Health Canada’s evaluation of the use of glycemic index claims on food labels

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ABSTRACT
The glycemic index (GI) is a system that ranks foods according to the blood glucose–increasing potential of servings of foods that provide the same amount of available carbohydrate. The GI was originally developed as a tool for carbohydrate exchange in the dietary management of glycemia in persons with diabetes, and studies have generally supported modest benefits of low-GI diets in this population. Despite inconsistent results for the utility of the GI in the nondiabetic population, there is some interest in its universal application on food labels to assist consumers in making food choices that would help them meet their dietary goals. The objective of this review was to evaluate the usefulness of including the GI values of foods as part of the information on food labels in Canada. Health Canada’s assessment identified 3 areas of concern with respect to GI labeling: 1) the GI measure has poor accuracy and precision for labeling purposes; 2) as a ratio, the GI does not vary in response to the amount of food consumed and the partial replacement of available carbohydrates with unavailable carbohydrates, whereas the glycemic response does; and 3) an unintended focus on the GI for food selection could lead to food choices that are inconsistent with national dietary guidelines. Hence, Health Canada’s current opinion is that the inclusion of the GI value on the label of eligible food products would be misleading and would not add value to nutrition labeling and dietary guidelines in assisting consumers to make healthier food choices. Am J Clin Nutr doi: 10.3945/ajcn.113.061770.

INTRODUCTION
In 1998, Health Canada recognized the principle of allowing health claims for food (1). Among other requests, both industry and consumers have expressed interest in glycemic index (GI) claims for foods in Canada. After a first assessment conducted in 2004, the Canadian Food Inspection Agency and Health Canada concluded that in the absence of a defined method, statements related to the GI, such as low GI or GI = 10, were not acceptable (2). Since then, work has been done on the standardization of the methodology (3–6). Given the continued interest and new information, a new evaluation of the labeling of foods according to their GI has been performed.

OVERVIEW OF THE GI
The premise for the GI concept is that not all carbohydrates and carbohydrate-containing foods have the same glycemic potential. Studies dating from the 1970s clearly showed that, in addition to the amount, the source and kind of dietary carbohydrates are important determinants of the glycemic and insulinemic responses (7, 8). Whereas the relevance of these findings to the dietary treatment of diabetes was acknowledged, the practicality of their application was limited because of the lack of a classification system for the selection of carbohydrate foods based on their glycemic potential. Indeed, the chemical structure of carbohydrates was not a determinant of their effect on blood glucose. For example, starch is the major component of bread, potatoes, corn, and rice; nevertheless, when provided on an equi-carbohydrate basis, corn and rice elicited a lower glycemic response than did potatoes, whereas bread exerted an intermediate effect (9).

The GI was therefore developed as a classification system to rank carbohydrates and carbohydrate-containing foods according to their blood glucose–increasing potential (10). The GI is defined as the incremental AUC after the ingestion of a serving of a food containing 50 g (or 25 g) of carbohydrates available for digestion and absorption in the small intestine, expressed as the percentage of the incremental AUC of a serving of a reference food (glucose or white bread) containing the same amount of available carbohydrates (3). Foods are subsequently classified as low, medium, or high GI if their GI values are ≤55, between 56 and 69, and ≥70, respectively (3). The basis for this classification is not well documented in the scientific literature and appears to be arbitrary. However, the cutoffs have been shown in...
practice to be useful in the selection of low-GI diets for the management of diabetes (11, 12). It is interesting to note that foods generally considered healthy on the basis of their overall nutritional value, such as legumes, fruits, and intact whole grains have a low GI, whereas the reverse may not be true (13). This may be an important confounding variable in studies of the health benefits of low-GI diets, which also have the attributes of generally recognized healthy eating patterns.

The GI methodology consists of a set of procedures that define requirements and recommendations for the characteristics and preparation of study participants, foods tested, and analyses (3–6). The methodology has been thoroughly described and reviewed elsewhere (3–6, 14, 15) and is discussed in this review only in the context of labeling. Nevertheless, the provision that the servings of foods tested for the GI contain the same amount of available carbohydrates is important and is of particular relevance to our evaluation: it means that the GI measure only allows comparison of the glycemic potency of servings of foods containing the same amount of available carbohydrates. Although typically determined for single-item foods, the GI value of mixed dishes or composites of whole meals can also be assessed through direct measurement.

The glycemic load (GL) is a related concept that will also be mentioned when discussing the concerns about the GI. The GL is a term that was first coined by Harvard scientists to refer to the global insulin demand induced by the diet (16). The biological premise of the GL is that the insulin demand elicited by the glycemic response to foods depends on both quantity and quality (represented by the GI) of dietary carbohydrates. Thus, the GL is a measure that takes into account both the amount of carbohydrates and the GI and can be applied to individual foods, meals, and diets by using the following formula:

$$GL_{food} = GI_{food} \times \text{amount (g) available carbohydrate}_{\text{food/serve}} \times n \text{ of serving}_{\text{food/d}}$$ (I)

THE REGULATORY PERSPECTIVE

Since its inception, the GI has attracted attention from the research community, health care professionals, the food industry, and the general public. The publication of the international GI tables (13,17,18) has allowed a broad community of researchers to use the GI in epidemiologic and intervention studies. Consequently, the GI has evolved from being mainly a tool intended for diabetes care to one with potential applications in the management and prevention of chronic diseases and conditions, including diabetes, cardiovascular diseases, certain forms of cancer, and obesity. Although inconsistent results have been reported, studies have generally supported modest benefits of low-GI diets, mostly for glycemic control in diabetes (19–23). Although it is neither the aim nor the scope of this article to review the evidence on the health effects of low-GI diets, Health Canada considers any form of GI labeling on individual food products an implied health claim because of the widespread knowledge of these reported benefits.

Over the past decade, the GI concept has been applied to labeling in a number of countries around the world; however, the regulatory status of the GI is not uniform across jurisdictions (Table 1). In the United States, the Food and Drug Administration has no official view on GI labeling, but it does not object to it either, thus leaving the responsibility on the food manufacturer to ensure that the information is accurate, truthful, not misleading, and in line with existing regulations (24). On the other hand, the European Food Safety Authority concluded in 2010 that carbohydrate foods with a low GI were not sufficiently characterized, and hence a cause-effect relation could not be established between low-GI carbohydrate foods and the claimed effects (25). However, South Africa and Australia and New Zealand have provisions for GI claims in their regulations. In South Africa, the claim should refer to the GI category only, with no reference to the value (26). Furthermore, the claim may be applied to foods containing ≥40% of their total energy value as available carbohydrates (26). In Australia and New Zealand, the recently approved new food standard (standard 1.2.7) regulating nutrition content claims and health claims on food labels and in advertisements sets out the conditions for GI claims (27).

Standard 1.2.7 considers a GI claim as either a nutrition content claim or a health claim (28). All types of health claims need to meet the Nutrient Profiling Score Criterion (NPSC) set by the standard. Currently, there are no permitted health claims in relation to the GI. Although nutrition content claims are not subject to the NPSC, GI (and GL) claims are an exception because they refer to the effect of a food on blood glucose concentrations and not to the presence or absence of a food property (eg, presence of fiber or absence of trans fatty acids). In addition, the new standard allows endorsements, which are claims made with the permission of an endorsing body, provided that the endorsing body is independent of the supplier of the food for

### TABLE 1

<table>
<thead>
<tr>
<th>Country</th>
<th>Regulatory status</th>
<th>Conditions/comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia and New Zealand</td>
<td>Authorized</td>
<td>Nutrition content claim subject to Nutrient Profiling Score Criterion</td>
</tr>
<tr>
<td>Canada</td>
<td>Nonauthorized</td>
<td>No currently approved health claim</td>
</tr>
<tr>
<td>European Union</td>
<td>Nonauthorized</td>
<td>Evaluation detailed in this report</td>
</tr>
<tr>
<td>United States</td>
<td>No official view/no objection</td>
<td>Foods insufficiently characterized to scientifically assess the claim</td>
</tr>
<tr>
<td>South Africa</td>
<td>Authorized</td>
<td>Manufacturers responsible for ensuring information is truthful and nonmisleading</td>
</tr>
</tbody>
</table>

GI, glycemic index.
which the endorsement is made. Endorsements are exempt from the other requirements of the standard, such as the application of the NPSC, except for the requirement that the claims not be therapeutic in nature. An example of endorsement would be the GI symbol, an Australian program that has been in place for a number of years and that has its own criteria for GI symbol eligibility (29).

Currently, GI labeling is not acceptable on food products sold in Canada (2). However, many industry stakeholders have expressed their wish to include GI claims (value and category) on the label of some of their food products. In Canada, such claims cannot be considered nutrient content claims because the GI does not characterize the amount of a nutrient in food products. Canada’s evaluation of GI labeling has revolved around 3 issues: 1) the poor accuracy and precision of the GI measure for labeling purposes; 2) as a ratio, the GI does not vary in response to the amount of food consumed and the partial replacement of available with unavailable carbohydrates, whereas the glycemic response does; and 3) congruency with national nutritional policies and guidelines. Each of these issues is discussed in detail below.

Issue 1: Poor accuracy and precision of the GI measure for labeling purposes

Nutrition information present on the food label must be truthful and not misleading to the consumer. In this regard, the first question that arises is, How accurate and precise is the GI measure? This question was investigated in 2 interlaboratory studies involving testing centers from different parts of the world (30, 31). Results showed that 1) GI values are not associated with subject characteristics, such as age, sex, BMI, and ethnicity, confirming previous reports (10, 32), and 2) the between-laboratory SD of GI values is ~9. It was concluded that the GI is a property of the food and not of the subjects in whom it was tested, that the within-subject variation in glycemic responses appears to account for the variation in GI, and that the GI can reliably distinguish between a low- and high-GI food, as was recently further explained (33).

This conclusion that the GI is a property of the food independent of an individual’s characteristics has been challenged. A recent study showed that ethnicity might have a considerable effect on the mean (accuracy) of GI value (34). In this study, a ready-to-eat breakfast cereal with a published GI value of 55 was tested in 73 healthy whites and 27 healthy Asians; results showed that the mean GI (95% CI) of the cereal was 61 (55, 67) and 77 (66, 90) in whites and Asians, respectively, a difference that was significant. Of particular interest were the observations that 1) ethnicity shifted the GI ranking of the food from medium (whites) to high (Asians), and both were different from the GI ranking on the label (low), and 2) the GI in the Asians excluded the cereal from being low GI on the basis of the CI. Consistent with an effect of ethnicity on GI, Wolever et al (35) also showed that white bread had a significantly higher GI in nonwhites (mean GI = 78, high GI) than in whites (mean GI = 66, medium GI) when the sample size was large enough (n = 37 and 40, respectively). It follows that the current practice of measuring the GI in 10–12 subjects, predominantly whites, might not yield a GI estimate and ranking representative of the food when consumed by different population groups. Therefore, more research is needed to elucidate the impact of subject characteristics on the GI.

In addition, the low precision of the GI constitutes another problem from a labeling perspective. A between-laboratory SD of ~9 implies that if the difference in the mean GI value measured by 2 laboratories is <18 (2 × SD), then this difference will likely be a result of chance. For example, if a food bears a GI value of 55 on its label, and the test is repeated in a different laboratory with the use of the standard methodology, any mean GI value between 37 and 73 can be a result of chance. This degree of imprecision is too large and brings into question the meaningfulness of the GI value on the label. In the example above, the food can be classified as either low, medium, or high GI depending on the result obtained. The implication is that a food can be consistently low GI only if its GI value is <40. Indeed, in the first interlaboratory study (30), only barley (mean GI = 35) was consistently low GI, whereas spaghetti (mean GI = 47) was low GI in 5 laboratories, medium GI in one, and high GI in another.

Issue 2: As a ratio, the GI does not vary in response to the amount of food consumed and the partial replacement of available with unavailable carbohydrates, whereas the glycemic response does

One of the key features of nutrition labeling is the reporting of the information per amount consumed or serving size. As such, the amount of nutrient ingested is directly proportional to the amount of food consumed. On the other hand, the GI, as a relative value based on a standard amount of available carbohydrate, is not reflective of the amount of food consumed: whether 0.75 cup (180 mL) or 1.5 cups (360 mL) of a breakfast cereal with a GI of 50 are consumed, the GI remains the same. This could be confusing and misleading to the consumer for 2 reasons. First, the GI is supposed to rank the glycemic potential of foods containing the same amount of available carbohydrates. Hence, selection based on the GI can work properly only when the foods compared contain the same amount of available carbohydrate/serving. However, consumers select from a wide variety of foods with different carbohydrate content per consumed serving. If the consumer replaces a high-GI food with a low-GI food containing higher amounts of available carbohydrate/serving, then the lower GI food could elicit a higher glycemic response. This can be shown by using the GL concept, which takes into account both the GI and the amount of available carbohydrates as determinants of the glycemic response. For example, a serving of boiled potato (150 g; GI = 82 or high) provides 25 g of available carbohydrates, and thus a GL of ~21 (high) (13). Conversely, a serving of spaghetti (180 g; GI = 49 or low) provides 48 g of available carbohydrates and has a GL of ~24, which is also high and in fact higher than that of the boiled potato despite a marked difference in their GIs (13). On the other hand, watermelon has a GI of 72 but provides only 6 g of carbohydrate/120 g serving size and consequently has a GL of 4, similar to that of a medium-sized apple (120 g), which has a GI of 39 but provides 16 g of available carbohydrates and has a GL = 6 (13). The picture becomes even more confusing when considering different forms of the same food; for example, both an apple and unsweetened apple juice have low GIs of 39 and 44, respectively. Nevertheless, the GL of 250 mL apple juice is double
that of a medium-sized apple (13 compared with 6, respectively) (13). The difference would even be greater if the amount of juice consumed was 355 mL or 475 mL as for commonly sold single-serving containers. Thus, the use of the GI as a tool to control the postprandial glycemic response to foods in the context of broad dietary selection is of limited value.

Another limitation of the GI is its lack of responsiveness to the partial replacement of available by unavailable carbohydrate in the food (36). For example, let us consider a food product containing 30 g sucrose/100 g and having a GI of 60: if we substitute the nonnutritive sweetener sucralose for 15 g sucrose, the GI will still be 60 (because the GI is a property of the available carbohydrate in foods), even though the glycemic impact of the food will decrease by half. Inasmuch as the GI is supposed to help consumers control their postprandial blood glucose response, the fact that it is only appropriate for use in equi-carbohydrate food servings and that it is not responsive to partial substitution of unavailable for available carbohydrates in the food limits its validity for the stated purpose.

**Issue 3: Congruency with national nutritional policies and guidelines**

Health Canada is responsible, as the federal regulator on issues related to health, for ensuring that the messages displayed on the food label are consistent with national dietary guidelines. This is particularly important because the proposed GI labeling targets products intended for consumption by the general population. Although the surge in interest in GI labeling is relatively recent, the GI concept was introduced in 1981 and has since been referenced frequently in many research articles and popular books and in media coverage. Therefore, consumers are familiar with the concept, even though their understanding of it might not be accurate (37). More importantly, consumers associate the GI with many health benefits, such as the dietary management and prevention of diabetes and obesity (37). As such, the GI concept could be viewed as a proxy for the healthfulness of the food, and, as an apparently simple rating scheme, its presence on the principal display panel of the food label could thus become the sole or predominant criterion for food selection.

There are 2 risks associated with this outcome. First, healthy nondiabetic individuals are unlikely to consider carbohydrate exchange, the dietary management system in which the GI could be most useful. Thus, the focus on GI could inadvertently lead to an increase in available carbohydrate intake. In support of this, a meta-analysis of GI intervention studies showed that small reductions in GI were accompanied by increases in available carbohydrate and energy (22).

Second and more importantly from Health Canada’s perspective, reductions in the GI of foods could be achieved by selecting foods with a nutrient composition that is undesirable and that is at odds with Canadian national dietary guidelines.

Of particular concern is that low-GI claims on the food label could trump undesirable characteristics of foods identified in the Nutrition Facts Table. For example, ice cream has a low GI value of 37, but it is high in total and saturated fat, as well as kilocalories. A scan of the published international GI table (13) showed that ~75% of the cookies, which are identified as foods to limit in Canada’s Food Guide because of their high content of sugar and/or fat, are low GI. Also, the majority of mixed meals and convenience foods (~80%), with varying amounts of energy values, carbohydrates, saturated fat, and sodium (eg, pizza), have a low GI (13).

Furthermore, Health Canada is concerned that the GI of foods could be lowered by substituting fructose (GI ~ 15) for sucrose (GI = 58) in sweetened products. Although the use of pure fructose as a sweetener is uncommon, some sweeteners have high amounts of sucrose, such as blue agave nectar (>90%), fruit (apple, pear) juice concentrates (~65%), and some formulations of high-fructose corn syrups (>55%), which if used as sweeteners could lower the GI of foods to varying degrees, sometimes quite considerably. The health effects of dietary fructose are a subject of debate within the scientific community (38–44). However, it appears that fructose intakes of ≥100 g/d are associated with adverse metabolic effects, such as increased fasting triglyeride concentrations (39). The extent to which low-GI products would contribute to an increase in fructose intake from prepackaged foods and whether this increase would be harmful are unknown, but it would not be prudent to support GI labeling if substitution of fructose for other sugars is not accompanied by a significant reduction in total sugar content. This issue is particularly relevant in the case of beverages, because sweetened beverages labeled as low GI might be perceived as healthier than their “diet” counterparts, which would not be eligible for GI labeling because they contain no carbohydrate.

Another important consideration is that educational tips on broad food selection, preparation, and storage to help limit the glycemic impact of foods might prove more beneficial than a labeling rating scheme that is imprecise and confusing. For example, people can be encouraged to choose more intact whole-grain products than their refined counterparts, to consume more whole vegetables and fruit and less of their juices and purées, to incorporate more legumes in their meals, and to refrigerate and add some vinegar to their potatoes before consumption. These manipulations reduce the glycemic impact of foods (45, 46) in ways that cannot be adequately captured by GI labeling. Interestingly, many of these tips are already captured in Canada’s Food Guide.

**CONCLUSIONS**

Interest in GI claims, specifically the labeling of a GI value or GI category, on food labels has been expressed to Health Canada. The issues associated with GI labeling were evaluated and are reported in this review. We found the following: 1) that the GI measure has poor accuracy and precision, which are important factors in the context of labeling; 2) as a ratio, the GI does not vary in response to the amount of food consumed and the partial replacement of available with unavailable carbohydrates, whereas the glycemic response does, 3) that GI labeling could have the unintended consequence of becoming the predominant criterion for food selection by consumers even when the nutritional characteristics of low-GI foods are not always consistent with national dietary guidelines. Recommendations based on Canada’s Food Guide already promote intake of many foods that are low GI, such as whole vegetables and fruit, pulses, and dairy products in amounts and formulations (low fat, low sodium, and no added sugar) that provide essential nutrients and promote health without explicit reference to the GI. When these recommendations are combined with the nutrition information already
available on the food label, Canadians should be able to make appropriate, healthy food choices. Therefore, Health Canada’s current opinion is that any form of GI labeling of eligible food products would be misleading and would not add value to nutrition labeling and dietary guidelines in assisting consumers to make healthier food choices. However, Health Canada acknowledges that messages on the label related to the mitigation of the increase in postprandial glycemia could be useful for consumers and is currently preparing a guidance document that sets out the criteria for this type of health claim. Moreover, Health Canada encourages further research in food carbohydrates and their impact on postprandial glycemia and health to help improve and refine messages, through the Food Guide or health claims on foods for example, to the consumer.

The authors’ responsibilities were as follows—AA: contributed to the evaluation and wrote the manuscript; LD: contributed to the evaluation and wrote the manuscript; JB: contributed to the regulatory perspective and knowledge; and JB: contributed to the evaluation. None of the authors had any conflicts of interest to report.

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