Evidence Synthesis

Exploring the impact of front-of-package, shelf, and menu labelling for obesity and chronic disease prevention

POWER UP

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OVERVIEW

Overweight and obesity is a significant problem in Canada, which is linked to a range of chronic diseases, including hypertension, type 2 diabetes, cardiovascular disease, and certain cancers [1]. In 2014, 20.2% of Canadian adults were obese and 40% were overweight, while 6.2% of young people were obese and 16.9% were overweight [1]. The problem of overweight and obesity in Canada is a complex issue. Nevertheless, an important contributing factor is the energy imbalance that has resulted in recent decades from changes in eating behaviours, such as increased consumption of ultra-processed foods and increased eating outside the home, tied with declines in physical activity [2-4].

Given the growing reliance on processed and prepared foods, nutrition labelling on food packages has become a key policy tool for providing Canadian consumers with nutrition information and helping to reduce consumption of calories and less healthy nutrients [5-8]. In recent years, menu labelling has also emerged as a potential policy option for improving diets by making healthy food options more visible in eating venues outside the home [9].

In Canada, the provision of detailed nutrition information using the Nutrition Facts Table on the back of pre-packaged foods has been mandatory since December 12th, 2007 [10]. However, concerns have been raised regarding this current policy approach to nutrition labelling. For example, the Nutrition Facts Table is widely acknowledged as difficult for consumers to understand [7]. Further,

Box 1. Definitions and Examples: Front-of-package (FOP), shelf and menu labelling

Front-of-Package (FOP) and Shelf
FOP and shelf labelling systems are easily identifiable, simplified labelling systems that are placed on either the front of a package or on a shelf tag next to the product price. These systems can be organized into two general categories (20, 27).

Nutrient Specific Systems: These systems provide an overall nutrient profile (i.e. Percentage Guideline Daily Amounts [%GDA] and traffic light [TL] system). %GDA highlights nutrients per portion and includes grams as a percentage of recommended GDA for each nutrient. The TL system ranks nutrients (i.e. total fat, saturated fat, sugar, sodium, and energy) according to a color-coded scheme (red, amber, green). Some manufacturers have introduced combinations of the %GDA and TL system (20, 27).

Summary Systems: These systems use an algorithm to provide an overall nutrient score. These systems can be binary, such as a simple check mark like the one used by the Choices Programme, or graded, such as the NuVal or Guiding Stars shelf-tag system (20, 27).

Menu Labelling
Menu labelling refers to the practice of providing nutrition information, such as calories, fat, sodium, or other selected nutrients, on menu items at the point of purchase (6).

emerging research indicates that labelling regulations should apply to the entire food package for greatest impact [7, 11]. Moreover, given the large number of people eating in out-of-home venues, there have been calls to expand the scope of nutrition labelling to settings such as restaurants and fast-food outlets [7].

Despite the above concerns, alternative labelling formats, such as Front-of-Package (FOP), shelf, and menu labels (see Box 1. for definitions) remain largely unregulated in Canada [7, 12]. As Morestin et al. [12] outlined in their knowledge synthesis concerning nutrition labelling in Canada and other industrialized countries, this has created a regulatory void, through which various companies and organizations have developed their own health logos, leading to potential issues such as lack of uniformity and impartiality. Moreover, within the current regulatory system, menu labelling by restaurants is voluntary at the federal level [12] and has not been widely adopted across Canada.

To-date, a number of governments around the world, including the United Kingdom (UK), Australia, Chile, Denmark, and the Pacific Islands, have developed regulations regarding FOP, shelf, and/or menu labelling, though many of the systems in place are voluntary for industry [13]. For example, in 2013 the UK government established a voluntary FOP nutrition-labelling scheme for pre-packaged products using a traffic light system [13]. The US is also moving forward with mandatory federal regulations on menu calorie labelling through the Affordable Care Act [14]. While the policy was set to come into full force in early 2016, enforcement has been delayed [15]. In a Canadian context, the Government of Ontario passed the Healthy Menu Choices Act in 2015, which requires owners and operators of more than 20 food service premises in Ontario to display calorie information, alongside a contextual statement (e.g., “the average adult requires 2,000-2,400 calories a day”), on menus. However, there are concerns that these caloric recommendations are too steep and may contribute to excessive energy intake, given that, for example, Health Canada recommends 1,650-1,900 calories per day for sedentary females 19-70 years old [16]. The Act comes into full force January 1st, 2017 [17].

Considering the limits of Canada’s current nutrition labelling policies and actions of jurisdictions world-wide, regulation of alternative labelling formats, such as FOP, shelf, and menu labels, have emerged as important topics within Canada’s food policy debate [5, 11]. Indeed, organizations, such as the Standing Senate Committee on Social Affairs, Science, and Technology, have recently called for stricter regulations around FOP labelling systems, menu labelling, and nutrition claims [11]. That said, researchers have also raised concerns regarding nutrition and menu labelling policies, including their potential to reinforce disparities across socio-economic groups [18]. With this in mind, this synthesis summarizes the evidence on the impact of FOP, shelf, and menu labelling with the goal of informing policy action for obesity and chronic disease prevention.

METHODS

This synthesis involved the collection of review articles from four data-bases (Ovid Medline, Ovid Embase, CINAHL, PsycINFO) and four grey literature sources (Robert Wood Johnson Foundation, Rudd Center for Food Policy and Obesity, National Collaborating Centre for Healthy Public Policy, Centre for Science in the Public Interest). In addition, reviews were recommended by researchers and identified through a search of Google Scholar and Pub-Med-related references. To be included in the synthesis, reviews had to meet the following criteria: (1) English or French-language; (2) published after 2010; (3) systematic or comprehensive in nature, outlining explicit methods and inclusion criteria; (4) examined policies or interventions relevant to FOP labels, shelf labels, and/or menu labels in the context of healthier diets; and (5) explore outcomes related to consumer comprehension, understanding, awareness, preferences, use, purchasing, consumption, and/or body weight. As a secondary objective, systematic or comprehensive reviews were included if they discussed factors or barriers relevant to the implementation of FOP, shelf, and menu labelling policy, such as cost, feasibility, and acceptability [12]. Reviews were not included if they explored general scientific claims or focused on labels related to food allergies, gluten, organic food, dietary supplements, or alcohol.

The first round of screening involved reviewing titles and abstracts to remove irrelevant articles. The second-level screening involved a full-review of articles to determine relevance in relation to the inclusion criteria. When extracting information from reviews, the focus was on information specific to FOP, menu, and/or shelf labelling. However, content was retained on nutrition labelling more generally if it provided necessary context for the findings of interest.

SYNTHESIS OF EVIDENCE

Twenty-seven reviews were included in this evidence synthesis. Thirteen were relevant to FOP and/or shelf labelling and seventeen were relevant to menu labelling. A synthesis of evidence pertaining to FOP, shelf, and menu labelling is provided below.

Front of Package (FOP) and Shelf Labels

Thirteen reviews were relevant to FOP and/or shelf labelling and the outcomes of interest [5, 7, 12, 19-28]. Taken together, review findings suggest that FOP and shelf labelling are suitable policy options for helping consumers make healthier food choices. While more research is needed comparing different labelling formats, the nutrient-specific Traffic Light (TL) FOP system appeared to be a promising option across a number of reviews [5, 20, 28]. In addition, one review concluded that the “Guiding Stars” and “Special Diet Alert” shelf-tag systems hold promise [20, 21, 28]. For a summary of review findings and characteristics, see Table 1.

Comprehension, Understanding, Awareness, and/or Preferences. Eight reviews reported on FOP and/or shelf labels and findings related to consumer comprehension, understanding, awareness, and/or preferences [7, 12, 20, 21, 23, 25, 27, 28].

FOP Labels. Across reviews, findings related to FOP and consumer comprehension, understanding, attention, and/or preferences appeared promising. Campos et al. [7] conducted a systematic review of research on comprehension and understanding of nutrition labels in the US, Canada, Australia, New Zealand, Norway, Thailand, and Trinidad. They reported that nutrition information on the FOP may be more effective than information on the side or back, particularly among individuals who have low education and knowledge of nutrition labels. Review findings also indicated that consumers may be more likely to identify healthier foods with FOP labels compared to packages without such a label, and that consumers have favourable opinions regarding the usefulness of FOP labels, especially when information is clear and succinct [23, 28].

A number of reviews explored different FOP labelling schemes in relation to the outcomes of interest. Hersey et al.'s 2013 systematic review [21] examined nutrient-specific and summary system FOP labelling schemes in the US in relation to consumer attention, processing, and understanding. This review concluded that consumers are able to identify healthy food options more easily using nutrient-specific schemes compared to summary systems [21]. Further, reviews indicated that nutrient-specific schemes using text and colour to indicate different levels of nutrients, such as Traffic Light (TL) labels, may be easier for consumers to interpret compared with those that only use numeric information, such as Percent Guideline Daily Amounts (%GDA) or grams [20, 21, 28]. With that said, %GDA combined with text and colour may help some consumers determine the level of individual nutrients [20].

Across reviews, TL logo systems, such as the Multiple Traffic Light logo, emerged as a promising option for helping consumers identify healthy products, especially when a combination of colour and interpretive text was used [12, 20, 28]. Further, Koehler et al. [28] concluded from their environmental scan and literature review that such labels may be particularly beneficial for certain consumer groups, including individuals who are older and of lower socioeconomic status [28]. While more research is needed to explore consumer preferences pertaining to different labelling systems, review findings also indicated that consumers generally like TL systems [12, 20, 28]. With that said, it is important to note potential limitations of TL logos. For instance, Hawley et al. [20] discussed findings from a UK focus group, which found that some people did not know that the TL colours had meaning, some thought they were only meant to make the label stand out, and others thought they represented a specific nutrient. [20]. However, as outlined by Hawley et al. [20], these issues were addressed with the addition of text to the colour scheme [20]. This review also noted that some participants in the focus group study did not recognize that different nutrients have different maximum daily amounts [20].

Reviews also reported on other types of FOP labels. For instance, reviews highlighted positive findings related to summary systems, such as the simple keyhole and check mark logo. Indeed, reviews indicated that many consumers have a desire for simple logos and that summary systems may help improve consumer processing time, capture consumers' attention, and assist with the identification of healthy products [12, 20, 21, 25, 28]. That said, reviews outlined limitations pertaining to such logos, including the fact that they may discourage consumers from seeking more detailed nutrition information and can lead to potential misunderstandings regarding product healthfulness [12, 25]. Further, Hawley et al. [20] briefly explored FOP exercise and energy balance labels, which illustrate the required exercise needed to burn calories per serving, in relation to outcomes of interest. According to the review, research on the impact of such logos is limited. However, findings from one European focus group indicated that while some of the younger participants found such labels motivating and easy to understand, the majority of participants did not like them, with some participants indicating that they were demotivating and patronizing [20].

Reviews discussed additional factors pertaining to FOP labels in relation to outcomes of interest, such as logo placement. For example, Hawley et al. [20] found that presence of a large logo with consistent placement may help to improve attentional performance [20]. Koehler et al. [28] also concluded that to best gain consumers' attention, FOP labels should be positioned in a way that stands out against competing elements on food packages.

Shelf Labels. Research on shelf labelling systems and consumer comprehension, understanding, awareness, attention, and/or preferences was limited [20, 21, 28]. Hawley et al. [20] discussed a small number of studies relevant to consumers' awareness and knowledge of shelf labelling systems. One of these studies took place in Detroit and examined consumer awareness and use of colour-coded shelf labels. As outlined by the review, this study found that only 28% of the sample surveyed was aware of the shelf-labelling system, with ethnic and racial minority groups significantly more likely to report awareness compared to Caucasians [20]. Another supermarket study of shelf labelling included in the review found no difference in consumer knowledge between the control and intervention. However, according to Hawley et al. [20], this study had a short time period, which may have influenced results [20]. In relation to consumer preferences, consumers appear to view shelf labelling favourably, though more research is needed to understand the specific types of shelf labelling systems that consumers prefer, and consumer preferences of shelf labels in relation to other labelling types, such as FOP [28].

Reported Use and/or Likely Purchasing. Four reviews reported on FOP and/or shelf labelling and findings related to reported use and/or likely purchasing behaviours [12, 20, 21, 28]. Overall, findings in this area were limited and variable across the studies reviewed. Hersey et al. [21] examined 13 studies from Europe, the US, Canada, Australia, and New Zealand relevant to consumers' reported use and likely purchasing behaviours of FOP and shelf-labelling systems. As outlined by this review, five of these

studies found that over 50% of study participants reported that they were likely to use FOP and shelf labelling systems at least some of the time and likely to allow the labels to influence their purchases [21]. With that said, this review reported on another six studies that outlined mixed findings, generally indicating that consumers' reported use of FOP labels and shelf tags were low. An additional two experimental studies examined willingness to pay with variable results [21]. In addition, Koehler et al. [28] explored FOP and shelf labelling systems in relation to likely purchasing behavior, indicating that consumers report using FOP labels mostly when comparing products in supermarkets, do not use FOP labels for all food categories, and are likely to purchase healthy products with shelf labels [28]. Of note, reviews indicated that FOP and shelf labels tend to be used less often by certain consumers, such as those who are less nutrition conscious, of lower socio-economic status, or have young children, while consumers who are nutrition conscious or have family members on special diets are more likely to use such labels [21, 28].

Purchasing, Selection, and/or Sales. Ten reviews reported on FOP and/or shelf labels and findings related to consumer purchasing, sales, and/or selection of healthier products [5, 7, 12, 19-21, 24, 26-28].

FOP Labels. Research on FOP and outcomes related to purchasing, sales, and/or selection is limited, with some reviews reporting mixed findings [7, 20, 21, 28]. Of note, a 2015 systematic review and meta-analysis by Ceccini and Warin [5] assessed the effectiveness of TL schemes, %GDA, and other food labelling schemes on purchasing outcomes, as well as consumption, in the US, Canada, UK, France, and Germany. As outlined by this review, the majority of studies (six) assessed FOP labelling, though three studies did not specifically indicate the position of the label. Overall, this review indicated that food labelling would increase the amount of people selecting/purchasing a healthier food product by about 18.0%. In terms of specific labelling schemes, the TL labelling system was the most effective, increasing the number of people selecting a healthier option by 29.4%. The category of other food labels was associated with an increase in 14.7%, while %GDA was associated with an increase in 11.9%. Overall, this review concluded that food labelling may be beneficial in terms of helping consumers select healthier food products with the TL label emerging as particularly effective [5].

Shelf Labels. Research related to shelf labels and purchasing, sales, and/or selection outcomes was limited across reviews, though the available evidence appeared promising [20, 21, 28]. For example, Hersey et al. [21] included six empirical studies relevant to shelf labelling and purchasing outcomes, with four reporting positive impacts related to the purchasing of healthier products [21]. Hawley et al. [20] also reviewed a number of findings, concluding that the "Guiding Stars" and "Special Diet Alert" systems have had beneficial impacts on the sales of healthy products.

A number of reviews included in this analysis explored shelf labels as part of a broader suite of strategies to promote healthier options in various settings [19, 24, 26]. For example, van't Riet [26] investigated the sales effects of product health information, including shelf tags, posters, flyers, brochures, and/or

public access systems, on food products at the point of purchase. The systematic review, which included 17 studies in the US and Canada, concluded that the effectiveness of product health information is mixed, though interventions appear to be more effective when they include additional components beyond product health information [26]. Further, Gittelsohn et al. [24] examined 16 small store interventions involving multi-pronged strategies including shelf labelling, many of which had a positive impact on purchasing behavior. In particular, a study of the Baltimore Healthy Corner Store Project, which included the use of signage, shelf labels, handouts, giveaways, taste testing, coupons, and owner information, reported increased purchasing as a direct consequence of shelf labels [24].

Consumption and/or Dietary Intake. Seven reviews described FOP and/or shelf labels and findings related to consumer consumption or dietary intake, reporting limited and mixed results [5, 12, 20-22, 24, 28]. Ceccini and Warin's 2015 review [5] found that food labelling would decrease calorie intake/choice by about 3.6%. However, the findings are not statistically significant due to the limited data available [5]. This review also indicated that meta-analysis of the TL and %GDA sub-categories was not possible given the low number of studies [5]. That said, this review reported that the category of other food labels resulted in a non-statistically significant effect of -2.88%, slightly lower than the overall results [5].

In terms of shelf labelling, Koehler et al. [28] discussed findings from two relevant studies. The first study explored the impact of the "Guiding Stars" shelf labelling system using supermarket data and found that the program reduced shoppers' consumption of calories and sugar, while it increased fiber intake. The second study, which involved a shelf labelling system to indicate low-fat products, did not result in a significant reduction in fat intake among shoppers [28]. Further, Cappaci et al.'s European review [22] included one study of a shelf labelling intervention in a Dutch supermarket, which had no effect on clients' total fat intake. Finally, two studies in Gittlesohn et al.'s review [24] that involved shelf labels as part of multi-component interventions reported increased consumption of healthier products.

Body Weight. Gittelsohn et al. [24] reported on a small-store randomized controlled trial, called the Healthy Foods Hawai'i, conducted over a 9-11 month period in five food stores in Honolulu [24]. This intervention involved shelf labelling, in addition to other strategies including signage, handouts, and taste testing. As outlined by the review, the study did not report any significant changes in Body Mass Index (BMI) [24]. Further, Morestin et al. [12] aimed to explore the effectiveness of nutrition labelling on addressing the target problem of obesity, but did not report on any relevant studies to FOP and/or shelf labels.

Policy Considerations. In addition to outcomes of interest, reviews discussed a number of factors relevant to the implementation of FOP and shelf labelling policies. For instance, when discussing whether FOP labels should be government mandated or implemented voluntarily by industry, Hawley et al. [20] indicated that a key theme across studies was the idea that labelling systems are most effective

when they are perceived as credible and coming from a trusted source. In addition, Morestin et al. [12] provided a detailed discussion of nutrition labelling and policy implementation factors, including cost, feasibility, and acceptability. Key points from this discussion relevant to FOP and/or shelf label policy include the understanding that consumers appear to favour food labelling, particularly if it is simple, standardized, and informative, while those involved in consumer health and protection emphasize the importance of understandability. Interestingly, this review also stated that while industry tends not to be readily supportive of labelling policies, there is acknowledgement that standardization has benefits, such as making implementation easier and creating a level playing field [12]. Also, reviews highlighted the importance of education and communication efforts targeting individuals less likely to use FOP and shelf labels to increase effectiveness [21, 28].

In addition, reviews discussed the potential for FOP and shelf labelling policies to have unintended or indirect impacts, which are worth noting. For instance, reviews highlighted the potential for regulation in this area to encourage industry to provide healthier food options through product reformulation. Indeed, Cecchini and Warin [5] indicated that product reformulation may be one of the main mechanisms through which food labels work to improve diets in the short term given the complexity of shifting individual behaviours. With that said, Morestin et al. [12] discussed potential issues pertaining to FOP and product reformulation. For example, labelling schemes that use a threshold, such as the TL logo, may create a barrier to reformulation given the difficulty in moving a product all the way from a "less healthy" to a "healthier" category [12].

Limitations. Reviews in this category outlined a number of limitations to consider in relation to the findings presented. In terms of included studies, reviews highlighted issues such as variability across studies (i.e. study protocols, types of interventions, outcome measures, and definitions), lack of reporting means and variances, and small sample sizes [5, 7, 20, 21, 24, 28]. Such limitations, in turn, made it difficult to compare study findings and generate firm conclusions [7, 21, 24]. Reviews also highlighted issues with the types of study designs used, limited research taking place in real-world settings with time constraints and low-income countries, and over-reliance on self-reported data [5, 7, 19, 21, 28]. Further, reviews highlighted limitations regarding their analyses. Examples of limitations discussed include the possibility that relevant studies may have been excluded due to the evolving evidence base and issues with meta-analysis due to heterogeneity of retrieved studies [5, 7].

Future Research. A number of areas for future research emerged across reviews. For example, reviews outlined a need to better understand the impact of FOP and shelf labelling, particularly on outcomes related to consumption, purchasing, and body weight, as well as more research in real-world settings, with sufficient sample sizes, and on populations with diverse socio-economic backgrounds [5, 7, 20, 21, 28]. Reviews also highlighted a need for more studies comparing different labelling systems, both in terms of FOP and shelf labelling formats [21]. For example, Hersey et al. [21], noted that there were

several studies comparing the TL labelling system with systems such as the %GDA, single check mark, and tick logo. However, limited studies have compared the TL system with multiple-level or graded summary icons, such as the one recommended by the Institute of Medicine (currently the National Academy of Medicine) [21]. Finally, reviews called for more research that considers FOPs in the context of the entire package in relation to outcomes of interest, examines substitution effects, and examines the impact of FOP and shelf labels as part of multi-pronged strategies involving public education [20, 21, 28].

Menu Labelling

Seventeen reviews were relevant to menu labelling, with fifteen reporting on findings related to consumer awareness, understanding, preferences, use, purchasing, consumption, and/or body weight outcomes [6, 12, 14, 19, 22, 29-40]. The majority of reviews focused on calorie menu labelling and reported weak evidence to support menu labelling as a strategy to promote healthy choices and significantly reduce calorie purchasing and consumption [31]. For a summary of review findings and characteristics, see Table 2.

Comprehension, Understanding, Awareness and/or Preferences. Four reviews reported on findings related to consumer comprehension, understanding, awareness, and/or preferences. Research on menu labelling and consumer comprehension and understanding was limited, particularly compared to research on FOP labels. Indeed, Morestin et al. [12] noted that menu labelling in restaurants was less likely to produce comprehension difficulties compared to labelling on pre-packaged foods because it tends to focus on one nutritional component (calories), pointing to this as a potential reason research is limited in this area. That said, a US study included in the Krieger and Saelens review [6] found that respondents considered menu labelling with information on multiple nutritional components to be more effective and credible than menu labels with information on only one nutritional component, such as calories. Further, Sarink et al. [34] reported on findings from two qualitative studies, which found that lack of understanding of calories was a barrier to the use of menu labelling information among low-income residents of New York City neighbourhoods. In terms of consumer awareness, findings varied across the included studies, with some evidence to suggest that menu labelling helps increase awareness of nutrition information, including among low socio-economic populations [6, 12, 34, 36].

In regards to consumer preferences, Krieger and Saelens [6] concluded that most consumers are in favour of menu labelling and believe it to be helpful. In terms of preferred labelling formats, this review also highlighted findings from another US study of 663 adults, which found almost equal preferences for the following schemes: (1) providing the number of calories, (2) physical activity equivalent for calories, and (3) percentage of recommended total daily energy intake [6]. However, this review outlined findings

from a second US study, which found that 71% of the 150 participants preferred the provision of calorie information to information on the physical activity equivalent of calories [6].

Reported Use and/or Likely Purchase. Five reviews reported on menu labelling and findings related to reported use and/or likely purchasing [6, 12, 19, 34, 36]. Overall, the impact of menu labelling in this area appeared variable across included studies. Kiszko et al. [36] highlighted seven studies from real world restaurant settings, noting that reported use of menu labelling was low in each study. Further, Krieger and Saelens [6] found that across the cross-sectional surveys included in their review, more than 60% of each sample said they would use menu labelling, although the reliability of such subjective reports is debatable. This effect varied across sub-groups, such as women and individuals motivated to seek out nutrition information [6]. In addition, Sarink et al. [34] concluded in their systematic review that although self-reported or intended use of menu labels in low socio-economic populations (SEP) was favourable, the impact was generally less than what has been observed for higher SEPs.

Purchasing, Selecting, and/or Sales. Fourteen reviews examined menu labelling and findings related to purchasing, selecting, and/or ordering behaviour. In reviewing findings from these reviews, it is important to note that several of the included studies had weak designs [6, 12, 19, 29-38, 40]. Many of these reviews focused on calories purchased or selected, reporting weak and/or mixed results [29, 31, 32, 36, 40], particularly in real-world settings [41]. For example, Long et al. [31] examined the impact of menu calorie labelling on changes in calories ordered or purchased per meal. This review focused on calorie labelling with or without a daily anchor statement and excluded menu labelling formats not included in the US federal menu calorie labelling laws (i.e. nutrition facts table, traffic light labels, physical activity labels, and percentage daily energy intake labels) [31]. This review found that, among all 19 included studies, menu labelling was associated with a –18.1 kilocalorie reduction ordered per meal, with significant heterogeneity across studies [31]. However, this review reported that among the six controlled studies in restaurant settings, labelling was associated with a non-significant –7.6 kilocalorie reduction per meal [31]. Interestingly, Sinclair et al. [35] found that menu labelling with calories alone did not contribute to a significant decrease in calories selected (-31 kilocalorie). However, the addition of contextual or interpretive information on menus did appear to help consumers select fewer calories (-67 kilocalorie) [35].

It is important to note that, across reviews, outcomes related to menu labelling and consumer purchasing, selecting, and/or sales were not uniform. For example, VanEpps et al.'s 2016 review [29] found limited evidence that labelling of calories reduced energy content of food purchased at traditional fast-food restaurants, but found some impact at full service restaurants and coffee shops. Sarink et al. [34] concluded that menu labelling may have a greater benefit for higher SEP groups in terms of purchasing outcomes, though the review called for more research in this area. Further, Nikolaou et al. [33] found that while a meta-analysis resulted in no overall effect of menu labelling on calories

purchased, there was an enhanced effect for those who noticed calorie-labelling. Finally, reviews noted that certain populations may be more inclined to use calorie information when selecting meals, including women, residents of wealthy neighbourhoods, consumers who made high calorie purchases prior to policy implementation, dieters, and individuals who are generally nutrition conscious [6, 35, 36].

Consumption and/or Dietary Intake. Eight reviews reported on menu labelling and findings related to consumption and dietary intake, reporting limited and weak results [6, 19, 22, 30, 31, 34, 35, 40]. Long et al. [31] only identified two studies assessing the impact of menu labelling on energy consumption during a meal, which limited the potential for meta-analysis. Moreover, Swartz et al. [40] found two US studies measuring calories consumed, with both studies reporting statistically insignificant results overall [40]. However, this review reported differences according to sub-group analysis [40]. Further, Sinclair et al. [35] noted that menu labelling with calories alone did not significantly decrease calories consumed (-13 kilocalorie), although the addition of interpretive information on menus contributed to some decreases in calories consumed (-81 kilocalorie). This systematic review and meta-analysis of US studies also concluded that women are more likely than men to use menu labels to consume fewer calories [35].

Body Weight. Four reviews reported on findings relevant to body weight [12, 19, 30, 37]. Another two reviews aimed to examine body weight outcomes, but no relevant studies met their inclusion criteria [31, 34]. Overall, findings in this area were too limited to draw conclusions [12, 19, 30, 37]. Of note, Gittlesohn et al. [37] reported on one study of a multi-component intervention, called “Shape Up Somerville,” which took place in a small local restaurant. This study involved the use of menu labels as part of a multi-component intervention (i.e. signage, increased availability of healthful foods, and community components), which resulted in a reduced BMI among children by 0.101 [24]. Further, Roy et al. [19] reported on one study involving nutrition labelling on menu and menu boards in a university residence hall canteen. As outlined by the review, this intervention resulted in a 3.5 kg reduction in weight gain, thus representing an effective intervention approach to address rapid weight gain in young adults [19].

Policy Considerations. Reviews relevant to menu labelling discussed a number of considerations for policy implementation. For example, Eyler et al. [39] reviewed US state policies related to childhood obesity and predictors of enactment. This review found that many of the bills enacted did not require complex implementation or funding, whereas menu labelling was a highly regulatory bill topic, creating a barrier to enactment [39]. Considering this, this review emphasized the need for consistent implementation strategies and increased evidence of the benefit of such policies to facilitate a cultural shift and legislative support [39].

Reviews discussed additional factors related to implementation of menu labelling policies. For example, Morestin et al. [12] noted that while the cost of implementing nutrition-labelling policies, such as menu labelling, ultimately falls to government and industry groups, including restaurants, these policies are relatively cost-effective, with the economic benefits of chronic disease prevention outweighing the costs [12]. Along these lines, a 2015 evidence review and microsimulation by Gortmaker et al. [14] on the cost effectiveness of childhood obesity prevention policies found that menu calorie labelling has the potential to save $5.90 in health care costs per dollar spent. With that said, this review also noted that the estimate is associated with high uncertainty levels, indicating a need for ongoing monitoring of the national menu labelling policy as it is implemented [14]. In terms of feasibility, Morestin et al. [12] discussed the importance of cooperation from the food and restaurant industry, as well as the need for careful policy formulation to avoid industry contestation. Tied to this, McGuffin [38] stated that for menu labelling policy to be successful, policy-makers must not only convey nutrition information in an effective way, they must also help relevant actors, such as caterers, overcome real and apparent obstacles to implementation. Further, reviews highlighted the fact that, to achieve effectiveness, menu labelling policy may need to be part of a more comprehensive approach, including nutrition education campaigns, and increased availability of healthy food [34, 36]. Regarding consumer acceptability, reviews suggested that consumers have generally favourable views about labelling as it supports individuals' right to choose [6, 12, 29, 31].

In addition, reviews discussed potential unintended or indirect impacts pertaining to menu labeling policies. For example, reviews outlined the possibility that restaurants required to implement menu labeling may experience loss of revenue and engage in value pricing to offset consumer responses [12, 31]. In contrast, reviews considered emerging evidence indicating that menu labelling does not have an impact on restaurant revenue and may prompt restaurants to offer healthier food through reformulation [6, 31]. Indeed, product reformulation was reported as having potential to benefit all consumers regardless of their interest in menu labelling [31]. However, given the current emphasis on menu labelling of calories versus a broader range of nutrients, it will be important to ensure that overall nutrition quality is not sacrificed in an effort to provide less energy-dense products [29, 31].

Limitations. Reviews highlighted a number of limitations regarding the existing evidence base, which are important to note. In regards to included studies, reviews indicated that studies had not been conducted in realistic settings and identified high variation across studies in terms of methods, settings, and time frames [31, 34-37]. Reviews outlined additional issues pertaining to included studies, such as the presence of underpowered studies, lack of comparison groups, inadequate impact measurements, and difficulty accessing pertinent study information [31, 32, 36, 37]. Of note, a number of reviews discussed limitations related to sub-group analysis. For example, Kiszko et al. [36] and Sinclair et al. [35] identified an absence of sub-group analysis across the majority of studies, making it difficult to determine the effect of menu labelling on specific groups. Further, Sarink et al.'s analysis [34] reported

that the majority of reviewed studies did not include sample size considerations for sub-group analyses by SEP, making it difficult to determine if studies had sufficient power [34]. This review also highlighted the fact that most studies employed a neighborhood-level measure of SEP, which may be less sensitive than an individual-level measure [34].

Future Research. In terms of areas for future research, reviews called for more rigorous study designs and policy evaluation methods, natural experiments of existing and newly implemented policies, increased research in real-world settings, and studies exploring a wider variety of outcomes, including consumer purchasing, consumption, and total daily intake [6, 19, 29, 30, 32, 33, 40]. Reviews also called for additional research examining the impact of different labelling formats (i.e. labels with interpretive information, daily calorie anchor statement), menu labelling as part of multi-pronged interventions (i.e. involving communication campaigns and education), the effectiveness of menu labelling in different settings, the impact of sodium labelling, and the role of food industry participation and product reformulation [6, 29, 31, 34, 36, 38, 40]. Finally, reviews emphasized the need to examine the impact of menu labelling on different population sub-groups using more robust study designs [34, 36, 40].

CONCLUSIONS

The aim of this synthesis was to summarize evidence on the impact of FOP, shelf, and menu labelling with the goal of informing policy action for obesity and chronic disease prevention. Overall, FOP and shelf labelling emerged as promising policy options to increase uptake of nutrition information and help consumers make healthier choices. While more research is required to understand the impact of different labelling formats, the nutrient-specific TL FOP system appeared to have support across a number of reviews [5, 20, 28]. Moreover, one review concluded that the "Guiding Stars" and "Special Diet Alert" systems hold promise in terms of shelf labelling [20]. In terms of menu labelling, reviews reported relatively weak impacts and presented evidence to suggest effectiveness varies across population sub-groups [31, 36, 41]. With that said, a number of reviews also highlighted menu labelling as a cost-effective, feasible, and acceptable policy option with potential to contribute to small, but significant impacts if implemented appropriately [12, 31]. In addition, reviews emphasized the need for nutrition labelling to be paired with additional strategies, such as education and communication campaigns, to increase effectiveness of nutrition labelling, particularly among those less likely to use labels [21, 40], and the potential role of product reformulation in contributing to healthier diets [5, 31].

In considering findings from this synthesis, it is important to discuss the limitations of this analysis. First, reviews did not categorize outcomes uniformly and did not always provide explicit outcome definitions. Thus, while an effort was made to categorize information in a systematic way, the analysis may have missed or inappropriately categorized outcome information. Second, this synthesis did not use a quality rating system to analyze reviews. For this reason, some of the included documents may be of poor

quality. Many of the systematic reviews included reviewed the same, small number of weak studies. Third, this analysis took place at the review level and likely excluded relevant and pertinent information from individual studies. Future syntheses could address this by extracting information directly from studies included in reviews. Finally, many of the findings presented by included reviews were descriptive rather than definitive in nature [24], which made it difficult to draw definitive conclusions.

Overall, findings from this synthesis point to a number of important areas for future research and consensus. In terms of FOP and shelf labelling, there is a need for more studies examining the effectiveness of different labelling systems and logo combinations [20]. In regards to menu labelling, additional research is required to understand the impact of menu labelling in various real-world settings, and to examine the effect of different labelling formats, such as those that incorporate interpretive information and provide nutrition information beyond calories [6, 31, 35]. Across the board, there is a need for rigorous research and policy evaluation on FOP, shelf, and menu labelling, impacts on purchasing, consumption, and body weight outcomes, and the influence of such labels on product reformulation to promote healthier diets at the population level [5, 21, 31]. There is also a need to explore the impact of labelling as part of multi-pronged strategies and for stronger sub-group analysis to determine impacts of labelling from an equity perspective [20, 21, 34]. In considering the available evidence, moving forward it will be important to achieve consensus on the most appropriate FOP and/or shelf labelling system for the Canadian context, how such a system should be regulated (i.e. voluntary/mandatory system, role of government and industry), and key considerations for policy implementation. Consensus is also required on the suitability of menu labelling as a policy option for obesity and chronic disease prevention in Canada, and key recommendations for increasing its effectiveness, particularly from an equity perspective.

Table 1. Front-of-Package and Shelf Labelling: Review Characteristics and Key Findings

Author	Title	Journal	Year	Type	Objectives	Search Year	Countries of Included Studies/ Populations	Intervention/Policy Details and Relevant Outcomes	Relevant Findings, Conclusions and/or Implications
Cecchini and Warin [5]	Impact of food labelling systems on food choices and eating behaviours: a systematic review and meta-analysis of randomized studies	Obesity Reviews	2015	Systematic Review and Meta-Analysis	-To assess the effectiveness of food labeling schemes in increasing the selection of healthier products and in reducing calorie intake/choice -To determine whether food labels' format influences choices and consumption	-January 2008-April 2015	USA, Australia, UK, France, Germany, Canada -Population not specified	-This review compares TL, %GDA, and other schemes (i.e. various FOP logos) -According to the review, n=6 interventions involved FOP, while n=3 did not explicitly state the position -Relevant outcomes: selecting/purchasing a healthier option, calorie intake/choice	-This review reported that food labeling would increase the amount of people selecting a healthier food product by about 17.95% (CI: +11.24% to +24.66%). -The TL label was identified as the most effective scheme, increasing the number of people selecting a healthier option by about 29.36% (CI: 19.73% to 39.00%). The category of other food labels followed, with an increase of about 14.69% (CI: 3.56% to 25.82%). %GDA was last, with an increase of about 11.85% (CI: 5.43% to 18.28%. -This review reported that food labelling would decrease calorie intake/choice by about 3.59% (CI: 8.90% to +1.72%), but results were not statistically significant. Further, due to the low number of studies included in the %GDA and traffic light categories, the review recommended that results not be compared across sub-categories. In terms of intake/choice, other food labels would have an effect of 2.88% (CI: 10.08% to +4.32%). -This review concluded that food labelling seems to have a statistically significant effect in steering consumers' choice towards healthier products, and that interpretive nutrition labels, such as traffic light schemes, may be more effective than other approaches. -This review indicates that food labelling may also help consumers in choosing/consuming foodstuff with lower calorie content. However, as outlined by the review, the available evidence is too limited to produce statistically significant results.

Roy et al. [19]	Food environment interventions to improve the dietary behavior of young adults in tertiary education settings: a systematic literature review	Journal of the Academy of Nutrition and Dietetics	2015	Systematic Review	-To identify and assess the effectiveness of intervention strategies that have been conducted to improve the dietary behavior of young adults through food environment changes in university/college settings	-1998-December 2014	-United States and Europe -Conducted within tertiary educational institutions such as colleges and/ or university and targeted toward young adults attending university/college	-University/college-based environmental interventions to improve dietary behaviours. One study was relevant to shelf-tags -Relevant outcomes: sales	-The relevant intervention consisted of target food items labelled as healthful using a "Fuel Your Life" shelf tag. According to the review, the intervention did not result in significant changes in the sale of any single food item. -This review concluded that interventions, including food labelling, promotional materials, increasing the availability of healthy products, and providing price incentives to increase purchases of healthy foods, may be potentially useful.
Hawley et al. [20]	The science on front-of-package food labels	Public Health Nutrition	2013	Review	-To evaluate existing research in order to identify FOP/Shelf labelling systems that hold the most promise -To identify key FOP/shelf labeling research needs	-January 2004 - February 2011	-Countries and populations not specified	-FOP and shelf-labelling systems -Relevant outcomes: understanding, preferences, use, purchases, consumption	-This review reported on a number of findings relevant to outcomes of interest. -The review stated that research on FOP labellng systems in a variety of countries has produced mixed results. -According to the review, the multiple traffic light label had the most consistent support. -This review also indicated that an effective MTL label should contain calorie information per serving, daily caloric requirement information and convey nutrient levels using high, medium or low text. -This review also indicated that shelf-labelling systems, such as 'Guiding Stars' and "Special Diet Alert' hold promise. -This review indicated that more research pertaining to the impact of FOP labeling systems on purchasing and consumption of foods is needed, as well as more research pertaining to the impact of FOP and shelf labelling systems among diverse US populations.
Hersey et al. [21]	Effects of front-of-package and shelf nutrition labeling systems on	Nutrition Reviews	2013	Systematic literature review	-To inform policymakers in the United States about which types of labelling	-1990-2010	-Europe, the Americas, Australia, New Zealand -Population not specified	-FOP and shelf labelling systems -Discusses nutrient specific systems (i.e. %GDA and TL system) and summary systems (i.e.	-This review reported on a number of findings relevant to outcomes of interest. -This review concluded that, in general, FOP and shelf systems can assist consumers in making healthier food

	consumers				schemes or which specific features of labels have been scientifically tested on consumers and have been found to most quickly capture their attention, are easiest for them to understand, and prompt them to make healthier purchases and consumption choices			Choices Program Logo and Keyhole Symbol) -Relevant outcomes: understanding, attention and processing, use and likely purchase, purchasing, consumption	choices. -This review found that nutrient specific FOP labels, in contrast to summary systems, more easily helped consumers identify healthier products. -The review indicated that consumers can more easily interpret nutrition information with FOP schemes that use text and colour to indicate high, medium and low nutrient levels. This is in contrast to FOP labels that only display numeric information, such as %GDA. -This review indicated that there is some evidence consumers use FOP and shelf labels. -According to the review, there is evidence shelf labels help consumers make healthier purchases. -The review highlighted a need for more studies exploring the relationship between FOP labels, purchasing outcomes, and dietary intake.
Capacci et al. [22]	Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness	Nutrition Reviews	2012	Review of macro-level policy interventions	-To provide a structured classification of public policies to promote healthier eating as well as a structured mapping of existing measures	-Not specified	-Europe -Population not specified	-Policy and macro-level interventions, including shelf-tags -Relevant outcomes: dietary intake	-This review included one study, which involved a shelf labelling system in a Dutch supermarket. As outlined in the review, the intervention had no effect on clients' total fat intake.
Glanz, Bader, & Iyer [23]	Retail grocery store marketing strategies and obesity: an integrative review	American Journal of Preventive Medicine	2012	Review	-To synthesize research and publications from industry and academic sources and provide direction for developing and evaluating promising interventions	-1995-2005	-Countries and population not specified	-Discusses Europe's FOP labelling system and shelf labels -Relevant outcomes: understanding and preferences	-This review included one study from Europe, which reported that consumers find FOP labelling helpful, especially when the information is succinct (particularly among certain population groups, such as older consumers). -This review also included findings indicating that consumers are interested in shelf labels to identify healthier products.

Gittelsohn, Rowan, & Gadhoke [24]	Interventions in small food stores to change the food environ-ment, improve diet, and reduce risk of chronic disease	Prevention Chronic Disease	2012	Review	-To identify small-store interventions and to determine their impact on food availability, dietary behaviors, and psychosocial factors that influence chronic disease risk	-After 1990	-United States and abroad -Included urban, rural and remote settings -Low-income populations -Most targeted a racial/ethnic minority group	-Small store intervention strategies involving in-store -signage such as shelf-labels -Relevant outcomes: purchasing, sales, consumption, and body weight	-This review discussed a number of findings relevant to outcomes of interest. -This review reported that most of the trials that showed positive impact used multipronged strategies (food provision, infrastructure, and health communication) designed to improve both access to healthy foods (supply) and consumption of those foods (demand), thus demonstrating the need for combined environmental and behavioral approaches in small-store interventions.
Hieke & Taylor [25]	A critical review of the literature on nutritional labeling	Journal of Consumer Affairs	2012	Review	-To provide an overview and critique of the nutrition labeling literature	-More than 30 years of empirical research	-Countries and population not specified	-FOP labels -Relevant outcomes include: understanding, processing, and preferences	-This review discussed a number of findings relevant to outcomes of interest. -This review concluded that while some useful findings have resulted from research on nutritional labelling, a more holistic view is needed if the research is to be more helpful in framing policy. For example, a need to explore the most effective way to present FOP information.
Van't Riet [26]	Sales effects of product health information at points of purchase: a systematic review	Public Health Nutrition	2012	Systematic Review	-To provide an overview of empirical evidence on the effectiveness of product health information for food products at the point of purchase	-1980-2010	-United States -Population not specified	-Interventions in tertiary education settings involving shelf tags -Relevant outcomes: purchasing	-This review discussed a number of findings relevant to the outcome of interest. -This review investigated the effectiveness of product health information, including shelf tags, posters, flyers, brochures, and/or public access systems, at the point of purchase. -This review concluded that the effectiveness of product health information was mixed. However, the review noted that interventions appear to be more affective when they include additional components beyond product health information.

Brambila-Macias et al. [27]	Policy interventions to promote healthy eating: a review of what works, what does not, and what is promising	Food and Nutrition Bulletin	2011	Review of Policy Interventions	-To classify types of policy interventions addressing unhealthy eating and identify through a literature review what specific policy interventions are best suited to improve diets	-2009-2010	-Countries and population not specified	-Policy interventions involving FOP nutritional information. Discusses %GDA and TL system -Relevant outcomes include: awareness, preferences and purchasing	-This review discussed findings relevant to the outcomes of interest. -The review concluded that nutritional labelling generally contributes to informed choice, however, informed choice is not necessarily healthier; knowing or being able to read and interpret nutritional labelling on food purchased does not necessarily result in consumption of healthier foods.
Campos, Doxey, & Hammond [7]	Nutrition labels on pre-packaged foods: a systematic review	Public Health Nutrition	2011	Systematic Review	-To review research on consumer use and understanding of nutrition labels, as well as the impact on dietary habits	-1990-2010	-Europe, Canada, Australia and New Zealand, Norway, Thailand and Trinidad -Range of ages, socio-economic strata and geographical regions	-FOP labels -Relevant outcomes include: comprehension, understanding, preferences, purchasing	-This review discussed a number of findings relevant to FOP and outcomes of interest. -This review stated that there is increasing evidence that labeling regulations need to take the entire package into consideration to maximize effectiveness. -The review highlighted that FOP labels may disproportionately benefit those with low-nutrition education and knowledge of nutrition labels. -This review included findings from a study indicating that consumers support the idea of FOP, particularly when it is consistent. -This review included preliminary evidence suggesting that FOP labels may promote healthier food purchasing behaviours, although additional research is required. -This review also stated that to capitalize on the potential of nutrition labels, governments need to explore new formats and different types of information content.
Koehler et al. [28]	Policy research for Front of package nutrition labeling: environmental scan and	Department of Health and Human Services, Office of the Assistant Secretary	2011	Literature Review and Environmental Scan	-Examines the impact of restaurant and cafeteria menu labellng on consumer behavior	1990-Present	-The United States and other countries -Population not specified	-FOP and shelf labelling systems -Discusses nutrient specific systems (i.e. %GDA and TL system) and summary systems (Choices Program Logo and Keyhole Symbol).	-This review reported on a number of findings relevant to outcomes of interest. Key highlights from the review findings are outlined below. -This review stated that consumers can more quickly process simple graphic FOP labels (i.e. labels displaying TL colours or graphic elements) than labels

	literature review	for Planning and Evaluation						-Relevant outcomes: understanding, attention and processing, liking, preferences, use, purchasing, and consumption	primarily displaying detailed numeric information (e.g., a monochrome %GDA). -This review noted that consumers like and understand nutrient-specific FOP nutrition labels that incorporate TL colour-coding more than nutrient-specific FOP labels that emphasize numeric information (this is particularly the case for diverse populations) -This review indicated that TL colour-coding appear to enhance consumer understanding of nutrition information. -This review indicated that consumers who are less nutrition conscious and of low socioeconomic status are less likely than nutritious-conscious consumers to purchase heathier products using FOP or shelf labels. -This review indicated that the impact of FOP labelling on consumers' purchase and consumption habits is unclear due to insufficient research and mixed results of existing research. -This review indicated that FOP and shelf labels may benefit food producers by increasing sales of products over time, and may stimulate food producers to develop healthier products
Morestin et al. [12]	Public policies on nutrition labelling: effects and implementation issues - a knowledge synthesis	National Collaborating Centre for Healthy Public Policy	2011	Knowledge Synthesis	-To gather available knowledge on the effectiveness of nutrition labelling, its unintended effects, its equity, its cost, its feasibility and its acceptability	2006-2009	-Canada, United States, European countries, Australia, New Zealand -General public, but not those focused on groups following a particular diet (i.e. persons with diabetes)	-Simplified labelling including FOP -Relevant outcomes include: comprehension, use, purchasing, consumption	-This review reported on a number of findings relevant to outcomes of interest. -One of the key conclusions from this review is that consumers are better able to understand simplified information in the form of a logo, which may explain why this option is increasingly being considered. -This review also highlighted relevant findings related to cost, feasibility and acceptability of nutrition labelling policies relevant to FOP.

Table 2. Menu Labelling: Review Characteristics and Key Findings

Author	Title	Journal	Year	Type	Objectives	Search Year	Countries of Included Studies/ Populations	Intervention/Policy Details and Relevant Outcomes	Relevant Findings, Conclusions and/or Implications
VanEpps et al. [29]	Restaurant menu labeling policy: review of evidence and controversies	Current Obesity Reports	2016	Review	-To identify and summarize the results of studies that have assessed the impact of real-world numeric calorie posting	-May to November 2015	-Countries not specified -Children and adults	-Real-world studies that have evaluated numeric calorie (energy) postings as required by US menu labelling laws -Relevant outcomes: purchasing	-This review found limited evidence that energy content labels reduced energy content of food purchased at traditional fast-food restaurants. However, the review reported some evidence that menu labels may reduce energy content of food ordered at full-service restaurants and coffee stores. -The review also highlighted a number of controversies related to menu labelling policies, including which settings should be included and how best to present information.
Freudenberg et al. [30]	The state of evaluation research on food policies to reduce obesity and diabetes among adults in the United States, 2000-2011	Preventing Chronic Disease	2015	Systematic Review	-To examine the impact of food policies	January 2000 – December 2011	-United States -Adults aged 18 or older	-Food-related policies, including calorie labelling in restaurants -Relevant outcomes: purchasing, consumption, body weight	-This review reported that 13 of 20 studies assessing menu labelling had positive findings, while none had negative findings. -This review also stated that across the 5 policy categories, calorie/menu labelling had positive results in 50% or more of the studies in at least 2 of the 3 assessment categories, with most of the positive findings assessing purchasing behavior. The fewest studies with positive findings related to BMI or body weight. -The review called for improved quality and rigor of policy evaluations.
Gortmaker et al. [14]	Three interventions that reduce childhood obesity are projected to save more than they cost to implement	Health Affairs	2015	Review and microsimulation modeling	-To examine the cost-effectiveness and population-level impact of seven interventions identified as potentially important strategies for	-Not specified	-United States -Policy interventions to reduce childhood obesity	-Restaurant menu calorie labelling, modeled on the federal menu regulations to be implemented under the Affordable Care Act	-The review stated that the largest population research occurred with interventions that would affect the whole population, such as restaurant menu calorie labelling, which was projected to reach 307 million people. -The review indicated that menu calorie labelling is likely to save $5.90 in health care costs per dollar spent, though the review noted that the estimate is associated with high uncertainty levels. -The review indicated there is a need for ongoing monitoring of the national menu

					addressing childhood obesity				labelling policy as it is implemented.
Long et al. [31]	Systematic review and meta-analysis of the impact of restaurant menu calorie labeling	American Journal of Public Health	2015	Systematic Review and Meta-Analysis	-To evaluate the impact of menu and calorie labeling with or without a daily anchor statement compared with menus without calorie labelling	Up to October 2013	-Countries not specified -No age or population restrictions	-Menu calorie labelling (with or without a daily anchor statement) similar to the Federal calorie labelling law -This review excluded studies evaluating the impact of menu formats not included in the Federal calorie labelling laws (i.e. the nutrition facts labels, TL labels, physical activity labels). -Relevant outcomes: calories ordered, calories consumed -This review aimed to examine outcomes related to body weight and total energy intake, but no relevant studies were retrieved	-This review concluded that among 19 studies, menu calorie labelling was associated with a -18.13 kilocalorie-reduction ordered per meal with significant heterogeneity across studies (95% confidence interval=-33.56, -2.70; P=0.021, I^2 =61.0%). -This review found that when stratified by setting, the estimated reduction in calories ordered or purchased per meal from non-restaurant settings (laboratory, internet, healthcare, street corner interview) remained statistically significant (-58.16 kcal; 95% CI=–102.44, –13.87; P=.01; I^2=61.0%, P for heterogeneity=.003) -However, this review found that among the 6 controlled studies in restaurant settings, labelling was associated with a nonsignificant -7.63 kilocalorie reduction (95% CI =-21.02, 5.76; P=0.264; I^2=9.8%). -According to this review, sub-group analysis of the 3 studies by age group (children and adolescents) resulted in a nonsignificant decrease in calories ordered or purchased (-58.16 kcal; 95% CI=–102.44, –13.87; P=.01; I^2=61.0%, P for heterogeneity=.003) -This review concluded that menu-labelling in restaurant settings, similar to those included in the national menu labeling regulations to be implemented in the United States, did not result in a significant reduction in calories purchased per meal. -This review indicated that menu labelling is a relevantly low-cost education strategy that may lead to slightly small reductions in calories purchased.
Mayne & Michael [32]	Impact of policy and built environment changes on	Obesity Reviews	2015	Systematic Review	-To identify published studies in the medical literature	2005-2013	-United States, Australia, United Kingdom, Canada, Chile and New Zealand	-Naturally occurring interventions due to a policy change or modification to the built environment	-The review discusses a number of findings relevant to outcomes of interest, reporting generally weak impacts overall.

	obesity-related outcomes: a systematic review of naturally occurring experiments				relating to natural- or quasi-experiments in obesity research		-Countries not specified Adults and children	related to physical activity, nutrition or obesity: nutrition labeling in restaurants -Relevant outcomes: calories/types of food purchased	
Nikolaou, Hanke, & Lean [33]	Calorie labelling: does it impact on calorie purchase in catering outlets and the views of young adults?	Internati-onal Journal of Obesity	2015	Review and meta-analysis	-To review the current literature, conduct a meta-analysis and determine young adults' views on calorie-labeling and on calories purchased	1990-2014	-Countries not specified -Studies on children excluded	-Calorie labelling in 'real-life' settings, such as chain restaurants, food/coffee chains, dining halls and restaurants. -Relevant outcomes: calories purchased	-This review reported that 3 of 7 studies found significant reductions in calories purchased (-38.1to -12.4 kcal). However, this review reported that meta-analysis showed no overall effect: − 5.8 kcal (95% confidence interval (CI) = − 19.4 to 7.8 kcal). With that said, there was a reduction of − 124.5 kcal (95% CI = − 150.7 to 113.8 kcal) among those who noticed the calorie-labeling (30–60% of customers). -The review stated that the superior effect of calorie-labeling among those noticing the calorie labels indicated its value for people who want to control their weights, but the lack of effect in others may reflect inappropriate labeling presentation or lack of educational supporting material and guidance -This review noted that, importantly, no study showed any increase in calorie purchased.
Roy et al. [19]	Food environment interventions to improve the dietary behavior of young adults in tertiary education settings: a systematic literature review	Journal of the Academy of Nutrition and Dietetics	2015	Systematic Review	-To identify and assess the effectiveness of intervention strategies that have been conducted to improve the dietary behavior of young adults through food environment changes in university/college settings	-1998-December 2014	-United States and Europe -Conducted within tertiary educational institutions such as colleges and/ or university and targeted toward young adults attending university/college	-University/college-based environmental interventions to improve dietary behaviours -Relevant outcomes: intent to purchase, use, selection, sales, intake, body weight	-This review discussed a number of finding related to outcomes of interest. -This review concluded that interventions, including food labelling, promotional materials, increasing the availability of healthy products, and providing price incentives to increase purchases of healthy foods, may be potentially useful.

Sarink et al. [34]	The impact of menu energy labelling across socioeconomic groups: a systematic review	Appetite	2015	Systematic Review	-To review evidence of the impact of menu energy labeling across socioeconom-ic strata	Up to September 2015	-Countries not specified -Adolescents or adults: papers reporting on outcomes only in children were excluded -Low SEP or analyses stratified by a measure of SEP	-Menu energy labeling intervention or policies -Relevant outcomes: awareness, understanding, intent to use, calories purchased, calories consumed, body weight - This review aimed to examine body weight outcomes, but no relevant studies were retrieved	- This review discussed a number of findings relevant to outcomes of interest. -According to the review, 5 of 6 studies did not find a positive effect of menu labelling on low socioeconomic populations. -As outlined, 2 of 5 studies that compared purchase outcomes of menu labeling across SEP groups reported that the policy was effective overall. However, both identifying a greater effect on fast food purchasing among consumers visiting stores in high compared to low SES neighbourhoods. -The review indicated that it is difficult to know whether the absence of effectiveness reported in low SEP populations represents a true lack of effectiveness. Alternatively, it may be the result of a more general lack of policy effectiveness of the limited quality of the reviewed studies.
Sinclair et al. [35]	The influence of menu labeling on calories selected or consumed: a systematic review and meta-analysis	Journal of the Academy of Nutrition & Dietetics	2014	Systematic Review and Meta-Analysis	-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 -To determine influence of format	January 1st, 1990-March 20, 2013	-All studies took place in the United States -Population not specified	-Controlled experimental and quasi-experimental studies that reported the effect of informative, contextual, or interpretive menu labelling -Relevant outcomes: selection of calories, consumption of calories	-This review found that menu labelling with calories alone did not have the intended effect of decreasing calories selected (-31 kcal [P=0.35]) and consumption (-13 kcal [P=0.61]). -According to the review, the addition of contextual or interpretive nutrition information on menus appeared to assist consumers in the selection (-67 kcal [P=0.008]) and (-81 kcal [P=0.007]. -This review also found that sex influenced the effect of menu labelling on selection and consumption, with women using the information to select fewer calories. -This review concluded that findings from the meta-analysis support menu-labelling 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 foodservice establishments.

Kiszko et al. [36]	The influence of calorie labeling on food orders and consumption: a review of the literature	Journal of Communi-ty Health	2014	Review	-To explore the effectiveness of calorie labeling at the point of purchase	2007-2013	-Countries and population not specified.	-Calorie labeling at the point of purchase or point of selection -Restaurant settings, cafeterias, and laboratory settings -Relevant outcomes: awareness, use, and calories ordered	-This review reported on a number of findings relevant to outcomes of interest. -This review reported that there is an abundance of evidence suggesting that calorie labeling, as it is currently being implemented, has no impact on overall food purchases or consumption of the population as a whole. -This review indicated that some studies show that certain groups are more likely to use calorie information while making their meal selections, such as women, residents of wealthy neighborhoods, consumers who made very high calorie purchases prior to the mandate, dieters, and those who reported being motivated by nutritional information when making food decisions.
Gittelsohn, Lee-Kwan, & Batorsky [37]	Community-based interventions in prepared-food sources: a systematic review	Preventing Chronic Disease	2013	Systematic Review	-To provide a systematic review of interventions in prepared food sources in community settings	2011-2013	-United States, Canada, South Korea -Interventions had a range of consumer levels and race/ethnicity	-Multi-component interventions in public prepared-food sources involving menu labeling -Relevant outcomes: purchasing, body weight	-The review reports on a number of findings relevant to the outcomes of interest. -The review concludes that results are promising, showing that cost-effective methods (e.g., labelling foods as healthful) may have a significant impact on prepared-food source sales and customer behavior.
Krieger & Saelens [6]	Impact of menu labeling on consumer behavior: a 2008-2012 update	Robert Woods Johnson Foundation Research Review	2013	Review	-To examine the impact of restaurant and cafeteria menu labelling on consumer behavior	2008-2012	-Country and population not specified	Studies assessing the effects of menu labeling, including survey and simulation studies, and real-world cafeteria and restaurant studies -Relevant outcomes include: preferences, awareness, use, calories purchase, and types of items purchased	-This review reported on a number of findings relevant to outcomes of interest. -The review stated that evidence from surveys and simulation studies suggests menu labelling reduces calories purchased or consumed, but evidence from real-world cafeteria and restaurant studies regarding calories purchased or menu items selected was mixed. -This review stated that the impact of menu labelling is not uniform and may have a greater effect on women than men, on higher calorie items, and among certain types of restaurant chains. -This review indicated that the optimal format for providing nutritional information on menus is not known. With that said, the review indicated that providing interpretive information may have some impact on reducing calories purchased.

									-The review indicated that while evidence of menu labelling on calories purchased or menu items selected is mixed, menu labelling may impact some customers and types of menu items more than others.
McGuffin et al. [38]	Family eating out-of-home: a review of nutrition and health policies	Proceeding-s of the Nutrition Society	2013	Review	-To identify a range of existing guidelines to provide healthy food options for families who eat out-of-home frequently	-Not specified	-Australia, Canada, the US and WHO's European (EUR) Member States -Population not specified	-National nutrition policies relevant to menu labeling -Relevant outcomes: calories purchased	-This review indicated that research on the influence of menu labeling has found that any beneficial effect is limited. -Findings from this review highlighted that while policy-makers need to be cognizant of the need to convey nutrition information in an effective way for consumers, they also need to help caterers overcome obstacles to implementation of menu labelling guidelines. -This review discussed formats for menu labeling, highlighting mixed findings across studies for different outcomes, indicating that more work is required to identify the most effective format for presenting nutrition information.
Capacci et al. [22]	Policies to promote healthy eating in Europe: a structured review of policies and their effectiveness	Nutrition Reviews	2012	Review of Macro-level Policy Interventions	-To provide a structured classification of public policies to promote healthier eating as well as a structured mapping of existing measures in Europe	-Not specified	-Studies from Europe -Population not specified	-Policy and macro-level interventions, including menu labeling -Eating outcomes	-This review stated that empirical evidence on the eating outcomes of nutrition information on menu labels is weak, with few studies exploring compensating behaviours within the same meal or across meals. -This review indicated that regulation of nutrition information on menus is gaining popularity in the United States. -The review concluded that the basis of evidence for the policy instrument – nutrition information on menus in Europe – is suggestive, though there is uncertainty regarding compensating information. -The review stated that there is a gap in policy evaluation regarding such policies.
Eyler et al. [39]	Patterns and predictors of enactment of state childhood obesity legislation in the United	American Journal of Public Health	2012	Content Review of State Legislation	-To review state policies relating to childhood obesity -To quantitatively describe the	2006-2009	-United States -Children	-State legislation involving menu labelling	-This review reported that product and menu labelling was one of two highly regulatory bill topics that created a barrier to enactment. -This review stated that although this may be discouraging to advocates of these initiatives, the fact that the bills were introduced is positive as they are at

	States: 2006-2009.				predictors of enactment of legislation on childhood obesity				least being considered in state legislation. -The review concluded that while advocates of product and menu labeling bills maintain that the bills promote increased decision making, less consumer confusion and reduction in the tool from poor diets, they can be viewed as highly regulatory, with complex implementation and governance issues.
Morestin et al. [12]	Public Policies on nutrition labelling: effects and implementation issues - a knowledge synthesis	National Collaborat-ing Centre for Healthy Public Policy	2011	Knowledge Synthesis	-To gather the available knowledge on the effectiveness of nutrition labeling, its unintended effects, its equity, its cost, its feasibility and its acceptability	2006-2009	-United States, European Countries, Australia and New Zealand -General population, not involving a specific diet	-Public policies or interventions involving menu labeling -Relevant outcomes: awareness of nutrition information, use, calories purchased, types of items purchased, body weight	-This review reported on a number of findings relevant to outcomes of interest. -The review also highlighted a number of relevant findings related to cost, feasibility and acceptability of menu labeling policies.
Swartz, Braxton, & Viera [40]	Calorie menu labeling on quick-service restaurant menus: an updated systematic review of the literature	Journal of Behavioral Nutrition & Physical Activity	2011	Systematic review	-To use current literature to answer the question of whether calorie labelling on menus at restaurants and cafeterias has an effect on consumer purchasing and eating behaviors.	2006-August 2011	-Country and population not specified	-Experimental or quasi-experimental studies comparing calorie menu labelling with a no-calorie menu -Laboratory, college cafeterias, and fast food restaurants -Relevant outcomes include: calorie ordering, calorie purchasing, calories consumed, sales volume	-This review discussed a number of findings relevant to outcomes of interest. -Only 2 of 7 studies reported a statistically significant reduction in calories purchased among consumers -Two studies focused on sales, finding no significant difference in sales volume of healthy versus unhealthy food. - Finally, the review included 2 studies related to calorie consumption, reporting insignificant results overall; though both studies found significance according to sub-groups (sex, label condition). -This review concluded that, based on available evidence it appears that calorie menu labelling does not have the intended effect of decreasing calorie ordering and consumption from quick-service restaurants.

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