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The glycaemic index in practice – consensus statement of a small group of South African dietitians*

GI Master Class 2002 Group
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A group of 36 dietitians and nutritionists evaluated the practical application of the glycaemic index (GI) of foods during a master class at the 2002 South African Nutrition Congress (Potchefstroom, 5 - 9 November 2002). The group reached consensus that the GI is a useful concept and a scientifically based tool to choose carbohydrate-containing foods. The group agreed that the GI of a food reflects the immediate effect of the food on blood glucose homeostasis. There was agreement that the habitual consumption of low-GI carbohydrate foods probably reduces risk of cardiovascular disease through effects on lipid risk factors and that it probably improves prevention and control of diabetes mellitus through effects on insulin resistance. The group further agreed that the evidence that the GI of foods may play a role in planning of diets with higher satiety value, preventing and controlling obesity and behavioural disorders, and improving physical performance, needs to be strengthened with more research. There was consensus that there is sufficient potential and experience with low-GI diets to support labelling of South African food products for GI, creating a mechanism to inform and educate the public towards responsible use of the concept. However, the group also agreed that there are problem areas and potential pitfalls in measuring and reporting the GI of foods, and therefore recommends standardisation of methodology. There was consensus that more research on the GI of typical South African foods, knowledge and attitudes of consumers, as well as the development of suitable teaching aids are needed.

During the 2002 South African Nutrition Congress ('Empowering nutrition: Broadening our horizons', Potchefstroom, 5 - 9 November 2002) a group of 36 dietitians and nutritionists participated in a master class on the glycaemic index (GI). In formulating desired outcomes for this master class, the group indicated that, in addition to a better understanding of the physiological basis and health relationships of low-GI diets, the participants would like to reach consensus on the practical use of the GI concept as a tool for their clients/patients to choose carbohydrate-containing foods for specific diets/purposes.

The objectives of this paper are to describe the activities in the master class and to communicate and motivate the consensus reached and statements defined by this group.

***Editorial Note:** This manuscript describes the consensus reached at a defined period in the evolution of our knowledge on the glycaemic index of foods. It may therefore not reflect more recent developments in the field.*

The master class

Delegates to the congress registered for the master class and received reading material to prepare for the class. This included copies of the World Health Organization/Food and Agriculture Organization (WHO/FAO) report on the role of the GI in food choice,[1] the 40 abstracts[2] of the FAO workshop on 'GI and health: The quality of the evidence', the six papers[3-8] published as a supplement to the *American Journal of Clinical Nutrition*: 'Is the glycaemic index important in human nutrition?', the international table[9] of GI and glycaemic load (GL) values, and the Department of Health's proposed regulations for GI labelling.[10]

The objectives of the master class were to examine the difference in the GI and GL concepts, the physiological basis of the GI, and the evidence from the literature regarding the immediate (acute, short-term) as well as the long-term effects of low- versus high-GI foods and diets. Attention was also paid to the 'weak' areas and to the group's experiences in using the GI concept in their practices. The aims were to reach consensus on the 'state of the art' and to formulate a number of consensus statements that could be used as guidelines

by practising dietitians and nutritionists. However, as can be seen from the literature used as basis for these discussions, mainly consisting of reviews and contributions to similar workshops and consultations on the GI, no attempts were made to evaluate the evidence from experimental studies in a systematic way. Rather, the conclusions from the stated review papers, combined with the outcomes of the discussions of the experiences of the participants, guided the formulation of the consensus statements. The programme of the one-day master class consisted of lectures in which the chemistry, biochemistry and physiology of carbohydrates were discussed and the review papers on the GI summarised, followed by interactive discussions that led to the consensus statements.

Statement 1

'The concept of the GI of foods is based on sound physiological principles and what is known about carbohydrate metabolism. It, therefore, has a potential use in choosing carbohydrate-containing foods for specific diets.'

The group accepted the WHO/FAO definition of the GI as the incremental area under the blood glucose response curve of a 50 g carbohydrate portion of a test food expressed as a percentage of the response to the same amount of carbohydrate from a standard food (either white bread or glucose) taken by the same subject.[1] According to this definition the GI of a food reflects its blood glucose-raising potential.[1] The chemistry and classification of dietary carbohydrates, digestion of carbohydrates in the small bowel, fermentation of undigested carbohydrates in the large bowel, absorption, metabolism and hormonal regulation of glucose metabolism were reviewed.[1-11] This provided a rationale for understanding why food factors such as the type of carbohydrate (e.g. amylose, amylopectin ratio of starch), particle size, macro- and micro-structure, the presence of enzyme inhibitors (antinutrients) and the lipid, protein and dietary fibre content of the food are responsible for the differences in the GI of different foods. It also clarified why host factors such as the degree of mastication in the mouth, gastric emptying rate and small-bowel transit time will be responsible for the between- and within-person variation in the glycaemic response and therefore for individual and day-to-day variations in the measured GI of a particular food.

The GL, a measure of the total effect of the diet, was defined as the product of the dietary GI (calculated as a weighted mean from the GI of all carbohydrate foods in the diet) and the total amount of dietary carbohydrate.[4,12] Other sources define the GL as the weighted mean of the dietary GI, multiplied by the percentage of total energy from carbohydrate.[3] In the Nurses Health Study, the frequency of consumption of a particular food was also included in the calculation of the GL.[12] Therefore, in interpreting the relationships between the GL and health/disease risk factors, it would be important to describe how the GL was calculated in specific studies.

Statement 2

'There is convincing evidence that the GI of a food or a meal reflects the immediate (acute or short-term) effects of the food or the meal on blood glucose levels and, therefore, also on insulin homeostasis and carbohydrate metabolism.'

The GI of a food depends on the rates of digestion of carbohydrate and absorption and metabolism of glucose. The GI of a food, therefore, reflects its effect on post-prandial blood glucose levels. Jenkins *et al.*[4] reviewed the literature that indicates that the post-prandial glucose response to a food is also associated with post-prandial free fatty acid (FFA), insulin, C-peptide and gastric inhibitory polypeptide (GIP) concentrations. The blood glucose level is the most important stimulus for insulin secretion.[11] It is therefore not surprising that significant correlations between post-prandial glycaemic and insulinaemic responses[13] and between low-GI diets and improved insulin sensitivity[14] have been observed. The effects of low- versus high-GI foods on risk of non-communicable diseases (NCDs) may therefore be related not only to blood glucose levels, but also to effects on FFAs, insulin and counter-regulatory hormonal responses, all influencing carbohydrate metabolism.[4,5]

Statement 3

'There is sufficient evidence that habitual (repeated) consumption of low- versus high-GI foods probably reduces risk of heart disease (in diabetic and non-diabetic individuals) through effects on lipid risk factors, although other mechanisms may also be involved.'

Leeds[7] has reviewed the relationship between the GI of the diet and heart disease. This review of prospective, cross-sectional and intervention studies in healthy subjects and patients with diabetes or coronary heart disease or with a family history of coronary heart disease, indicated that low- versus high-GI diets are associated with reduced FFA levels, high high-density lipoprotein (HDL) levels, and lower total and low-density lipoprotein (LDL) cholesterol and apolipoprotein B levels. He hypothesises that the lower FFA levels on a low-GI diet may suppress production or release of signalling hormones from adipose tissue, which may be responsible for the observed improvements in dyslipidaemia and insulin resistance. These

improvements have been seen with a reduction of dietary GI from approximately 70 to less than 60. According to Leeds[7] these changes can be manipulated easily with good patient compliance. However, he also mentions that low-GI diets may lower the risk of coronary heart disease by other mechanisms such as providing more dietary chromium or reduction of plasminogen activator inhibitor-1 (PAI-1). He also warns that a low-GI diet may be a marker of a healthy lifestyle. Based on these conclusions the group decided that there is sufficient evidence from intervention studies that low- versus high-GI diets improve lipid risk factors but that associations observed in epidemiological and other studies may indicate that the benefits of low-GI diets on prevention of heart disease probably involve more than one mechanism.

Statement 4

'There is sufficient evidence that habitual (repeated) consumption of low- versus high-GI foods or diets improves prevention and control of diabetes mellitus (DM) through effects on blood glucose and insulin sensitivity.'

The review of Willet *et al.*[5] was used to evaluate the role of low-GI diets in the prevention and treatment of DM. In this review, the potential mechanisms whereby high-GL diets could increase the risk of type 2 (non-insulin-dependent) DM were identified as glucose intolerance caused by increased insulin resistance (increases in counter-regulatory hormones and late post-prandial FFA) as well as pancreatic beta-cell exhaustion, a result of an increased insulin demand. Willet *et al.*[5] then evaluated the evidence from prospective epidemiological studies, and from animal and short-term human studies. They concluded that the GI and GL of the diet are related to risk of type 2 DM. They further concluded that the weight of the evidence suggests that replacing high-GI foods with low-GI foods in the diets of patients with type 2 DM will improve glycaemic control and reduce hypoglycaemic incidents in those treated with insulin.

Although Pi-Sunyer[8] questions the design and quality of dietary intake data of the epidemiological studies that led to this conclusion, the group decided that the support from results of intervention studies (reviewed by Willet *et al.*[5]) and their own experiences with diabetic patients warrant the recommendation that the GI of foods can be used to prevent and control type 2 DM.

Statement 5

'There is evidence that the GI of foods or diets may play a role in satiety, prevention and control of obesity, behavioural disorders and physical performance. However, more data are needed before a judgement will be possible.'

The review of Brand-Miller *et al.*[6] and several reports presented at the FAO workshop in Bandol, France,[2] were used to evaluate the role of the GI of the diet in preventing and treating obesity and behavioural disorders and improving sports performance. It seems that there is promising evidence that using the GI as a tool to choose carbohydrate foods may facilitate weight loss. However, in this and the other areas the group expressed the need for more research before a conclusion will be possible.

Statement 6

'The GI is not the only criterion for choosing foods/meals: characteristics such as total composition, fat composition, micronutrient density, adequacy and prudency of the total diet are also important. The GI can only be used to choose between carbohydrate-rich foods.'

There was agreement among the group that the GI of a food/meal/diet is but one of the many criteria for choosing foods for specific diets. Other criteria such as nutrient content, fat percentage, type of fat, micronutrient density and dietary needs should all influence choice. There was also agreement that some high-GI foods (such as carrots) may have other attributes (such as β-carotene content) that will override their GI value. Furthermore, there was agreement that in certain circumstances high-GI foods may be preferable, such as during recovery of athletes after sporting events, and that some low-GI foods may have undesirable high levels of saturated fat. The group realised that this statement highlights the need for consumer education, but also the need to define the minimum carbohydrate and other macronutrient content for foods to be labelled for GI.

Statement 7

'There is sufficient experience and exposure among South African dietitians to support a labelling initiative for the GI in order to inform the public and promote responsible use of the concept.'

The majority of the participants reported that they use the GI concept in their dietetic practice, especially to help patients with DM to choose appropriate foods. There was, however, awareness that the concept is also open to abuse – *inter alia* because many high-fat foods will have low GIs. The group felt that labelling of foods for GI, under 'controlled' conditions, may help more responsible use of the concept and will help consumers to choose between certain products.

Statement 8

'There are a number of potential problem areas and pitfalls regarding quantifying the GI of foods which should be addressed before labelling legislation is introduced.'

Emanating from statement 7, the group identified a number of issues that should be resolved before labelling of foods for the GI is introduced. Many of these came from practical experiences, but also from concerns expressed by various authors.[3,8,15] These issues include the practice of unstandardised methodology in determining the GI (number of subjects, standard food white bread or glucose?, venous or capillary blood?, method of determining glucose, calculation/measurement of glycaemic carbohydrates in foods, etc.) and how to express the GI on the food label (mean, standard deviation, 95% confidence interval, low versus medium versus high and cutpoints for these categories, etc.), as well as how to handle the often large variations in GI of a specific food and the day-to-day variations in glycaemic responses of individuals. The group acknowledged that recommending solutions to these problem areas fell outside the scope and objectives of the master class, but that they were important and warranted a warning statement.

Note: The Department of Health convened an expert group in 2003 to advise on these issues for labelling of the GI (personal communication, Ms A Booysen).

Statement 9

'More research is needed for better implementation of the GI to help in choosing carbohydrate foods. These include: more clarity on health benefits of low- versus high-GI diets; consensus on the best methodology for determining the GI of foods; more values of the GI of indigenous and typical South African foods and meals; the best way to express the GI on food labels; more information on the knowledge, attitudes and practice of dietitians/nutritionists, consumers and the food industry regarding the GI; and the development of appropriate teaching aids.'

The need for more clarity on the health benefits of low-GI foods and for consensus on best and standardised practices in measurement of the GI is evident from the above discussions and from the literature.[3,8,15] The ongoing research in potential interesting effects of low-GI foods, such as effects on satiety[16] and therefore on obesity, should also include research on 'dose-response' effects: in other words, how much should the GI and/or GL of the total diet be reduced or changed to have not only statistical but also clinical beneficial effects. The design of appropriate studies should therefore receive attention. More information on the knowledge, attitudes and practices of health professionals, consumers and the food industry will help dietitians to advise clients/patients on using the GI in choosing foods. The suggestion of developing appropriate teaching aids expressed the need by this group to teach or inform their clients/patients in the most appropriate and responsible ways.

Concluding remarks

There is controversy in the literature on the practical use of the GI concept,[8] often with reference to the responsibility of health professionals to advise consumers only when the scientific evidence supports their recommendations. This group of participants in the master class agreed that the proven beneficial effects of low- versus high-GI diets warrant the use of the concept in the prevention and treatment of certain NCDs. The group's recommendations regarding labelling of foods for GI are pragmatic: it places a responsibility on the Department of Health to define labelling principles, which should lead to standardised methodology and it is hoped to a responsible use of the concept. But it will also provide a tool to be used in practice in advising on choosing appropriate carbohydrate foods for specific purposes. The GI concept is one of the first attempts to classify foods on their physiological effects. As such, it should be recognised that individuals differ in their responses to their environment – including their diets. This concept of differences in human responses should be kept in mind when using the GI to classify foods.

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