IMPACT OF FOODS WITH LOW GL ON HEALTH
(Review)

Garnai Maria, Georgescu Luminita

„Dunărea de Jos" University of Galati, Galati, Romania

Garnai Maria: maria.garnai@ugal.ro

Abstract: The goal of this paper was to evaluate the impact of low GL diet and low GI foods on health. Cardiovascular diseases, diabetes, and obesity are the most common diseases of lifestyle. They can be prevented or can be lowered by modifications in diet with low GI/GL foods and changes in lifestyle. GL may be an useful nutritional tool because low-GL diets induce satiety, improve diabetes control, positively influence lipid profile, reduce the risk of heart disease. Therefore, low-GI/GL diets are recommended in diabetes, obesity, cardiovascular disease, some tipe of cancers.

Keywords: Low Glycemic Index/Load, Diet, Obesity, Diabetes, Cardiovascular disease.

Introduction

Lifestyle plays a crucial role in the development or prevention of chronic *diseases* such as obesity, coronary heart disease and diabetes mellitus.

Obesity is a public health problem that has become epidemic worldwide. Approximately 1.9 billion adults are considered to be overweight and over 600 million were obese. Obesity is associated with commonly occurring disorders such as hypertension, type 2 diabetes, hyperinsulinemia, dyslipidemia and atherosclerosis.

Diet plays an important role in the promotion of or protection against the development of obesity. Numerous energy-restricted diets with different proportion of proteins, carbohydrates and lipids have been investigated with or without success (*Möller et al., 2015; Juanola-Falgarona et al., 2013*).

Worldwide, the prevalence of diabetes is increasing at an alarming rate. Globally, an estimated 422 million adults were living with diabetes in 2014 and the number of people with diabetes is projected to grow to 552 million in 2030 (*World Health Organization, 2016*; *Al-Mssallem, 2014*). Diabetes of all types can lead to complications and can increase the risk of premature death. Possible complications include heart attack, stroke, kidney failure, leg amputation, vision loss and nerve damage (*World Health Organization, 2016*).

Type 2 diabetes is a leading cause of cardiovascular disease. It has been suggested that diets with high glycemic index (GI) or glycemic load (GL) increase glucose intolerance and risk of type 2 diabetes (*Greenwood et al., 2013*). Low GI diet may improve insulin sensitivity by minimising fluctuation in blood glucose levels and reducing the secretion of insulin over the day (*Al-Mssallem, 2014*).

Physiological responses to low-GI/GL foods

Most chronic diseases are potentially preventable and can be lowered by modifications in diet with low glycemic index foods, and changes in lifestyle (*Thilakavathy and Pandeeswari, 2012; FAO Food and Nutrition, 1998*).

Terms of GI (Glycemic Index - GI) and glycemic load (Glycemic Load - GL) were introduced to classify foods from a nutritional point of view (*Jenkins et al., 1981*),

in terms of their content in carbohydrates (*Scazzina et al., 2016*). The body uses carbohydrates as its main fuel source. The nutritionists recommend that carbohydrates should constitute 45-65% of the total daily energy intake (*Dietary Guidelines for Americans, 2010*). From 2,000 calories a day, between 900 and 1,300 calories should be from carbohydrates, which means 225-325 grams of carbohydrate.

The glycemic index (GI) concept was introduced by Jenkins et al. (1981) in the early 1980s as a ranking system for carbohydrates based on their immediate impact on blood glucose levels. The GI has proven to be a more useful nutritional concept to classify carbohydrates, permitting new insights into the relation between the physiologic effects of carbohydrate-rich foods and health (*Foster-Powell K. et al., 2002*). The nutritional classification of carbohydrates is to differentiate between those digested and absorbed in the upper digestive tract, providing fuel to body cells (available carbohydrates or glycaemic carbohydrates), and those passing to the large intestine, providing substrate for the colonic microflora (dietary fibre) (*Arvidsson-Lenner et al., 2004*).

The glycemic index ranks carbohydrate containing foods on how quickly they elevate blood sugar levels. The actual GI measurement compares the standard blood glucose-raising effects of ingesting 50g of a standard food (usually glucose, sometimes white bread) to ingesting 50g of available carbohydrate from a particular food. The glycemic response is measured as the area-under-the curve (AUC) for a 2-hour time period after ingestion of the test food or standard food (Fig.1). The blood sugar response of the standard is given a value of 100 and all other foods are compared to this value (*Thilakavathy and Karthiga Pandeeswari, 2012; Wheat Foods Council, 2010; Venn and Green, 2007; Arvidsson-Lenner et al., 2004*).

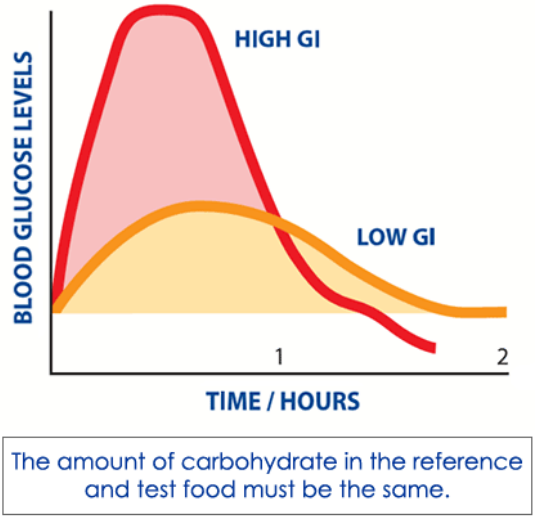

Fig. 1. Blood glucose levels and correlation with the area-under-the curve (AUC) for a 2-hour time period after ingestion (*http://www.glycemicindex.com/about.php*)

The term glycemic load (GL) was introduced to quantify the overall glycemic effect of food with respect to its specific carbohydrate content in typically consumed quantities (*Möller et al., 2015*). Glycemic load is calculated this way: GL = [GI/100] x Net Carbs (Net Carbs are equal to the total carbohydrates minus dietary fiber).

A GI value is considered as high >70, medium (55<GI ≥ 69) or low (≤55), while GL's of 10 or below are considered low and 20 or above are considered high (http://www.glycemicindex.com/about.php).

The glucose liberated from dietary carbohydrate (e.g. starch, sucrose, etc.) is affected by physiological and nutritional factors, which include the digestibility of the starch (resistant starches, amylose and amylopectin levels, degree of retrogradation), interactions of carbohydrate with proteins, amounts and kinds of fat, dietary fiber content and type (soluble or insoluble), antinutrients (enzyme inhibitors, phytates, lectins, tannins, etc.), as well as food processing. The composition or manufacturing procedures of individual products may change over time. Changes in the physiological state of the food, from green to ripe, increases its glycemic index. In addition, shelf life and preparatory methods may also affect glycemic index. The more cooked or processed a food, the higher the GI (*Möller et al., 2015; Allen et al., 2012; Jenkins, 2007; Venn and Green, 2007*).

The GI of a food is always measured individually. However, people mostly eat foods in combination. Simultaneous ingestion of other foods or food components changes the GI by several different mechanisms.

Protein ingested with carbohydrates reduces the GI of some foods, because protein ingestion increases insulin responses and slows gastric emptying, leading to reduced glycaemia. Proteins that are rich in leucine, valine, and isoleucine are particularly associated with enhanced insulin response. Protein influences glucose and insulin responses in a dose-dependent manner, but at least 30 g of protein is needed to cause a significant effect (*Hätönen, 2015*).

Ingestion of fat with carbohydrates reduces glycaemic response by delaying gastric emptying and slows the penetration of the amylase into the food matrix, blunting the glycemic response (*Wheat Foods Council, 2010*).

The viscous, soluble fiber thickens the mixture of food in the digestive tract, which lower GI.

Fermented foods (sourdough breads, addition of vinegar or lemon juice) slow down the rate that carbohydrates are digested (*Thilakavathy and Karthiga Pandeeswari, 2012*).

The mixing of foods together has generated great controversy regarding the GI. However, many epidemiological studies have shown that low GI or GL diets are associated with a number of positive health impacts: reduced risk of diabetes, more favorable lipid profiles, which means lower risk of cardiovascular disease, and reduced markers of inflammation, which are associated with lower risk of metabolic syndrome, overweight and other chronic diseases (*Bell et al., 2015; Juanola-Falgarona et al., 2013; Wheat Foods Council, 2010*). Diets of low GI and GL were considered particularly important in individuals with insulin resistance. (*Augustin et al., 2015*).

A few studies have shown associations between dietary GI/GL and the risk of colon, breast and other cancers. A significant positive association was found only between a high GI diet and colorectal cancer (*Turati et al., 2015*). A recent meta-

analysis of prospective studies suggested a borderline increase in breast cancer risk with high dietary GI and GL (*Mullie et al., 2016*).

There are also a number of studies that fail to link GI/GL of the diet with health and disease risk (*Wheat Foods Council, 2010*).

GI and GL values for individual foods

Knowing both the glycemic index as well as the glycemic load of foods is useful in the composition of diets. GI and GL for common foods are presented in table 1 (*http://nutritiondata.self.com/*).

Table 1. GI and GL for Common Foods

Peanuts	14	4 oz (113g)	15	2
Bean sprouts	25	1 cup (104g)	4	1
Grapefruit	25	1/2 large (166g)	11	3
Pizza	30	2 slices (260g)	42	13
Low fat yogurt	33	1 cup (245g)	47	16
Apples	38	1 medium (138g)	16	6
Spaghetti	42	1 cup (140g)	38	16
Carrots	47	1 large (72g)	5	2
Oranges	48	1 medium (131g)	12	6
Bananas	52	1 large (136g)	27	14
Potato chips	54	4 oz (114g)	55	30
Snickers Bar	55	1 bar (113g)	64	35
Brown rice	55	1 cup (195g)	42	23
Honey	55	1 tbsp (21g)	17	9
Oatmeal	58	1 cup (234g)	21	12
Ice cream	61	1 cup (72g)	16	10
Macaroni and cheese	64	1 serving (166g)	47	30
Raisins	64	1 small box (43g)	32	20
White rice	64	1 cup (186g)	52	33
Sugar (sucrose)	68	1 tbsp (12g)	12	8
White bread	70	1 slice (30g)	14	10
Watermelon	72	1 cup (154g)	11	8
Popcorn	72	2 cups (16g)	10	7
Baked potato	85	1 medium (173g)	33	28
Glucose	100	(50g)	50	50

Conclusions

- Research conducted over the last 25 years suggests that an low GI/GL diet has potential therapeutic utility.
- The GI concept is relevant for carbohydrate-rich foods only.
- Low-GI/GL diets resulted in beneficial effects on metabolic markers associated with the risk of type 2 diabetes mellitus, obesity and cardiovascular disease.
- Food factors affecting GI/GL are: processing/cooking method, type of starch, dietary fiber content and type, antinutrients, acidity, simultaneous ingestion of other foods or food components, e.g. proteins, fats.

- Some strategies for lowering dietary GL include: increasing the consumption of whole grains, nuts, legumes, fruit, and nonstarchy vegetables.

References

1. **Allen, J.C., Corbitt, A.D. et al.**, 2012. Glycemic Index of Sweet Potato as Affected by Cooking Methods. *The Open Nutrition Journal*, 6: 1-11
2. **Al-Mssallem, M.Q.**, 2014. The Association between the Glycaemic Index of Some Traditional Saudi Foods and the Prevalence of Diabetes in Saudi Arabia: A Review Article. *J. Diabetes Metab*., 5 (11), 452 doi:10.4172/2155- 6156.1000452.
3. **Arvidsson-Lenner et al.**, 2004. Glycaemic Index. Relevance for health, dietary recommendations and food labelling. *Scandinavian Journal of Nutrition*, 48(2): 84-94
4. **Augustin, L.S.A., Kendall, C.W.C et al.**, 2015. Glycemic index, glycemic load and glycemic response: An International Scientific Consensus Summit from the International Carbohydrate Quality Consortium (ICQC). *Nutrition, Metabolism & Cardiovascular Diseases*, 25: 795-815
5. **Bell, K.J., Smart, C.E. et al.**, 2015. Impact of Fat, Protein, and Glycemic Index on Postprandial GlucoseControl in Type 1Diabetes: Implications for Intensive Diabetes Management in the Continuous Glucose Monitoring Era. *Diabetes Care*, 38: 1008-1015
6. *Dietary Guidelines for Americans*, 2010. 7th Edition, Washington, DC: U.S. Government Printing Office, December 2010
7. FAO Food and Nutrition, Paper 66, 1998. *Carbohydrates in human nutrition.* Report of a joint FAO/ WHO Expert Consultation, Rome
8. **Greenwood, D.C. et al.**, 2013. Glycemic Index, Glycemic Load,Carbohydrates, and Type 2 Diabetes. Systematic review and dose–response meta-analysis of prospective studies. *Diabetes Care*, 36: 4166–4171
9. **Hätönen, K.**, 2014. *Challenges in Measuring Glycaemic Index*. National Institute for Health and Welfare (THL), Helsinki, Finland
10. **Jenkins, A.L.**, 2007. The Glycemic Index: Looking Back 25 Years. *CFW*, 52, 2: 50-53
11. **Juanola-Falgarona et al.**, 2013. Design and methods of the GLYNDIET study; assessing the role of glycemic index on weight loss and metabolic risk markers. *Nutr Hosp.*, 28(2): 382-390
12. **Möller, K., Willers, J., Schneider, I. and Hahn, A.**, 2015. Glycemic Index and Glycemic Load of a Carbohydrate-Rich and Protein-Rich Formula Diet. *Journal of Nutrition and Health Sciences*, 2 (4): 404-411
13. **Mullie, P., Koechlin, A. et al.**, 2016. Relation between breast cancer and high glycemic index or glycemic load: a meta-analysis of prospective cohort studies. *Crit. Rev. Food. Sci.*, 56(1): 152-159
14. **Thilakavathy, S. and Karthiga Pandeeswari, N.**, 2012. The Glycemic Index – a science based diet. *Int. J. Pharma Medicine and Biological Sciences*, 1(2): 259-265
15. **Turati, F., Galeone, C. et al.**, 2015. High glycemic index and glycemic load are associated with moderately increased cancer risk. *Mol. Nutr. Food Res.*, 59(7): 1384-1394

16. **Venn, B.J. and Green, T.J.**, 2007. Glycemic index and glycemic load: measurement issues and their effect on diet–disease relationships. *European Journal of Clinical Nutrition*, 61 (Suppl 1): S122–S131
17. Wheat Foods Council, 2010. *The Role of Glycemic Index & Glycemic Load on Carbohydrate Food Quality: A Status Report*. www.wheatfoods.org
18. World Health Organization, 2016. *Global report on diabetes.* WHO Library Cataloguing-in-Publication Data
19. http://www.glycemicindex.com/about.php
20. http://nutritiondata.self.com/