



The Influence of Menu Labeling on Calories Selected or Consumed: A Systematic Review and Meta-Analysis

Susan E. Sinclair, MSc; Marcia Cooper, PhD, RD; Elizabeth D. Mansfield, PhD, RD

ARTICLE INFORMATION

Article history:

Accepted 13 May 2014

Available online 16 July 2014

Keywords:

Menu labeling

Calories

Nutrition

Meta-analysis

Supplementary materials:

PowerPoint presentation, Figures 1, 2, 3, 4, 6, and 7, and Tables 1, 2, 5, 6, and 7 available at www.andjrn.org

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<http://dx.doi.org/10.1016/j.jand.2014.05.014>

ABSTRACT

Recent menu labeling initiatives in North America involve posting the calorie content of standard menu items, sometimes with other nutrients of public health concern, with or without contextual information (such as the recommended daily caloric intake for an average adult) or interpretive information (such as traffic light symbols). It is not clear whether this is an effective method to convey nutrition information to consumers wanting to make more-informed food choices. Of particular concern are those consumers who may be limited in their food and health literacy skills to make informed food choices to meet their dietary needs or goals. The purpose of this systematic review was to determine whether the provision of menu-based nutrition information affects the selection and consumption of calories in restaurants and other foodservice establishments. A secondary objective was to determine whether the format of the nutrition information (informative vs contextual or interpretive) influences calorie selection or consumption. Several bibliographic databases were searched for experimental or quasiexperimental studies that tested the effect of providing nutrition information in a restaurant or other foodservice setting on calories selected or consumed. Studies that recruited generally healthy, noninstitutionalized adolescents or adults were included. When two or more studies reported similar outcomes and sufficient data were available, meta-analysis was performed. Menu labeling with calories alone did not have the intended effect of decreasing calories selected or consumed (-31 kcal [$P=0.35$] and -13 kcal [$P=0.61$], respectively). The addition of contextual or interpretive nutrition information on menus appeared to assist consumers in the selection and consumption of fewer calories (-67 kcal [$P=0.008$] and -81 kcal [$P=0.007$], respectively). Sex influenced the effect of menu labeling on selection and consumption of calories, with women using the information to select and consume fewer calories. The findings of this review support the inclusion of contextual or interpretive nutrition information with calories on restaurant menus to help consumers select and consume fewer calories when eating outside the home. Further exploration is needed to determine the optimal approach for providing this menu-based nutrition information, particularly for those consumers who may be limited in their food and health literacy skills.

J Acad Nutr Diet. 2014;114:1375-1388.

RATES OF OBESITY AND DIET-RELATED CHRONIC disease in the North American population are increasing in tandem with food consumption and expenditure patterns that show an increasing reliance on eating outside the home, particularly at fast-food outlets.¹⁻⁹ Both cross-sectional and longitudinal surveys consistently associate frequent eating at restaurants and fast-food outlets with higher body mass index and weight gain.¹⁰⁻¹² Dietary intakes are noticeably affected by this

pattern of eating. Specifically, portion sizes are larger and include higher amounts of less-desirable nutrients of (eg, fat, saturated fat, sodium, and added sugars) and lower amounts of more-desirable nutrients (such as calcium and iron).^{12,13} These factors contribute to positive energy balance which can lead to overweight and obesity over the long term.

The provision of nutrition information (ie, nutrition labeling) is intended to act on one of the proximal determinants of overweight and obesity: consumers' food choices and subsequent dietary intakes. Yet nutrition labeling regulations for prepackaged foods in Canada and the United States do not currently extend to restaurant menus, except where a nutrient claim is made about the food offered. Although voluntary initiatives have made nutrition information available, typically upon request in some large chain restaurants, the information is rarely accessible at the point of ordering

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or purchase.^{14,15} Furthermore, there are several barriers to consumers' understanding and use of this nutrition information, including price and time constraints; confusion and lack of understanding about caloric values; as well as the competing priorities of preference, hunger, and habitual ordering habits.¹⁵ These factors, combined with consumers' general lack of awareness with respect to calorie content of restaurant foods, were key drivers of recent regulatory proposals in the United States to provide calorie content and contextual information for each standard menu item in chain restaurants, retail food establishments, and vending machines with 20 or more locations.¹⁶ This information would be displayed on all menus, including menu boards, drive-through boards, Internet menus, and take-out menus.

Current US regulatory proposals, as well as the barriers to healthy eating outside the home and the limited influence of current interventions, have heightened the call for action by Canadian policy makers, public health and consumer advocacy groups, and dietetics practitioners to improve Canadian consumers' access to nutrition information that they can use to make informed food choices in settings outside the home.¹⁷⁻²⁰ More than a decade ago, the World Health Organization also noted that nutrition information should be made available to consumers in a simple manner so that they can select healthier choices when eating in restaurants and fast-food outlets.²¹ Despite taste and the sensory appeal of foods being the most important determinants of food choices for the majority of people, consumers would also like to have nutrition information available when eating in restaurants and other foodservice establishments^{1,22-24}; however, evidence suggests that consumers may not be able to understand and use available nutrition information to make their food choices.^{25,26} Instead, many rely on simple decision-making heuristics that use only a fraction of the available information (eg, rule of thumb) or place their trust in organizations to help make their food choices with minimal effort, particularly when time and computational resources are limiting factors.^{27,28}

During the past 5 years, two reviews on the effect of menu labeling have been published.^{29,30} The first concluded that several studies reported modest increases in the selection of healthier menu items but also noted that a few of the included studies reported unintended effects among some population subgroups, such as college-age men.²⁹ The second review concluded that calorie labeling does not have the intended effect of decreasing calorie purchasing or consumption.³⁰ Both reviews noted that many of the included studies suffered from methodologic shortcomings; for example, some studies were pre-post designs with no control or comparison group. Since the publication of these reviews, the results of additional studies have become available.

The most effective way to convey nutrition information to those consumers with the weakest health and functional literacy skills has yet to be established. Consumer confusion and lack of understanding about caloric values in menu labeling initiatives suggests that informative approaches may not be the best approach to convey nutrition information. A recent examination of consumer use and understanding of nutrition information in the marketplace suggests that a shift from an informative

approach to a contextual or interpretive approach that provides quick and easy guidance would encourage healthier food choices, whereas informative approaches would have limited success in encouraging healthier food decisions and choices.³¹

A systematic review was undertaken to determine whether or not the current evidence, when limited to studies with a control or comparison group, supports menu-based nutrition information for the selection or consumption of fewer calories. A secondary objective was to determine if the format of the nutrition information (informative vs contextual/interpretive) influenced consumers' use of nutrition information and influenced calories selected or consumed.

METHODS

Study Selection

The aim of the study selection step was to identify all controlled experimental and quasiexperimental studies that reported the effect of informative, contextual, or interpretive menu labeling on calories selected or consumed. The term *informative* describes approaches that provide nutrient content amounts only, such as the number of calories in a menu item. *Contextual* refers to approaches that provide additional information, such as the recommended daily calories for an average adult, to help put the number of calories into context for consumers. The term *interpretive* describes approaches that offer an additional interpretation of the menu item. These include exercise equivalency labels that provide the number of minutes of exercise needed to burn the calories contained in the food item or traffic light labels, where green, amber, or red symbols are used to represent increasing calorie amounts. Databases searched included MEDLINE, EMBASE, CINAHL, Global Health, AGRICOLA, AGRIS, Econlit Food Science and Technology Abstracts, International Pharmaceutical Abstracts, PsycINFO, and Social Policy and Practice. Four search themes were combined: setting (restaurant or other foodservice establishment), intervention (provision of nutrition information, with or without additional contextual or interpretive information), outcome (consumers' response to menu labeling), and study type (experimental or quasiexperimental). A detailed description of the MEDLINE search strategy is provided in Figure 1 (available online at www.andjrn.org). Date limits were January 1, 1990 to March 20, 2013, because the nutrition labeling environment was fundamentally different in Canada and the United States before 1990. Reference lists of all relevant articles and reviews were hand-searched for studies not identified by the database search. The Internet was searched by entering a subset of the key search terms into Google.

Two reviewers (M.C. and E.D.M.) independently screened titles and abstracts for eligible articles. Full versions of all potentially eligible articles were obtained and assessed. When there was disagreement on the relevance of an article, it was discussed until consensus was reached. Articles were considered for inclusion if they were conducted in Canada, the United States, or any other country with a similar nutrition labeling environment, such as the United Kingdom, Australia, or New Zealand. Study participants had to be generally healthy, noninstitutionalized adolescents (aged 11 to 17 years) or adults (aged ≥ 18 years). The intervention needed to be the provision of nutrition information in a

restaurant or other foodservice setting. Relevant forms of nutrition information included menu labels with the amount of calories or other nutrients targeted for reduction, such as sodium, saturated fat, or sugars, with or without additional contextual or interpretive information. Studies that measured calories selected, consumed, or some other estimates of caloric intake, such as the frequency of purchase of calorically targeted items, were included. Studies that were published as abstracts only were excluded from consideration. Studies that were published in a language other than French or English were also excluded, because funds for translation were not available. Studies were excluded if there was no control group. Also excluded were studies where the nature of the control condition(s) did not allow the effect of the nutrition information to be isolated. If participants' nutrition literacy, knowledge, or their awareness of the nutrition information was measured rather than their actual behavior in response to the provision of nutrition information, the study was excluded. Studies that measured consumers' intentions (eg, using online surveys rather than their actual food selection or consumption behavior) were also excluded.

Data Extraction

One reviewer (S.E.S.) was responsible for extracting data. General information on characteristics such as the study setting, sample size, study population characteristics, as well as information about the intervention and the outcomes were extracted into Study Characteristics tables. Next, detailed results were extracted into Study Results tables. Study authors were contacted by e-mail to obtain any data needed to complete data extraction.

Quality Appraisal of Individual Studies

Two reviewers (S.E.S. and M.C.) independently performed the quality appraisals. Differences in ratings were settled by consensus. The Scottish Intercollegiate Guidelines Network methodology checklists for cohort studies and for controlled trials³² were used to assess the quality of the quasiexperimental and experimental studies, respectively. These checklists were selected over other tools because they covered the main sources of potential bias that cause study results to deviate from the truth and because they allow for review judgment in the rating. Using the checklists in their original form led to low quality ratings for all of the studies selected for inclusion, so the basic concepts from the Scottish Intercollegiate Guidelines Network checklists were incorporated to focus on items that distinguished between studies with results that were relatively more (or less) likely to deviate from the truth. Sensitivity analysis was used to take into account the influence of studies judged to be of lower quality. Summaries of the criteria used to appraise the quality of individual quasiexperimental and experimental studies are provided in Figures 2 and 3 (available online at www.andjrnl.org), respectively.

Data Synthesis

When two or more experimental studies reported calories selected or consumed and they were sufficiently similar, the data were pooled using Review Manager 5.12 software (2012, The Cochrane Collaboration). Weighted mean between-group differences were computed using the random-effects model,

to account for any heterogeneity. When a crossover study reported combined data for the treatment and control periods, the combined data were used in the meta-analysis. When a study tested more than one nutrition information condition, the data for each condition were entered as if it were a separate study. The mean value for the control group was used as the comparator for each arm. The total number of participants in the control group was divided by the number of nutrition information conditions to help ensure that the weight attributed to each arm was appropriate. Because Review Manager does not allow decimal places in the group sample size fields, the number of participants was rounded down if this calculation resulted in a fraction (eg, 35 participants in the control group and two relevant test arms would result in control group sizes of 17 for each test arm). When results were only reported separately for subgroups, the data were entered as if subgroups were separate conditions.

Statistical heterogeneity between trial results was assessed using the I^2 statistic.³³ The following criteria for heterogeneity were established: I^2 statistics $\geq 50\%$ indicated substantial heterogeneity, I^2 values between 25% and 50% indicated moderate heterogeneity, and I^2 statistics $\leq 25\%$ indicated little heterogeneity. If heterogeneity was substantial or moderate, potential reasons for the variation would be identified by examining the study characteristics. If one study seemed to be the source of the heterogeneity, sensitivity analysis would be used to determine the influence of the study on the pooled mean difference. If removing the study made little difference to the summary mean difference, the study would be left in the pooled analysis. The symmetry of funnel plots was examined for evidence of publication bias.

In addition to the sensitivity analysis to evaluate the influence of study quality, several subgroup analyses were planned to test the influence of certain factors thought to influence the effect of menu labels on calorie selection and consumption, including sex, age, socioeconomic status, study setting, type of menu label, and cost of food. A description of the planned subgroup analyses is provided in Figure 4 (available online at www.andjrnl.org).

RESULTS

The literature search and filtering results are described in Figure 5. Studies excluded at the full-text filtering stage and the reason for their exclusion are provided in Table 1 (available online at www.andjrnl.org). In total, 17 publications met the selection criteria.^{19,34-49} Seven studies were quasiexperimental,^{19,44-49} and 10 were experimental.³⁴⁻⁴³

Quasiexperimental Studies

The main characteristics of the quasiexperimental studies are described in Table 2 (available online at www.andjrnl.org). All seven studies took place in the United States, either in fast-food restaurants^{19,46-49} or in worksite cafeterias.^{44,45}

In the five fast-food restaurant studies, menu labels consisted of calorie content only; there were no contextual or interpretive components.^{19,46-49} Transaction data (ie, food items purchased) before mandatory menu labeling was compared with transaction data after mandatory menu labeling came into effect. This pre-post difference was then compared with the pre-post difference from a comparable location where mandatory menu labeling was not in effect.

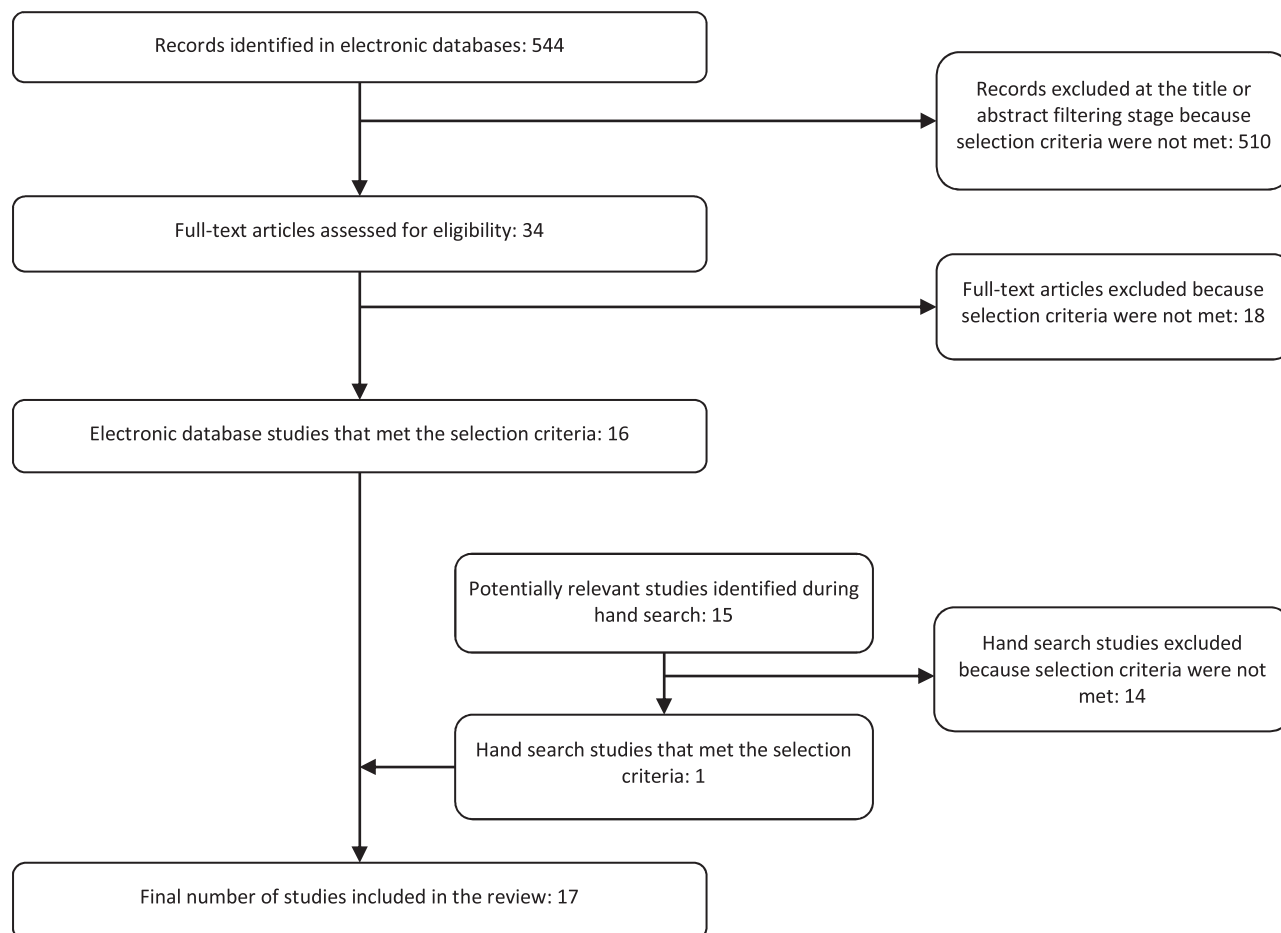


Figure 5. Flow diagram of the literature search and filtering results for a systematic review of the impact of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments.

Three studies collected the transaction data directly from foodservice operators^{46–48} and two approached patrons for their receipt.^{19,49} The relevant outcome in the fast-food restaurant studies was mean calories purchased per transaction.^{19,46–49}

In both cafeteria studies, one of two cafeterias was selected to receive a menu label intervention.^{44,45} In the first, the intervention was nutrient content only; calorie content was posted at the point of decision and the nutrient content (eg, calories, fat, and sodium) was provided on a centrally placed poster in the test cafeteria.⁴⁵ In the second, the intervention was interpretive; a heart symbol next to three low-fat items on a menu board at the point of decision and on a poster in a central location away from the point of decision.⁴⁴ Transaction data from the test and the control locations were collected from the cafeteria operators before and after the intervention was implemented at the test location. The outcome was the difference in percent change in targeted items sold. In the first study, percent change in targeted items sold was reported separately for entrées, sides, and snacks.⁴⁵ In the second, percent change was reported for entrées only.⁴⁴

Detailed quality appraisal results of the quasiexperimental studies are provided in Figure 6 (available online at www.andjrn.org). Of the seven quasiexperimental studies, three

were rated as higher quality because they provided data to show that the source populations were comparable at baseline and results were adjusted for potential confounding.^{19,46,47}

The main findings from the five fast-food restaurant studies^{19,46–49} are summarized in Table 3, and those from the two workplace cafeteria studies^{44,45} are summarized in Table 4. Among the five fast-food restaurant studies that reported calories purchased (Table 3), only one reported a statistically significant association between the introduction of menu labeling and the selection of fewer calories.⁴⁶ In this study,⁴⁶ customers purchased 14.4 (5.8%) fewer calories per transaction after mandatory menu labeling was introduced in New York City. The effect was due to consumers' food choices; calories from beverages did not change. The study authors reported that calories purchased by customers in Boston, MA, and Philadelphia, PA, where menu labeling was not mandatory, stayed constant over the same time period; however, the data for the comparison group were not provided. Calorie reductions tended to be greater in locations where residents had more education and higher incomes. The reductions also tended to be larger for customers who typically made what the authors considered high-calorie (>250 calories per transaction) purchases. Among the four fast-food restaurant studies that did not find statistically

Table 3. Summary of characteristics and results of five quasiexperimental studies that measured the association between the introduction of menu labeling and average calories purchased per transaction

Author(s), y	Study location (test vs comparison)	Sample size (n)	Calories purchased per transaction at the test location before vs after mandatory menu labeling was introduced (kcal)	Calories purchased per transaction at the comparison location at the same time points as the test location where mandatory menu labeling was introduced (kcal)	Test difference vs comparison difference in calories purchased per transaction (kcal)	Interaction effects reported by study authors
Elbel et al, 2011 ⁴⁹	United States (New York City vs Newark)	Male: 82 Female: 102	747 vs 814 712 vs 716	878 vs 795 560 vs 730	+67 vs -83 ^a +4 vs +170	Not reported
Finkelstein et al, 2011 ⁴⁸	United States (King County, Washington vs adjacent counties)	>11,000	1,211 vs 1,217	1,391 vs 1,392	+5.7 vs +0.9	There was no difference in the result when food and beverage calories were looked at separately
Tandon et al, 2011 ⁴⁷	United States (Seattle/ King County, Washington vs San Diego County)	128	823 vs 720	895 vs 789	-103 vs -106 ^a	The weight status of participants did not influence the association between the introduction of menu labeling and the average calories purchased per transaction
Bollinger et al, 2010 ⁴⁶	United States (New York City vs Boston and Philadelphia)	118,480	247 vs 232.6 ^a	NR ^b	-14.4 vs NR ^{b*}	The association between the introduction of mandatory menu labeling and the average calories purchased per transaction occurred in food but not beverage calories. The association was stronger in locations where residents had higher incomes and more education
Elbel et al, 2009 ¹⁹	United States (New York City vs Newark)	1,156	825 vs 846	823 vs 826	+21 vs +3 ^a	The sex, race, or age of participants did not influence the association between the introduction of menu labelling and the average calories purchased per transaction

^aValue was imputed from other values provided in the study report (actual value was not reported).^bTo protect the confidentiality of the data, the authors did not provide these data in the study report.^{*}The regression coefficient estimate of the effect of mandatory calorie posting was statistically significant at $P < 0.01$.NOTE: Information from this table is available online at www.andjrn.org as part of a PowerPoint presentation.

Table 4. Summary of characteristics and results of two quasiexperimental studies that measured the association between the introduction of menu labeling and the percent frequency with which targeted food items were purchased

Author(s), y	Comparison	Sample size n	Food items targeted with menu labeling	Frequency with which targeted items were purchased in the test cafeteria before vs after menu labeling was introduced	Frequency with which targeted items were purchased in the comparison cafeteria at the same time points as in the test cafeteria where menu labeling was introduced	Test difference vs control difference in frequency with which targeted items were purchased	P value
Webb et al, 2011 ⁴⁵	Test cafeteria vs control cafeteria	600	Entrées Sides Snacks	68.6 vs 68.6 ^a 78.4 vs 83.2 ^a 40.3 vs 41.6 ^a 4.3 vs 11.9 ^c	79.2 vs 79.3 ^a 69.2 vs 64.4 ^a 27.8 vs 19.7 ^a 5.4 vs 5.1 ^d	+0.028 vs +0.05 +4.8 vs -4.8 +1.3 vs -8.1 +7.6 vs -0.3 ^a	NS ^b 0.0007 0.006 NR ^e
Levin, 1996 ⁴⁴	Test cafeteria vs control cafeteria	406	Entrées				

^aValue was imputed from other values provided in the study report (actual value was not reported).

^bNS=not significant. Actual values were not reported.

^c*p*<0.001.

^d*p*=0.78.

^eNR=not reported.

NOTE: Information from this table is available online at www.andjrnl.org as part of a PowerPoint presentation.

significant differences between the locations, the sample sizes in two were relatively small ($n < 150$) and may not have been sufficient to detect small changes in the amount of calories purchased.^{47,49} In the other two studies,^{19,48} the sample sizes were large but the between group differences were small and still not statistically significant.

Among the two workplace cafeteria studies^{44,45} that reported purchase frequency of targeted items (Table 4), both reported more frequent selection of targeted items in cafeterias where menu labels were provided. In the first study,⁴⁵ the proportion of targeted sides and snacks sold but not entrées sold was higher in cafeterias where calories were posted at the point of decision and more detailed nutrient content (eg, calories, fat, and sodium) was posted in a central location. In the second study,⁴⁴ the proportion of target entrées sold was significantly higher after the heart symbol was implemented compared with before, whereas sales in the control cafeteria remained stable. The statistical significance of the between-group difference was not reported. There was no evidence that certain factors, such as sex, influenced the effect in either study.

Experimental Studies

The main characteristics of the experimental studies selected for inclusion are described in Table 5 (available online at www.andjrnl.org). Seven studies tested the effect of providing the caloric content of menu items.^{35-37,39,40,42,43} Of these, three also tested the effect of adding the recommended daily caloric intake for an average adult to the caloric content label.^{39,40,42} One study tested the effect of adding exercise equivalents to the caloric content label.³⁶ One tested the effect of adding traffic light symbols to the caloric content labels.⁴³ Three other studies tested the effect of other types of menu labels: standard nutrition labels^{38,41} and the effect of “low fat” labels and “low fat” plus preparation information labels.³⁴ One of the two that tested standard nutrition labels also tested the effect of traffic-light labels.⁴¹ In terms of the outcomes measured, three studies reported both calories selected and calories consumed.^{35,36,39} Four studies reported calories selected only,^{34,37,40,43} and three reported calories consumed only.^{38,41,42} Detailed quality appraisal results for the experimental studies are provided in Figure 7 (available online at www.andjrnl.org). Only three experimental studies were rated as higher quality.^{35,36,39} These studies randomized participants, provided baseline data to show that the treatment and control groups were similar at the start of the trial, and reported attempting to conceal, at least partially, the intent of the study from the participants to reduce bias.

Overall Pooled Effect of Menu Labeling. Seven of 10 experimental studies measured calories selected in participants provided with menu labels compared with those who were not.^{34-37,39,40,43} Six reported calories consumed rather than (or in addition to) calories selected.^{35,36,38,39,41,42} Overall, the effect of 13 separate menu label conditions on calories selected was measured and the effect of 11 separate conditions on calories consumed was measured. The authors of six studies^{34,37,38,40,41,43} were contacted for data that were not provided in the study report. Detailed calorie selection and consumption results are reported in Tables 6 and 7

(available online at www.andjrn.org), respectively. Compared with the control groups, participants in the menu label groups selected 43 fewer calories (95% CI -82 to -3; $P=0.03$) and consumed 41 fewer calories (95% CI -79 to -3; $P=0.03$) (Figure 8). According to the I^2 statistics, statistical heterogeneity was not an issue. The funnel plots for each calorie group (selected and consumed) were symmetrical.

Eight of the 10 studies reported testing for interaction effects. One found that sex and weight status influenced the effect of menu labels on calories consumed, with lean women in the test condition consuming fewer calories than others.⁴¹ One study reported that overweight participants selected more calories when recommended daily caloric intakes were provided with the calorie content.⁴⁰ Conversely, two reported no effects of weight status,^{37,39} two reported no

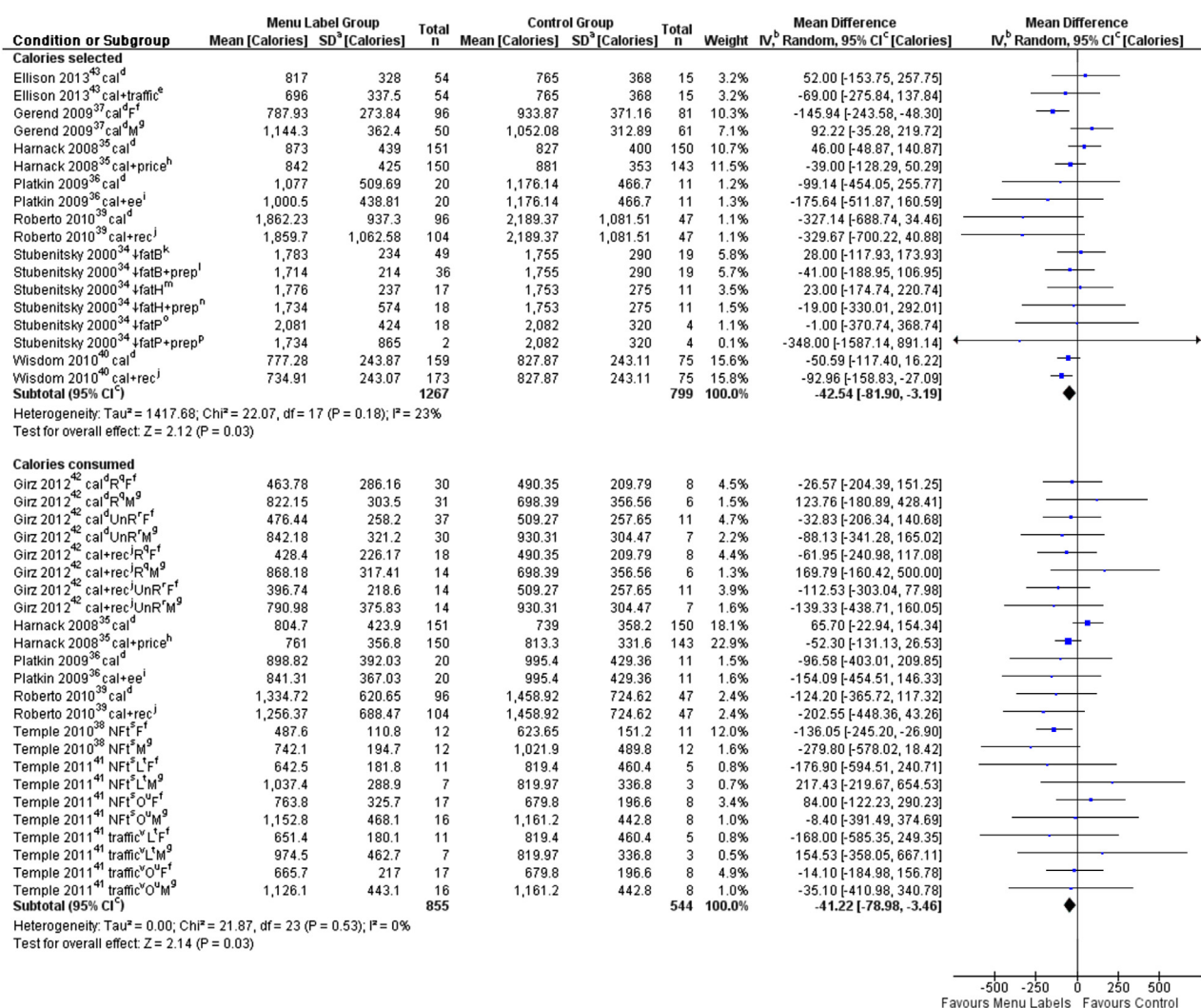


Figure 8. Forest plot showing the pooled weighted mean difference with 95% CI for 18 menu label conditions or subgroups for which the calories selected effect was estimated and 24 menu label conditions or subgroups for which the calories consumed effect was estimated. For each condition or subgroup, the shaded square represents the point estimate of the menu label effect. The horizontal lines join the lower and upper limits of the 95% CI of these effects. Arrows at the end of the line indicate that the CI extends beyond the scale shown at the bottom of the plot. The size of the shaded square reflects the relative weight of the study in the meta-analysis. The diamond at the bottom of each plot represents the pooled weighted mean difference with the 95% CI. ^aSD=standard deviation. ^bIV=inverse variance. ^cCI=confidence interval. ^dcal=calorie content menu label. ^ecal+traffic=calorie content and traffic light symbol label. ^fF=female participant subgroup. ^gM=male participant subgroup. ^hcal+price=calorie content and value pricing label. ⁱcal+ee=calorie content and exercise equivalent label. ^jcal+rec=calorie content and recommended daily caloric intake for an average adult label. ^kfatB=low-fat label on the beef item. ^lfatB+prep=low-fat and preparation details label on the beef item. ^mfatH=low-fat label on the haddock item. ⁿfatH+prep=low-fat and preparation details label on the haddock item. ^ofatP=low-fat label on the pasta item. ^pfatP+prep=low-fat and preparation details label on the pasta item. ^qR=restrained eating participants subgroup. ^rUnR=unrestrained eating participants subgroup. ^sNFT=Nutrition Facts table label. ^tL=lean participants subgroup. ^uO=overweight or obese participant subgroup. ^vtraffic=traffic light label.

effect of restrained eating status,^{36,42} and four reported no effect of sex.^{35,38,39,42} One study reported that there was no evidence for difference due to race.³⁵ One reported that reductions were greater in side dish and drink calories compared with sandwich calories,⁴⁰ whereas another reported that participants in the menu label groups ordered

fewer appetizers and side dishes ($P=0.051$) but not beverages or desserts.³⁹

Subgroup Effects of Menu Labeling. Results of the planned subgroup and sensitivity analyses are reported in Table 8. Only one study population had a mean age

Table 8. Sensitivity and subgroup analysis results for the effect of menu labeling on calories consumed and selected

Description of the sensitivity/ subgroup analysis	Studies included in the sensitivity or subgroup analysis n	Relevant menu labeling comparisons included in the studies n	Participants in the Menu Label (Test) Group and in the No Menu Label (Control) Group Conditions		Mean Difference in Calories between the Menu Label Group and in No Menu Label Group		
			Test (n)	Control (n)	Mean difference		P value
					(kcal)	95% CI	
Calories selected analyses							
Overall (all conditions)	7	18	1,267	799	−42.54	−81.90 to −3.19	0.03
Conditions from studies rated as higher quality	3	6	541	409	−63.89	−166.86 to 39.09	0.22
Calorie content only menu label conditions	6	8	776	583	−30.84	−95.85 to 34.18	0.35
Calorie content and contextual or interpretive information menu label conditions	4	4	351	148	−67.39	−116.99 to −17.79	0.008
Conditions from studies that took place in a natural setting	3	10	580	248	−52.57	−92.16 to −12.98	0.009
Conditions from studies where participants believed they needed to pay for their meal	5	14	1,027	683	−34.59	−73.11 to 3.94	0.08
Results reported for women separately	2	3	128	110	−145.05	−235.70 to −54.39	0.002
Results reported for men separately	1	1	50	61	+92.22	−35.28 to 219.72	0.13
Calories consumed analyses							
Overall (all conditions)	5	22	855	544	−41.22	−78.98 to −3.46	0.03
Conditions from studies rated as higher quality	3	6	541	409	−45.18	−129.22 to 38.86	0.29
Calorie content only menu label conditions	4	8	545	383	−12.73	−62.29 to 36.82	0.61
Calorie content and contextual or interpretive information menu label conditions	4	10	310	161	−80.67	−138.99 to −22.36	0.007
Results reported for women separately	3	10	207	97	−72.38	−130.26 to −14.50	0.01
Results reported for men separately	2	8	147	60	−21.82	−133.01 to 89.37	0.70

NOTE: Information from this table is available online at www.andjrn.org as part of a PowerPoint presentation.

>30 years,³⁴ so it was not possible to test the influence of age on the results. Education level was not consistently reported so this factor also could not be tested. Only three studies were conducted in a natural setting, all of which measured calories selected,^{34,40,43} so the influence of this factor could not be tested in the calories consumed analysis. Only one study that measured calories consumed led participants to believe that they would need to pay for their meal³⁵ so the influence of cost could only be tested in the calories selected analysis.

When comparing studies that tested calorie content labels without additional contextual or interpretive information, the pooled mean difference for calories selected was attenuated to 31 fewer calories (95% CI -95.85 to 34.18; $P=0.35$). Similarly, calories consumed was attenuated to 13 fewer calories (95% CI -62.29 to 36.82; $P=0.61$). Conversely, when conditions that provided additional contextual or interpretive information were examined, the pooled mean difference in calories selected was 67 fewer calories (95% CI -116.99 to -17.79; $P=0.008$). Contextual or interpretive interventions resulted in a pooled mean difference in calories consumed of 81 fewer calories (95% CI -138.99 to -22.36; $P=0.007$). The forest plots for the calories selected and consumed subgroup analyses are provided in Figures 9 and 10, respectively.

When results reported separately for women or men were pooled, the direction of the effect changed from favoring menu labels in women, to favoring no labels in men in both the calories selected and consumed analyses. It should be noted that for the calories selected analysis, there were only three conditions where results were reported separately for women and one where results were reported separately for men. The pooled mean differences in men for calories selected and consumed were not statistically significant.

DISCUSSION

This systematic review summarizes the current evidence for adding nutrition information to restaurant menus. Results of the meta-analysis of the experimental studies suggest that labeling of menus with calories alone had no effect on calories selected or consumed. Data from the quasiexperimental studies confirm that calorie labels have little influence on calories purchased in settings where mandatory menu labeling had been implemented. This finding is consistent with that of the systematic review by Swartz and colleagues,³⁰ who concluded that calorie labeling does not have the intended effect of decreasing calorie purchasing or selection. In contrast, consumers did select and consume fewer calories when contextual or interpretive

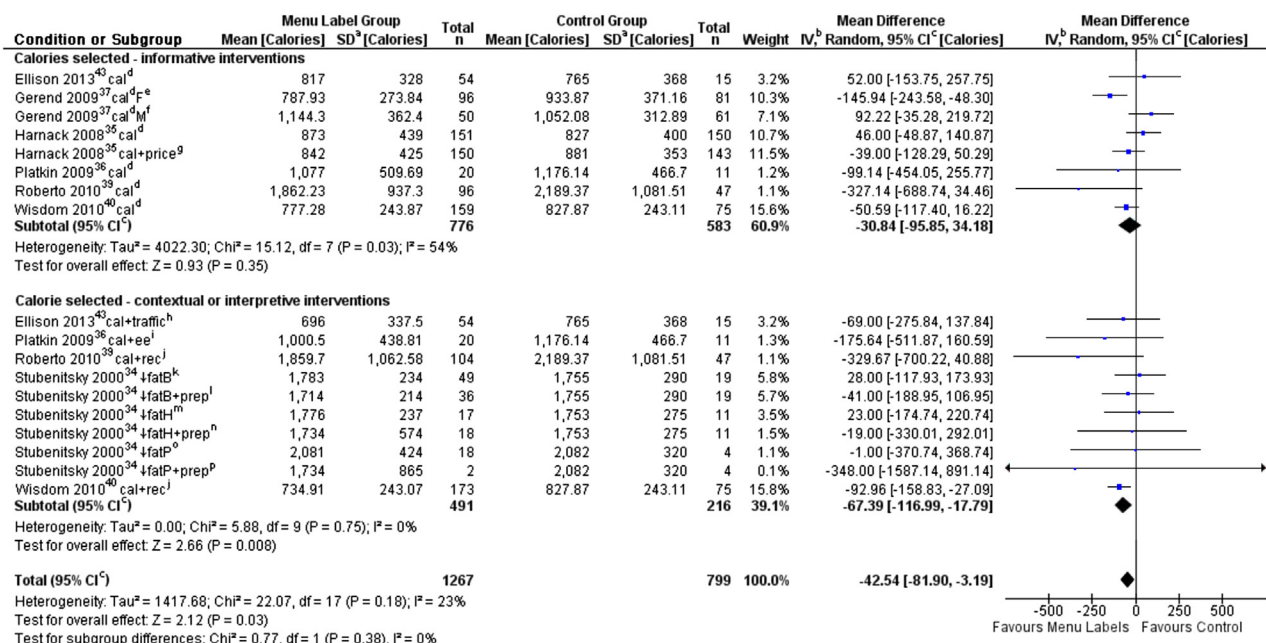


Figure 9. Forest plot showing pooled weighted mean difference with 95% CI for 8 informative menu label conditions or subgroups and 10 contextual or interpretive conditions or subgroups for which the calories selected effect was estimated. For each condition or subgroup, the shaded square represents the point estimate of the menu label effect. The horizontal lines join the lower and upper limits of the 95% CI of these effects. Arrows at the end of the line indicate that the CI extends beyond the scale shown at the bottom of the plot. The size of the shaded square reflects the relative weight of the study in the meta-analysis. The diamond at the bottom of each plot represents the pooled weighted mean difference with the 95% CI. ^aSD=standard deviation. ^bIV=inverse variance. ^cCI=confidence interval. ^dcal=calorie content menu label. ^eF=female participant subgroup. ^fM=male participant subgroup. ^gcal+price=calorie content and value pricing label. ^hcal+traffic=calorie content and traffic light symbol label. ⁱcal+ee=calorie content and exercise equivalent label. ^jcal+rec=calorie content and recommended daily caloric intake for an average adult label. ^kfatB=low-fat label on the beef item. ^lfatB+prep=low-fat and preparation details label on the beef item. ^mfatH=low-fat label on the haddock item. ⁿfatH+prep=low-fat and preparation details label on the haddock item. ^ofatP=low-fat label on the pasta item. ^pfatP+prep=low-fat and preparation details label on the pasta item.

NOTE: Information from this figure is available online at www.andjrn.org as part of a PowerPoint presentation.

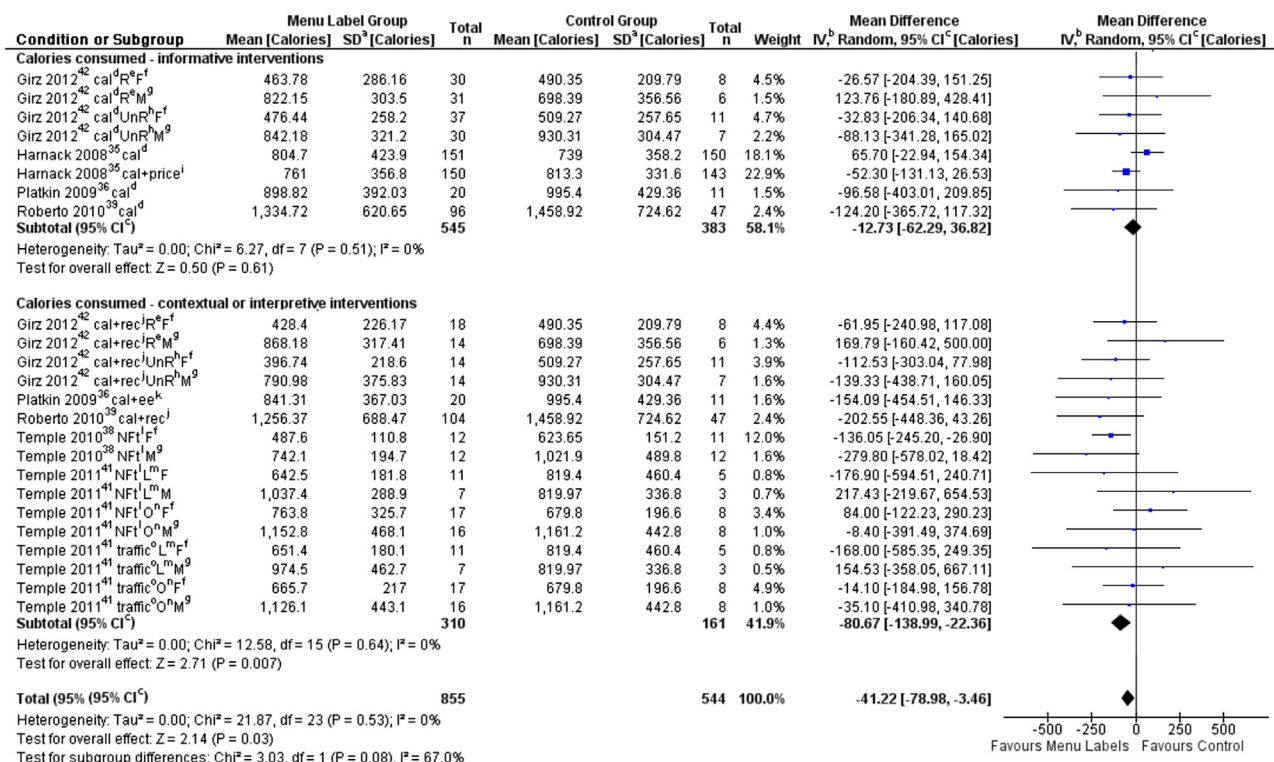


Figure 10. Forest plot showing pooled weighted mean difference with 95% CI for 8 informative conditions or subgroups and 16 contextual or interpretive conditions or subgroups for which the calories consumed effect was estimated. For each condition or subgroup, the shaded square represents the point estimate of the menu label effect. The horizontal lines join the lower and upper limits of the 95% CI of these effects. Arrows at the end of the line indicate that the CI extends beyond the scale shown at the bottom of the plot. The size of the shaded square reflects the relative weight of the study in the meta-analysis. The diamond at the bottom of each plot represents the pooled weighted mean difference with the 95% CI. ^aSD=standard deviation. ^bIV=inverse variance. ^cCI=confidence interval. ^dcal=calorie content menu label. ^eR=restrained eating participants subgroup. ^fF=female participant subgroup. ^gM=male participant subgroup. ^hUnR=unrestrained eating participants subgroup. ⁱcal+price=calorie content and value pricing label. ^jCal+rec=calorie content and recommended daily caloric intake for an average adult label. ^kcal+ee=calorie content and exercise equivalent label. ^lNFT=Nutrition Facts table label. ^mL=lean participants subgroup. ⁿO=overweight or obese participant subgroup. ^otraffic=traffic light label.

NOTE: Information from this figure is available online at www.andjrn.org as part of a PowerPoint presentation.

information was added to the menu labels. Furthermore, when the influence of sex was tested, women used menu labels to select and consume fewer calories, whereas men did not. This finding is consistent with that of a literature review by Larson and Story,²⁹ who concluded that menu labeling may not have the intended effect in some population subgroups, such as college-aged men.

The finding that interpretive but not informative menu labels are effective is supported by related primary research. In a recent US consumer research report,⁵⁰ the authors concluded that labeling with calories alone is unlikely to be of benefit to consumers because it is well known that consumers struggle with the relationship between calories in food and their overall health, especially weight management. In the prepackaged food environment, there is evidence to suggest that unless some form of interpretive nutrition information is provided, not all consumers access the information; many have a poor understanding of the terms used, and most find it difficult to use the information to place a food choice within the context of their overall diet.⁵¹ Consumer research in both the prepackaged and quick-service

restaurant environments indicates that a trusted, uniform, understandable, interpretive icon or symbol representing a healthy choice is valuable for use in both contexts, in particular at those times when consumers are in a hurry and not wanting to take the time to access and use more detailed nutrition information.²² In a recent online survey among first-year university students, menus labeled with calorie content alone did result in fewer calories selected, with those menus with rank-ordering or traffic light symbols being even more effective.⁵² It is interesting to note that in addition to the interpretive information, the factual information, such as calorie content, may be important. In a qualitative study among seniors (men and women) and mothers, the inclusion of nutrient information (eg, calories, fat, fiber, and sodium) with a heart symbol on items that offer fewer calories, less cholesterol, and lower fat content had a stronger effect on food selections than just the symbol alone.⁵³

In all likelihood, menu labels compete with other influential factors at the point of purchase. These could include situational (time, convenience), personal (taste, hunger, and weight loss/gain), social (eating for pleasure and social

desirability of food choices), and environmental determinants (availability, affordability, and accessibility of foods).⁵⁴⁻⁵⁶ Recent findings of consumers' attitudes toward food and nutrition reinforce that taste is the key factor influencing food and beverage choices but that price and convenience have seen a growing influence.⁵⁰ Concern for nutrition, although known to influence food choices, differs markedly between and within individuals depending on the context.⁵⁷⁻⁵⁹ Whereas consumers are familiar with dietary guidance messages and other nutrition tools, the majority do not use them to make healthier food choices, which may explain the consistent reports of poor efficacy of menu labels in support of such choices.⁵⁰

Many factors likely contribute to an individual's motivation and competence to access, understand, and use nutrition information to shape eating habits and manage dietary concerns.⁶⁰ The ability to correctly understand, evaluate, and use the nutrition information and to contextualize food choices within the total diet requires a high level of health and functional literacy (eg, numeracy).⁶¹ It may be that the contextual and interpretive menu label interventions are more effective because the level of health literacy required to use the information is not as high. In other words, these interventions help facilitate consumers' access to, understanding of, and appraisal of menu labels so they can use the nutrition information to make their food choices.⁶² Although interpretive information on menus that provides consumers with an expert judgment on the food may be more effective, there may be certain drawbacks and unintended effects. In one study, many consumers reported that although they used the interpretive information (in this case, traffic light symbols) to make their choice, they did not like the labels, suggesting that consumers do not want a paternalistic approach that prejudices foods and tells consumers what is good or bad for them.⁴³ Nonetheless, it seems that interpretive components may be easier for the majority of consumers to understand and use and, as a result, are more effective.

Limitations

In terms of menu labeling studies selected for inclusion, the majority of the studies had methodologic weaknesses. Several of the studies had small sample sizes with questionable power to detect statistical differences. All of the studies measured the immediate effect rather than the longer-term effects of menu labeling. The quasiexperimental designs were susceptible to confounding bias because the comparison groups were from different source populations. More than half of the quasiexperimental studies did not adjust for potential confounding variables in the analysis. None of the experimental studies reported concealing allocation or the method of randomization used to allocate participants to treatment groups. Furthermore, whereas blinding of the participants was not feasible, blinding of the individuals performing the analysis of calories selected or consumed should have been feasible but was not reported. Most of the experimental studies selected were conducted in artificial settings, such as university classrooms, where participants were instructed to use the menu information to make their food selections. The experimental studies also tended to recruit from a narrow segment of the population:

most participants were young and relatively well educated. Several limitations of the analysis should be noted. Subgroup analyses were planned to explore the influence of age, socioeconomic status, study setting, and whether or not cost was a factor in food choice on the results. However, clear data on socioeconomic status were not provided in the studies and, for the other factors, the study populations, settings, and designs were so similar that most of the data fell into one subgroup with little or no data in the other. Although the funnel plots were generally symmetrical and attempts were made to identify the totality of the evidence through systematic searching of the literature, some publication bias is inevitable. In our review, publication bias could inflate the effect of menu labeling because positive results are more likely to be published than null studies.

Future Research

Menu labeling research is in its infancy. It has yet to include designs that test the health literacy of menu labeling interventions among diverse population subgroups. None of the studies assessed consumers' health literacy competences, including their ability to access, understand, appraise, and apply the nutrition information to make food choices. The personal and situational/contextual factors that affect a person's knowledge, competence, and motivation to access, understand, and use health and nutrition information to make a food-related behavior change should be considered in this research. There is also no evidence that the effect of menu labeling is sustained beyond the immediate purchase and consumption.⁶³

The most effective format(s) of nutrition information for menu labeling approaches merits further investigation. Further investigation of menu label formats should be guided by key stakeholders (eg, government, industry, researchers, consumers, and health professionals) and be developed and designed with food and health literacy experts. Future randomized controlled trials integrating these designs should be conducted in more naturalistic environments, expose participants to labeling over a longer time frame, and assess dietary intakes over multiple meals and days. Studies should be sufficiently powered to enable subgroup analysis of more than just sex (ie, literacy level, nutrition knowledge, dietary needs/goals, and level of hunger).

CONCLUSIONS

Despite mixed findings on the efficacy of labeling foods in restaurants and foodservices, public health and consumer advocacy groups, within both Canada and the United States, continue to advocate for the availability of nutrition information for foods sold in these settings. The findings of our meta-analysis support menu-labeling approaches that include contextual or interpretive nutrition information along with calories to help consumers select and consume fewer calories when eating in restaurants and other food-service establishments. The labeling of menus with calories alone does not have a significant influence on consumers' selection or consumption of calories. The best approach for menu-based nutrition information, particularly for those consumers who may be limited in their food and health literacy skills, merits further exploration.

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AUTHOR INFORMATION

S. E. Sinclair and E. D. Mansfield are research analysts, Nutrition Regulations and Standards Division, and M. Cooper is a research scientist, Nutrition Research Division, Bureau of Nutritional Sciences, Food Directorate, Health Products and Food Branch, Health Canada, Ottawa, Ontario, Canada.

Address correspondence to: Susan E. Sinclair, MSc, Nutrition Regulations and Standards Division, Bureau of Nutritional Sciences, Food Directorate, Sir Frederick G. Banting Research Centre, 251 Sir Frederick Banting Dr, Tunney's Pasture, Ottawa, Ontario, Canada K1A 0K9. E-mail: susan.sinclair@hc-sc.gc.ca

STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

This work was supported by the Bureau of Nutritional Sciences, Food Directorate, Health Products and Food Branch, Health Canada. Its contents are the responsibility of the authors and do not necessarily represent the official view of Health Canada.

ACKNOWLEDGEMENTS

The authors thank Melanie Weger, MLIS, reference librarian, Health Canada Library, for contributing expert technical guidance in the development and execution of the electronic database search; and Amanda Sullivan, MHSc, RD, Vanessa Lien, MSc, RD, and Lydia Dumais, PDt, Bureau of Nutritional Sciences, Health Canada, for providing expert advice during planning as well as feedback on the final draft manuscript.

Table 1. Reasons for excluding studies at the full-text filtering stage from the review of studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments, including the total number of articles excluded for each reason, and references for excluded articles

Reasons for excluding studies from the review at the full-text filtering stage	Articles excluded for this reason (n)
Study population was foodservice operators rather than individual consumers	1 ⁶⁴
Food selection and consumption was self-reported	1 ⁶⁵
No control or comparison group (pre–post design)	17 ⁶⁶⁻⁸²
Published before 1990	6 ⁸³⁻⁸⁸
Outcomes of interest (calories consumed, calories selected, and frequency of purchase of targeted items) were not measured	3 ⁸⁹⁻⁹¹
Consumers' intention was measured rather than their selection or consumption behavior	4 ^{25,52,92,93}

Table 2. Study location, sample size, setting, population characteristics, intervention, methods, and outcomes measured for the seven included quasiexperimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments

Author(s), y	Location (test vs comparison)	Sample size (n)	Setting	Population characteristics	Menu label condition(s) ^a	Methods	Outcome(s)
Elbel et al, 2011 ⁴⁹	United States (New York City vs Newark, NJ)	184 (136 transactions at the test site, 48 at the control site)	Fast-food restaurants (McDonald's, Burger King, Wendy's, KFC)	Ages 13-17 y; 52% female	Calorie content labels	Collected lunch and dinner receipts from restaurant patrons 2 weeks before and 4 weeks after mandatory calorie labeling in New York City and during same periods at the control site	Mean calories purchased per participant
Finkelstein et al, 2011 ⁴⁸	United States (King County, Washington vs adjacent counties)	>11,000 transactions (7 test, 7 control restaurants)	Fast-food restaurant (Taco Time Northwest)	Not reported	Calorie content labels	Examined transactions in King County and compared them with locations where menu labeling was not legislated over 3 time periods: 1 year before menu labeling legislation was implemented; 7 months after in-restaurant menu labeling; and 7 months after both in-restaurant and drive-through menu labeling was implemented.	Mean calories purchased per transaction
Tandon et al, 2011 ⁴⁷	United States (Seattle/King county, Washington vs San Diego county)	128 (75 transactions at the test site, 53 at the control site)	Fast-food restaurant (unspecified)	College degree held by 70%; 64% were overweight/obese; 80% female	Calorie content labels	Examined transactions before (January 1, 2009) and after menu labeling legislation was implemented in Seattle and King County (March-June 2009). These were compared with transactions at the same time points in nonregulated San Diego County	Mean calories purchased per transaction
Bollinger et al, 2010 ⁴⁶	United States (New York City vs Boston, MA, and Philadelphia, PA)	118,480 (222 test; 94 control locations)	Fast-food restaurant (Starbucks)	Not reported	Calorie content labels	Examined transactions before (January 1, 2009) and after (February 28, 2009) menu labeling legislation was implemented in New York City compared with before and after in nonregulated Boston and Philadelphia	Mean calories purchased per transaction

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Table 2. Study location, sample size, setting, population characteristics, intervention, methods, and outcomes measured for the seven included quasiexperimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments (*continued*)

Author(s), y	Location (test vs comparison)	Sample size (n)	Setting	Population characteristics	Menu label condition(s) ^a	Methods	Outcome(s)
Elbel et al, 2009 ¹⁹	United States (New York City vs Newark, NJ)	1,156 (7 test sites, 7 control sites)	Restaurants (McDonald's, Burger King, Wendy's, KFC)	Low-income; racially/ethnically diverse	Calorie content labels	Collected lunch and dinner receipts from restaurant patrons 2 weeks before and 4 weeks after mandatory calorie labeling in New York City and during same periods at the control site	Mean calories purchased per participant
Webb et al, 2011 ^{45b}	United States (California)	600 (400 transactions at the test site, 200 at the control site)	Urban worksite cafeteria	At least some college completed by 80%; >50% trying to lose weight; 33% female	Calorie content labels on menu and nutrient content on a centrally placed poster	Examined transactions 4 weeks before and 4 weeks after a menu labeling intervention compared with before and after at a control site	% change in targeted items (via menu board and poster), based on items sold
Levin, 1996 ⁴⁴	United States (New Mexico)	406 (300 transactions at the test site, 106 at the control site)	Urban worksite cafeteria	60% Hispanic; mean age 40 y; government employees	Heart symbol for 3 low-fat items	Examined transactions 2 weeks before and 4 weeks after a menu labeling intervention compared with before and after at a control site	% change in targeted items (via menu board and poster), based on items sold

^aIn all of the quasiexperimental studies selected for inclusion, the comparison condition was the standard menu with no nutrition information.

^bThis study was originally a randomized controlled trial that included 6 sites; however, only 2 sites (1 test and 1 control) had electronic transaction data available. Because transaction data before and after menu labeling at the test site was compared with the same data at a control site it was treated as a quasiexperimental study.

Table 5. Study location, design, sample size, population characteristics, whether or not cost was a factor in the participant's decision, intervention, methods, and outcomes measured for the 10 experimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments

Author(s), y	Location	Design	Sample size (n)	Population characteristics	Cost	Setting	Menu label condition(s) ^a	Methods	Outcome(s)
Ellison et al, 2013 ⁴³	United States (Oklahoma)	Randomized parallel; objective was concealed from participants	138 (final)	University restaurant patrons; 70% aged between 18-35 y	Yes	University campus restaurant	Two test conditions: • Calorie content labels • Calorie and traffic light labels	Restaurant was split into 3 sections. Patrons were randomly assigned to a section where they received 1 of 3 menus (2 test conditions and control). After finishing their meal, patrons were informed about the study and given a survey to complete	Calories selected
Girz et al, 2012 ⁴² (study II)	Canada (Toronto, Ontario)	Nonrandomized parallel; objective was concealed from participants	254	Students enrolled in psychology subject pool; mean age of female participants 18.69±2.87 y, men 18.71±1.79 y	No	Laboratory	Two test conditions: • Calorie content label • Calorie content and recommended daily caloric intake label	Participants were presented with menus containing 2 items with the same caloric value, a salad, and a pasta dish, and told to select 1. Menus had no calorie information, information that the salad was low in calories and the pasta was high in calories, information that the salad was high in calories and the pasta was low in calories, or information that both were high in calories	Calories consumed
Temple et al, 2011 ⁴¹	United States (Buffalo, NY)	Nonrandomized crossover; objective not concealed from participants	51	Students, staff, community recruited from a university campus; lean women mean age 27.1±3.1 y, lean men 21.4±0.8 y, overweight women 28.2±2.4 y, overweight men 23.9±1.6 y	No	Laboratory	Two test conditions: • Standard nutrition label • Traffic light label	Participants were told that "green" foods are low in calories, added sugar (<10%), and fat (0-1 g); "yellow" foods are moderate in calories, added sugar (10%-25%), and fat (2-5 g). "Red" foods are higher in calories, added sugar (>25%), and fat (>5 g)	Calories consumed

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Table 5. Study location, design, sample size, population characteristics, whether or not cost was a factor in the participant's decision, intervention, methods, and outcomes measured for the 10 experimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments (*continued*)

Author(s), y	Location	Design	Sample size (n)	Population characteristics	Cost	Setting	Menu label condition(s) ^a	Methods	Outcome(s)
Wisdom et al, 2010 ⁴⁰	United States (Pittsburgh, PA)	Randomized parallel; objective was concealed from participants	698	Fast-food restaurant patrons; 39% women; 41% overweight (body mass index ≥ 25); mean age 29 y	Yes	Fast-food restaurant	Two test conditions: <ul style="list-style-type: none"> • Calorie content label • Calorie content and recommended daily caloric intake label 	Customers entering restaurant around lunchtime were approached and offered a free meal of their choice in exchange for completing a survey. Patrons chose their meal from the provided menu, completed a survey, and then were handed a gift card and a coupon with their order to take into the restaurant	Calories selected
Roberto et al, 2010 ³⁹	United States (Connecticut)	Randomized parallel; objective was concealed from participants	295	Participants recruited from the community; mean age 31.59 \pm 12.48 y, calorie content label group: 31.59 \pm 12.48 y, calorie content and recommended daily intake label group: 31.59 \pm 12.48 y	No	Laboratory	Two test conditions: <ul style="list-style-type: none"> • Calorie content label • Calorie content and recommended daily caloric intake label 	Participants were given 1 of 3 menus and told to select their meal. Study personnel retrieved the meal from a local restaurant. Calorie values of menu items were estimated by weighing the items and entering those weights into a calorie content database. Leftovers were collected and weighed to calculate calories consumed	Calories selected and consumed
Temple et al, 2010 ³⁸	United States (Buffalo, NY)	Randomized parallel; objective was concealed from participants	47	Students, staff, community recruited from a university campus; mean age 29.9 \pm 1.5 y	No	Laboratory	One test condition: <ul style="list-style-type: none"> • Nutrition Facts label 	After watching a video, participants consumed a buffet lunch. Buffet foods were weighed before and after the meal to determine which foods and how much participants consumed to allow calculation of total calories consumed from foods and beverages	Calories consumed

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Table 5. Study location, design, sample size, population characteristics, whether or not cost was a factor in the participant's decision, intervention, methods, and outcomes measured for the 10 experimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments (*continued*)

Author(s), y	Location	Design	Sample size (n)	Population characteristics	Cost	Setting	Menu label condition(s) ^a	Methods	Outcome(s)
Gerend, 2009 ³⁷	United States (Florida)	Randomized parallel; objective was not concealed from participants	288	Introductory psychology students; mean age 18.6±1.3 y	Yes	Laboratory	One test condition: <ul style="list-style-type: none"> • Calorie content label 	Participants made food choices based on 3 different scenarios (quick dinner, starving, not too hungry). Menus were modeled after McDonald's and included prices	Calories selected
Platkin, 2009 ³⁶	United States (Miami, FL)	Randomized parallel; objective was not concealed from participants	62	Overweight female students, staff, community recruited from a university campus; mean age 21.9±3.03 y	No	Laboratory (food from Burger King)	Two test conditions: <ul style="list-style-type: none"> • Calorie content label • Calorie content and exercise equivalents label 	Subjects were divided into restrained and unrestrained eaters. At baseline all participants received the same menu with no nutrition information. Later participants chose foods from 3 menus based on their group assignment. Food and drinks were weighed before and after consumption both weeks	Calories selected and consumed
Harnack et al, 2008 ³⁵	United States (Minnesota)	Randomized parallel; objective was concealed from participants	594	Participants recruited from the community; regular (≥1 time/wk) consumers at fast-food restaurants; 24.8% ages 16-25 y; 19.4% ages 26-40 y; 41.8% ages 41-60 y; 14.1% aged ≥60 y	Yes	Laboratory	Two test conditions: <ul style="list-style-type: none"> • Calorie content label • Calorie content and value price label (vs value price only label) 	Four paper menus with lunch and dinner items, intended to be similar in format to menu boards at fast-food restaurants (eg, McDonalds), were provided. After the meal, food waste was weighed to allow calculation of total calories consumed	Calories selected and consumed

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Table 5. Study location, design, sample size, population characteristics, whether or not cost was a factor in the participant’s decision, intervention, methods, and outcomes measured for the 10 experimental studies on the influence of menu labeling on consumers’ selection and/or consumption of calories in restaurants and other foodservice establishments (*continued*)

Author(s), y	Location	Design	Sample size (n)	Population characteristics	Cost	Setting	Menu label condition(s) ^a	Methods	Outcome(s)
Stubenitsky et al, 2000 ³⁴	United Kingdom	Randomized parallel; objective was concealed	279	University training restaurant patrons; 6.9% ages 16-24 y; 4.7% ages 25-34 y; 22.8% ages 35-49 y; 25.0% ages 50-65 y; 40.6% ages ≥65 y	Yes	Training restaurant	Two test conditions: <ul style="list-style-type: none">• “Low fat” label• “Low fat” and preparation information	One main dish (smoked haddock with welsh rarebit) was targeted for composition and menu information manipulations; subjects were randomized to different parts of the restaurant where they received menus differing in the descriptive information accompanying the target dish.	Calories selected

^aIn all of the experimental studies selected for inclusion, the control condition was the standard menu with no nutrition information, unless otherwise stated.

Table 6. Sample size, menu label condition, mean calories selected in the menu label (test) group, mean calories selected in the no menu label (control) group, mean difference in calories selected between the test and the control groups, proportional difference in mean calories selected between the test and the control groups, and additional comments from the seven included experimental studies on the influence of menu labeling on consumers' selection of calories in restaurants and other foodservice establishments

Lead author, y	Sample size (n)	Menu label condition(s) ^a	Mean calories selected in the menu label (test) group \pm standard deviation (kcal)	Mean calories selected in the no menu label (control) group \pm standard deviation (kcal)	Mean difference in calories selected between the test and the control groups (kcal)	Proportional difference in calories selected between the test and the control groups ^b (%)	Comments
Ellison, 2013 ^{43c}	138	Calorie content label	817 \pm 328	765 \pm 368	+52	+7	Both menu label condition main effects were statistically significant (<i>P</i> values not provided). The reduction in entrée calories was significantly lower in the traffic light group. Health consciousness of participants modified the effect of menu labels on calories selected
		Calorie content and traffic light label	696 \pm 338	765 \pm 368	−69	−9	
Wisdom, 2010 ^{40d}	698	Calorie content label	777 \pm 244	828 \pm 243	−51*	−6	Both menu label condition main effects were statistically significant (<i>P</i> values not provided). Overweight participants purchased more calories in response to nutrition info. Reductions were achieved through side and drink calories, not sandwich calories
		Calorie content and recommended daily caloric intake label	735 \pm 243	828 \pm 243	−93*	−11	
Roberto, 2010 ³⁹	295	Calorie content label	1,862 \pm 937	2,189 \pm 1,082	−327*	−15	The menu label condition main effect was statistically significant (<i>P</i> =0.04). In response to nutrition info, participants ordered fewer appetizers and sides (<i>P</i> =0.051) but not beverages or desserts. There was modification of the effect according to sex or body weight status
		Calorie content and recommended daily caloric intake label	1,860 \pm 1,063	2,189 \pm 1,082	−330*	−15	

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Table 6. Sample size, menu label condition, mean calories selected in the menu label (test) group, mean calories selected in the no menu label (control) group, mean difference in calories selected between the test and the control groups, proportional difference in mean calories selected between the test and the control groups, and additional comments from the seven included experimental studies on the influence of menu labeling on consumers' selection of calories in restaurants and other foodservice establishments (*continued*)

Lead author, y	Sample size (n)	Menu label condition(s) ^a		Mean calories selected in the menu label (test) group±standard deviation (kcal)	Mean calories selected in the no menu label (control) group±standard deviation (kcal)	Mean difference in calories selected between the test and the control groups (kcal)	Proportional difference in calories selected between the test and the control groups ^b (%)	Comments
Gerend, 2009 ^{37e}	288	Calorie content label	Men	1,144±362	1,052±313	+92	+9	The menu label condition main effect was not statistically significant. Effect of menu labels on calories selected was affected by sex but not body mass index
			Women	788±274	934±371	−146*	−16	
Platkin, 2009 ³⁶	62	Calorie content label		1,077±114	1,176±100	−99	−8	Effect of menu labels on calories selected was not affected by whether or not the participants reported restrained eating behaviors (ie, dieting)
		Calorie content and exercise equivalent label		1,001±98	1,176±100	−175	−15	
Harnack, 2008 ³⁵	594	Calorie vs no label		874±439	828±401	+46	+6	There were no significant differences in calories selected between menu conditions. The effect of menu labels on calories selected was not affected by sex, race, or age
		Calorie and price vs price label		842±425	882±354	−40	−4	
Stubenitsky, 2000 ^{34f}	279	"Low fat" label	Haddock	1,734±574	1,753±275	−19	−1	Menu labels did not significantly increase the subsequent energy intakes. Age group did not affect direction of the outcome measures
			Beef	1,783±234	1,755±290	+28	+2	
			Pasta	1,734±865	2,082±320	−348	−17	
		"Low fat" and preparation details	Haddock	1,776±237	1,753±275	+23	+1	
			Beef	1,714±214	1,755±290	−41	−2	
			Pasta	2,081±424	2,082±320	−1	0	

^aIn all of the experimental studies selected for inclusion, the control condition was the standard menu with no nutrition information unless otherwise stated.

^bProportional Difference=($\bar{X}_E - \bar{X}_C$)/ \bar{X}_C , where \bar{X}_E is the mean difference in the control group and \bar{X}_C is the mean difference in the test group that received nutrition information. Negative proportional differences favor the test condition (nutrition information), whereas positive differences favor the control (no information).

^cOriginal data were provided in an e-mail communication from Brenna Ellison, PhD, April 23, 2013.

^dOriginal data were provided in an e-mail communication from George Loewenstein, PhD, May 2, 2013.

^eOriginal data were provided in an e-mail communication from Mary A. Gerend, PhD, May 6, 2013.

^fOriginal data were provided in an e-mail communication from David J. Mela, PhD, May 3, 2013.

*Difference between menu label and control group is statistically significant at $P < 0.05$.

Table 7. Sample size, menu label condition, mean calories consumed in the menu label (test) group, mean calories consumed in the no menu label (control) group, mean difference in calories consumed between the test and the control groups, proportional difference in mean calories consumed between the test and the control groups, and additional comments from the six included experimental studies on the influence of menu labeling on consumers' consumption of calories in restaurants and other foodservice establishments

Lead author, y	Sample size (n)	Menu label condition(s) ^a	Mean calories consumed in the menu label (test) group ± standard deviation (kcal)	Mean calories consumed in the no menu label (control) group ± standard deviation (kcal)	Mean difference in calories consumed between the test and the control groups (kcal)	Proportional difference in calories selected between the test and the control groups ^b (%)	Comments
Girz, 2012 ⁴²	254	Calorie content label	Unrestrained eating men Unrestrained eating women Restrained eating men Restrained eating women	842±321 476±258 698±357 490±210	−88 −33 +124 −26	−9 −6 +18 −5	The menu label condition main effect was not statistically significant ($P=0.72$). The effect of menu labels on calories consumed was not affected by restrained eating status or sex.
		Calorie content and recommended daily caloric intake label	Unrestrained eating men Unrestrained eating women Restrained eating men Restrained eating women	791±376 397±219 698±357 490±210	−139 −112 +170 −62	−15 −22 +24 −13	
Temple, 2011 ^{41c}	51 ^d	Standard Nutrition Facts table label	Lean women Lean men Overweight/obese women Overweight/obese men	643±182 1,037±289 680±197 1,161±443	−176* +217 +84 −8	−21 +26 +12 −0.7	
		Traffic light label	Lean women Lean men Overweight/obese women Overweight/obese men	651±180 974±462 680±197 1,161±443	−168* +154 −14 −35	−21 +19 −2 −3	
Roberto, 2010 ³⁹	295	Calorie content label		1,335±621	−124	−8	
		Calorie content and recommended daily caloric intake label		1,256±688	−203	−14	

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Table 7. Sample size, menu label condition, mean calories consumed in the menu label (test) group, mean calories consumed in the no menu label (control) group, mean difference in calories consumed between the test and the control groups, proportional difference in mean calories consumed between the test and the control groups, and additional comments from the six included experimental studies on the influence of menu labeling on consumers' consumption of calories in restaurants and other foodservice establishments (*continued*)

Lead author, y	Sample size (n)	Menu label condition(s) ^a	Mean calories consumed in the menu label (test) group ± standard deviation (kcal)	Mean calories consumed in the no menu label (control) group ± standard deviation (kcal)	Mean difference in calories consumed between the test and the control groups (kcal)	Proportional difference in calories selected between the test and the control groups ^b (%)	Comments
Temple, 2010 ^{38e}	47	Standard Nutrition Facts table label	Men 742 ± 195 Women 488 ± 111	1,022 ± 490 624 ± 151	−280* −136*	−16 −22	The menu label condition main effect was statistically significant ($P=0.04$). Interaction effects were not reported
Platkin, 2009 ³⁶	62	Calorie content label Calorie and exercise equivalent label	899 ± 392 841 ± 367	995 ± 429 995 ± 429	−97 −154	−10 −15	The effect of menu labels on calories consumed was not statistically significant ($P=0.344$). Effect of menu labels on calories consumed was not affected by whether or not the participants reported restrained eating behaviors (ie, dieting)
Harnack, 2008 ³⁵	594	Calorie content label Calorie content and value price (vs value price only label)	805 ± 424 761 ± 357	739 ± 358 813 ± 332	+66 −52	+9 −6	There were no significant differences in calories consumed between menu conditions. The effect of menu labels on calories consumed was not affected by sex, race, or age

^aIn all of the experimental studies selected for inclusion, the control condition was the standard menu with no nutrition information unless otherwise stated.

^bProportional difference = $(\bar{X}_t - \bar{X}_c) / \bar{X}_c$, where \bar{X}_c is the mean difference in the control group and \bar{X}_t is the mean difference in the test group that received nutrition information. Negative proportional differences favor the test condition (nutrition information), whereas positive differences favor the control (no information).

^cOriginal data were provided in an e-mail communication from Jennifer Temple, PhD, on May 6, 2013.

^dStudy was a crossover design, meaning each of the 51 participants experienced each condition (standard nutrition facts table label, traffic light label, and control label).

^eOriginal data were provided in an e-mail communication from Jennifer Temple, PhD, on May 6, 2013.

*Difference between menu label and control group is statistically significant at $P < 0.05$.

Setting <ul style="list-style-type: none"> ■ (take?out* or (take adj2 out*) or takeout or cafeteria* or (fast* adj2 food*) or fast?food* or ((food* or meal*) adj2 (service* or prepar*) adj2 outlet*) or (away adj2 home*) or (point* adj2 purchas* adj5 (food* or meal*)) or point?of?purchas* or restaurant* or food?court* or (food adj2 court*) or canteen* or (tuck* adj2 shop*)).tw. ■ exp food services/
Intervention <ul style="list-style-type: none"> ■ (((food* or menu* or content*) adj2 (label* or logo* or symbol* or icon*)) or ((nutrit* or sodium* or fat* or Calorie* or sodium* or ingred* or fruit* or vegetab* or micronutrient* or macronutrient*) adj2 (label* or logo* or symbol* or icon* or informat* or content*))).tw. ■ exp food labeling/ or exp food packaging/ or exp product labeling/
Outcome <ul style="list-style-type: none"> ■ ((impact* or influenc* or chang* or introduct*) adj3 (take?out* or (take adj2 out*) or takeout or cafeteria* or (fast* adj2 food*) or fast?food* or ((food* or meal*) adj2 (service* or prepar*) adj2 outlet*) or (away adj2 home*) or (point* adj2 purchas* adj5 (food* or meal*)) or point?of?purchas* or restaurant* or food?court* or (food adj2 court*) or canteen* or (tuck* adj3 shop*))).ti. ■ ((impact* or influenc* or chang* or introduct*) adj3 (((food* or menu* or nutrition* or calorie* or fat* or content* or sodium* or ingredient*) adj2 (label* or logo* or symbol* or icon*)) or ((nutrit* or sodium* or fat* or calorie*) adj2 (informat* or content*))).ti.
Study types <ul style="list-style-type: none"> ■ (clinical trial or clinical trial phase i or clinical trial phase ii or clinical trial phase iii or clinical trial phase iv or controlled clinical trial or multicenter study or randomized controlled trial).pt. or exp epidemiologic study characteristics as topic/ or exp research design/ or ((clin* adj5 trial*) or ((singl* or doubl* or treb* or trip*) adj5 (blind* or mask*)) or placebo* or random* or survey* or questionnair*).tw. or exp health surveys/ or exp questionnaires/
Combination <ul style="list-style-type: none"> ■ (((1 or 2) and (3 or 4)) or 5 or 6) and 7
Limits <ol style="list-style-type: none"> 1. limit 8 to (yr=1990-present and (English or French))

Figure 1. Terms, combinations, and limits used to search the MEDLINE journal citation database for publications on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments.

Criteria used to judge the quality of quasiexperimental studies	Description of how each criterion was used to judge the quality of quasiexperimental studies
Comparable source populations	If the study groups were not as similar as possible in all characteristics (except for exposure to nutrition information), or if the study report did not discuss the comparability of the source populations, the study was given a lower rating.
Blinded assessment of outcome	If the individual(s) analyzing the data were not blinded to which participants were exposed to nutrition information, the study was given a lower rating.
Validated and reliable outcome assessment	If the study did not provide evidence that the method of outcome assessment is reliable and valid, or if the study did not use multiple methods to verify the outcome, the study was given a lower rating.
Adjustment for potential confounding	If the study did not report which potential confounders were considered, or the study did not attempt to control for potential confounding, such as weight status or sex, the study was given a lower rating.

Figure 2. Four criteria used to judge the quality of individual quasiexperimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments, including a description of how each criterion was used to judge study quality.

Criteria used to judge the quality of experimental studies	Description of how each criterion was used to judge the quality of experimental studies
Randomization	If the study did not report randomizing participants to treatment groups, the study was given a lower rating.
Allocation concealment	If the study did not ensure that the investigators were unaware of to which groups participants were allocated to when they entered the study, the study was given a lower rating.
Blinding	If a study did not attempt to blind investigators, analysts, or participants to the treatment allocation to the extent possible, the study was given a lower rating.
Treatment and control groups are as similar as possible at baseline	If the treatment and control groups were not similar at the start of the trial, or if the baseline characteristics were not reported for each group, the study was given a lower rating.
Validated and reliable outcome assessment	If the study did not provide evidence that the method of outcome assessment is reliable and valid, or if the study did not use multiple methods to verify the outcome, it was given a lower rating.
Purpose of study was concealed from participants	If the study did not report attempting to at least partially conceal the purpose of the study from study participants, the study was given a lower rating.

Figure 3. Six criteria used to judge the quality of individual experimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments, including a description of how each criterion was used to judge study quality.

Factor thought to influence the effect of menu labeling	Methodology planned to test the influence of each factor on menu labeling
Sex	Group the mean differences from studies that reported results for women separately from those from those that reported differences for men only. Exclude results from a mix of men and women.
Age	Group the mean differences from studies in younger (age <30 y) study populations separately from those in older populations (age ≥30 y).
Socioeconomic status	Group the mean differences from studies that tested study populations with more education (majority had at least some postsecondary education) from those that tested populations with less education (majority did not have at least some postsecondary education).
Study setting	Group mean difference from studies conducted in natural (eg, restaurant) separately from those conducted in artificial settings (eg, university classroom).
Cost	Group mean differences from studies where participants believed they would need to pay for their meal separately from those where participants knew the food would be provided free of cost.
Type of nutrition information condition	Group the mean differences from calorie content conditions separately from those that tested calorie content plus additional contextual (eg, recommended daily caloric intake for an average adult) or interpretive (eg, traffic light symbol) information.

Figure 4. Factors thought to influence the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments as well as the subgroup analysis methodology planned to test for potential effects.

Author(s), y	Source populations are as comparable as possible	Exposure assessment is reliable	Assessment of outcome is made blind to exposure status	Potential confounders are adjusted for in the analysis	Overall quality rating
Elbel et al, 2011 ⁴⁹	Yes	Yes	Not reported	No	Lower
Finkelstein et al, 2011 ⁴⁸	Not reported	Yes	Not reported	No	Lower
Tandon et al, 2010 ⁴⁷	Yes	Yes	Not reported	Yes	Higher
Bollinger et al, 2010 ⁴⁶	Yes	Yes	Not reported	Yes	Higher
Elbel et al, 2009 ¹⁹	Yes	Yes	Not reported	Yes	Higher
Webb et al, 2011 ⁴⁵	Not reported	Yes	Not reported	No	Lower
Levin, 1996 ⁴⁴	Not reported	Yes	Not reported	No	Lower

Figure 6. Quality appraisal item scores and overall quality ratings for the seven included quasiexperimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments.

Author(s), y	Randomization	Allocation concealment	Blinding	Study purpose concealed	Comparable at baseline	Outcomes measured in a standard, valid, and reliable way	Overall quality rating
Ellison et al, 2013 ⁴³	Yes	Not reported	Not reported	Yes	Not reported	Yes	Lower
Girz et al, 2012 ⁴²	Not reported	Not reported	Not reported	Yes	Not reported	Yes	Lower
Temple et al, 2011 ⁴¹	Not reported	Not reported	Not reported	Not reported	Yes	Yes	Lower
Wisdom et al, 2010 ⁴⁰	Yes	Not reported	Not reported	Yes	Not reported	Yes	Lower
Roberto et al, 2010 ³⁹	Yes	Not reported	Not reported	Yes	Yes	Yes	Higher
Temple et al, 2010 ³⁸	Yes	Not reported	Not reported	Not reported	Not reported	Yes	Lower
Gerend, 2009 ³⁷	Yes	Not reported	Not reported	Not reported	Yes	Yes	Lower
Platkin, 2009 ³⁶	Yes	Not reported	Not reported	Yes	Yes	Yes	Higher
Harnack et al, 2008 ³⁵	Yes	Not reported	Not reported	Yes	Yes	Yes	Higher
Stubenitsky et al, 2000 ³⁴	Yes	Not reported	Not reported	Not reported	Yes	Yes	Lower

Figure 7. Quality appraisal item scores and overall quality ratings for 10 included experimental studies on the influence of menu labeling on consumers' selection and/or consumption of calories in restaurants and other foodservice establishments.