J Community Health (2014) 39:1248–1269
DOI 10.1007/s10900-014-9876-0

REVIEW

The Influence of Calorie Labeling on Food Orders and Consumption: A Review of the Literature

Kamila M. Kiszko · Olivia D. Martinez · Courtney Abrams · Brian Elbel

Published online: 24 April 2014
© Springer Science+Business Media New York 2014

Abstract Obesity is a challenging public health problem that affects millions of Americans. Increasingly policy makers are seeking environmental and policy-based solutions to combat and prevent its serious health effects. Calorie labeling mandates, including the provision in the 2010 Patient Protection and Affordable Care Act that is set to begin in 2014, have been one of the most popular and most studied approaches. This review examines 31 studies published from January 1, 2007 through July 19, 2013. It builds on Harnack and French's 2008 review and assesses the evidence on the effectiveness of calorie labeling at the point of purchase. We find that, while there are some positive results reported from studies examining the effects of calorie labeling, overall the best designed studies (real world studies, with a comparison group) show that calorie labels do not have the desired effect in reducing total calories ordered at the population level. Moving forward, researchers should consider novel, more effective ways of presenting nutrition information, while keeping a focus on particular subgroups that may be differentially affected by nutrition policies.

Keywords Obesity · Nutrition policy · Calorie labeling · Menu labeling · Fast food

K. M. Kiszko · O. D. Martinez · C. Abrams · B. Elbel (✉)
Department of Population Health, New York University School of Medicine, 550 First Avenue, VZ30 6th Floor, New York, NY 10016, USA
e-mail: Brian.Elbel@nyumc.org

K. M. Kiszko
e-mail: Kamila.Kiszko@nyumc.org

O. D. Martinez
e-mail: Olivia.Martinez@nyumc.org

C. Abrams
e-mail: Courtney.Abrams@nyumc.org

B. Elbel
New York University Wagner School of Public Service, New York, NY, USA

Introduction

Obesity is a challenging public health problem. Being obese increases the risk of many chronic conditions, including diabetes, hypertension, high cholesterol, stroke, heart disease, certain cancers, and arthritis [1]. Nearly 36 % of all American adults and 17 % of children are obese [2, 3], with minorities disproportionately suffering from the disease [2, 4]. In recent years, obesity has also become a severe burden for the US health care system, with total obesity-related costs exceeding $215 billion annually [5].

Fast food consumption has been linked to higher caloric intake and greater risk for obesity [6–8]. As an increasing number of consumers are dining at fast food restaurants [9], policy makers are giving attention to environmental and policy approaches that influence consumer choice, including mandated calorie menu labels in fast food restaurants. The 2010 Patient Protection and Affordable Care Act included a provision requiring restaurants with more than 20 locations nationwide to post calorie information at the point of purchase [10]. The legislation followed the actions of dozens of cities, counties, and states that passed their own laws requiring the posting of nutritional information in chain restaurants [11].

Calorie labeling as an obesity prevention policy holds promise. In its absence, nutritional information is difficult to access and understand [12]. Many consumers are not

aware that nutritional information is available on pamphlets in restaurants or on restaurants' websites. Of those who are aware, a very small percentage actively seeks out this information [13]. Consumers often underestimate calories in their foods, especially calories in items purchased from fast food restaurants [14–18]. As the total number of calories in a meal increases, so too does the consumer's underestimation of the total calories in the meal [14]. Furthermore, consumers want access to nutrition information [19–21], and report that they would to use it to inform healthier food choices [19, 22]. Therefore, calorie labels at the point of purchase could be an important and necessary source of information for consumers.

In 2008, Harnack and French published the first comprehensive review of the impact of calorie labels on food choice and concluded that calorie labeling had potential to affect food choices. However, the available evidence supported only "weak" or "inconsistent" effects. [23]. Although all but one study they reviewed demonstrated that calorie information may have a positive influence, the effects tended to be marginal and inconsistent across different categories of foods. At the time of their review, only six experimental, laboratory-based studies were available, as no jurisdictions had yet implemented calorie labeling. The studies reviewed included menu interventions at university and worksite cafeterias, as well as experiments where participants made hypothetical food choices. The authors concluded that the six articles reviewed contained "major methodological shortcomings," and called for research conducted in natural settings.

In the years since that review, a number of localities implemented mandatory calorie labeling requirements for restaurants, and several studies examining the impact of the policies have been published. In 2011, Swartz and colleagues published an update to Harnack and French's 2008 review [24]. All of the studies in that review were required to have calorie labeling at the point of purchase or selection as a central component of the study; include original empirical evidence of the impact of calorie labeling on food choice; and use a natural, quasi-experimental, or experimental design. Thus, studies conducted in laboratory settings, some of which relied on hypothetical food selections, were excluded. The review ultimately examined seven papers and concluded that calorie labeling was not an effective way to reduce calories purchased or consumed [24].

This review builds on Harnack and French's 2008 review and uses less restrictive inclusion criteria than Swartz et al. (2011) in order to assess the evidence on calorie labeling published since 2008. Thus, we include studies examining hypothetical food selections. Properly framed, the results from these provide insight into how calorie labeling at the point of purchase affects food choices and how this policy can be improved. We are also very clear about how to differentially view these studies as compared to other work. In advance of the national expansion of calorie labeling, this article summarizes the state of knowledge about the effectiveness of calorie labeling and offers suggestions for future research.

Methods

Search Strategies

A literature search was conducted through two online search engines—PubMed and Google Scholar—for articles published from January 1, 2007 through July 19, 2013. The search term combinations used in Google Scholar were Menu nutrition labeling + (choice or purchase or order) and (restaurant or "fast food"), and in PubMed were (Restaurant OR Chain* OR Fast Food OR Cafeteria) AND [Menu OR ("point of purchase" OR "Point-of-Selection")] AND [(Label*) OR (Calorie*) OR Information]. The main outcome of interest was change in total calories ordered. We also paid attention to self-reported awareness and use of calorie labels.

Inclusion and Exclusion Criteria

All articles were published in or after 2007, the year that Harnack and French (2008) conducted the last comprehensive literature review. Studies were excluded if they did not examine calorie labeling at the point-of-purchase or point-of-selection, relied solely on self-reported use of calorie labels or only focused on participants' attitudes toward calorie labeling. Review, editorial and commentary articles were excluded. Relevant information from all articles were entered into a Microsoft Excel spreadsheet to facilitate comparison.

The initial search produced a total of 503 titles, 103 from PubMed and 400 from Google Scholar. After an eligibility screening of titles and abstracts, 402 papers were removed for being irrelevant (i.e. studies unrelated to the influence of calorie labeling specifically, or those that did not focus on food choice). Following that process, an additional 27 duplicates were removed. A total of 74 studies remained for a full text screening. Forty-three studies were excluded for being off topic or not meeting the inclusion criteria. The remaining 31 studies are reviewed in this paper and organized hierarchically into categories based on setting and study design. See Fig. 1 for a more detailed description of the search process.

We divided the studies into the following categories, from strongest to weakest study design: "real world" settings, which include fast food restaurants or cafeterias, and

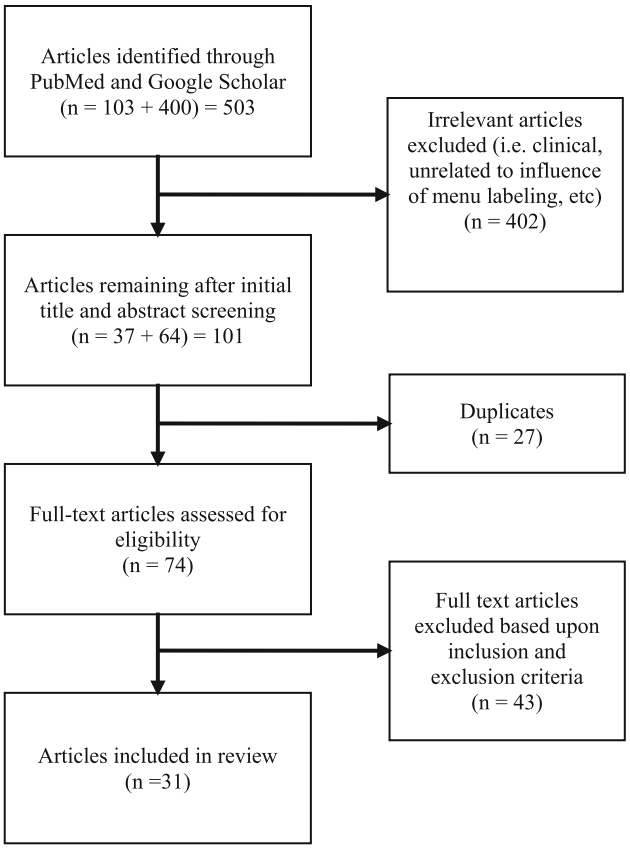

Fig. 1 Flowchart of the literature review process

"laboratory settings", which include other controlled settings where participants either ordered and consumed meals or simulated their food selections based upon imitation menus or scenarios. Research has shown that people make choices differently in contrived settings [25], which is why we differentiate between studies conducted in naturalistic versus controlled settings. We separated studies conducted in fast food restaurants versus those conducted in cafeterias because the population in each of these is less generalizable to the general population.

We gave the most weight to studies that include a comparison group, as the use of a comparison group helps determine if the observed effects were attributable to calorie labels as opposed to other factors. In this paper, we first discuss studies focusing on purchases made at fast food restaurants that include a comparison group, followed by those without a comparison group. We then turn to studies conducted in cafeterias, first highlighting those that include a comparison group, followed by those that do not. Finally, we examine all studies conducted in laboratory settings, dividing them into two categories: those that examine actual food orders and consumption, and those that look at simulated food selections. For further details, see Table 1.

Results

Overview of Study Characteristics

Setting

Of the 31 studies reviewed, 18 were conducted in "real world" settings and focused on actual food purchases [16, 26–42]. Twelve of these are natural experiments, conducted in locations where calorie labeling in fast food chain restaurants has been implemented, either by legal mandate or voluntarily by restaurants [16, 26–34, 39, 40]. Six were conducted in university or worksite cafeterias [35–38, 41, 42]. We discuss these studies separately from those focusing on fast food restaurants, because each of these involved an intervention designed specifically for patrons of these dining halls. The remaining 13 studies were conducted in controlled laboratory settings and utilize experimental designs to measure the impact of calorie labels on food choices [13, 17, 22, 43–52]. Three analyzed the effect of calorie labels on total calories ordered and consumed during an organized study meal [13, 44, 45], and 10 examined the role of calorie information on menus in hypothetical food selections [17, 22, 43, 46–52].

Measures and Samples

Twenty-three studies in this review include a survey component to examine if and how fast food consumers use calorie labels when deciding what to order [13, 17, 22, 26–29, 31, 33, 37–48, 51, 52]. Eight studies quantify total calories purchased or ordered using transaction data obtained from restaurants and cafeterias [16, 32–38], seven examine receipts collected from customers as they exited restaurants [26–29, 31, 39, 40], and three prepare foods on-site [13, 44, 45]. Of the 31 studies reviewed here, all but four examine purchases made by and for adults [29, 30, 48, 49]; seven of these focus on college students [13, 17, 22, 35, 37, 42, 46]. Of the studies examining real food orders, most attempted contact with all consumers present at the study site during the study period, such as lunch and/or dinner time [26–29, 33, 38, 39], or other busy times for restaurants [27, 34, 40] or cafeterias [41].

Category 1: "Real World" Settings: *Restaurants*

Twelve studies focus on purchases made at restaurants [16, 26–34, 39, 40], ten at fast food chains [16, 26–29, 31–33, 39, 40], and two at small sit-down establishments [30, 34]. Seven of these studies also inform on customers' self-reported awareness and/or use of calorie labels when ordering food [26, 28–31, 33, 40]. Self-reported awareness of calorie labels varies in each study, from only 28 % of

Table 1 Article Summary Chart

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Category 1: Real world studies: fast food restaurants					
Bollinger, Leslie, Sorensen. 2011 [32][a]	Quasi-experimental; Analysis of transaction data from Starbucks locations in NYC and Seattle (and control locations) to estimate impact of the policy on consumers' food choices, pre- and post-calorie labeling mandate	>100 million transactions at all locations in study areas; 1.51 million transactions of ~10,000 Starbucks cardholders in New York, NY, Boston, MA, Philadelphia, PA; 792 adults in Seattle and San Francisco	Calories on menus, as per NYC and Seattle mandates	Transaction data; surveys (Seattle only)	Effect of calorie labels increased for consumers who tend to make high calorie purchases (26 % decrease in calories per transaction) Calories per transaction decreased by 6 %, but negligible effect on beverage calories 74 % of the reduction is due to consumers not purchasing a food item; 26 % due to consumers choosing lower calorie food items Average food calories fell by 14 % while average beverage calories did not fall No effect on frequency of store visits, purchases or profits
Elbel, Kersh, Brescoll, Dixon. 2009 [28][a]	Natural experiment—Difference in difference; Analysis of purchases at fast food chains in low-income neighborhoods, pre- and post-implementation of NYC menu labeling mandate	1,156 adults at fast food chains in low-income minority communities in New York, NY and Newark, NJ (control city)	Calories on menus, as per NYC mandate	Receipts; surveys	Increase in respondents who noticed menu labels in NYC only, not in Newark 27.7 % of post labeling NYC sample reported noticing and using menu labels to purchase food; of those 88 % said they used it to buy lower calorie food ($P < 0.05$ for all three) No difference in mean calories purchased pre- and post- menu labeling mandate in NYC No significant decrease in calories purchased among those who reported purchasing fewer calories because of menu labels in NYC

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Elbel, Gyamfi, Kersh. 2011 [29][a]	Natural experiment—Difference in difference; Analysis of children's and adolescents' purchases at fast food chains in low-income neighborhoods, pre- and post- implementation of NYC menu labeling mandate	349 Children and adolescents (1-17) at similarly located fast food chains in low-income neighborhoods in New York, NY and Newark, NJ	Calories on menus, as per NYC mandate	Receipts; surveys	57 % of respondents reported noticing calorie information post-mandate in NYC (vs. 0 pre-mandate) Of those who noticed menu labels, 9 % reported the information influenced their food choice; 9 % said they purchased a lower calorie meal after seeing calorie information No significant differences in average calories purchased pre- and post- menu labeling in intervention or control communities (NYC $P = 0.82$, Newark $P = 0.37$) Adolescents shopping without parents tended to buy higher calories foods Parental involvement in child's food choices did not have an impact on total calories purchased
Finkelstein, Strombotne, Chan, Krieger. 2011 [16][a]	Natural experiment—Difference in difference; Analysis of average calories per transaction in fast food chains, pre- and post- implementation of King County menu labeling mandate.	7 randomly selected Taco Time Northwest chains in King County, WA; 7 Taco Time chains in adjacent counties (control)	Calories on menus, as per King County mandate	Transaction data	Slight increase in food (4.5 cal) and decrease (3.6 cal) in beverage calories pre- to post-mandate in King County, with no change in total calories purchased Total calories purchased in King County pre- and post-mandate were significantly lower than outside of King County (180 cal lower; $P < 0.05$). This may help explain why mandate did not have a greater effect No significant differences in sales across all major food/beverage categories

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Tandon, Zhou, Chan, et al. 2011 [30][a]	Prospective cohort; Analysis of parents' and children's purchases at fast food chains, pre- and post- implementation of King County menu labeling mandate	145 families with 6–11 years old children in King County, WA and San Diego County, CA (control county)	Calories on menus, as per King County mandate	Receipts; phone interviews	Significantly more parents in King County reported seeing menu labels on menu boards post mandate (12 vs. 68 %; $P = 0.002$) Only 13 % of parents who reported seeing menu labels said it influenced the food choice for their child ($P < 0.001$), and 45 % reported that menu labels influenced meal choice for themselves ($P < 0.001$) No difference in number of calories purchased pre- and post- menu labeling mandate in either county Mean calories for overweight participants in King County decreased significantly from pre to post (848 vs. 737; $P = 0.04$), but results were not significant between counties
Vadiveloo, Dixon, Elbel. 2011 [31][a]	Natural experiment—Difference in difference; used Elbel et al. 2009 (XX) data to analyze the types of food purchased, pre- and post-implementation of NYC menu labeling mandate	1,156 adults at fast food restaurants in low-income minority communities in New York, NY and Newark, NJ (control city)	Calories on menus, as per NYC mandate	Receipts, surveys	Adults who noticed menu labels and reported using them were more likely to order a salad than those who reported not seeing the menu labels, or those who saw it but didn't use it (15 vs. 6 vs. 4 %; $P < 0.05$) Adults who noticed menu labels and reported using them consumed .64 fewer lunches and .48 fewer dinners at fast food restaurants than those who did not notice menu labels; those who saw menu labels, but didn't use them ate .39 fewer fast food snacks and 1.12 fewer fast food meals than those who didn't notice the information (all $P < 0.05$) Increase in caloric beverage orders in NYC post-labeling (12 vs. 18 %; $P < 0.05$) No significant differences found for orders of French fries or order frequency of fast food breakfasts, snacks, and overall meal consumption

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (P values reported where available)
Bassett, Dumanovsky, Huang, et al. 2008 [26]	Cross-sectional; Analysis of purchases at fast food chains and consumers' observation and use of menu labels	7,318 adult fast food chain consumers at 167 restaurants in New York, NY	Number of calories; deli cases near cash register	Receipts; surveys	Only 4 % of consumers at non-Subway restaurants reported seeing calorie information, versus 32 % of Subway consumers ($P < 0.001$) Subway consumers who reported seeing and using calorie information ordered 99 fewer calories than those who reported seeing the information but not using it ($P < 0.001$) Subway consumers who reported seeing and using calorie information ordered 99 fewer calories than those who reported seeing the information but not using it ($P < 0.001$)
Downs, Wisdom, Wansink, Loewenstein. 2013 [39]	Randomized experiment; analysis of food purchases at fast food chains under two calorie information conditions in addition to NYC menu labeling mandate requirements	1,121 McDonald's patrons at two restaurants in NYC	Calories on menu, as per NYC mandate, plus 3 conditions of additional information: daily, per meal, or no caloric intake recommendations	Receipts, surveys	Daily calorie intake recommendation led to a better estimation of one's own daily recommended calorie intake compared to per meal or no recommendation ($P = 0.001$; $P = 0.009$, respectively) No significant interaction between the daily or meal recommendations and calorie labels ($P = 0.74$, $P = 0.7$, respectively) Neither calorie recommendation condition reduced calories purchased

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (P values reported where available)
Dumanovsky, Huang, Nonas, Matte, Bassett, Silver. 2011 [27]	Cross-sectional; Analysis of consumers' lunchtime purchases at fast food chains, pre- and post- implementation of NYC menu labeling mandate	16,480 consumers at 168 fast food chain locations during lunchtime hours in New York, NY	Calories on menus, as per NYC mandate	Receipts; surveys	1 in 6 consumers reported using menu labels Women and consumers in wealthiest areas were most likely to report using calorie information ($P < 0.001$) 18–24 year olds were least likely to report using calorie information ($P < 0.001$) There was no difference in purchase price between consumers who reported using calorie information and those who did not ($P = 0.07$) There was no significant change in mean calories per purchase from pre- to post-regulation (828 vs. 846) Consumers who reported using the calorie information purchased 106 fewer calories, compared to consumers who didn't see or didn't use the information ($P < 0.001$); these consumers also purchased fewer food items on average ($P < 0.001$), and fewer purchased a beverage ($P = 0.03$)
Holmes, Serrano, Machin, Duetsch, Davis. 2013 [34][a]	Longitudinal; Analysis of the impact of three different menu designs for children's meals on total calories and fat ordered by families	1275 children's meals at a full service family-oriented restaurant at a private club	4 labeling conditions 1: Control; 2: Calorie and fat information; 3: Symbol to indicate a healthier choice; 4: Nutrition Bargain Price (NBP) assigned to each combination; Each menu was offered for 2 months	Sales data	No significant changes on total calories and fat ordered under any labeling condition ($P < 0.05$) Decrease in calories and fat for combo purchases and increase in calories and fat purchases for a la carte menu items; most striking effects were observed under the NBP menu format Decrease in calories of unhealthy meals purchased and a significant increase in calories healthy a la carte meals purchased (difference of −53.39 cal for the unhealthy combos and 36.14 for the healthy a la carte meals) observed from the NBP menu ($P < 0.05$)

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Krieger, Chan, Saelens. 2013 [40]	Cross-sectional; Examines the effectiveness of menu labeling and consumer awareness of menu labels pre and two times post implementation of menu labeling mandate in King County	7,325 restaurant patrons at 50 locations of 10 chain restaurants in King County, WA	Calories on menu, as per King County mandate.	Receipts, surveys	Increase in seeing calorie labels at food chains increased from 19 to 58 % Post 1, to 62 at Post 2; at coffee chains: 4 to 31–30 %. 36 % of food and 28 % of coffee chain customers reported using calorie labels. No significant change in calories purchased pre and Post 1 (6 months post-implementation) data collection. Decrease in mean calories purchased from pre to Post 2 (18 months post-implementation): 38 calories in fast food chains ($P = 0.06$) and 22 calories in coffee chains ($P = 0.002$); taco and coffee chains experienced decrease in calories purchased, burger and sandwich chains did not Customers who saw labels purchased fewer calories than those didn't, but this difference was not significant (39.2 kcal less, $P = 0.10$). Larger decrease in calories purchased at coffee chains among women than men (36.6 kcal more, $P = 0.02$).
Pulos, Leng. 2010 [33]	Cross-sectional; Analysis of change in average calories, fat, and carbohydrates per order, as well as consumers' use of nutritional information, pre- and post-voluntary menu labeling in Pierce County restaurants	206 consumers surveyed, ~16,000 entrees from 6 restaurants in Pierce County, WA	Calories, fat (g), sodium (mg), carbohydrates (g); posted voluntarily in 14 restaurants (though not always at point of purchase)	Transaction data; surveys	71 % of consumers reported noticing nutrition information after menu labeling; 57 % looked at nutrition key 54 % of respondents understood the information well enough to identify healthier menu options, but only 20 % of them used it to purchase a lower calorie item, and only 16.5 % to purchase an item lower in fat Average calories per order decreased by 15 cal, 1.5 g of fat, and 45 mg of sodium after posting nutrition information; no difference in carbohydrate content

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Category 1: Real world studies: cafeteria interventions					
Chu, Frongillo, Jones, Kaye. 2009 [35]	Quasi-experimental, single group, time-series interrupted study; Analysis of average calories purchased per transaction over time with pre/during/post menu labeling intervals in a university cafeteria	Consumers at student dining center (mainly college students and some staff); 42,170 entrees in dining center at Ohio State University	Calories; serving size (g); fat (g); protein (g); carbohydrates (g); labels next to point of selection	Transaction data	Entrees with the highest calorie content decreased in sales during labeling period ($P = 0.007$), but increased during post-labeling period ($P = 0.005$) Average energy content of all entrees sold decreased 12.4 kcal during labeling condition ($P = 0.007$), but increased immediately post-labeling, at the rate of 1.5 cal per day ($P = 0.013$) Revenue per entre did not change between study periods—no loss of revenue to dining hall
Lowe, Tappe, Butryn, et al. 2010 [36]	Quasi-experimental; Analysis of the effect of environmental changes in a worksite cafeteria and worksite nutrition education program on food intake over time	96 university/hospital staff members in 2 hospital cafeterias who reported eating lunch in the hospital cafeteria at least 2x/week in Philadelphia, PA.	Calories; color codes highlighting very low through high energy foods	Dining card scans; dietary recalls; anthropometric measurements; blood lipids and pressure; cognitive restraint test	Total energy intake from purchased cafeteria foods and percent of energy from fat in purchased food declined significantly over the 6-month period among overweight and obese participants ($P = 0.001$) There was a reduction in the percentage of fat in lunches consumed which was accompanied by an increase in carbohydrate intake ($P < 0.001$) Introduction of food labeling and the availability of lower energy dense foods decreased the consumption of fat among overweight and obese participants ($P = 0.001$)
Freedman. 2011 [37]	Quasi-experimental, single group, observational study; Analysis of changes in portion choices of food pre and post at an all-you-can-eat dining hall at a large college campus	Convenience sample of 1675 students living on campus and subscribed to the university meal plan, attending San Jose University	Signs, portion size pictures, nutrition information (calories, fat (g) % of calories from fat); at point of selection)	Direct observation; survey data; transaction data; foodservice inventory records; focus groups	POSNI affected portion size choice for French fries; 17 % of students who chose the large portion size prior to POSNI switched to the small portion size once POSNI was in place (63 % chose larger portions prior to POSNI vs. 43 % after POSNI; $P < 0.05$) Students were willing to choose salad dressings that were lower in calories if they were similar in taste and texture to the originally preferred higher calorie options; however POSNI had no impact on students choosing the lowest-calorie salad dressing option

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (P values reported where available)
Webb, Solomon, Sanders, Akiyama, Crawford. 2011 [38]	Experimental design; Evaluated a calorie labeling intervention in Kaiser Permanente Hospital cafeterias	A total of 554 respondents from the 3 intervention sites completed the survey, 334 from sites with both menu boards and a poster, and 220 from the poster only site	Condition 1: no labeling; Condition 2: calorie and nutrient labeling on posters away from point of selection; Condition 3: posters plus point of purchase menu board calorie labeling	Surveys; transaction data	Respondents from sites with menu board plus poster were significantly ($P < 0.05$) more likely to notice calorie information (69 %) compared to respondents at the site with posters alone (58 %) Among the 32 % of respondents who noticed the posted calorie information at each site, one-third stated that their purchase was influenced by the posted calorie information The proportion of target side dishes purchased increased by 4.8 % at the intervention site and decreased by 4.8 % at the nonintervention site ($P = 0.0007$) The proportion of target snacks purchased increased by 1.3 % at the intervention site and decreased by 8.1 % at the comparison site ($P < 0.006$) Significant positive impact of calorie labeling on menu boards plus posters compared with no labeling on the selection of lower calorie side dishes and snacks
Vanderlee, Hammond. 2013 [41][a]	Cross-sectional; Examined the impact of nutrition labeling in hospital cafeterias food ordered and consumed	1,003 patrons of 2 hospital cafeterias in two cities in Canada	Intervention: digital menu boards at POS with prominent calorie, sodium, fat and saturated fat content for most food groups. Healthy food logos and educational campaigns throughout cafeteria. Control: limited nutrition labeling for limited items, on paper signs.	Surveys	More respondents noticed labeling in the intervention cafeteria than the control cafeteria (27 vs. 10 %, $P < 0.001$) Hospital staff were more influenced by menu labels than visitors or patients ($P = 0.029$; $P = 0.018$, respectively). Whites were least likely to report using menu labels ($P = 0.046$). Those who noticed menu labeling consumed 322 kJ (77 kcal) less energy ($P = 0.001$), 159 mg less sodium ($P = 0.001$), 1.5 g less saturated fat ($P = 0.001$) and 4.8 g less fat ($P = 0.001$) than those who did not notice menu labeling.

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Ellison, Lusk, Davis. 2013 [42][a]	Field experiment;Examines the impact of menu labeling format in restaurants, patrons' health consciousness and socio-demographic characteristics on caloric intake	138 survey respondents at a full service restaurant at Oklahoma State University Campus	3 menu groups: 1. Control (no nutritional information); 2. Calorie-Only group; Calorie + Traffic Light group	Surveys; calories of menu items	The calorie + traffic light menu label led to significantly fewer entrée calories ordered ($P = 0.033$) compared to the other two labeling formats; no significant reductions of extra calories ordered ($P = 0.294$) Neither label significantly changed total calories ordered relative to the control, however diners in the calorie + traffic light label condition ordered 121 fewer calories than those in the calorie-only label condition ($P = 0.063$). Women ordered significantly fewer entrée calories than men ($P = 0.026$) Those with a BA degree ordered fewer "extra" calories (92 calories fewer, $P = 0.086$) than those without a college degree Participants who reported health being the most important factor when ordering food were more likely to be low-calorie diners versus medium- or high-calorie diner ($P = 0.001$), as were participants whose restaurant visit was business-related ($P = 0.038$)
Category 2: Laboratory settings: food orders and consumption behaviors					
Girz, Polivy, Herman, Lee. 2011 [13]	S1: Quasi-experimental cross-sectional; Analysis of food orders of dieters versus non dieters (females only) S2: Quasi-experimental cross-sectional: Analysis of food orders and actual food consumption of dieters versus non dieters (males and females)	S1: 149 female students; S2: 254 male and female students	Calories on menus	Surveys; calories of foods prepared on site	S1: Calorie information influenced food selection among restrained eaters, but not among unrestrained eaters There were no significant differences in the amount of food eaten based on availability of calorie information S2: Restrained female eaters were more likely to choose low calorie options Unrestrained eaters used calorie labels when choosing what food to consume Calorie labeling impacted food choice when the labels differed from expectations (i.e.: when food that is thought to be low-calorie is in fact not low-calorie)

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (P values reported where available)
Harnack, French, Oakes, Story, Jeffery, Rydell. 2008 [44]	Randomized controlled 2 × 2 factorial experiment; Analysis of ordering behavior and food consumption based on randomly distributed menus	594 frequent consumers at fast food chains in Minneapolis-St. Paul, MN	Calories on randomized menus	Surveys; weighing of food pre- and post-consumption; exit interview	No significant differences in calories and nutrition composition of the meals ordered across the groups that received each respective menu No significant differences in calories of meals selected and consumed across experimental conditions and demographic characteristics (age, education level, body weight strata) Significant differences in energy intake between experimental conditions based on those who reported that nutrition was very important or somewhat important when buying foods at a fast food restaurant ($P < 0.01$) Significant differences between experimental conditions based on gender, but only for males ($P < 0.01$)
Roberto, Larsen, Agnew, Baik, Brownell. 2010 [45][a]	Randomized controlled experiment; Analysis of calories ordered and consumed when receiving a menu with no calorie information, a menu with calorie labels, or a menu with calorie labels and an anchor statement	303 community residents in New Haven, CT	Calories on randomized menus	Surveys; weighing of food pre- and post-consumption; 24-h dietary recall; focus groups	Meals ordered by individuals in the two "calorie labels" groups were, on average 326 calories lower than those ordered by individuals in the "no calorie labels" group ($P = 0.03$ for both); no significant difference between calorie labeling versus calorie labeling with information groups Those in the "calorie labeling" group consumed more calories post-study meal than those in the "no calorie labeling" group or in the "labeling plus information" group ($P < 0.006$) Participants in the "calorie labeling plus information" group consumed significantly less total calories at dinner and evening meals than the remaining two groups (~250 less calories; $P = 0.03$) The "calorie labeling plus information" group was more likely to accurately estimate the caloric content of their dinner ($P = 0.02$ for no labels vs. labels, and $P = 0.003$ for no labels vs. labels plus information)

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Category 2: Laboratory settings: simulated food selections					
Gerend. 2009 [17][a]	Randomized controlled experiment; Analysis of difference in food choices when receiving a menu with calories listed per item versus no calorie information for three difference scenarios: quick dinner, starving, not too hungry	288 Introductory Psychology college students	Calories on menus; printed next to items	Surveys	Women ordered fewer calorie meals and meal items when menus with calorie information were provided versus ordering from menus where no calorie information was listed (difference of 146 cal; $P < 0.05$) Women chose lower-priced meals in the presence of calorie labeling; Calorie labeling did not have an effect on men's ordering with regard to calorie content or price of the meal ($P < 0.05$)
Bates, Burton, Huggins, Howlett. 2009 [14]	Study 1 of 2 randomized experimental studies; Analysis of the effects of nutrition disclosure on consumer evaluations and purchase intentions while also considering potential moderating effects due to gender differences and motivation levels	68 college students	Calories printed on menu board, items printed in various orders	Surveys	Participants underestimated calories by nearly half (618 calories of 1,300 cal meal) Purchase intentions for less healthy items decrease significantly when calorie information is included ($P < 0.01$) Females are more likely to order healthier food ($P < 0.05$) There is a significant relationship between the accuracy of the consumers' expectations of calorie level and their intention to purchase a specific food item. ($P < 0.05$)
Wisdom, Downs, Loewenstein. 2010 [47]	Two cross-sectional studies; S1: Analysis of consumers' orders when presented with a menu that emphasized informational approach; S2: Analysis of consumers' orders when presented with a menu that emphasized an asymmetrically paternalistic approach to encourage low-calorie meals	Two survey designs: study 1N = 292, study 2 N = 346; Consumers at a local sandwich chain restaurant—Subway	S1: Calories and recommended daily caloric intake information; printed on paper menu; S2: Calories and certain options separated on the basis of being healthy/unhealthy; printed on paper menu and unhealthy choices listed separately	Surveys, calorie counts from presented menus	Calorie information reduced calorie intake of the non-overweight The strong intervention (a sealed menu with alternative, higher calorie sandwiches inside) reduced calorie intake while the weak intervention (high calorie options on the reverse side) increased calorie consumption S1: Providing specific calorie information was significantly associated with participants ordering lower calorie meals (44 % more likely to choose a healthier sandwich) ($P < 0.001$), as did providing daily calorie recommendations ($P < 0.05$) S2: Providing limited information about calories influenced participants' sandwich choice but not overall calories (35 % more likely to choose a healthier sandwich) ($P < 0.03$)

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (*P* values reported where available)
Stutts, Zank, Smith, Williams. 2011 [48]	Experimental; tested whether providing nutrition information (calories and fat grams) or healthy heart symbol on fast food menus influenced the calories and fat content of the items they chose to order.	236 children ages 6–11	Menu boards with food items from McDonald's and Wendy's. Calories and fat listed below each item.	Surveys; recorded children's hypothetical orders	Children in the nutrition information condition did not choose items with fewer calories or fat and did not differ significantly from the control group Significant interaction between condition and SES ($P < 0.05$). Nutrition information was only effective for children in high SES
Tandon, Wright, Zhou, Rogers, Christakis. 2010 [49][a]	Randomized, controlled experiment; Examines whether nutrition labeling on menus would lead to lower-calorie choices for children.	99 families recruited from a pediatric clinic in Seattle, WA.	McDonald's picture menu with and without nutrition labeling presented to parents, asked to circle choices for themselves and their child.	Calculated calories for items ordered	Parents in intervention group ordered an average of 102 fewer calories for their children than those in control group (567.1 vs. 671.5 cal; $P = 0\ .04$) No difference in calories parents ordered for themselves
Giesen, Payne, Remco, Jansen. 2011 [50]	Experimental design; Explored potential combined effects of calorie information and taxes on highly caloric foods.	178 university students.	Menu viewed on a computer screen. 3 categories: main courses, desserts/ snacks, and drinks. Each category had 4 high calorie and 4 low calorie products.	Momentary hunger measured before viewing menus, restraint scale, calories of items ordered	Demand for calories decreased with increase in restraint score; Demand for calories increased with level of hunger Significant main effect for tax (estimate = −.435, $P < 0.001$) and calorie information (estimate = −.345, $P = 0.007$) Significant interaction of tax by calorie information ($P = 0.003$) Price increase for high calorie foods reduced the percentage of calories chosen for lunch, but only in the no calorie group ($P = 0.001$)
Morley, Scully, Martin, Niven, Dixon, Wakefield. 2013 [51][a]	Between-subjects experiment; Examines the influence of five different menu labeling formats at the point of sale on total calorie content of selected evening meals	1,294 subjects in Victoria, Australia	Experimental conditions: (1) no menu labeling (control) (2) kilojoule information (3) kJ + DI% (4) kJ + traffic light (v) kJ + traffic light + DI%	Online survey	Participants in the control condition chose highest calorie meals Kilojoule labeling and kilojoule plus traffic light menu condition led to significantly lower mean calorie orders compared to no labeling condition (490 and 500 kJ decrease, respectively, $P = 0.05$ for both). Differences between the other 2 labeling conditions compared to control were not significant. 20-37 % of those who saw calorie information in any condition reported using it to guide food choice Among participants in the condition that included all pieces of nutrition information, traffic light labels were most commonly used when making food selections

Table 1 continued

Authors	Study design/description	Sample	Menu information provided and placement	Measurement tools	Outcome and results (P values reported where available)
Prins, Gonzales, Crook, Hakkak. 2012 [22]	Experimental; Analysis of impact of providing calorie information on restaurant menus on total calories ordered by college students	64 undergraduate students from southern universities in the US	2 menus: 1. No nutritional information; 2. Calories on menu and a daily calorie recommendation statement.	Online survey; calorie information from offered menu items	Decrease in mean calories selected when ordering from the calorie information menu (136 calories) ($P < 0.001$). 57 % of respondents changed the number of calories ordered after seeing the menu containing calorie labels
Wei, Miao. 2013 [52][a]	2 × 2 full-factorial experiment; Examines the impact of providing calorie information on food selections in fast food restaurants and interaction effects of provided calorie information, psychological variables, and perceived healthfulness of the restaurant on food selections	178 consumers in a Mid-Western town in Indiana	Calories on menu boards	Online survey	Interaction between perceived restaurant healthfulness and disclosure of calorie information on food choices ($P < 0.05$) In a perceived "healthful" restaurant those with access to calorie information chose about 100 fewer calories than those without access to calorie information. In a perceived "unhealthful" restaurant there was no significant difference in calories ordered, although those with access to calorie information ordered about 50 more calories than those without access to calorie information.
Liu, Roberto, Liu, Brownell. 2012 [43][a]	Experimental; Examines the different calorie information formats and perceived healthfulness of restaurant on calories ordered.	419 consumers in an online database hosted by a university in northeastern United States	4 menu formats: 1: no calorie information 2: calorie labeling plus daily caloric intake recommendation 3: calorie labeling with rank ordered food items 4: all from above 2 and 3 plus colors indicating high and low calorie option	Survey, caloric content of items ordered	No significant differences in calories ordered between no calorie and calorie information only group ($P = 0.262$) Rank-ordered and colored-calories menu format led to fewer calories ordered compared to the no calorie information group ($P = 0.013$) Participants in all three menu format conditions estimated the number of calories ordered more accurately than the no calorie information condition.

[a] These studies include a comparison group

customers reporting seeing calorie labels post policy implementation [28], to 57 % [29], and 68 % [30] of respondents reporting noticing calorie labels on restaurant menus in cities where the policy was implemented.

The reported use of this information is low in each study. Of the 57 % of youth who reported seeing calorie labels in NYC's fast food restaurants, only 9 % used the information when deciding what to order [29]. In another study conducted in NYC, of the 28 % of fast food patrons who saw calorie labels, 88 % reported being influenced by the information [28]. Finally, of the 68 % of customers dining at restaurants in Seattle, 45 % said the calorie labels informed their meal choice, and only 13 % reported the information had an impact on what they ordered for their child [30]. Residents of low-income neighborhoods have been found to be the least likely to report using calorie labels to make a lower calorie food choice [28, 29], while those living in more affluent communities are among those most likely to use this information [27]. Women, more so than men, report using calorie labels [27, 40], as do those between 18 and 24 years of age compared to other age groups [27].

For the purposes of reporting the main findings of the papers reviewed, we distinguish those studies that included a comparison group from those that did not.

With a Comparison Group

Six studies utilizing a comparison group examined the influence of calorie labels on calories ordered [16, 28–32]. Five found no significant effect of calorie labeling on purchases [16, 28–31]. The only study to find a positive change was conducted by Bollinger and colleagues (2010), who analyzed over 100 million transactions from Starbucks locations in New York City (as well as two control cities, Boston and Philadelphia), before and after New York City implemented its calorie labeling law. After the introduction of calorie labels, total calories per transaction decreased by 6 % (decrease from 323 to 247 cal), with 74 % of the reduction attributable to customers purchasing fewer food items. Calorie labels were associated with a 26 % decrease in calories per transaction among consumers who made high calorie purchases (upwards of 250 cal) [32].

Without a Comparison Group

Six of the twelve natural experiments reviewed did not include a comparison group [26, 27, 33, 34, 39, 40]. All but one found no significant impact of calorie labeling on purchases [26, 27, 33, 34, 39]. The remaining study found a small but significant decrease in calories purchased across the entire sample from baseline to a second post-implementation data collection, with even fewer calories purchased by women and those who reported seeing the labels [40].

Two other notable studies in this category deserve mention. Researchers at the NYC Department of Health and Mental Hygiene found that, among a subgroup of customers of a well-known sandwich chain, just seeing calorie labels at point of selection was associated with a decrease of 52 total calories ordered. However, they were unable to establish that this relationship was causal. Among those who reported using the information there was an average observed difference of 99 calories ordered compared to those reporting not using calorie labels to guide their food choice [26], though again questions of causality remain. In another study conducted by researchers in Pierce County, WA, calorie labels were associated with a decrease of 15 calories per order, as well as a decrease in other key nutrients typically associated with negative health outcomes, specifically fat (decrease of 1.5 g per order) and sodium (45 milligrams per order) [33]. However, in the aforementioned study the implementation and duration of the voluntary calorie labeling in the restaurants varied across sites and may have affected the results.

Across all these studies, there is a trend toward calorie labeling having no effect on calories purchased at fast food restaurants. In nine of 12 studies conducted in localities where calorie labeling was implemented, the policy did not lead to a significant decrease in total mean calories or unhealthy items purchased [16, 27–31, 33, 34, 39]. However, seven of these nine studies did report significant relationships between calorie labeling and calories purchased within specific sub-populations, such as those who reported noticing the nutritional information, women, or those who were overweight [27–31, 33, 40].

Category 1: "Real World" Settings: *Cafeterias*

Three studies conducted in university dining halls [35, 37, 42], and three within worksite cafeterias [36, 38, 41] examined the impact of calorie labels at point of selection on patrons' orders. In five studies calorie counts of select food items were accompanied by additional information, such as values of additional key nutrients [35, 37, 41], colors highlighting low versus high calorie meals [36, 42], or photos of portion sizes [37]. Additionally, one site added healthier food items to the existing cafeteria menu and offered a nutrition education program to participants [36].

With a Comparison Group

Two of the six studies used a comparison group. One, a study by Ellison and colleagues (2013), found that although calorie labeling did not significantly alter total calories ordered relative to the comparison group, the presence of

calorie information led participants to order fewer entrée calories. However, this difference was not significant when considering calories ordered from drinks, sides, or appetizers added together [42]. The other, a study by Webb and colleagues (2011), concluded that there was a positive impact of calorie labeling after consumers at the intervention site ordered more lower calorie items than those at the comparison site [38].

Without a Comparison Group

In the five studies that did not utilize a comparison group, calorie labeling demonstrated a somewhat positive impact on food orders, resulting in a decrease in total calories [35, 36, 41], fat [36, 41], or serving size ordered [37]. Also of importance, the introduction of labeling did not lead to a loss of revenue in at least one dining hall that reported this outcome [35].

Category 2: Laboratory Settings: *Food Orders and Consumption Behaviors*

The three studies that examine food purchase and consumption behaviors in laboratory settings returned mixed results [13, 44, 45]. Researchers at Yale University found that providing calorie information on menus led to a decrease in total calories ordered and consumed, with the largest decrease observed when calorie labels were accompanied by a statement with recommended daily caloric intake. In addition, after combining calories consumed during and after the study period, it was discovered that those given the calorie plus statement menu ate significantly fewer calories overall than did participants in either of the other two experimental groups [45].

While the other two studies did not report overall differences in the nutritional content of items ordered and consumed, they did discover significant differences among specific populations [13, 44]. Calorie information was more influential among dieters than non-dieters, and especially among female dieters [13]. Similarly, for those who reported that nutrition was important to them when ordering food, average energy intake was the lowest when presented with both calorie and price information on the same menu. However, males in that same condition consumed significantly more than their control counterparts [44].

Category 2: Laboratory Settings: *Simulated Food Selections*

Ten studies focused on simulated food selections wherein participants were asked to indicate what they *would* order from mock menus but did not actually order or consume food [17, 22, 43, 46–52]. All but one reported some positive influence of calorie labeling [17, 22, 46–52], with up to 44 % of participants choosing lower calorie meals when calorie information was provided [47]. Of the two studies that examined gender differences in the presence of calorie labeling, one found that women ordered 146 fewer calories [17], and the other that men's purchase intentions for unhealthy items decreased [46]. Another two tested the effect of calorie labeling on food selections related to children. When parents chose for children, those given calorie information ordered an average of 102 fewer calories [49]. However, when children ordered for themselves nutrition information only affected the choices of those from high SES backgrounds [48].

Discussion

This review identified 31 studies that look at the effect of calorie labels at the point of purchase on food selection and/or consumption, of which 12 are natural experiments. The results of these studies demonstrate existing concerns about the effectiveness of calorie labeling policy. Authors of all the reviewed papers call for further research in this area. Some even suggest additional strategies to improve the effectiveness of this policy [27, 31, 36], such as nutrition education campaigns (34) or adding more healthful options to existing menus [33].

It is promising that most fast food restaurant patrons are aware of calorie labels on menus, as demonstrated in eight of the studies reviewed here which measure this outcome [26, 28–31, 33, 38, 40]. However, providing this information at the point of purchase is not enough to influence purchasing behaviors of most fast food restaurant consumers. Some studies show that certain groups are more likely to use calorie information while making their meal selections—such as women [17, 27, 40, 42], residents of wealthier neighborhoods [27], consumers who made very high calorie purchases prior to the mandate [32], dieters [13], and those who reported being motivated by nutritional information when making food decisions [30, 31, 44, 46]. Yet, there is an abundance of evidence that suggests calorie labeling, as it is currently being implemented, has no impact on overall food purchases or consumption for the population as a whole.

Limitations and Strengths of the Evidence

The studies reviewed in this paper have several limitations. First, there are a wide variety of settings and only a limited number of studies within each setting. Three studies sampled at only one chain restaurant [16, 32, 39], two were conducted in full-service restaurants [33, 34], six took place in cafeterias [35–38, 41, 42], and three were done in

laboratory settings with mock menus [13, 44, 45]. In addition, six of the twelve natural experiments sampled in either exclusively low-income neighborhoods [28, 29] or non-fast food settings [16, 32–34]. This diversity means the results are not generalizable to all food outlets or consumers that menu labeling policies might affect.

Second, methodologies are not consistent. The lack of a comparison group in ten of the eighteen real world studies [26, 27, 33–40] makes it difficult to determine whether any of the observed effects of the policy are attributable to menu labeling, or if other factors were responsible. This problem is compounded by the absence of subgroup analyses across the majority of the studies, be it due to a small sample size [28, 29] or no survey data collected [16, 32]. Thus, with only about one-third of studies specifically examining subgroups [13, 17, 27, 30–32, 40, 42, 44, 46], there is little insight into whether specific groups of fast food consumers may have been affected by menu labels or how strong that effect might be. And, none of the controlled studies included in this review found any effect of any meaningful magnitude, even if not significant. Furthermore, ten studies relied on hypothetical food selections [17, 22, 43, 46–52], making it unclear whether the participants would have behaved similarly had they been ordering real food.

The timing of data collection in the reviewed studies is another limitation. Most of the studies examining purchases at fast food restaurants were conducted over a short period of time and did not capture any potential long-term impacts of menu labeling [26–30, 33, 39]. Only one study continued to collect data for up to 11 months post calorie labeling implementation [32]; two studies include an additional wave of data collection to the one closely following the mandate [16, 40]. The results from this study are encouraging, as they seem to suggest that calorie labels may have longer term impacts on consumer behavior. However, because the study conducted by Krieger and colleagues (2013) did not use a comparison group the results should still be interpreted with caution [40].

Lastly, all studies conducted in a real world setting were only able to analyze the number of calories purchased—as reflected by receipt and sales data—and not what was actually consumed. Only the laboratory studies were able to look at this phenomenon, and the evidence from the majority of these studies suggests that the presence of menu labels does influence consumers to order and consume fewer calories in these laboratory settings [44, 45]. Further, because these studies focus on receipt and survey data collected on specific days, they do not report data on the frequency of restaurant visits and potential changes in restaurant attendance as a result of menu labeling policies. Thus far evidence from Elbel et al. (2013) in Philadelphia, PA indicates that frequency of fast food visits has not changed in response to the introduction of calorie labeling [53]. However this, too, is an area that deserves attention in future research.

On the upside, this review exhibits several noteworthy strengths. Although the variety of settings affects the generalizability of results, each study nevertheless provides an important glimpse into the impact of calorie labels on food choice in their respective settings—from localities where calorie labeling policies were implemented or mandated [16, 26–34, 39, 40], to work or school cafeterias [35–38, 41, 42], even to controlled settings [13, 17, 22, 43–52]. Also, even though many studies did not find the desired results, positive impacts were observed among certain subgroups such as women [17, 27, 40, 42, 46], those who reported being motivated by nutrition information [30, 31, 44, 46], or those who were overweight [30, 36].

Another notable strength in some of the reviewed work is study design. The majority of studies selected for review were conducted in settings in which participants made real food selections. Eighteen of these studies were in real world settings—fast food restaurants or cafeterias/dining halls [16, 26–42], and three were in laboratory settings which required participants to order and consume their selected meals [13, 44, 45]. Among them were a number of notable characteristics: nine had large sample sizes [26, 27, 29, 32, 37, 39–41, 51]; seven included a comparison group [16, 28–32, 42]; 13 utilized multiple measures, most frequently receipt data and surveys [26–33, 36–40]; and seven utilized transaction data obtained from food venues [16, 32–35, 37, 38].

Implications for Future Research/Policy

As a group, the studies reviewed in this paper have set important groundwork for future research in this area. First, it is apparent that some fast food patrons are still not noticing calorie labels, and the percentage of those who both notice and use these labels to make food choices is low. Two qualitative studies, one that recruited from low-income neighborhoods in New York City [54] and another that recruited from fast food patrons in Philadelphia [55], have explored this issue and identified a number of barriers to calorie label usage. Schindler et al. (2013) cited the desire for quick, high calorie meals in spite of their nutritional content, familiarity with the menus (hence not even consulting them while waiting to order food), intentions to burn off the consumed calories later via physical activity, and lack of nutritional knowledge as reasons why consumers do no not use calorie labels [54]. Auchincloss and colleagues (2013) further identified confusing menu display, low expectations of nutritional quality, and sales promotions as reasons for lack of label usage [55]. More research needs to be done on this subject.

Second, the effectiveness of the current presentation of calorie labels on menus has been questioned by others, specifically the confusing nature of calorie ranges listed for menu items, as well as the size and placement of calorie information. After visiting 70 restaurants in NYC and rating 200 food items in an effort to determine how well calorie labeling complies with regulations, Cohn et al. (2013) discovered that although most of the restaurants visited displayed calorie information, in most cases that information was not sufficient for the average consumer to effectively use it. Calorie counts were often given for entire meals rather than for individual servings or food items, and calorie ranges did not specify which menu items fell at the lower and upper bounds. Furthermore, calorie labels posted online often differed from what was posted on restaurant menus [56]. In order for consumers to effectively use calorie information on menus, it has to be consistent and accurate everywhere it is posted, and the accuracy of this information needs to be enforced.

Third, it may be the case that calorie labeling alone is not sufficient to modify consumer behavior in the desired direction. Other presentation formats—traffic lights, physical activity equivalents, healthy logos, color coding, and the like—show promise beyond calories and even beyond relaying nutrition information [41, 43, 51, 57–59]. Thus, a simplified and more direct way of highlighting healthy food options may be a better way to inform consumers.

Fourth, providing the daily calorie recommendation statement at the point of purchase, and openly informing customers that additional nutritional information is available to those who wish to see it—as currently proposed in the guidelines for national menu labeling—may improve the effectiveness of the policy. The daily calorie recommendation could be a particularly beneficial reminder to those with low nutritional knowledge and low understanding of the meaning of calories. However, it's important that the additional information is presented clearly. Most menu boards in restaurants are already criticized for being crowded and difficult to read. The format in which existing and additional information will be presented should be strongly considered.

In the months leading up to nationwide implementation of mandatory calorie labeling, it is important to evaluate and understand existing evidence concerning the policy. While there are some positive results reported from studies examining the effects of calorie labeling, overall these studies show that calorie labels do not have the desired effect in reducing total calories ordered or consumed at the population level. Moving forward researchers should consider novel ways of presenting nutrition information, while keeping a focus on particular subgroups that may be differentially affected by nutrition policies.

Acknowledgments This project was supported by Grant Number R01HL095935 from the NIH/NHLBI. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

References

1. Malnick, S., & Knobler, H. (2006). The medical complications of obesity. *Quarterly Journal of Medicine, 99*(9), 565–579.
2. Flegal, K., Carroll, M., Kit, B., & Ogden, C. (2012). Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999–2010. *Journal of the American Medical Association, 307*(5), 491–497.
3. Ogden, C., Carroll, M., Kit, B., & Flegal, K. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999–2010. *Journal of the American Medical Association, 307*(5), 483–490.
4. Centers for Disease Control and Prevention. Overweight and obesity: adult obesity. Retrieved from: http://www.cdc.gov/obesity/data/adult.html#Groups.
5. Hammond, R., & Levine, R. (2010). The economic impact of obesity in the United States. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy, 3*, 285–395.
6. Bowman, S., & Vinyard, B. (2004). Fast food consumption of U.S. adults: Impact on energy and nutrient intakes and overweight status. *Journal of American College of Nutrition, 23*(2), 163–168.
7. Todd, J., Mancino, L., Lin, B., & Jessica, E. (2010). *The impact of food away from home on adult diet quality*. ERR: United States Department of Agriculture Economic Research Service. 90.
8. Mancino, L., Todd, J., & Lin, B. (2010). *How food away from home affects children's diet quality*. ERR: United States Department of Agriculture Economic Research Service. 104.
9. Liu, M., Kasteridis, P., & Yen, S. (2013). Who are consuming food away from home and where? Results from the consumer expenditure surveys. *European Review of Agricultural Economics, 40*(1), 191–213.
10. 111th Congress (2010). Patient protection and affordable care Act. H.R. 3590, PL 111–148, sec. 4205(b)(i)–(iii).
11. Center for Science in the Public Interest. (2010). State and local policies for chain restaurants. Retrieved from: http://www.cspinet.org/menulabeling/state-local-policies.html.
12. Roberto, C., Agnew, H., & Brownell, K. (2009). An observational study of consumers' accessing of nutrition information in chain restaurants. *American Journal of Public Health, 99*(5), 820–821.
13. Girz, L., Polivy, J., Herman, C., & Lee, H. (2011). The effects of calorie information on food selection and intake. *International Journal of Obesity, 36*, 1–7.
14. Bates, K., Burton, S., Huggins, K., & Howlett, E. (2011). Battling the bulge: menu board calorie legislation and its potential impact on meal repurchase intentions. *Journal of Consumer Marketing, 28*(2), 104–113.
15. Elbel, B. (2011). Consumer estimation of recommednded and actual calories at fast food restaurants. *Obesity, 19*(10), 1971–1978.
16. Finkelstein, E., Strombotne, K., Chan, N., & Krieger, J. (2011). Mandatory menu labeling in one fast-food chain in King County, Washington. *American Journal of Preventative Medicine, 40*(2), 122–127.
17. Gerend, M. (2009). Does calorie information promote lower calorie fast food choices among college students? *Journal of Adolescent Health, 44*(1), 84–86.
18. Block, J. P., Condon, S. K., Kleinman, K., et al. (2013). Consumers' estimation of calorie content at fast food restaurants:

Cross sectional observational study. *British Medical Journal, 346*, f2907.
19. Martinez, O., Roberto, C., Kim, J., Schwartz, M., & Brownell, K. (2013). A Survey of undergraduate student perceptions and use of nutrition information labels in a university dining hall. *Health Education Journal, 72*(3), 319–325.
20. Rudd Center for Food Policy and Obesity. (2008). Menu Labeling in chain restuarants: Opportunities for public policy. Retrieved from: http://www.yaleruddcenter.org/resources/upload/docs/what/reports/RuddMenuLabelingReport2008.pdf.
21. Center for Science in the Public Interest. (2009). Summary of polls on nutrition labeling in restaurants. Retrieved from: www.cspinet.org/new/pdf/census_menu_board_question.pdf.
22. Prins, A., Gonzales, D., Crook, T., & Hakkak, R. (2012). Impact of menu labeling on food choices of Southern undergraduate students. *Journal of Obesity and Weight Loss Therapy, S4*, 001.
23. Harnack, L., & French, S. (2008). Effect of point-of-purchase calorie labeling on restaurant and cafeteria food choices: A review of the literature. *International Journal of Behavioral Nutrition and Physical Activity, 5*, 51.
24. Swartz, J. J., Braxton, D., & Viera, A. J. (2011). Calories menu labeling on quick-service restaurant menus: an updated systematic review of the literature. *International Journal of Behavioral Nutrition and Physical Activity, 8*(1), 135.
25. Loureiro, M. L., & Rahmani, D. (2013, August 4–6). Calorie labeling and fast food choices in surveys and actual markets: some new behavioral results. Paper presented at: 2013 AAEA & CAES Joint Annual Meeting; Washington, D.C.
26. Bassett, M., Dumanovsky, T., Huang, C., et al. (2008). Purchasing behavior and calorie information at fast-food chains in New York City, 2007. *American Journal of Public Health, 98*(8), 1457–1459.
27. Dumanovsky, T., Huang, C., Nonas, C., Matte, T., Bassett, M., & Silver, L. (2011). Changes in energy content of lunchtime purchases from fast food restaurants after introduction of calorie labelling: cross sectional customer surveys. *BMJ, 343*, d4464.
28. Elbel, B., Kersh, R., Brescoll, V., & Dixon, L. (2009). Calorie labeling and food choices: a first look at the effects on low-income people in New York City. *Health Affairs, 28*(6), 1110–1121.
29. Elbel, B., Gyamfi, J., & Kersh, R. (2011). Child and adolescent fast-food choice and the influence of calorie labeling: A natural experiment. *International Journal of Obesity, 35*(4), 493–500.
30. Tandon, P., Zhou, C., Chan, N., et al. (2011). The impact of menu labeling on fast-food purchases for children and parents. *American Journal of Preventative Medicine, 41*(4), 434–438.
31. Vadiveloo, M., Dixon, L., & Elbel, B. (2011). Consumer purchasing patterns in response to calorie labeling legislation in New York City. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 51.
32. Bollinger, B., Leslie, P., & Sorensen, A. (2010). Calorie posting in chain restaurants. *American Economic Journal: Economic Policy, 3*(1), 91–128.
33. Pulos, E., & Leng, K. (2010). Evaluation of a voluntary menu-labeling program in full-service restaurants. *American Journal of Public Health, 100*(6), 1035–1039.
34. Holmes, A., Serrano, E., Machin, J., Duetsch, T., & Davis, G. (2013). Effect of different children's menu labeling designs on family purchases. *Appetite, 62*, 198–202.
35. Chu, Y., Frongillo, E., Jones, S., & Kaye, G. (2009). Improving patrons' meal selections through the use of point-of-selection nutrition labels. *American Journal of Public Health, 99*(11), 2001–2005.
36. Lowe, M., Tappe, K., Butryn, M., et al. (2011). An intervention study targeting energy and nutrient intake in worksite cafeterias. *Eating Behaviors, 11*(3), 144–151.
37. Freedman, M. (2011). Point-of-selection nutrition information influences choice of prtion size in an all-you-can-eat university dining hall. *Journal of Foodservice Business Research, 14*(1), 86–98.
38. Webb, K., Solomon, L., Sanders, J., Akiyama, C., & Crawford, P. (2011). Menu labeling responsive to consumer concerns and shows promise for changing patron purchases. *Journal of Hunger and Environmental Nutrition, 6*(2), 166–178.
39. Downs, J. S., Wisdom, J., Wansink, B., & Loewenstein, G. (2013). Supplementing menu labeling with calorie recommendations to test for facilitation effects. *American Journal of Public Health, 103*(9), 1604–1609.
40. Krieger, J. W., Chan, N. L., Saelens, B. E., et al. (2013). Menu labeling regulations and calories purchased at chain restaurants. *American Journal of Preventive Medicine, 44*(6), 595–604.
41. Vanderlee, L., & Hammond, D. (2013). Does nutrition information on menus impact food choices? Comparisons across two hospital cafeterias. *Public Health Nutrition*. doi:10.1017/S136898001300164X.
42. Ellison, B., Lusk, J. L., & Davis, D. (2013). Looking at the label and beyond: The effects of calorie labels, health consciousness, and demographics on caloric intake in restaurants. *International Journal of Behavioral Nutrition and Physical Activity, 10*, 21.
43. Liu, P. J., Roberto, C. A., Liu, L. J., & Brownell, K. D. (2012). A test of different menu labeling presentations. *Appetite, 59*, 770–777.
44. Harnack, L., French, S., Oakes, J., Story, M., Jeffery, R., & Rydell, S. (2008). Effects of calorie labeling and value size pricing on fast-food meal choices: results from an experimental trial. *International Journal of Behavioral Nutrition and Physical Activity, 5*, 63.
45. Roberto, C., Larsen, P., Agnew, H., Baik, J., & Brownell, K. (2010). Evaluating the impact of menu labeling on food choices and intake. *American Journal of Public Health, 100*(2), 312–318.
46. Bates, K., Burton, S., Howlett, E., & Huggins, K. (2009). The roles of gender and motivation as moderators of the effects of calorie and nutrient information provision on away-from-home foods. *Journal of Consumer Affairs, 43*(2), 249–273.
47. Wisdom, J., Downs, J., & Loewensteing, G. (2010). Promoting healthy choices: Information versus convenience. *American Economic Journal: Applied Economics, 2*(2), 164–178.
48. Stutts, M., Zank, G., Smith, K., & Williams, S. (2011). Nutrition information and children's fast food menu choices. *Journal of Consumer Affairs, 45*(1), 52–86.
49. Tandon, P., Wright, J., Zhou, C., Rogers, C., & Christakis, D. (2010). Nutrition menu labeling may lead to lower-calorie restaurant meal choices for children. *Pediatrics, 125*(2), 244–248.
50. Giesen, J., Payne, C., Remco, H., & Jansen, A. (2011). Exploring how calorie information and taxes on high-calorie foods influence lunch decisions. *American Journal of Clinical Nutrition, 93*, 689–694.
51. Morley, B., Scully, M., Martin, J., Niven, P., Dixon, H., & Wakefield, M. (2013). What types of nutrition menu labelling lead consumers to select less energy-dense fast food? An experimental study. *Appetite, 67*, 8–15.
52. Wei, W., & Miao, L. (2013). Effects of calorie information disclosure on consumers' food choices at restaurants. *Int J Hospitality Manag, 33*, 106–117.
53. Elbel, B., Mijanovich, T., Dixon, L. B., et al. (2013). Calorie labeling, fast food purchasing and restaurant visits. *Obesity, 21*(11), 2172–2179.
54. Schindler, J., Kiszko, K., Abrams, C., Islam, N., & Elbel, B. (2013). Environmental and individual factors affecting menu labeling utilization: A qualitative research study. *Journal of the Academy of Nutrition and Dietetics, 1113*(5), 667–672.
55. Auchincloss, A. H., Young, C., Davis, A. L., Wasson, S., Chilton, M., & Karamanian, V. (2013). Barriers and facilitators of

consumer use of nutrition labels at sit-down restaurant chains. *Public Health Nutrition, 16*(12), 2138–2145.

56. Cohn, E. G., Larson, E. L., Araujo, C., Sawyer, V., & Williams, O. (2012). Calorie postings in chain restaurants in a low-income urban neighborhood: measuring practical utility and policy compliance. *Journal of Urban Health, 89*(4), 587–597.
57. Bleich, S. N., Herring, B. J., Flagg, D. D., & Gary-Webb, T. L. (2012). Reduction in purchases of sugar-sweetened beverages among low-income black adolescents after exposure to caloric information. *American Journal of Public Health, 102*, 329–335.
58. Dowray, S., Swartz, J. J., Braxton, D., & Viera, A. J. (2013). Potential effect of physical activity based menu labels on the calorie content of selected fast food meals. *Appetite, 62*, 173–181.
59. Levy, D. E., Riis, J., Sonnenberg, L. M., Barraclough, S. J., & Thorndike, A. N. (2012). Food choices of minority and low-income employees: A cafeteria intervention. *American Journal of Preventive Medicine, 43*(3), 240–248.