban, 2021; Feldman et al., 2015; Oliveira et al., 2018; Roy & Alassadi, 2020; Seward et al., 2016; Sogari et al., 2019; Vermote et al., 2020) used a variety of menu labelling models. One study applied an ingredients list plus food component symbols (Oliveira et al., 2018). Another found that a green heart icon and green heart plus substitution message were effective in indicating that fruits are healthier dessert options (Vermote et al., 2020). One found that text messages about vitamin benefits or about fibre were more effective than no messages (Sogari et al., 2019). Two studies used traffic light labelling (Feldman et al., 2015; Seward et al., 2016). The other three studies that reported positive direction of effects of menu labelling (Biden et al., 2018; Cerezo-Prieto & Frutos-Esteban, 2021; Roy & Alassadi, 2020) used symbols. One of them (Cerezo-Prieto & Frutos-Esteban, 2021) combined symbols, traffic light labels and nutritional properties messages. The studies that had mixed effects provided calorie information combined with a symbol (Cinciripini, 1984) and others tested the Nutri-Score system (Mora-García et al., 2019).

Comparing the formats of the menu labelling using vote counting based on the direction of effect, 7/7 interventions using symbols alone or with other formats found positive effects (100%; 95%CI 65%–100%; $p = 0.0156$), while 3/4 interventions using traffic light labelling found positive effects (75%; 95%CI 30%–95%; $p = 0.6250$) and 2/3 interventions using only text messages (vitamin, fibre or organic) found a positive effect (67%; 95%CI 21%–94%; $p = 1.000$). Overall, the findings show that positive effects in promoting healthier food choices among university students and/or individuals who eat at university restaurants were seen with the use of symbols, alone or in association with another intervention, to identify healthier foods and meals.

DISCUSSION

The evidence from the vote counting results showed that most interventions with qualitative menu labels were better than no intervention for promoting healthy food choices and/or purchase behaviour among university students and/or individuals who eat at university restaurants. The use of symbols, alone or in association with another intervention, was particularly effective in promoting healthier food choices compared to other strategies. In the evaluated studies, several different parameters were adopted to characterise healthy eating, hindering comparisons between studies. Studies also differed in research designs, requiring different quality classifications. Only one study was classified as strong quality (Oliveira et al., 2018), demonstrating that the methodological model used was adequate. This study had a randomised controlled trial design and controlled for a number of confounders (sex, age, BMI, dietary restrictions and frequency of eating out).

Despite the analysis based on the direction of effect showing an overall positive effect, when only significant statistical results are considered, Cinciripini (1984), Oliveira et al. (2018) and Vermote et al. (2020) found that the display of qualitative menu labelling influences mainly women. Studies conducted in other countries (Bates et al., 2009; Feng & Fox, 2018; Lando & Labiner-Wolfe, 2007; Lee-Kwan et al., 2014; Mbogori & Freeland, 2021) also found that women are more likely to use menu labelling.

Oliveira et al. (2018) observed a negative direction of effect of traffic light labelling combined with another quantitative system on students' food choices, corroborating the results of studies using traffic light-based labels in several types of food establishments, (Fernandes et al., 2016; Oliveira et al., 2018). Also, Mora-García et al. (2019) had mixed effects in their study that tested Nutri-Score, which is similar to the traffic light label (Mora-García et al., 2019). As observed in studies on the use of traffic light labelling in packaged foods (Khandpur et al., 2018; Lando & Labiner-Wolfe, 2007; Mazzonetto et al., 2022; Morley et al., 2013), consumers find it difficult to use the system for comparisons between product types and may be confused by a large number of possible colour combinations. Despite a positive direction of effect found by Cerezo-Prieto and Frutos-Esteban (2021), Feldman et al. (2015) and Seward et al. (2016) using traffic light labelling, it is not possible to conclude if positive results were provided by the traffic light labelling itself because the authors used more than one kind of intervention at the same time (Cerezo-Prieto & Frutos-Esteban, 2021; Fernandes et al., 2016; Seward et al., 2016).

The use of traffic light labelling to highlight caloric content in fast-food restaurants is questioned since energy value alone is not sufficient to indicate the nutritional quality of food items (Fernandes et al., 2019). To focus only on calories is to reduce foods to a single aspect (Fernandes et al., 2019); it is important to analyse the content of nutrients, such as fibre, added sugars and sodium and, especially, the ingredients list. Furthermore, the use of a calorie label to prevent and reduce obesity implies that to combat obesity, individuals simply need to exert more self-control to manage their caloric intake (McGeown, 2019). Thus, healthy eating recommendations should be focused on healthier foods, diet quality and healthy eating patterns, not on calories (Hoefkens et al., 2011; Schaumberg & Anderson, 2016).

Mora-Garcia et al. (2019) applied the Nutri-Score system, which uses a five-colour, five-number scale as an indicator of nutritional quality. The results showed an increase in the purchase of green and light green (healthy) food items only, whereas that of red items was higher compared to the control group, representing mixed effects. Such findings corroborate those of de la Cruz-Góngora et al. (2017), who, when analysing packaged foods, observed that the colour scheme of traffic light labels might not have been well understood by consumers. The authors reported that consumers easily relate green to the best option and red to the worst but yellow causes doubt. A similar finding was reported by León-Flández et al. (2015) who found that Spanish consumers had a low comprehension of the traffic light system. In a study conducted in Germany, Borgmeier and Westenhoefer (2009) observed that when the traffic light label is used in conjunction with other labels, consumers may find the excess information hard to use, in line with the results of this review.

According to Viswanathan and Hastak (2002), the identification of healthier foods is often more accurate when less information is provided to consumers. The authors argued that providing summarised information (deemed as a shortcut to assess the healthiness of a food item) may contribute to healthy food choices. Consumers seem to prefer simple presentations of nutritional information, the use of symbols to identify excess nutrients or less healthy foods and formats that allow quick comparison between items. The results from Roy and Alassadi (2020) and Biden et al. (2018) corroborate these findings. In a systematic review of the influence of food labels on university student diets, Christoph and An (2018) concluded that interpretative labels are more effective in improving diet quality than simple calorie labels. Consumers may have difficulty understanding quantitative information such as calorie and nutrient contents but can easily comprehend qualitative nutrition information about foods (Christoph & An, 2018).

Symbols indicating the nutritional quality of foods are generally easier to understand, assisting in healthier food choices and improvement of eating habits. As previously mentioned, consumers seem to prefer simpler

nutritional information systems, such as symbols and are more likely to use nutrition information when it is easy to understand and requires less effort (Lando & Labiner-Wolfe, 2007; Morley et al., 2013). This fact was observed in the study of Vermote et al. (2020), in which the most effective interventions were a green heart icon and green heart icon plus a substitution message displayed above the healthiest foods. In that study, the Flemish food triangle was the only intervention used alone, not leading to statistically significant differences in food choices, even though it was the most noted intervention among customers. The increase in fruit consumption was consistent with the percentage of students who reported noticing all interventions. Thus, qualitative labels, such as symbols that indicate the nutritional quality of foods, seem to be more effective in promoting healthier food choices than complex information or general content, if they are noticed by consumers. This shows that nutrition information needs to be easily noticeable to communicate to consumers.

In the study of Oliveira et al. (2018), a higher number of healthier foods were chosen by participants who received menus containing the ingredients list and highlighted symbols to communicate food components. The tested information formats (traffic light and ingredients list plus symbols) were chosen based on the results of previous focus groups conducted with Brazilian and English students (Oliveira et al., 2017). Although participants had different cultures and eating habits, both groups preferred the ingredients list plus highlighted symbols format, considered to be more understandable and useful for making informed food choices. Moreover, participants agreed that caloric content or caloric content plus nutrient information did not influence their food choices (Oliveira et al., 2017).

In view of the results, it is suggested to use symbols, alone or in association with another intervention, to indicate healthy foods or the presence of specific food components. Criteria for defining the healthiness of a food item, other than solely caloric and fat contents, need to be established.

Limitations and strengths

One of the limitations of this area of research is the diversity of terms used to describe menu labelling in the literature, as previously underscored by Fernandes et al. (2016) making it difficult to ensure all relevant studies are included in the review. Extensive research and the use of several combinations of uniterms were required to select studies. The main other limitations were the variety of study designs and the absence of randomisation and blinding, which led some studies to be classified as weak quality. However, it is noted that blinding is not possible in informative intervention studies. Only one study adopted a randomised controlled design (Oliveira et al., 2018), showing strong quality. Thus, the limitation of this review lies in the impossibility of recommending, with a high degree of certainty, the use of interventions that promoted positive effects on students' food choices. In most studies, the baseline period was used as the control; thus, the positive results might have been influenced by factors extrinsic to the intervention.

One of the strengths of this study is that it is the first systematic review of the influence of qualitative menu labelling on food choices in the real environments of university restaurants. The results of the current review are relevant to researchers, nutrition policymakers, nutritionists, university managers and food service professionals and may serve as a basis for future research using high-quality methodological approaches to afford reliable results and help minimise the use of ineffective information formats in university restaurants.

CONCLUSION

Qualitative menu labels in university settings were shown to be effective in promoting healthy food choices and/or purchase behaviour among those eating at university restaurants. Among studies which had positive effects on healthy food choices or purchase behaviour, the most frequent qualitative menu label were symbols for healthier foods or food components, alone or in association with another intervention. Despite most studies using traffic light labelling and text messages alone (vitamin, fibre or organic) finding a positive direction of effect on food choices or purchase behaviour, this was not statistically significant.

Although most studies were of moderate or weak quality, the results of this review may serve as a basis for future research using high-quality methodological approaches to afford reliable results and help minimise the use of ineffective information formats in university restaurants. The findings here reported may serve as a basis for the implementation of nutrition information policies in university restaurants. Menu labels should also allow for easy comparison between available foods to facilitate more informed food choices.

AUTHOR CONTRIBUTIONS

NF and ADS were responsible for collecting, analysing and interpreting the data, and for drafting the manuscript. GLB, PLU, RCO and VMR were responsible for interpreting and discussing the data, and for revision of the manuscript. RPCP contributed to planning and coordinating the research, to the interpretation and discussion of the data and to the revision of the manuscript. ACF contributed to collecting, analysing and interpreting the data, and for manuscript drafting, as well as was responsible for planning the

research, research coordination and for the revision of the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors report no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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