

Nutrition labels on pre-packaged foods: a systematic review

Sarah Campos, Juliana Doxey and David Hammond*

Department of Health Studies and Gerontology, University of Waterloo, 200 University Avenue West, Waterloo, Ontario N2L 3G1, Canada

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Abstract

Objective: To review research on consumer use and understanding of nutrition labels, as well as the impact of labelling on dietary habits.

Design: A systematic review was conducted by searching electronic databases. Relevant articles were screened by two reviewers and included if they met inclusion criteria, including eight methodological criteria. A total of 120 articles were included in the review, including cross-sectional surveys (n 96), experimental designs (n 17), 'natural experiments' (n 7) and longitudinal population-based surveys (n 2).

Setting: Articles covered seven jurisdictions: USA (n 88), Europe (n 12), Canada (n 9), Australia and New Zealand (n 4), Norway (n 2), Thailand (n 1) and Trinidad (n 1).

Subjects: Participants were from a wide range of age groups, socio-economic strata and geographical regions.

Results: Nutrition labels on pre-packaged foods are among the most prominent sources of nutrition information. Nutrition labels are perceived as a highly credible source of information and many consumers use nutrition labels to guide their selection of food products. Evidence also shows a consistent link between the use of nutrition labels and healthier diets. However, the use of labels varies considerably across subgroups, with lower use among children, adolescents and older adults who are obese. Research also highlights challenges in terms of consumer understanding and appropriate use of labelling information.

Conclusions: Nutrition labels on pre-packaged foods are a cost-effective population-level intervention with unparalleled reach. However, to capitalize on their potential, governments will need to explore new formats and different types of information content to ensure that nutrition information is accessible and understandable.

Keywords
Nutrition
Labels
Food products
Policy

The prevalence of overweight and obesity is increasing at an alarming rate^(1,2). Globally, approximately 1.6 billion adults are overweight and over 400 million are obese⁽²⁾. Although obesity is more common in high-income countries, increases in obesity have occurred in many low- and middle-income countries, particularly among urban populations⁽²⁾. The increasing prevalence of overweight and obesity places a considerable burden on public health, including increases in CVD, diabetes, arthritis, sleep and breathing disorders, depression, as well as functional limitations⁽³⁾. Diet is also estimated to account for approximately 30% of cancers in industrialized countries, making it the second largest modifiable risk factor after cigarette smoking⁽⁴⁾. The economic burden of overweight and obesity is considerable, with direct health-care costs in the billions for most Western countries⁽⁵⁾.

Nutrition labelling on food products has emerged as a prominent policy tool for promoting healthy eating⁽⁶⁾. As a health education intervention, mandatory nutrition

labels have broad reach and are present at the point of purchase, as well as when food is prepared or consumed⁽⁷⁾. The display of nutritional information on pre-packaged foods is mandatory in most high-income countries. In the USA, the Nutrition Labelling and Education Act of 1990 mandates that pre-packaged foods carry a nutrition label, with exceptions for foods intended for immediate consumption⁽⁸⁾. In Canada, mandatory nutrition labelling was first implemented on pre-packaged foods in December 2005 and became mandatory on virtually all pre-packaged foods in 2007^(8–10). Nutrition labelling on pre-packaged foods remains voluntary in the European Union, except in the case of health claims, although mandatory regulations are under development⁽¹¹⁾ (see Fig. 1 for examples of nutrition labels in the USA, Canada, Australia and the UK).

There is a large and growing evidence base on the impact of nutritional labels, including six literature reviews between 1991 and 2007^(6,12–16). The most recent reviews have focused on specific geographical areas, including European

*Corresponding author: Email dhammond@uwaterloo.ca

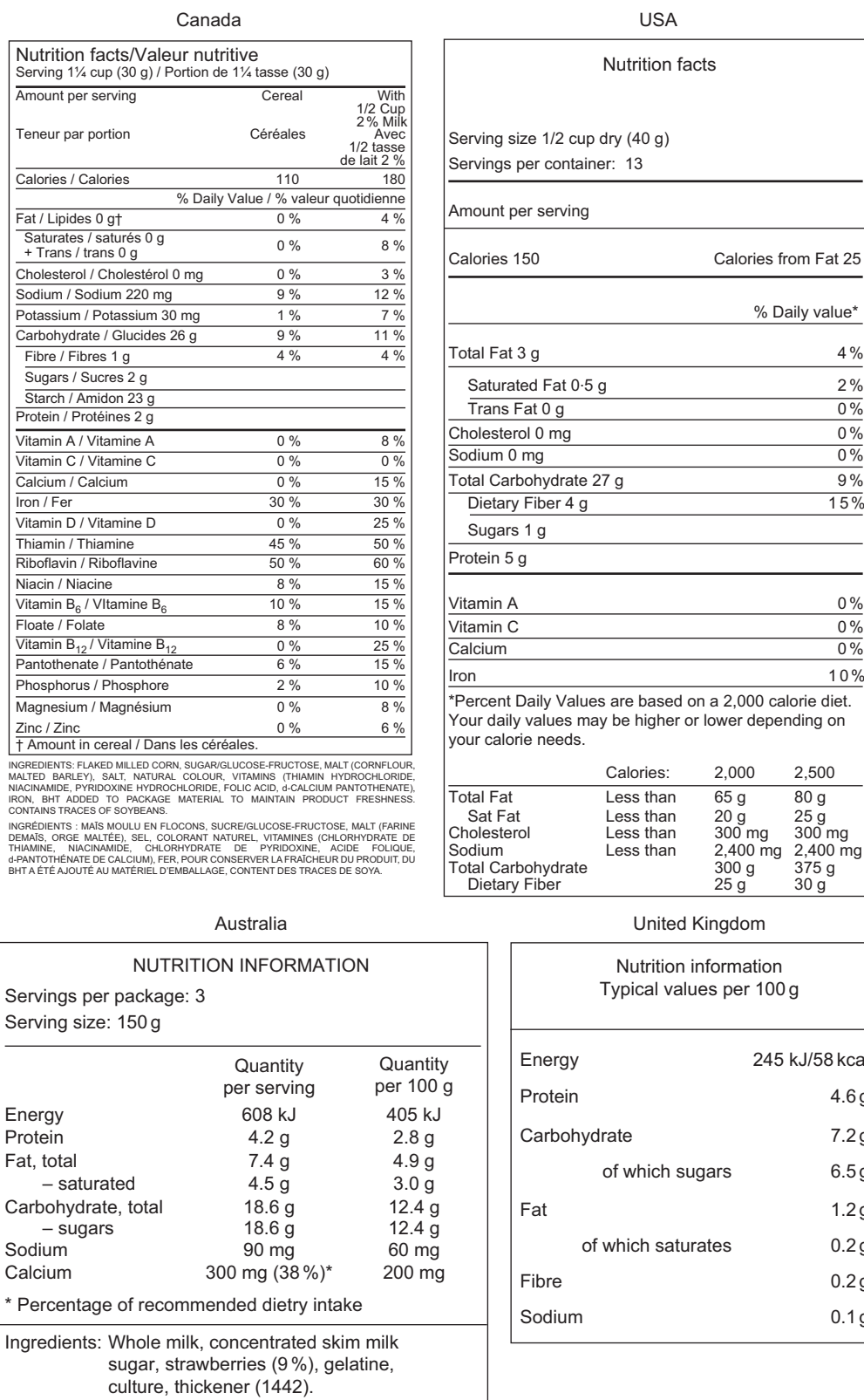


Fig. 1 Examples of nutrition labels on pre-packaged foods

countries^(6,15) and Australia and New Zealand⁽¹⁶⁾, with the exception of Cowburn and Stockley, who reviewed literature up to 2002 across a broader geographical area⁽¹⁴⁾.

The findings of these reviews are generally consistent: self-reported use of nutrition labels was found to be prevalent^(6,12–16); however, consumers often report

difficulty in interpreting quantitative information contained in labels^(6,13,14,16). Some consumers found different nutrition label formats confusing⁽¹⁵⁾ and generally preferred graphical information to the traditional label⁽¹²⁾. Label use was more prevalent among the female population^(6,13–15), and could be predicted by health awareness⁽¹³⁾, income^(6,14–16) and education level^(6,13–16). Finally, one review concluded a positive effect of nutrition labels on diet⁽¹⁴⁾.

The evidence base and regulatory practice have grown considerably in the 7 years since the last systematic review was conducted. Several countries have implemented mandatory nutrition labelling legislation within this time. Furthermore, many of the previous reviews did not include studies on the link between label use and diet⁽⁶⁾. In light of this, the current systematic review aims to examine the existing body of evidence regarding the prevalence of consumer use and understanding of nutrition labels, as well as the impact of nutrition labelling on consumer dietary habits.

Methods

Inclusion criteria

The present review was restricted to studies that examined consumer behaviour related to nutrition labels on pre-packaged foods, published in English in peer-reviewed journals or research reports completed on behalf of government agencies. Studies were included if they examined the prevalence or determinants of nutrition label use, or if they measured consumer knowledge, understanding, perceptions or format preferences related to nutrition labels. Articles that examined the relationship between nutrition label use or legislation and consumer diet were also included. Articles that only examined health claims, food safety labelling, brand naming, package design or shelf labelling were excluded, as were articles that focused on labelling at the point of purchase.

Search strategy

Electronic searches were conducted using the following databases: MEDLINE, CSA Illumina Social Sciences Subject Area (covering forty-six databases); Web of Science (including Science Citation Index Expanded (SCI-EXPANDED) – 1900–present); and the Cochrane Library. Additional searches using the reference lists of relevant articles were also conducted.

The initial search generated a total of 23 801 citations, of which 1450 titles appeared to meet the inclusion criteria and were reviewed. Of these abstracts, 247 were selected for article retrieval. Following review of the full-text articles, 109 were excluded on the basis that they did not meet the inclusion criteria. The remaining 138 articles were assessed using a data extraction form and were rated on eight methodological criteria (see Table 1).

Table 1 Methodological evaluation criteria for including articles in the review

Criterion	Possible outcomes
1. Is the research question well stated?	Y/N
2. Is the sample/population identified and appropriate?	Y/N
3. Are the inclusion/exclusion criteria described and appropriate?	Y/N or N/A
4. If applicable, is the participation rate reported and appropriate?	Y/N or N/A
5. Is the same data collection method used for all respondents?	Y/N
6. Are important baseline variables measured, valid and reliable?	Y/N or N/A
7. Is the outcome defined and measurable?	Y/N
8. Is the statistical analysis appropriate?	Y/N or N/A

Y, yes; N, no; N/A, not applicable.

Studies were included in the review if they met all of the eight criteria. This led a total of 120 articles being included in the review.

Results

The 120 articles selected for review originated from seven jurisdictions: the USA (*n* 87), Europe (*n* 13), Canada (*n* 9), Australia and New Zealand (*n* 4), Norway (*n* 2), Germany (*n* 1), Thailand (*n* 1) and Trinidad (*n* 1), as well as one study jointly from the UK and the USA, and one including participants from the Netherlands, Germany, France and the UK. Cross-sectional surveys were the most common study design (*n* 96), followed by experimental designs (*n* 19), 'natural experiments' (*n* 7) and longitudinal population-based surveys (*n* 2). Thirteen of the surveys were based on nationally representative samples and thirty were conducted with individuals who reported being the primary food shopper for their household, or who were approached while shopping for food at the point of purchase.

Prevalence of label use

Of the 120 studies reviewed, sixty-five reported the frequency with which consumers attended or used nutrition labels on pre-packaged foods^(12,15–79). Among studies targeted at the general population, the prevalence of self-reported label use was generally high (e.g. 82% in New Zealand⁽⁶⁴⁾, 52% in Canada⁽⁸⁰⁾, 47% in the EU⁽⁶⁹⁾ and 75% in the USA⁽¹⁸⁾) according to the most recent nationally representative data in each country. Definitions of label 'use' varied across studies, complicating comparisons. For example, several studies defined users as those who cite nutrition labels as a source of nutrition information, rather than other sources such as health-care practitioners^(32,43,44). Studies also used different time frames for label use, including 'ever' use *v.* use in the past 1 month⁽¹²⁾ or 12 months⁽⁵³⁾. Overall, these studies indicate that use of nutrition labels among the general population is generally high and typically above 50%.

Age

A majority of studies found that middle-aged or younger adults were more likely to use nutrition labels than were older individuals^(25,32,37,42,44,47,69–74,80–84), with several exceptions^(20,30,35,85,86). For example, a large survey of the nutrition perceptions of Americans found that older participants tended to trust nutrition labels as a source of accurate nutrition information to a less extent than younger respondents⁽⁴⁴⁾.

Six articles examined the impact of nutrition labels on adolescents^(36,54,87–90). Of these, two studies indicated that use of nutritional labels was low among adolescents^(54,90). Only one 2004 study of youth at an urban primary care clinic in the USA reported a self-reported prevalence rate: 22% reported 'always' reading nutrition labels, 57% 'sometimes' and only 22% reported 'never' reading them⁽³⁶⁾. Evaluations of a 2006 US web-based nutrition intervention in adolescents found no improvement in food label use as a result of the intervention⁽⁸⁸⁾; however, a similar 2008 study found that web-based interventions increased adolescents' use of labels⁽⁸⁹⁾. A single qualitative study examined the use of nutrition labels among children. The majority of US children in grades 3–6 had difficulty using nutrition labels and could not categorize healthy foods on the basis of label⁽⁹¹⁾.

Gender

Women report using labels significantly more often than men in a majority of studies that include both genders^(25,30,33,35,42–44,46,53,59,64,69,70,72–74,76,80,82,85,92,93). Women were also more likely to report that nutrition labels had influenced their food choices⁽⁵³⁾ and to trust nutrition labels⁽⁴⁴⁾. Similar rates of nutrition label use have been documented among women of different levels of income and socio-economic status^(34,38,51,55,57). Only four studies reported no significant difference between male and female participants' use of nutrition labels^(17,46,94,95).

Income/education

Most studies have concluded that individuals with lower income are less likely to use nutrition labels^(27,62,82,96), with only two studies finding the opposite effect^(67,86) and one reporting no significant effect of income⁽³⁵⁾. Individuals with lower income were also more likely to have lower levels of nutrition knowledge^(86,94), which were associated with label non-use^(50,63,80,97). Similar effects have been observed for education levels: individuals with greater education have reported greater use of nutrition labels in most studies^(17,30,41,42,44,62,63,67,70,73,76,80,86,92,93,96,97), with only two exceptions^(35,94). Seven studies targeting socio-economically disadvantaged populations reported variable rates of nutrition label use, ranging from 20% to 74%^(23,38,39,41,51,61,92), although these rates were typically lower than those reported for the general population.

Mixed findings were observed with respect to the effect of employment^(67,76,94,96), job satisfaction⁽⁶⁹⁾ and rural

urban habitation on label use^(35,37,62,82,98,99). Only one study of older Americans in 1990 directly compared rural with urban groups, with no significant difference in label use⁽⁴³⁾. Larger households and those with children were found to more likely use labels⁽⁴¹⁾ and support their mandatory implementation^(35,37), as were married couples⁽²⁷⁾.

Race/ethnicity

A majority of studies have found that Caucasian participants are significantly more likely to use nutrition labels than are other ethnic groups^(21,39,71,100), with one study of African-American adults in North Carolina reporting high levels of use⁽³⁰⁾. Studies with Latino adults in the USA also reported lower rates of label use^(23,51). For example, a study comparing ethnic groups in the USA found that only half of the proportion of Latinos, compared with their African-American and 'white' respondents, had 'ever used' labels⁽³⁹⁾. Low rates have also been observed among ethnic minorities in New Zealand⁽⁶¹⁾. Racial/ethnic differences have also been observed with respect to the type of information sought from nutrition labels⁽²⁵⁾. For example, Latinos were found to be more likely to check dietary fibre and Na information⁽⁷²⁾.

Health behaviours

A wide range of studies have examined the association between label use and health practices. Individuals with healthier eating habits report greater use of nutrition labels, either as a result of personal preference^(25,30,50,53,80) or because of the requirements of a health-related diet^(25,37,41,43,64,67,68,76,86,96,101). Greater use has also been reported by individuals more concerned with dietary guidelines^(32,33,35,41,53,63,86,94,96) and by those who place greater emphasis on the nutritional quality of food while shopping^(35,68,72,94,96,98,102). Nutrition and label knowledge^(17,31,35,59,80,86,98,103), nutrition education^(19,40,41) and knowledge of diet–disease relationships^(17,29,31,33,60,71,72,82) or of specific diseases⁽²⁹⁾ have also been associated with label use, with few exceptions^(69,85,94). Weight control^(30,33) and diagnosis of a disease^(30,41,53,69,79,82,104–106) have also been associated with greater label use.

Grocery shopping habits have been identified as being a strong predictor of nutritional label use. Consumers who spend more time, or report having more time to shop for groceries, were more likely to be label users^(86,96,98), and lack of time was consistently reported as a reason for non-use^(17,33,37). Shoppers who placed less emphasis on price^(67,86,96) were more likely to use nutrition labels, although one study reported no association⁽³⁵⁾. The importance of taste was positively related to label use in three studies^(35,94,96) and was negatively related by two others^(63,86). Meal planning^(68,72,86) and grocery spending were other variables related to use⁽⁶²⁾.

Among health behaviours not directly related to nutrition, using supplements, exercising regularly and not smoking were associated with the use of nutrition labels^(19,30,40,68,85).

Attitudes/perceptions towards nutrition labels

Many consumers have reported that nutrition labels are an important source of information^(22,60,101,107,108), although ingredients and health claims may be perceived as more important⁽¹⁰⁸⁾. Most consumers were willing to use information if it was provided on the label⁽⁹⁷⁾, although consumers' beliefs about the healthiness of foods did not necessarily depend on information on the label⁽¹⁰⁹⁾. There was, however, popular support for mandatory labelling in studies, although conflicting findings have been found for consumers' willingness to pay extra for nutrition information⁽⁸¹⁾. Positive attitudes were higher among individuals reporting greater use of labels^(56,59,85,108,110); however, negative attitudes were also prevalent in the literature^(41,48,111,112). Many consumers believed that serving sizes and health claims were misleading and were sceptical of the compliance of labels to regulatory law^(85,113). The credibility of manufacturers' health claims was rated poorly, especially when these claims contradicted nutrition information on the label^(59,85,114–116); however, in one case, health claims helped consumers to choose more nutritious products⁽¹¹⁷⁾. Trust in labels also predicted use^(44,60,69), and was greater among younger respondents and among those with higher levels of education⁽⁴⁴⁾.

Comprehension and understanding of nutrition labels

Studies suggest that consumers generally find nutrition labels to be useful^(17,54,59,85), although consumers in the USA⁽¹¹⁸⁾ and Australia⁽²⁶⁾ report a desire for simpler presentation of information^(26,49,118). In one case, Australian participants requested more detailed information⁽²⁶⁾. Following the Nutrition Labeling and Education Act in the USA, which implemented a consistent label format in 1993, 80% of consumers thought that the label was more helpful and the proportions of those seeking more information declined, except with respect to cholesterol information⁽²⁸⁾.

There is mixed evidence with respect to the ease^(30,80,93) or difficulty of using nutrition labels^(26,107,118). Frequent label use was associated with better understanding in general^(69,98,119), with other studies providing mixed results^(56,120). Younger participants⁽⁵³⁾, as well as those with higher education^(52,53), income, literacy and numeracy⁽⁵²⁾, were more likely to report understanding nutrition labels. One longitudinal study found that self-reported awareness of nutrition terms, but not understanding, improved between 1984 and 1994 in Canada⁽³²⁾.

Several studies reported a good understanding of nutrition labels based on consumers' performance on tasks requiring them to retrieve or manipulate information^(56,95,121). Understanding was greater in younger⁽¹¹⁰⁾, female, educated and white participants⁽¹²¹⁾, and was also related to knowledge^(95,122,123), perceived understanding⁽⁹⁵⁾, attitude towards and motivation to use the nutrition

label^(95,123), as well as frequent label use^(69,98,119). Self-reported understanding is generally high among lower-income groups^(38,41,51); however, with the exception of one sample of individuals eligible for a US food supplementation programme⁽⁴¹⁾, most showed poor performance on items measuring their ability to use the label, especially when calculations were required^(38,51). Low perceived self-efficacy in using the label was also reported by women on social assistance⁽¹¹³⁾.

A variety of studies indicate that many consumers have difficulty with the quantitative information presented on labels, especially with respect to recommended daily amounts, per cent daily values, serving sizes or other forms of reference information on the label^(17,21,31,52,54,81,85,120,124). This difficulty was common among diabetics⁽¹⁰⁶⁾, chronic kidney disease patients⁽⁷⁹⁾, older adults^(81,110,125), adolescents⁽⁵⁴⁾, infrequent label users⁽¹⁷⁾ and those with less education⁽⁸¹⁾.

Other tasks that were reportedly confusing for consumers included comparisons between products⁽⁵²⁾, determination of energy per serving and per package⁽¹²⁶⁾ and comprehension of E-numbers representing additives⁽⁴²⁾. For example, 24% of consumers in Trinidad read nutrition labels without understanding them⁽⁴⁶⁾, and this was listed as a reason for non-use among many groups of consumers^(37,46,93,125). Several studies conducted among females in the USA and UK have also provided mixed evidence, showing that most participants could locate nutrition information, but had difficulties with per cent daily value and information on food claims^(34,55,57). Frequent label reading, better education, better self-assessments of diet quality, health status and nutrition knowledge were related to these skills⁽⁵⁵⁾. Educational interventions targeting label knowledge and understanding have generally shown positive results in a range of sub-populations^(21,22,54,125,127,128), including among low-income and literacy groups⁽⁹²⁾.

Label format and content

Compared with 'traditional' nutrition labels with quantitative information on nutrient content, several studies have reported greater effectiveness for labels using graphics and symbols^(129–131), adjective labels⁽¹³²⁾ and labels with minimal numerical content⁽⁷⁶⁾. For example, information accompanied by graphics helped consumers to better apply reference information, especially consumers who had not seen labels before⁽⁶¹⁾. The use of well-recognized health symbols^(7,106) and 'traffic lights' may be particularly effective^(64,133,134). For example, traffic light symbols – which typically display green, amber or red labels to indicate whether foods contain low, medium or high amounts of contents such as fat, saturated fat, sugars – have been found to increase consumer ability to identify healthier food options and consumer attention in general^(133,135,136).

Research also suggests that placing nutrition information on the front of packages is more effective than information positioned on the side or back of packages^(15,87,137).

Front-of-pack (FOP) labels may disproportionately benefit those with low-nutrition education and knowledge of nutrition labels⁽¹⁵⁾. For example, in a 2009 study conducted in Australia, consumers supported the idea of FOP labeling, especially when it is consistent across products and manufacturers⁽¹³⁴⁾. Simple energy information on the FOP was also well received in a 2007 study conducted in Germany, The Netherlands, France and the UK⁽¹³⁵⁾. Preliminary evidence suggests that FOP labels may also promote healthier food purchasing behaviours, although additional research is needed^(7,15).

Evidence is mixed with respect to the level of detail or complexity of information favoured by consumers. More detailed information was favoured by some consumers^(76,79,131), especially non-label users⁽¹⁷⁾, whereas frequent users preferred less detail⁽¹⁷⁾. Simplified labels have been shown to promote more accurate nutrition judgements of unhealthy products^(74,84,119) and improved performance on diet-related tasks^(121,131), even when daily reference values were added⁽¹²¹⁾. The use of reference information, such as per cent daily value, is often welcomed by consumers^(122,133,134); however, many struggle to apply the quantitative values^(7,124,138). Labels presenting information in two columns side-by-side have also been shown to reduce food consumption by non-dieters when compared with a version presenting information as a single, longer column⁽¹³⁹⁾. Consumers have also expressed a desire for nutrient information listed in the context of a healthy diet^(93,131); larger, more legible print^(37,130); simpler terms⁽⁷⁶⁾; explanations of terms or nutrients^(37,93); the use of colour and a consistent appearance across nutrition labels⁽⁹³⁾.

Types of nutrition information sought by consumers

Consumers tend to look more closely at nutrients they wish to avoid⁽⁹³⁾. To this end, the nutrients most commonly sought were fat^(26,28,37,42,49,53,73,79,85,97,108,115,118), energy content^(28,37,53,79,97,118), protein^(49,79,97,118), cholesterol^(28,97), carbohydrates^(42,118), vitamins and minerals^(97,118), types of fat^(42,97), serving size⁽⁸⁵⁾, additives^(42,73) and Na information^(42,97,118). Low-fat dieters were more likely to look at fat information^(42,53,98), and younger^(67,73) female participants were more likely to look at energy than men^(59,67). Cholesterol was most often looked at by older^(50,67,98), suburban participants who believed in a diet-disease relationship⁽⁹⁸⁾ and had high cholesterol⁽⁵³⁾, and less often looked at by white, well-educated individuals with low cholesterol intake⁽⁹⁸⁾. Those with experience reading labels were more likely to use carbohydrates and fibre information⁽⁵⁹⁾, and younger individuals were more likely to use vitamin and mineral information⁽⁶⁷⁾.

Similar to the general population, adolescents were most likely to seek fat and energy information⁽⁸⁷⁾. A range of studies have also examined information sought by a range of other sub-populations, including low-income women^(38,41), Latino populations⁽⁷²⁾ and diabetes patients⁽¹⁰⁶⁾.

The impact of nutrition labels on diet

Observational studies have consistently found an association between use of nutrition labels and healthier diets^(70–72,82,103,140,141). Several studies have reported an association between label use and lower fat consumption^(70–72,82,140,141). Label users are also more likely to eat healthier varieties of foods⁽¹⁴⁰⁾, and to have reduced Na^(72,103), cholesterol^(63,72) and energy intakes, coupled with increased fibre^(72,142), Fe⁽¹⁴³⁾ and vitamin C intakes⁽⁷⁰⁾. Cross-sectional associations between label use and healthier diets are also related to socio-economic status⁽¹⁴²⁾, education^(71,82), age^(71,72) gender^(36,72) and ethnicity/race^(71,72).

Three longitudinal studies in the USA have evaluated the implementation of new nutrition labels on dietary patterns. In the USA, the 1990 Nutrition Labeling and Education Act came into effect in 1994 and required nutrition labels on all pre-packaged foods. A study comparing nationally representative surveys of consumers in 1989 and 1995 found that frequent label users in 1995 had a significantly greater probability of consuming a low-fat diet than both non-label users in 1995 and frequent label users in 1989⁽⁷⁴⁾. In addition, fat intake among less-educated respondents decreased significantly during the 'pre-post' study period⁽⁷⁴⁾. A second study found that BMI of nutrition label users fell significantly following implementation of the Act, with the greatest change among those with the highest BMI score⁽¹⁰⁴⁾. In addition, low-fat and low-Na food purchases increased significantly following the impact of new labels, although the same effect was not observed for low-energy choices, or healthy nutrients such as vitamins and minerals⁽¹¹⁶⁾.

Evidence from five experimental studies is generally consistent with cross-sectional and longitudinal findings. Two experiments compared consumption of low-fat with energy-dense foods by randomizing participants to either a blind or information condition^(144,145). Both studies found that, although participants tended to consume greater amounts of reduced-energy food in terms of food weight, total energy intake was significantly lower among those who consumed reduced-energy food^(144,145). Only one study showed this effect on daily energy consumption, as opposed to short-term intake during the study⁽¹⁴⁵⁾. Participants who received nutrition information consumed more of the low-energy version of the food⁽¹⁴⁴⁾. A third experiment found no differences in participants' satiety after consuming fat-free compared with regular potato chips, irrespective of the provision of information⁽¹⁴⁶⁾. Finally, providing nutrition information also increased healthier purchase intentions and accurate perceptions of nutrient content⁽¹⁴⁷⁾.

Discussion

Research conducted to date indicates that nutrition labels on pre-packaged foods are among the most prominent

sources of nutrition information. Evidence also suggests that consumers perceive nutrition labels to be a highly credible source of information, and many consumers report using nutrition labels to guide their selection of food products.

The use of nutrition labels varies considerably across population subgroups. Use is particularly high among individuals with health conditions and special dietary requirements – those with the greatest need for nutritional information. However, label use is notably lower among children, adolescents and older adults. More research targeting these populations is needed, given their increased prevalence of obesity^(1,148), nutrient deficiencies⁽¹⁴⁹⁾ and chronic disease^(149–153). Individuals with lower socio-economic status are also less likely to use nutrition labels, which is particularly problematic given that low socio-economic status is associated with an increased risk of being overweight and obese⁽¹⁵⁴⁾.

The evidence in this review shows a consistent link between the use of nutrition labels and healthier diets. The causal nature of this association is likely bidirectional: nutrition labels may promote healthier eating, whereas individuals with healthier diets are more likely to seek out nutritional labels in the first place. However, there is sufficient evidence from a range of study designs to conclude that providing nutrition information on packages has a positive impact on diet. In countries such as the USA, government agencies and non-government organizations have estimated the impact of mandatory nutrition labelling to be in the range of billions of dollars⁽¹⁰⁴⁾, although the magnitude of benefit and the extent to which it varies across different types of nutrition labels and population subgroups cannot be estimated with any precision from the existing evidence base.

Research to date also highlights the need to balance the complexity of information presented on labels with consumers' ability to process this information in a quick and meaningful manner. Nutrition labels that require calculations with respect to nutrient amounts and serving sizes are confusing to many consumers, particularly those with lower education and literacy skills⁽⁹⁶⁾. Educational interventions aimed at improving the understanding of nutrition labels have shown promise and a broader application of these interventions may provide one potential solution^(92,155); however, the evidence highlights the need to improve the ways in which nutrition information is presented to consumers on food packages.

Future research should examine the effectiveness of using symbols, images and different graphical layouts to a greater extent. Indeed, there is growing evidence regarding the consumer-friendly nature symbols used by the industry, as well as the greater impact of FOP labels, compared with labels on the side or back of packages. These formats may be more consumer-friendly in part because nutrition information is more accessible and in part because of a widespread desire for more 'prescriptive'

information that identifies 'healthier' food from less-healthy options. Indeed, an expert panel commissioned by the UK Food Standards Agency recently concluded that FOP formats are effective and the strongest FOP label is one that combines the use of words 'high, medium and low', traffic light colours and percentage of Guideline Daily Amount, in addition to levels of nutrients in a portion of the product⁽¹⁵⁶⁾.

More generally, there is increasing evidence that labelling regulations need to take the entire package into consideration to maximize their effectiveness. Industry 'health claims' are regulated to different extents across jurisdictions and the use of FOP symbols, which imply healthier alternatives, is largely unregulated. Ideally, consumers would use nutrition labels to help interpret health claims; however, in practice, many consumers rely solely on health claims⁽¹⁰⁸⁾. Indeed, there have been mixed reports as to whether consumers can determine whether claims are truthful^(56,114,120,157).

Limitations

This review is subject to several limitations. First, it is possible that relevant articles were not included in the review, given the rapidly evolving evidence base. Attempts were made to minimize this limitation by using a comprehensive searching strategy and a systematic selection process using two independent reviewers and inclusion criteria. Second, the articles included in this review were disproportionately from high-income Western countries, and from North America in particular. Therefore, it is unclear as to what extent the findings in this review apply to jurisdictions with different labelling regulations and in much different cultural and geographical contexts. Additional research on the impact of nutrition labels in low- and middle-income countries should be considered a priority. Even among the Western countries included in this review, there are important differences in labelling regulations that were not fully examined. The diversity in study protocols, measures and samples also presents challenges in terms of comparing studies. We have tried to note major differences wherever possible; however, it is likely that methodological differences between studies account for at least some of the variability in the findings. Finally, much of the evidence on the impact of nutrition labels is based on self-report data, which may over-report the use of nutrition labels, meaning that other factors, such as greater awareness of the link between nutrition and chronic disease, may be responsible for population-level changes over time that have been attributed to nutrition labels.

Conclusions

Population-level interventions and changes to the food environment are necessary to halt the rising health and economic burden from obesity. The evidence to date

indicates that nutrition labels on pre-packaged foods are a cost-effective population-level intervention with considerable reach. In order to capitalize upon the potential of nutrition labels, governments will need to explore new formats and different types of information content to ensure that nutrition information is accessible and understandable. A number of jurisdictions are in the process of developing new formats and revising labelling standards, such as the European Union⁽¹⁵⁸⁾. There is an immediate need for evidence to inform these regulatory developments. Regulators should also consider expanding the scope of mandatory nutrition labelling. In the vast majority of jurisdictions, nutrition labelling regulations are limited to pre-packaged food products and do not apply to foods served in restaurants or fast-food outlets, which account for a significant proportion of dietary intake in many high-income countries^(159,160). Mandatory display of nutrition information on menus and menu boards of food outlets may be a promising means of increasing the impact of nutrition labelling regulations⁽¹⁶¹⁾ and harmonizing nutrient information across information channels.

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