

Influence of menu labeling on food choices in real-life settings: a systematic review

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Context: Evidence that menu labeling influences food choices in real-life settings is lacking. Reviews usually focus on calorie counts without addressing broader issues related to healthy eating. **Objective:** This systematic review assessed the influence of diverse menu-labeling formats on food choices in real-life settings. **Data Sources:** Several databases were searched: Cochrane Library, Scopus, MEDLINE, Web of Science, Food Science and Technology Abstracts, Biological Abstracts, CAB Abstracts, EconLit, SciELO, and LILACS. **Study Selection:** Articles reporting experiments, quasi-experiments, and observational studies using control or preintervention groups were selected blindly by two reviewers. **Data Extraction:** Data was extracted using a standard form. Analyses differentiated between foodservice types. The quality of the 38 included studies was assessed blindly by two reviewers. **Data Analysis:** The results were mixed, but a partial influence of menu labeling on food choices was more frequent than an overall influence or no influence. Menu labeling was more effective in cafeterias than in restaurants. Qualitative information, such as healthy-food symbols and traffic-light labeling, was most effective in promoting healthy eating. In general, the studies were of moderate quality and did not use control groups. **Conclusions:** Calorie labeling in menus is not effective to promote healthier food choices. Further research in real-life settings with control groups should test diverse qualitative information in menu labeling.

INTRODUCTION

Eating out has been increasingly associated with weight gain¹ and unhealthy eating,² and thus the use of menu labeling in restaurants and other foodservice establishments has been proposed as a tool to help decrease the rates of obesity and related chronic diseases.

The term *menu labeling* has been used with different meanings. Some authors employ it as a synonym for calorie information,^{3,4} while others use it to designate

nutritional information such as calories and nutrients^{5,6} or as a reference to the traffic-light system^{7,8} or other food information.^{9,10} In this study, the term *menu labeling* was broadly applied to designate all calorie information, nutritional information (eg, nutrient counts), contextual information (eg, daily calorie recommendations), food information (eg, ingredients, alerts such as “contains gluten,” and symbols or phrases to identify healthy food, such as keyhole or heart symbols), and traffic-light labeling. In traffic-light labeling, colors are

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used to designate low (green), medium (amber), or high (red) levels of calories and/or certain nutrients that the public health community recommends limiting. Colors are also used to indicate food healthfulness on the basis of certain ingredients (such as the presence of whole grains) in the food. In this case, green would indicate high levels of healthful ingredients and red would indicate low levels.

Although public health policy regarding menu labeling has focused mainly on the calorie content of food,^{11,12} evidence showing that calorie labeling influences food choices in restaurants, especially in real-life settings, is lacking.^{13–17} Studies have often considered calorie labeling to be synonymous with menu labeling, making the frequently unsupported assumption that calorie labeling could lead individuals to choose reduced-calorie foods, with the outcome being healthier food choices.^{13–17} Besides calorie content, however, food healthfulness and dietary factors related to obesity involve food patterns and synergistic interactions between nutrients and other components and aspects of food.^{18–21}

Studies on the effect of menu labeling on food choices in formats other than the calories-only approach report conflicting results.^{7,22,23} This could be attributable to the different formats of qualitative information (eg, traffic-light system, which considers several healthy-eating criteria,⁷ heart-healthy symbol, which considers macronutrient parameters,²² and reduced-fat labeling²³) or to the different outcomes assessed. Moreover, to date there have been no studies comparing quantitative and qualitative menu-labeling information. Conflicting results may also be due to the variety of study settings, which include different types of foodservice and both real and hypothetical settings.^{13–17} Customers often behave differently under artificial conditions, suggesting the need to conduct studies in real-life settings in order to better inform public health policy.^{14,15,24}

Despite the increase in the number of studies on menu labeling, only a few systematic reviews and meta-analyses have been published, and gaps in knowledge about the influence of menu labeling on food choices remain. Systematic reviews on menu labeling usually focus on calorie labeling and its influence on the calorie content of food selected, and not on qualitative labeling such as healthy-eating symbols or outcomes related to healthy-eating indicators other than calorie content.^{13–17} Additionally, they include studies in both real-life and hypothetical settings, such as online and street surveys as well as laboratory experiments.^{13,15–17} Moreover, differences between types of foodservices, such as restaurants (fast-food and sit-down) and

cafeterias (workplace and university), have not been explored.^{13–17}

The aim of this systematic review was to identify studies investigating the influence of menu labeling on food choices of adults in real-life settings and to assess study quality by exploring differences between information formats, foodservice types, and expected outcomes, focusing on healthy eating rather than merely calorie content.

METHODS

A systematic review was conducted according to the *Cochrane Handbook for Systematic Reviews of Interventions*²⁵ and followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Statement.²⁶ This review is not registered with any systematic review database.

The guiding question of this systematic review asked “What is the influence of menu labeling on the food choices of adults in real-life settings?”

Eligibility criteria

The criteria for study eligibility in this review, including PICOTS (Population, Intervention, Comparison, Outcome, Type of study, and Setting) elements, are described in [Table 1](#).

Search strategy and selection criteria

The following electronic databases were searched: MEDLINE, Food Science and Technology Abstracts, Biological Abstracts, CAB Abstracts, and EconLit (all via Ovid MEDLINE), the Cochrane Library, Scopus, Web of Science, SciELO, and LILACS. Four search themes were combined; for example, intervention (eg, menu label, calorie content, nutrition content) was combined with outcome (eg, food selection, meal choice, eating behavior) and setting (eg, restaurant, food eaten away from home, catering), excluding child populations (eg, children, infants, schoolchildren). All keywords and a complete description of the Ovid search strategy are shown in [Box 1](#).

Preliminary searches were helpful for making adjustments to search terms and their combination in order to find the largest possible number of articles related to the topic. One researcher (A.C.F.) conducted the official searches on September 29, 2014, and updated these on June 29, 2015. Additional studies were located by searching the references of past reviews and of papers included in this review.

One researcher (A.C.F.) identified and removed duplicate papers by using reference management

Table 1 PICOTS and other criteria for the inclusion of studies

Parameter	Criteria
Population (P)	Adults or university students or general consumers, regardless of age (in the case of studies based on sales analyses in fast-food restaurants)
Intervention (I)	Quantitative menu labeling (eg, number of calories, nutrient content, proportion of calories from fat) or qualitative menu labeling (eg, traffic-light labeling, healthy-food symbols, or messages) of meals and/or drinks, visibly displayed at points of selection (eg, on menus, table displays, or menu boards, or beside food items at buffets, and counters)
Comparison (C)	Control group, unexposed group, or preintervention group (AB studies) without menu labeling or with same menu labeling prior to a second menu-labeling intervention
Outcome (O)	Absolute number (number of calories and/or nutrients) or proportion (%) of sales, purchases, choice of targeted items (eg, food items with qualitative menu labeling, or low- and high-calorie food items), food items/food groups (eg, vegetables and fruits, regular dairy), or different portion sizes (% of big/small portions) purchased or selected on site (not using food records or recalls)
Type of study (T)	Experiments (randomized trial), quasi-experiments (controlled trial or pre-post experiments [AB studies ^a] with or without control groups), observational pre-post studies that were natural experiments [AB studies ^a] with or without controls (nonexposed groups), or cross-sectional studies with exposed and nonexposed groups
Setting (S)	Real settings ^b of restaurants (fast-food, sit-down) or cafeterias (workplace, canteens)
Assessment methods	Sales data, sales receipts, or choices observed by researchers (not self-reported data)
Category of paper	Original papers
Full-text language	English, Portuguese, Spanish, French, and Italian
Publication year	No restriction

^aAB studies: pre-post intervention studies.

^bReal settings: in real-world or nonlaboratory settings.

software. Two researchers (A.C.F. and R.C.O.) independently screened titles, abstracts, and full articles for eligibility. Disagreements were resolved through discussions with a third person, the senior researcher (R.P.C.P.).

Quality assessment of included studies

Risk of bias in individual studies was assessed using the Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies (EPHPP), as recommended by the Guidelines for Systematic Reviews in Health Promotion and Public Health Taskforce²⁷ and the Cochrane Public Health Review Group.²⁸ This tool is applied to the design of all quantitative studies. The tool is composed of 6 components that can be rated as strong, moderate, or weak, and a global rating for each study is established on the basis of the number of “weak” ratings. Two independent researchers (A.C.F. and R.C.O.) conducted the quality assessment, and differences in ratings were discussed until consensus was reached.

The EPHPP criteria, which are directed more toward clinical trials with individuals as the unit of analysis, were adapted to suit the included studies. The following considerations for each component’s rating explain these adaptations and the resulting scores:

Selection bias. Sales analyses of all transactions in establishments selected by convenience were indicative of 100% agreement among selected individuals, and thus were rated as strong indicators.

Study design. The instrument rated only randomized and controlled trials as strong in quality. Other study designs were rated as moderate, except for cross-sectional studies, which were rated as weak.

Confounders. The tool rates as strong the studies with no important differences between intervention and control groups prior to the intervention. Thus, AB studies in which A and B groups were composed of the same people were also considered strong for confounders.

Blinding. Sales analyses or receipt collection provided information automatically generated from real purchases. In this case, the outcome assessor was considered blind. When no survey was applied during the intervention, it was not possible to tell if participants were blinded, and so the study was considered moderate in blinding.

Data collection. Sales data and receipts were considered valid and reliable instruments, and were rated as strong indicators. Studies that used other instruments and did not mention validity and reliability were classified as weak.

Attrition. Assessment of withdrawals and dropouts did not apply to studies that analyzed sales data without participants’ agreement, which led to a moderate score.

Data extraction and analysis

One researcher (A.C.F.) extracted data using a standard form, and a second researcher (R.C.O.) reviewed

Box 1 Strategy used to search the MEDLINE, Food Science and Technology Abstracts, Biological Abstracts, CAB Abstracts, and EconLit databases, via Ovid search engine, for studies investigating the influence of menu labeling on food choices in real-life settings

Intervention

- exp Nutrition labeling/ or exp Food labeling/
- (nutri\$ facts or energy posting or calori\$ posting or joule\$ posting or menu label\$ or menu information).ti,ab.
- (nutrition\$ adj1 (content\$ or sign\$ or symbol\$ or tag\$ or ticket\$ or sticker\$ or claim\$ or icon\$)).ti,ab.
- (health\$ adj1 (content\$ or sign\$ or symbol\$ or tag\$ or ticket\$ or sticker\$ or claim\$ or icon\$)).ti,ab.
- (label\$ adj3 (food\$ or fat\$ or sugar\$ or salt or diet\$ or health\$ or energy or calori\$ 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)).ti,ab.
- (information\$ adj3 (food\$ or fat\$ or sugar\$ or salt or diet\$ or health\$ or energy or calori\$ 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)).ti,ab.
- (menu adj3 (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 calori\$ or nutrition\$ or guideline daily amount\$ or recommended daily amount\$ or nutrient reference value\$ or nutrient daily value\$ or traffic light)).ti,ab.

AND

Outcome

- exp Health Food/or exp Eating behavior/or exp Food preference/or exp Food habits/ or exp Food selection/
- (Health\$ food or Health\$ choice or Meal choice or Eat\$ behavior\$ or Food preference).ti,ab.
- (Food adj3 (purchas\$ or sale\$ or sell\$ or select\$ or pick\$ or consum\$ or order or intention or intake)).ti,ab
- (Meal adj3 (purchas\$ or sale\$ or sell\$ or select\$ or pick\$ or consum\$ or order or intention or intake)).ti,ab

AND

Setting

- exp restaurant/or exp food services/or exp fast food/ or exp convenience food/or exp ready prepared food/or exp ready to eat meal/
- (restaurant\$ or food service\$ or fast food or food away from home or eat\$ out or Catering or point of selection or point of purchase or menu or cafe\$ or canteen\$ or cafeteria\$ or dinner hall\$ or dining area\$ or dining room\$ or refector\$ or eatery or buffet or bistro\$ or eating place\$).ti,ab.

NOT

Excluded population

- exp child/ or exp infant/
- (child\$ or preschool or infant\$ or schoolchild\$).ti,ab.

extracted data. The following characteristics were extracted from papers: authors; country and year of publication; settings; main objectives; methods (eg, study design, data analysis); intervention (or exposure), baseline and/or control (or unexposed) group; outcomes; and main results (from fully adjusted models). Principal summary measures were difference in means (eg, calories selected and percentage of targeted items purchased) and difference-in-difference analysis (eg, between baseline and menu-labeling period in the intervention and at the control site).

Studies in restaurants and cafeterias were analyzed separately because of differences in foodservice characteristics (commercial vs institutional) and in menu-labeling formats. Most studies in cafeterias displayed information designed specifically for the patrons of each location. Additionally, each category of studies was classified according to the type of foodservice (fast-food vs sit-down restaurants) and location (university, hospital, or other types of workplace cafeterias) because of differences in service (restaurants) or in patrons (who were specific to each type of cafeteria).

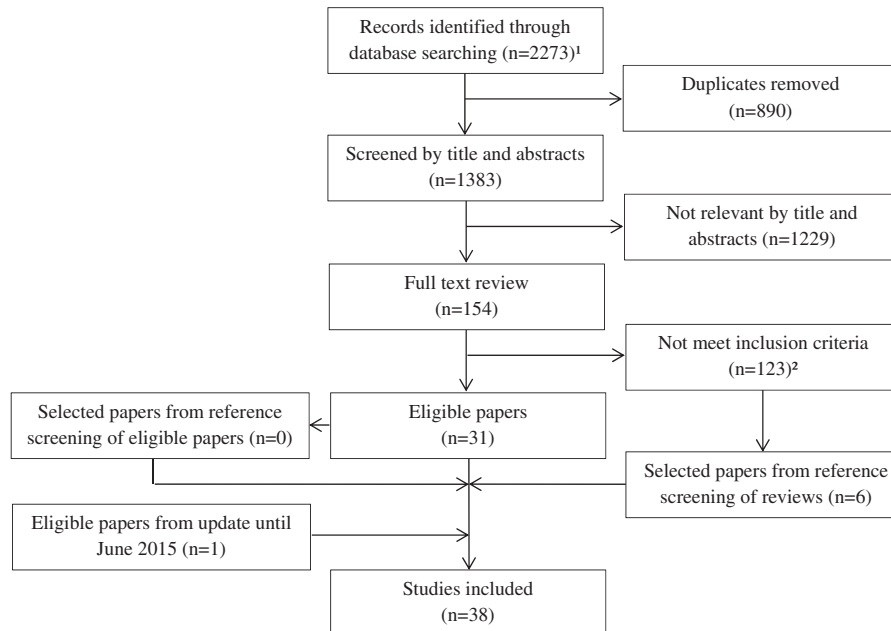


Figure 1 Flow diagram of manuscript selection for systematic review of studies investigating the influence of menu labeling on food choices in real-life settings.

¹Records were identified from the following databases: Scopus (n = 1004), Ovid (n = 823), Web of Science (n = 431), Cochrane Library (n = 8), LILACS (n = 4), and SciELO (n = 3).

²The basis for exclusion of papers (n = 123) was as follows: category of paper (n = 33), study design (n = 31), study setting (n = 27), type of intervention (n = 21), overlapping of data, ie, studies analyzing same data as other included studies (n = 6), language (Korean, Japanese, and German) (n = 4), and outcome (n = 1).

Qualitative synthesis grouped the studies conducted with the same foodservice type according to the results found. Outcomes were classified into 3 categories according to the influence of menu labeling on food choices considered desirable: yes (overall desirable influence), partial (partially desirable influence, eg, on the food choices of some groups of people or on the sales of some food items), or no (no overall or partially desirable influence).

Analyses encompassed the influence of menu-labeling formats on food choices, the magnitude of results, and the assessment of the studies' quality in order to determine the recommendations.

RESULTS

A total of 2273 papers were retrieved from all databases. After removing duplicates, 1383 were screened by title and abstract. Of the 154 potentially relevant papers obtained as full texts, 123 did not meet the inclusion criteria. After examining the reference lists of the 31 eligible papers and of the excluded reviews, 6 papers were added, and 1 paper was selected through an update. These 38 papers^{3,4,6-9,22,23,29-58} were included in this review. Figure 1 shows the number of studies identified

per database and the major reasons for exclusion, as well as an overview of the screening procedures.

Thirty-two studies were carried out in the United States and 6 in the United Kingdom and European countries (Denmark, the Netherlands, Sweden, and Switzerland). Seven studies were published before or during 1990, 4 between 1991 and 2000, 7 between 2001 and 2010, and 20 between 2011 and 2014 (10 in 2013–2014). This information and other characteristics of the included studies are shown in Tables 2 and 3.

Quality assessment of included studies

Half of the studies were assessed as moderate in quality, 29% as weak, and 21% as strong (Tables 2 and 3). All studies were community or institutional interventions (or observations of natural interventions), and most of them (n = 23) used the foodservice establishment as the unit of analysis and sales/purchase data as the outcome.

Most studies did not explain the selection of foodservice establishments or clarify whether the samples adequately represented the target population. In those AB studies rated as weak for selection bias, it was not possible to determine if participants in the A and B

Table 2 Summary of 22 studies of the influence of menu labeling on food choices in real-life settings, ranked by setting, desirable influence (results), quality assessment, and design, conducted in restaurants and included in the systematic review

Reference, country	Setting (type of restaurant)	Design ^a	Menu labeling (and criteria)	Outcome of interest related to food choice	Desirable influence	Quality ^b
Wisdom et al. (2010), ²⁹ USA	Fast food	Q-experiment (controlled trial)	Calories; DCR, and calories + DCR	Calories	Yes	Weak
Bollinger et al. (2011), ³⁰ USA	Fast food	Observational (ABC)	Calories	Calories	Partial	Strong
Dumanovsky et al. (2011), ³¹ USA	Fast food	Observational (AB)	Calories	Calories	Partial	Strong
Krieger et al. (2013), ⁴ USA	Fast food	Observational (ABB)	Calories	Calories	Partial	Strong
Bassett et al. (2008), ³² USA	Fast food	Observational (cross-sectional)	Calories	Calories	Partial	Weak
Elbel et al. (2013), ³³ USA	Fast food	Observational (ABC)	Calories	Calories	No	Strong
Elbel et al. (2009), ³⁴ Vadiveloo et al. (2011), ³⁵ USA	Fast food	Observational (ABC)	Calories	Calories and percent of sales of each food type	No	Moderate
Finkelstein et al. (2011), ³ USA	Fast food	Observational (ABC)	Calories	Calories	No	Moderate
Downs et al. (2013), ³⁶ USA	Fast food	Observational (ABC)	DCR, MCR, and calories + DCR or MCR	Calories	No	Moderate
Brissette et al. (2013), ³⁷ USA	Fast food	Observational (cross-sectional)	Calories	Calories	No	Weak
Fotouhinia-Yepes (2013), ³⁸ Switzerland	Sit-down	Q-experiment (AB)	Calories	Calories and percent of sales of targeted foods (lower and higher calorie)	Yes	Moderate
Sharma et al. (2011), ²² USA	Sit-down	Q-experiment (AAB)	Healthy symbol (balanced CHO, protein, fat, and saturated fat)	No. of targeted foods (from mean weekly sales)	Partial	Moderate
Albright et al. (1990), ³⁹ USA	Sit-down	Q-experiment (AB)	Healthy symbol (low fat and cholesterol)	Percentage of targeted foods	Partial	Moderate
Eldridge et al. (1997), ⁴⁰ USA	Sit-down	Q-experiment (AB)	Healthy symbol (low fat) + calorie and fat content of targeted foods	Percentage of targeted foods, percentage of food item types	Partial	Moderate
Pulos and Leng (2010), ⁴¹ USA	Sit-down	Observational (AB)	Calories + fat + sodium + CHO	Calories, fat, sodium, CHO	Partial	Moderate
Anderson and Haas (1990), ⁴² USA	Sit-down	Q-experiment (AB)	Healthy symbol (food items and preparation techniques)	No. of targeted foods	Partial	Weak
Auchincloss et al. (2013), ⁶ USA	Sit-down	Observational (cross-sectional)	Calories + saturated and trans fat + sodium + CHO (+ healthy symbol ^c)	Calories, saturated and trans fat, sodium, CHO	Partial	Weak
Ellison et al. (2014), ⁸ USA	Sit-down	Q-experiment (controlled trial)	Calories and calories + traffic-light labeling (calories)	Calories and percentage of food item types	Partial	Weak
Stubenitsky et al. (2000), ²³ UK	Sit-down	Q-experiment (controlled trial)	Reduced-fat message	Calories and fat (percentage of targeted items)	No	Strong
Nelson et al. (1996), ⁴³ USA	Sit-down	Q-experiment (AABB)	Calories + fat + cholesterol + sodium + fiber	Percentage of targeted foods (nutrients that met nutrition guidelines)	No	Moderate
Colby et al. (1987), ⁴⁴ USA	Sit-down	Q-experiment (controlled trial)	Health message	No. of targeted foods	No	Moderate
Thunstrom and Nordstrom (2011), ⁹ Sweden	Sit-down	Q-experiment (AB)	Healthy symbol (low in calories, fat, sugar, and salt; and high in fiber)	Percentage of food item type, calories, fat and saturated fat, sodium, CHO, fiber, and sugar	No	Weak

Abbreviations: CHO, carbohydrate; DCR, Daily Calorie Recommendation; MCR, Meal Calorie Recommendation.

^aQ-experiment, quasi-experiment; AB, pre- and 1 postintervention measures; AABB, 2 pre- and 1 postintervention measures; AABBB (2 pre- and 2 postintervention measures); C, studies with control group.

^bClassification according to the quality assessment instrument (Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies).

^cInformation displayed prior to calorie and nutrients labeling; criteria to label an item as healthy were based on lower caloric content.

Table 3 Summary of 16 studies of the influence of menu labeling on food choices in real-life settings, ranked by setting, desirable influence (results), quality assessment, and design, conducted in cafeterias and included in the systematic review

Reference, country	Setting	Design ^a	Menu labeling (and criteria)	Outcome of interest related to food choice	Desirable influence	Quality ^b
Crane et al. (2004), ⁴⁵ USA	University	Q-experiment (AB, same people)	Calories + total and saturated fat + cholesterol + sodium + fiber + CHO + protein	Percentage of high- and low-calorie and high- and low-fat entrées. No. of food item types	Yes	Strong
Chu et al. (2009), ⁴⁶ USA	University	Q-experiment (ABA)	Calories + fat + CHO + protein	Calories and no. of high-calorie foods	Yes	Moderate
Nikolaou et al. (2014), ⁴⁷ UK	University	Q-experiment (ABBC)	Calories (+ healthy message ³)	Percentage of high- and low-calorie and high- and low-fat items. Percentage of healthy-labeled sandwiches	Partial	Moderate
Freedman (2011), ⁴⁸ USA	University	Q-experiment (ABA)	Calories + fat + %fat per portion size	Percent portion size of French fries and type of salad dressing	Partial	Weak
Cinciripini (1984), ⁴⁹ USA	University	Q-experiment (ABABAB, only 1 AB evaluated)	Calories and healthy symbol (indicating food items high in nutritional value and low in calories and fat)	Percentage of food item types	Partial	Weak
Davis-Chervin et al. (1985), ⁵⁰ USA	University	Q-experiment (ABA)	Calories, percentage of calories from fat, and cholesterol	Percentage of low-calorie, low-fat, and low-cholesterol foods	No	Moderate
Lassen et al. (2014), ⁵¹ Denmark	Hospital	Q-experiment (ABBC)	Healthy symbol (low ⁵²⁻⁵⁶ fat, sodium, sugars, and high fiber and whole grain)	Energy, fat, sodium, whole grain, sugar, fruit, and vegetable	Yes	Strong
Thorndike et al. (2012), ⁷ USA	Hospital	Q-experiment (AB)	Traffic-light labeling (fruit/vegetable, whole grain, lean protein/low-fat dairy compared with saturated fats and high calorie contents)	Percentage of targeted foods	Yes	Moderate
Webb et al. (2011), ⁵² USA	Hospital	Experiment (randomized trial ABC)	Calories (+ healthy symbol ⁴)	Percentage of low-calorie foods	Partial	Moderate
Milich et al. (1976), ⁵³ USA	Hospital	Q-experiment (AAB)	Calories	Calories	Partial	Weak
Sato et al. (2013), ⁵⁴ USA	Hospital	Q-experiment (ABB) ^{57,58}	Healthy message (low calorie from fat and saturated fat, and low sodium) + calorie + fat + sodium + %RDV of calorie and fat	Percentage of targeted foods	No	Moderate
Levin (1996), ⁵⁵ USA	Workplace	Q-experiment (ABBC)	Healthy symbol (low fat)	Percentage of targeted foods	Yes	Strong
Dubbert et al. (1984), ⁵⁶ USA	Workplace	Q-experiment (ABA)	Low calorie message	Percentage of targeted foods and calories	Partial	Moderate
Anderson and Haas (1990), ⁴² USA	Not shown (considered workplace)	Q-experiment (AB)	Healthy symbol (food items and preparation techniques)	No. of targeted foods	Partial	Weak
Vyrt et al. (2011), ⁵⁷ Netherlands	Workplace	Experiment (randomized trial ABAC)	Healthy symbol (low calorie, sodium, added sugar, saturated and trans fats, and high fiber)	No. of targeted foods	No	Strong
Sproul et al. (2003), ⁵⁸ USA	Workplace	Q-experiment (ABB)	Healthy symbol (low fat and cholesterol) + calorie + fat + cholesterol (targeted foods)	No. of targeted foods	No	Moderate

Abbreviations: CHO, carbohydrate; RDV, recommended Daily Value.

^aQ-experiment, quasi-experiment; AB, pre-post intervention study; AAB, 2 pre- and 1 postintervention measures; ABB (1 pre- and 2 postintervention measures); ABA, pre- and postintervention plus another baseline measure without intervention; ABABA, multiple baselines and interventions; C, studies with control group.

^bClassification according to the quality assessment instrument (Effective Public Health Practice Quality Assessment Tool for Quantitative Studies).

^cDisplayed prior to calorie intervention. Criteria for disclosing healthy-food symbol or label were not shown.

groups were the same, or if the authors controlled for identified confounders.

Studies usually did not mention whether the participants were blinded to the research question, but data collection instruments were valid and reliable. Most studies analyzed the sales data without participants' agreement or analyzed the receipts before and after the intervention, without evaluating the same people. Thus, assessment of attrition was not applicable.

Results of included studies

The overall results of the studies indicate that a partial influence of menu labeling on food choices was more frequent than a positive influence or no influence (Table 4). Considering both the positive and partial effects, 65% of studies found some expected effect of menu labeling (eg, a reduction in calories of selected foods), even if it was restricted to a particular subject or food group.

Most studies in restaurants (59%) also showed a total or partial effect of menu labeling on food choices. However, the proportion of studies not showing desirable effects of menu labeling was higher in restaurants than in all types of foodservice grouped together (restaurants plus cafeterias).

When restaurant type was examined, 50% of studies in fast-food establishments and 30% of studies in sit-down restaurants showed no effect of menu labeling on food choices.

Most studies showing an overall desirable influence of menu labeling were conducted in cafeterias ($n = 16$), suggesting that interventions would be more effective at these venues. Of the 16 cafeteria studies, 5 showed a

total effect of menu labeling and 7 a partial effect. Most studies with overall or partially positive results were conducted in university cafeterias ($n = 5$), followed by hospital cafeterias ($n = 4$), and others ($n = 3$), but the difference was insubstantial. Below, the studies are further explored according to foodservice type.

Restaurants

Nine of 10 studies conducted in fast-food restaurants were observational, and most of them ($n = 7$) analyzed sales before and after the introduction of a menu-labeling law (AB studies) in specific cities. Five of these AB studies also analyzed sales in control restaurants and obtained results that are more robust by analyzing difference-in-difference data. Four of these studies found no effect of menu labeling on food choices,^{3,33–36} and one of them found only a partial effect.³⁰ Two other cross-sectional observational studies collected data on only one occasion in fast-food restaurants where menu-labeling legislation did and did not apply, respectively.^{32,37}

Only one study in fast-food restaurants found an overall positive effect. Calorie information and daily calorie recommendations had statistically significant effects on the reduction of calorie content of selected foods (-61 kcal and -38 kcal, respectively), with the mean caloric content considered as 851 kcal/meal. The combination of these two information formats improved this effect to around -100 kcal, which is also statistically significant. However, when analyzing only the subsample of overweight (body mass index ≥ 25 kg/m²) participants ($n = 262$; 41% of sample), neither of the two information formats led to a significant reduction in the calorie content of selected foods.²⁹ Thus, although this study was a controlled trial, its overall quality was weak.

Four studies reporting the influence of calorie labeling on the calorie content of selected foods in fast-food restaurants found a partial effect. Basset et al.³² observed a reduction in the calorie content of foods selected at intervention sites (sandwich chain restaurants) only among customers who reported using menu labeling (86.7 kcal fewer than in control restaurants of the same chain). Dumanovsky et al.³¹ found a decrease in the calorie content of foods selected at 3 of the 11 fast-food chains included in the study (varying from -44 to -80 kcal). Krieger et al.⁴ reported desirable results only at coffee-shop chains (-22 kcal) among the remaining 3 types of chains under consideration. Bollinger et al.³⁰ observed a reduction in the calorie content of foods (estimated at -14 kcal), but not of drinks, selected in fast-food restaurants. Three of these studies had an overall quality rating of strong, while the other one was evaluated as weak.³²

Table 4 Results of the 38 studies included in the systematic review of the influence of menu labeling on food choices, according to foodservice type^a

	Percentage of studies showing desirable influence of menu labeling in food choices (no.) ^b		
	Yes	Partial	No
Total	18 (7)	47 (18)	34 (13)
Restaurants ($n = 22$)	9 (2)	50 (11)	41 (9)
Fast food ($n = 10$)	10 (1)	40 (4)	50 (5)
Sit-down ($n = 12$)	17 (2)	50 (6)	33 (4)
Cafeterias ($n = 16$)	31 (5)	44 (7)	25 (4)
Universities ($n = 6$)	33 (2)	50 (3)	17 (1)
Hospitals ($n = 5$)	40 (2)	40 (2)	20 (1)
Other workplaces ($n = 6$)	20 (1)	40 (2)	40 (2)

^aOne article was considered twice because it showed data from both restaurants and cafeterias,⁴² and 2 articles, because of overlapping participants, were considered together as 1 study with 2 different outcomes.^{34,35}

Five studies conducted in fast-food restaurants analyzed the effect of calorie labeling on the calorie content of food selections and found no effect.^{3,33,34,36,37} One of them evaluated calorie labeling in addition to the daily calorie recommendation or the meal calorie recommendation, as well as only the daily calorie recommendation and meal calorie recommendation information.³⁶ Furthermore, the study of Vadiveloo et al.,³⁵ which overlapped the intervention, locations, period, and most of the sample of Elbel et al.,³⁴ evaluated as outcome the percentage of different food types purchased (caloric beverages, salads, regular salad dressings, French fries, and the addition of cheese). Three studies^{3,34,36} were ranked as being of moderate quality, one was considered strong,³³ and one was considered weak.³⁷

Regarding the studies at sit-down restaurants, 10 of the 12 were quasi-experiments, consisting of 3 controlled trials that showed partial ($n = 1$)⁸ or no ($n = 2$)^{23,44} effect of menu labeling and 7 pre-post studies (2 with repeated measures).^{22,43} Observational studies at sit-down restaurants showed partial effects of menu labeling, including one AB study⁴¹ and one cross-sectional study.⁶

Only one study in sit-down restaurants showed overall positive effects, which was also the only included study conducted in a fine dining restaurant. Calorie labeling was associated with a reduction in the calorie content of ordered meals (-221 kcal) and an increase in the ordering of the lower-calorie menu option (1630 calories), which was selected 5 times more frequently during the labeling phase (36.7%) than during the pre-labeling phase (7.8%). This was the greatest magnitude of reduction in calories found among the studies. Since there was no control group, it is not possible to know if this effect was attributable to the intervention alone. Moreover, according to a survey conducted at the restaurant, more than 75% of the clients were eating there for the first time. The study was classified as moderate in overall quality.³⁸

Four of 7 studies conducted in sit-down restaurants that found partial effects analyzed the influence of healthy-food symbols (heart symbol^{22,39,42} or green check mark⁴⁰) on the sale of targeted foods. The healthy-food symbols identified the targeted food items alongside the menu or menu board, accompanied by a notation at the bottom of the menu or on a table tent indicating the meaning of the symbol. Targeted food sales increased at half of the restaurants analyzed^{39,42} or among some types of food.^{22,40} In the Eldridge et al.⁴⁰ study, numeric information on calories and fat was displayed in addition to the healthy-food symbol (green check mark indicating low-fat items). All these studies were considered to be of moderate quality, except for one that was assessed as weak.⁴²

Other studies conducted in sit-down restaurants that found only partial effects analyzed the influence of either calories plus numeric information for nutrients (fat, sodium, and carbohydrate content)⁴¹ or calories plus a healthy-food symbol (“healthier choice” tag, already displayed in restaurants belonging to the control group)⁶ on the same calorie and nutrient outcomes. In the study by Pulos and Leng,⁴¹ rated as moderate in terms of overall quality, there was a significant reduction of calories selected in 4 of the 6 restaurants analyzed (-16.8 ; -55.6 ; -53.6 ; and -20.6 kcal), a reduction of fat in 5 restaurants (-2.53 ; -2.70 ; -4.25 ; -1.39 ; and -1.01 g), and a reduction of sodium (-131.4 mg) and carbohydrates (-5.36 g) in 1 restaurant. There was also a significant increase in carbohydrates selected in 2 restaurants ($+1.99$ and $+2.30$ g).

Auchincloss et al.⁶ found significant reductions in calories (-151 kcal), saturated fats (-3.7 g), and carbohydrates (-14.7 g) in selected foods ($P < 0.05$ for all), but not in sodium (-224 mg, $P > 0.05$, not significant) or trans fats (adjusted data not shown).

Another study with partial results analyzed the influence of calorie labeling and calorie plus traffic-light labeling (indicating high, medium or low calorie content) on calories and percentage of food item types purchased.⁸ In this study by Ellison et al.,⁸ calorie plus traffic-light labeling was the only variable that significantly reduced calories (-73.22 kcal) and selection of high-calorie foods (28.1% vs 34.5% in the control group).⁸ Both studies by Auchincloss et al.⁶ and by Ellison et al.,⁸ however, were weak in terms of overall quality.

The only strong study in a sit-down restaurant was a controlled trial, and it did not find any effect of a reduced-fat message on total energy or fat content of dishes ordered (numeric data not shown) or on percentages of targeted items selected. Overall, and in every group, more consumers selected the beef dish (56%) than the targeted haddock (30%) or pasta (14%) dish ($P < 0.05$).²³

Three other studies in sit-down restaurants did not find any effect of menu-labeling strategies on food choices. Nelson et al.,⁴³ whose study quality was assessed as moderate, found that numeric information on calorie, fat, cholesterol, sodium, and fiber led to insignificant changes overall on sales of targeted items (F score = 0.564; $P = 0.4531$, no overall magnitude shown). The study of Thunstrom and Nordstrom⁹ was assessed as weak in quality, and, despite being a controlled trial, the study of Colby et al.⁴⁴ was considered to be of moderate quality. Both studies found no effects of a healthy-food symbol (keyhole symbol) or a healthy message (“for a low-calorie, low-cholesterol choice”) on sales of targeted foods. The number of sales of targeted food

items chosen from the menu labeled with the healthy message was 101, compared with 119 sales of targeted food items chosen from menus with a nonspecific message (“today’s special”),⁴⁴ and the coefficient of the effect of the keyhole symbol on meal sales was -0.40 ($P=0.924$).⁹ In addition, Thunstrom and Nordstrom⁹ did not find statistically significant differences in the calorie content or nutrients of foods sold (-9 kcal, $+0.9$ g of carbohydrates, -1.5 g of fat, -0.3 g of saturated fat, $+0.4$ g of fiber, $+11$ mg of sodium, -0.3 g of sugar).

In general, studies of higher quality in restaurants seemed to be associated with partial or negative results, and those of lower quality were associated with positive results.

Cafeterias

Two studies conducted in university cafeterias showed overall desirable effects^{45,46} of displaying numeric information about calories and various nutrients on different outcomes. Cranage et al.⁴⁵ observed a reduction in the sales of high-calorie and high-fat entrées from 67% to 47% ($P<0.001$) and of some less-healthy side dishes, such as French fries, cakes, apple pies, brownies, and cookies (total $n = -41$; P value not shown), while sales of vegetables, salads, and fruits increased (total $n = +29$; P value not shown). Chu et al.⁴⁶ found reductions in mean calorie content (-12.4 kcal of difference on final day of pretreatment and first day of treatment) and in high-calorie entrées sold per day during an intervention. However, both mean calorie content and sales of high-calorie entrées increased in the postintervention period ($+1.512$ kcal/d, $P=0.013$; slope: 1.541 of difference in sales based on energy content; $P=0.005$). Both studies were quasi-experiments without control groups. The study of Chu et al.,⁴⁶ however, had a second baseline and was rated as moderate in quality, while the one by Cranage et al.,⁴⁵ which evaluated sales data of the same subjects before and after the intervention, was rated as strong.

In their study conducted at a university cafeteria, Nikolaou et al.⁴⁷ reported partially positive results with calorie (numeric) plus healthy (message) labeling by demonstrating increased sales of sandwiches labeled as healthy ($+11\%$ at intervention site, $P<0.001$; $+5\%$ at control site, $P>0.05$) in comparison with those labeled as “classic,” “plain,” “special,” and “simple,” but no decrease in overall sales of high-calorie and high-fat sandwiches. Cinciripini⁴⁹ tested calorie content and a healthy-food symbol (green triangle to indicate food items considered healthier) on labels separately, showing partially positive results for both in effecting the selection of some food items by some groups when sex

and body weight of students were combined (eg, an increase in sales of salads only by overweight women, but no decrease in regular dairy purchases). In the study by Freedman,⁴⁸ numeric information on calorie plus fat content led to a significant reduction in the choice of large portions of French fries (60% to 43%; $P<0.05$) but not to a decrease in the number of people who chose French fries or selected salad dressings with high calorie and fat content. Two of these studies were considered weak in quality,^{48,49} and one was assessed as moderate.⁴⁷

One study conducted in a university cafeteria found no effect of numeric information about calories, calories from fat, or cholesterol on decreasing the same outcomes in purchased foods. It was of moderate quality and found no effect even when an extra postintervention baseline period was analyzed.⁵⁰

Of the 5 studies at hospital cafeterias, the 2 showing positive overall results analyzed the effect of qualitative menu-labeling strategies that highlighted healthier items (keyhole symbol and traffic-light labeling) and used several criteria to classify them.^{7,51} Lassen et al.⁵¹ conducted a quasi-experiment that included control groups and measures that were repeated post intervention, and the study was assessed as strong in quality. In the intervention group, there were significant decreases from baseline to end point (EP) and to follow-up (FU) in mean energy density (EP: -193 kJ/100 g; FU: -154 kJ/100 g) and fat (EP: $-20\%E$; FU: $-17\%E$), salt (EP: -0.4 g/100 g; FU: -0.3 g/100 g), and refined sugar (EP: -0.5 g/100 g; FU: -0.4 g/100 g) content of meals, as well as an increase in purchases of fruits and vegetables (EP: 15.0 g/100 g; FU: 17 g/100 g), while these factors remained the same in the control group. Thorndike et al.⁷ conducted a quasi-experiment with traffic-light labeling in which measures were repeated post intervention, and the study was assessed as moderate in quality. Sales of red items decreased (24% to $\approx 22\%$), while sales of green items increased (41% to $\approx 43\%$).⁷

Two studies at hospital cafeterias found partial effects of numeric calorie labeling,^{52,53} one of which reported this after healthy-food symbols had already been in place (a logo identified the healthiest choices).⁵² In the Webb et al.⁵² study, which was of moderate quality, the purchase of low-calorie side dishes and snacks increased at intervention sites ($+4.8\%$ and $+1.3\%$) and decreased at nonintervention sites (-4.8% and -8.1%), while purchases of entrées remained the same. In the study of Milich et al.,⁵³ considered of weak quality, two baselines were used before numeric calorie labeling was implemented. A reduction in the calorie content of food ordered was observed only between the second baseline and the intervention periods (-66 kcal).

Sato et al.,⁵⁴ who used repeated follow-up measures in a quasi-experiment study evaluated as moderate in quality, found no effect of a healthy-food message (“healthy picks” label on entrées considered healthier) plus numeric calorie labeling (including percentage of recommended daily value) and nutrient information on sales of targeted foods.⁵⁴

Among studies at other workplace cafeterias, only one showed overall positive effects of healthy-food symbols displayed at the intervention site on the sales of targeted low-fat items (shown as absolute percentages) from baseline (4.3%) to intervention (9.5%) and follow-up periods (11.9%), while no significant differences were observed at the control cafeteria or in sales between sites at baseline. The authors placed heart-shaped symbols next to targeted entrées on the menu board and on a poster at the cafeteria entrance that read “Look for the ♥ for your low-fat entrée selection.” The study, assessed as having overall strong quality, was a quasi-experiment that included a control group and one measure that was repeated after the intervention.⁵⁵

The two studies at other workplace cafeterias with partial results also evaluated qualitative menu labeling, such as a healthy-food symbol (green check mark indicating low-fat items)⁴² and a low-calorie message (message of “lower calorie selection,” use of a bright red dot at the upper right-hand corner of the labels, and a poster explaining the labels).⁵⁶ Dubbert et al.,⁵⁶ whose study’s quality was assessed as moderate, observed an increase in sales of targeted foods from the baseline period to the intervention period, followed by a decrease post intervention for salads (35% to 50% to 36%) and vegetables (20% to 40% to 25%), but not for entrées (≈20% in all periods). Anderson and Haas⁴² found an increase in sales of targeted items (+61%) at one of two investigated cafeterias. In fact, sales also increased at the second cafeteria, but there were too few items with accurate sales data to be included in the analysis. Moreover, study quality was assessed as weak.

The only randomized trial conducted at other workplaces included measures taken before, during, and after the intervention and was evaluated as strong. The authors found no effects of a healthy-food symbol (“Choices” logo) on sales of targeted foods. In fact, there was an increase in fruit sales, but the authors considered this insignificant because of low magnitude (+1 unit per 50 employees per week).⁵⁷ The study of Sproul et al.,⁵⁸ of moderate quality, also found no effect of a healthy-food symbol on sales of targeted foods. The authors used a healthy-food logo (red lightning bolt encased by a blue square) to indicate targeted entrées considered healthier, along with posters displaying a promotional slogan (“It’s a sure sign you’re eating better”).

Although the randomized trial conducted by Vyth et al.⁵⁷ was of strong quality, it did not find a positive effect of menu labeling on choices. Other studies of higher quality in cafeterias found more positive effects than those of lower quality, while those of weak quality were mostly identified as having partially effective results.

DISCUSSION

Summary of findings and recommendations

The current evidence seems to indicate that the influence of menu labeling on food choices is related to type of foodservice, type of information displayed, desired outcomes, and overall study quality.

According to the decision rules (based on the direction of effect⁵⁹) suggested by the *Cochrane Handbook for Systematic Reviews of Interventions*,²⁵ when 34% to 66% of studies favor intervention, evidence shows mixed effects. Partial or overall effects were shown in 65% of all studies. When results were stratified, 59% of studies in restaurants and 75% of studies in cafeterias showed partial or overall effects. These findings suggest that menu labeling produced mixed effects in restaurants but was generally effective in cafeterias. In general, studies in cafeterias showing partial or overall effects displayed mainly qualitative information, such as healthy-food symbols (keyhole or heart symbol) or traffic-light labeling, identifying healthier food choices directly on the menu or menu board. In general, studies of stronger quality indicated desirable results of menu labeling in cafeterias, but not in restaurants. This reinforces the idea that menu labeling may in fact be more effective in cafeterias.

Studies in cafeterias included subjects from universities and hospitals, who probably have a higher educational level than the general populations investigated in restaurants. Higher education may be correlated with more healthier items ordered.²² In addition, cafeterias are related mainly to the institutional sector,⁶⁰ where they are often used on a daily basis in educational and work environments, and may be more likely to encourage healthy eating habits⁶¹ and use menu labeling.⁶² On the other hand, restaurants are considered part of the profit sector,⁶⁰ and people usually eat at these locales more for pleasure and enjoyment than to eat healthily,⁶³ especially with regard to fast-food venues.⁶²

This would also explain why, in fast-food restaurants or in most fast-food chains, as well as in sit-down restaurants where people go to celebrate, calorie labeling appears not to be effective in reducing the amount of calories in selected foods. In the only study

conducted at a sit-down restaurant that showed positive results of calorie labeling, the magnitude of effect (in calories) was more than 2 times larger than that in the fast-food restaurant. However, the meals at this fine dining sit-down restaurant typically contained twice as many calories as meals served in the fast-food restaurant.

Only one study in a sit-down restaurant tested calorie labeling plus traffic-light labeling (regarding calories), which was effective in reducing calorie content in selections, while calorie labeling alone, when tested in the same study, was not. However, survey results in these locations suggested that taste was the main reason for choices.^{9,39,44}

No study in fast-food restaurants analyzed any other healthy-eating indicators besides calories. The definition of a healthy diet by the World Health Organization considers both amount and types of fats, amount of salt and free sugar, and food category (eg, fruits, vegetables, legumes, nuts, and whole grains) as part of a healthy diet. The causes of obesity include behaviors or factors that disrupt metabolism (eg, sedentary lifestyle, lack of sleep), and the consumption of foods that promote lipogenesis,^{18,19} and results in changes in insulin metabolism⁶⁴ (eg, different sources of fat have different effects on metabolism).²⁰ All of these may affect weight change, regardless of energy intake, and should be considered when aiming to reduce obesity rates.

Lucan and DiNicolantonio⁶⁵ noted several problems with public policies that target obesity by focusing on calorie counts rather than the quality of calorie sources. They consider the focus on calories to be “inherently biased against high-fat foods, many of which may be protective against obesity and related diseases, and supportive of starchy and sugary replacements, which are likely detrimental.” They conclude that policies should focus on promoting the consumption of whole foods and unprocessed foods.

In cafeterias, where menu labeling was most effective, qualitative information was shown to influence food choices more than quantitative information. Considering overall and partial effects, healthy-food labeling (symbols or messages) alone^{42,47,49,51,55} or combined with calorie⁵² or traffic-light labeling⁷ led to desirable changes in food choices. In the study by Thorndike et al.,⁷ changes in choice architecture (eg, making healthier foods more visible than others) improved the effect of traffic-light labeling.⁷

In 4 of the 7 studies mentioned above, several combined factors of healthy eating were considered in labeling foods as healthy.^{7,42,49,51} In 2 of them, the criteria were not mentioned,^{47,52} and in 1, the only criterion was fat content.⁵⁵ If low fat content is the only criterion for

awarding a healthy-food symbol, independent of whether the fat is saturated, unsaturated, or trans fat, the symbol may be of little value, as indicated by the World Health Organization’s criteria for a healthy diet.²¹

An excess of information can have a reverse effect (ie, by leading to an increase in calorie content of selected foods), as seen in tests when various nutrient data, calorie content, and healthy-food symbols were combined, or when these were used in addition to interpretative information. This effect is consistent with studies that investigated consumer attitudes toward menu labeling. Alexander et al.⁶⁶ found that participants preferred qualitative information to help avoid confusion when interpreting numbers. Other studies reported that consumers preferred simple menu-labeling formats, such as symbols, since they were more likely to use information that required less effort to interpret instead of purely quantitative information.^{67,68} Traffic-light labeling also helped consumers make food choices.^{68–70}

Furthermore, it is hard to ensure the accuracy of quantitative information, since small changes in ingredients can lead to changes in nutrient composition or calorie content. A study of the accuracy of quantitative menu labels showed that the values declared on menus may not accurately reflect actual nutritional information.⁷¹ Despite another study that found most calorie information in restaurants was accurate, the calorie content of reduced-calorie meals was underreported,⁷² which can lead to undesirable effects on food choices.

Secondary results suggest other intervention strategies that can affect food choices, such as price incentives,⁴⁹ healthy featured menus,²⁹ and messages combining taste and health attributes.⁴⁴ In addition, a review study on the impact of policy and environment changes on obesity-related outcomes in naturally occurring experiments found greater effects from bans/restrictions of unhealthy foods, mandates offering healthier foods, and the altering of purchase/payment rules for foods compared with other interventions such as menu labeling.⁷³

Evidence that current menu-labeling formats lead to changes in food choice is weak, perhaps because of the focus on calories, on outcomes that did not consider more criteria for healthy eating, or on study design or quality. Carter⁷⁴ and Cantor et al.⁷⁵ recommend the use of menu labels as just one of several strategies that can increase real-life opportunities to eat healthily, since complementary interventions are necessary for effective outcomes. Moreover, in some establishments studied, there were only lower-calorie items of the same food type (eg, fast-food sandwiches and sodas), and not necessarily healthier items.

Two of the included studies provided evidence that changing a menu's quality is more important than displaying information on menu labels to improve food choices. In the study by Sharma et al.,²² the nutritional quality of 9 dishes was improved to be classified as healthy, and 4 new healthy dishes were added to the menu, allowing all 13 dishes to be labeled as healthy. Purchases of only one targeted item increased, while purchases of the others remained the same. Sato et al.⁵⁴ changed the availability of entrées and offered a healthier option, but sales remained the same. Both tested healthy-food symbols plus several healthy-eating criteria. Despite the effectiveness of menu labels, customers were already eating more healthily, independent of the information provided.

The primary aim of menu labeling should be to provide consumers with information that allows them to make informed choices, as discussed by Smith.⁷⁶ This would, at the very least, support consumers' rights to know what ingredients are in their dishes. A secondary aim of menu labeling should be to promote healthy eating, since it not only encourages the reduction and prevention of obesity and other chronic diseases but also promotes good health. Therefore, menu labeling should include more qualitative information, such as healthy-food symbols and traffic-light labeling; indeed, the entire scheme of menu labeling should include more criteria related to healthy eating (ie, presence of added sugar, types of fat sources, presence of whole grains, and culinary methods of food preparation), going beyond calories and total fat. It is important to improve menu quality and to introduce other interventions, such as changes in choice architecture and price incentives. Lastly, the reliability of food information should be ensured.

On the basis of the quality assessment of the studies, further original research on menu labeling is suggested, ideally with a randomized controlled trial in a community population, such as the study by Vyth et al.⁵⁷ Nevertheless, due to the complexity of a community trial, AB studies with control groups can be conducted at a single site (with special attention to participant blinding) or at two sites selected by convenience, randomizing people and considering them as a unit of analysis. In the case of an analysis of menu-labeling law, the ideal choice would be a natural experiment that includes a control group, carefully designed to consider local income and other sociodemographic factors and to account for possible differences between groups before the intervention (see studies by Bollinger et al.³⁰ and Dumanovsky et al.³¹).

Limitations and strengths

Two limitations of this study were the diversity of terms used to describe study design, and the lack of

information available for analyzing certain criteria of study quality (most of which were related to subject selection, agreement, and blinding). Even though the EPHPP tool was best suited to assess the quality of these quantitative studies, it was difficult to apply some criteria to informational/educational intervention studies (ie, studies without a treatment arm), which evaluated outcomes that were not pathologies but were associated with sales of prepared food. This warranted several in-depth discussions among the authors about how to apply certain criteria to informational/ educational studies.

Another difficulty was the diversity of terms used to define menu labeling among the included studies. Extensive research was required, and several combinations of terms had to be tested before the search strategy could be defined. The main search was used to cover as many studies as possible, but some papers were identified only through a search of the references.

A significant limitation was the need to check for overlapping interventions and, especially, overlapping data. Certain studies that shared the same baseline population often had different first authors and did not clearly cite previous studies as included content. The synthesis of outcomes was also difficult because of the differences in measures and the diversity of settings and menu-labeling formats. However, similar studies were grouped together and analyzed according to their settings. Moreover, menu-labeling formats were taken into account and differences in outcomes discussed.

Although the papers analyzed did not evaluate actual intakes, the current systematic review builds on the work of previous systematic reviews by restricting its analysis to studies that observed only real purchases or sales made in real-life settings and by analyzing results according to the type of foodservice and the information provided on menu labels. This work is unique in trying to identify which labeling formats produce behavior change. On this basis, suggestions have been made to indicate what menu-labeling information seems most effective for changing food-selection behavior to favor healthier eating, rather than just calorie reduction. Not only was the quality of studies assessed, but also the assessment tool was discussed and future research designs suggested. As far as can be determined, this is the first systematic review of menu labeling to have done all this. Thus, the results are relevant for researchers, nutrition policymakers, nutritionists, dietitians, and other professionals working in the foodservice field.

CONCLUSION

The overall results suggest that menu labeling has mixed effects, although it is more effective in cafeterias than in

restaurants, especially fast-food restaurants. The use of calorie information as the focus of menu-labeling strategies is questionable, as it seems not to lead to healthier choices. Qualitative information, such as – but not limited to – the types used in the studies included in this review (healthy-food symbols and traffic-light labeling), may prove more effective in promoting healthy eating. Criteria for providing this information would ideally include broader indicators related to healthy eating, beyond quantitative parameters of calories and fat content, ie, presence of added sugar, types of fat sources, presence of whole grains, and methods of food preparation. In addition, consumers are entitled to know what they are eating, and the primary way to ensure this is to disclose information about the ingredients of prepared foods and dishes.

Further research could test the most effective menu-labeling formats identified in this study by using controlled randomized trials or other designs that include control groups and analyze real-life selection or consumption data before and after menu-labeling interventions.

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REFERENCES

1. Bezerra IN, Curioni C, Sichieri R. Association between eating out of home and body weight. *Nutr Rev*. 2012;70:65–79.
2. Lachat C, Nago E, Verstraeten R, et al. Eating out of home and its association with dietary intake: a systematic review of the evidence. *Obes Rev*. 2012;13:329–346.
3. Finkelstein EA, Strombotne KL, Chan NL, et al. Mandatory menu labeling in one fast-food chain in King County, Washington. *Am J Prev Med*. 2011;40:122–127.
4. Krieger JW, Chan NL, Saelens BE, et al. Menu labeling regulations and calories purchased at chain restaurants. *Am J Prev Med*. 2013;44:595–604.

5. Yoon HJ, George T. Nutritional information disclosure on the menu: focusing on the roles of menu context, nutritional knowledge and motivation. *Int J Hosp Manag*. 2012;31:1187–1194.
6. Auchincloss AH, Mallya GG, Leonberg BL, et al. Customer responses to mandatory menu labeling at full-service restaurants. *Am J Prev Med*. 2013;45:710–719.
7. Thorndike AN, Sonnenberg L, Riis J, et al. A 2-phase labeling and choice architecture intervention to improve healthy food and beverage choices. *Am J Public Health*. 2012;102:527–533.
8. Ellison B, Lusk JL, Davis D. The impact of restaurant calorie labels on food choice: results from a field experiment. *Econ Inq*. 2014;52:666–681.
9. Thunstrom L, Nordstrom J. 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 Agric Scand C*. 2011;8:200–207.
10. Feldman CH, Hartwell H, Brusca J, et al. Nutrition information and its influence on menu choice within higher education establishments. *Br Food J*. 2015;117:1399–1410.
11. Department of Health and Human Services, US Food and Drug Administration. Disclosure of nutrient content information for standard menu items offered for sale at chain restaurants or similar retail food establishments and for articles of food sold from vending machines. *Fed Regis*. 2014;79:71155–71268. Codified at 21 CFR §101 and 21 CFR §11.
12. Oliveira RC, Proença RPCP, Salles RK. The right to food and nutrition information in restaurants: a review. *Demetra*. 2012;7:47–58.
13. Hamack LJ, French SA. Effect of point-of-purchase calorie labeling on restaurant and cafeteria food choices: a review of the literature. *Int J Behav Nutr Phys Act*. 2008;5:51. doi:10.1186/1479-5868-5-51.
14. Kiszko KM, Martinez OD, Abrams C, et al. The influence of calorie labeling on food orders and consumption: a review of the literature. *J Commun Health*. 2014;39:1248–1269.
15. Long MW, Tobias DK, Cradock AL, et al. Systematic review and meta-analysis of the impact of restaurant menu calorie labeling. *Am J Public Health*. 2015;105:e11–e24.
16. Sindair SE, Cooper M, Mansfield ED. The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis. *J Acad Nutr Diet*. 2014;114:1375.e15–1388.e15.
17. Swartz JJ, Braxton D, Viera AJ. Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature. *Int J Behav Nutr Phys Act*. 2011;8:135. doi:10.1186/1479-5868-8-135.
18. Simopoulos AP, Bourne PG, Faergeman O. Bellagio Report on Healthy Agriculture, Healthy Nutrition, Healthy People. *Nutrients*. 2013;5:411–423.
19. Wells JC. Obesity as malnutrition: the dimensions beyond energy balance. *Eur J Clin Nutr*. 2013;67:507–512.
20. Deol P, Evans JR, Dhahbi J, et al. Soybean oil is more obesogenic and diabetogenic than coconut oil and fructose in mouse: potential role for the liver. *PLoS One*. 2015;10:e0132672. doi:10.1371/journal.pone.0132672.
21. World Health Organization. *Healthy Diet*. Geneva, Switzerland: World Health Organization; 2015. WHO fact sheet no. 394. January 13, 2016.
22. Sharma S, Wagle A, Sucher K, et al. Impact of point of selection nutrition information on meal choices at a table-service restaurant. *J Foodserv Bus Res*. 2011;14:146–161.
23. Stubenitsky K, Aaron J, Catt S, et al. The influence of recipe modification and nutritional information on restaurant food acceptance and macronutrient intakes. *Public Health Nutr*. 2000;3:201–209.
24. Levitt SD, List JA. What do laboratory experiments measuring social preferences reveal about the real world? *J Econ Perspect*. 2007;21:23. doi:10.1257/jep.21.2.153.
25. Higgins JPT, Green S, eds. *Cochrane Handbook for Systematic Reviews of Interventions* Version 5.1.0. Updated March 2011. London, England: The Cochrane Collaboration; 2011.
26. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med*. 2009;6:e1000100. doi:10.1371/journal.pmed.1000100.
27. Jackson N, Waters E, for the Guidelines for Systematic Reviews in Health Promotion and Public Health Taskforce. Criteria for the systematic review of health promotion and public health interventions. *Health Promot Int*. 2005;20:367–374.
28. Armstrong R, Waters E, Doyle J. Reviews in public health and health promotion. In: J Higgins, S Green, eds. *Cochrane Handbook for Systematic Reviews of Interventions*. Version 5.1.0. Updated March 2011. London, England: The Cochrane Collaboration; 2011:593–606.
29. Wisdom J, Downs JS, Loewenstein G. Promoting healthy choices: information versus convenience. *Am Econ J Appl Econ*. 2010;2:164–178.
30. Bollinger B, Leslie P, Sorensen A. Calorie posting in chain restaurants. *Am Econ J Econ Policy*. 2011;3:91–128.
31. Dumanovsky T, Huang CY, Nonas CA, et al. Changes in energy content of lunch-time purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys. *BMJ*. 2011;343. doi:10.1136/bmj.d4464.

32. Bassett MT, Dumanovsky T, Huang C, et al. Purchasing behavior and calorie information at fast-food chains in New York City, 2007. *Am J Public Health*. 2008;98:1457–1459.
33. Elbel B, Mijanovich T, Dixon LB, et al. Calorie labeling, Fast food purchasing and restaurant visits. *Obesity*. 2013;21:2172–2179.
34. Elbel B, Kersh R, Brescoll VL, et al. Calorie labeling and food choices: a first look at the effects on low-income people in New York City. *Health Aff (Millwood)*. 2009;28:w1110–w1121.
35. Vadiveloo MK, Dixon LB, Elbel B. Consumer purchasing patterns in response to calorie labeling legislation in New York City. *Int J Behav Nutr Phys Act*. 2011;8. doi:10.1186/1479-5868-8-51.
36. Downs JS, Wisdom J, Wansink B, et al. Supplementing menu labeling with calorie recommendations to test for facilitation effects. *Am J Public Health*. 2013;103:1604–1609.
37. Brisette I, Lowenfels A, Noble C, et al. Predictors of total calories purchased at fast-food restaurants: restaurant characteristics, calorie awareness, and use of calorie information. *J Nutr Educ Behav*. 2013;45:404–411.
38. Fotouhinia-Yepes M. Menu calorie labelling in a fine dining restaurant: will it make a difference? *J Qual Assur Hosp Tourism*. 2013;14:281–293.
39. Albright CL, Flora JA, Fortmann SP. Restaurant menu labeling: impact of nutrition information on entree sales and patron attitudes. *Health Educ Q*. 1990;17:157–167.
40. Eldridge AL, Snyder MP, Green Faus N, et al. Development and evaluation of a labeling program for low-fat foods in a discount department store foodservice area. *J Nutr Educ*. 1997;29:159–161.
41. Pulos E, Leng K. Evaluation of a voluntary menu-labeling program in full-service restaurants. *Am J Public Health*. 2010;100:1035–1039.
42. Anderson J, Haas MH. Impact of a nutrition education program on food sales in restaurants. *J Nutr Educ*. 1990;22:232–238.
43. Nelson DC, Almanza BA, Jaffe WF. The effect of point-of-sales nutrition information on the entree selection of patrons of a university foodservice operation. *J Nutr Recipe Menu Dev*. 1996;2:29–50.
44. Colby JJ, Elder JP, Peterson G, et al. Promoting the selection of healthy food through menu item description in a family-style restaurant. *Am J Prev Med*. 1987;3:171–177.
45. Cranage DA, Conklin MT, Lambert CU. Effect of nutrition information in perceptions of food quality, consumption behavior and purchase intentions. *J Foodserv Bus Res*. 2004;7:43–61.
46. Chu YH, Frongillo EA, Jones SJ, et al. Improving patrons' meal selections through the use of point-of-selection nutrition labels. *Am J Public Health*. 2009;99:2001–2005.
47. Nikolaou CK, Lean ME, Hankey CR. Calorie-labelling in catering outlets: acceptability and impacts on food sales. *Prev Med*. 2014;67:160–165.
48. Freedman MR. Point-of-selection nutrition information influences choice of portion size in an all-you-can-eat university dining hall. *J Foodserv Bus Res*. 2011;14:86–98.
49. Cinciripini PM. Changing food selections in a public cafeteria: an applied behavior analysis. *Behav Modif*. 1984;8:520–539.
50. Davis-Chervin D, Rogers T, Clark M. Influencing food selection with point-of-choice nutrition information. *J Nutr Educ*. 1985;17:18–22.
51. Lassen AD, Beck A, Leedo E, et al. Effectiveness of offering healthy labelled meals in improving the nutritional quality of lunch meals eaten in a worksite canteen. *Appetite*. 2014;75:128–134.
52. Webb KL, Solomon LS, Sanders J, et al. Menu labeling responsive to consumer concerns and shows promise for changing patron purchases. *J Hunger Environ Nutr*. 2011;6:166–178. doi:10.1080/19320248.2011.576210.
53. Milich R, Anderson J, Mills M. Effects of visual presentation of caloric values on food buying by normal and obese persons. *Percept Motor Skill*. 1976;42:155–162.
54. Sato JN, Wagle A, McProud L, et al. Food label effects on customer purchases in a hospital cafeteria in northern California. *J Foodserv Bus Res*. 2013;16:155–168.
55. Levin S. Pilot study of a cafeteria program relying primarily on symbols to promote healthy eating choices. *J Nutr Educ*. 1996;28:282–285.
56. Dubbert PM, Johnson WG, Schlundt DG, et al. The influence of caloric information on cafeteria food choices. *J Appl Behav Anal*. 1984;17:85–92.
57. Vyth EL, Steenhuis IH, Heymans MW, et al. Influence of placement of a nutrition logo on cafeteria menu items on lunchtime food choices at Dutch work sites. *J Am Diet Assoc*. 2011;111:131–136.
58. Sproul AD, Canter DD, Schmidt JB. Does point-of-purchase nutrition labeling influence meal selections? A test in an Army cafeteria. *Mil Med*. 2003;168:556–560.
59. Weir MC, Ryan R, Mayhew A, et al. The *Rx for Change* database: a first-in-class tool for optimal prescribing and medicines use. *Implement Sci*. 2010;5:1–9.
60. Edwards JSA. The foodservice industry: eating out is more than just a meal. *Food Qual Prefer*. 2013;27:223–229.
61. Raulio S, Roos E, Prattala R. School and workplace meals promote healthy food habits. *Public Health Nutr*. 2010;13:987–992.
62. Fernandes AC, de Oliveira RC, Rodrigues VM, et al. Perceptions of university students regarding calories, food healthiness, and the importance of calorie information in menu labelling. *Appetite*. 2015;91:173–178.
63. Jones CS. Encouraging healthy eating at restaurants: more themes uncovered through focus group research. *Serv Market Q*. 2010;31:448–465.
64. McClain AD, Otten JJ, Hekler EB, et al. Adherence to a low-fat vs. low-carbohydrate diet differs by insulin resistance status. *Diabetes Obes Metab*. 2013;15:87–90.
65. Lucan SC, DiNicolantonio JJ. How calorie-focused thinking about obesity and related diseases may mislead and harm public health. An alternative. *Public Health Nutr*. 2015;18:571–581.
66. Alexander M, O'Gorman K, Wood K. Nutritional labelling in restaurants: whose responsibility is it anyway?. *Int J Contemp Hospit Manag*. 2010;22:572–579.
67. Lando AM, Labiner-Wolfe J. Helping consumers make more healthful food choices: consumer views on modifying food labels and providing point-of-purchase nutrition information at quick-service restaurants. *J Nutr Educ Behav*. 2007;39:157–163.
68. Morley B, Scully M, Martin J, et al. What types of nutrition menu labelling lead consumers to select less energy-dense fast food? An experimental study. *Appetite*. 2013;67:8–15.
69. Feldman C, Harwell H, Brusca J. Using student opinion and design inputs to develop an informed university foodservice menu. *Appetite*. 2013;69:80–88.
70. Yepes MF. Mobile tablet menus: attractiveness and impact of nutrition labeling formats on millennials' food choices. *Cornell Hospit Q*. 2014;56:58–67.
71. Feldman C, Murray D, Chavarria S, et al. Menu label accuracy at a university's foodservices. An exploratory recipe nutrition analysis. *Appetite*. 2015;24–28. doi:10.1016/j.appet.2015.05.001.
72. Urban LE, McCrory MA, Dallal GE, et al. Accuracy of stated energy contents of restaurant foods. *JAMA*. 2011;306:287–293.
73. Mayne SL, Auchincloss AH, Michael YL. Impact of policy and built environment changes on obesity-related outcomes: a systematic review of naturally occurring experiments. *Obes Rev*. 2015;16:362–375.
74. Carter SM. The ethics of menu labelling. *Public Health Ethics*. 2015;8:94–97.
75. Cantor J, Torres A, Abrams C, et al. Five years later: awareness of New York City's calorie labels declined, with no changes in calories purchased. *Health Aff*. 2015;34:1893–1900.
76. Smith MJ. What's on the menu for an equitable approach to nutrition labelling in restaurants? *Public Health Ethics*. 2015;8:98–102.