

The Impact of Low-GI Foods on Human Health

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Abstract. The glycemic index (GI) has long been regarded as a crucial factor due to its key role in measuring the blood glucose response to carbohydrate intake. In recent years, it has garnered increasing attention in public health and nutrition circles. Glycemic control is not only linked to preventing metabolic disorders like diabetes but also closely associated with other prevalent health issues such as obesity and cardiovascular disease. This study focuses on low-glycemic index foods, systematically elucidating their physiological characteristics, mechanisms of blood glucose regulation, and positive impacts on weight management and cardiovascular health. The study shows that consuming low-GI food slows down the rate of glucose absorption and reduces the risk of type 2 diabetes. Also, it prolongs our satiety and suppresses appetite hormones, which provides a nutritional way for weight management. In addition, a low-GI diet improves lipid profiles and lowers inflammation levels, demonstrating a more comprehensive cardiovascular protective effect. This study aims to integrate relevant evidence both in China and abroad, further highlighting the value of low-GI foods in the public health system, providing a practical basis for the control of chronic disease to improve human health.

Keywords: Public health, glycemic index, blood sugar control, weight regulation, cardiovascular health.

1. Introduction

Due to many reasons, including irregular lifestyles, monotonous dietary structure and prevalence of ultra-processed food, the rate of having health problems caused by abnormal blood sugar levels has become increasingly serious. According to data released by the International Diabetes Federation (IDF), the number of diabetics globally reached 140.9 million in 2021, with 90%-95% of them suffering from type 2 diabetes, which is closely related to high-glycemic index diets [1]. Within this context, exploring the impact of dietary factor-- glycemic index (GI) on blood glucose level homeostasis and related chronic disease is really necessary and significant.

The glycemic index (GI) is an effective indicator for measuring the postprandial blood glucose response caused by food. The concept of GI was first proposed by JENKINS et al. in 1981, publishing the GI values of 62 kinds of food, reporting the impact of foods with different GI values on the blood sugar levels of diabetic patients, and the effect of using food GI in controlling blood sugar [2, 3]. The proposal of this concept attracted the attention and interest of many researchers. However, the earliest research report only focused on the selection of starchy foods by diabetic patients to control their blood sugar level [3]. During the following 20 years, the application of GI is quite controversial, but more and more research results tend to show that GI is not only related to the development of diabetes since they are directly influenced by blood sugar level [3]. They are also closely associated with the development of other health issues, such as obesity and cardiovascular disease (CVD) [3]. To be more exact, low GI food helps to control the blood sugar of diabetic patients, maintain our weight or prevent obesity, and decrease the probability of having CVD [3]. This has led to GI being increasingly valued in the application of the prevention of chronic diseases.

In summary, the concept of low-GI foods has gained a certain consensus due to their significant effect on blood sugar level control, weight regulation and maintaining cardiovascular health. However, there are still two limitations in correlated research, there are misunderstandings among the public about GI, thinking that “low GI equates to absolute health”; second, since the actual dietary behaviors of people nowadays are complex, judging the healthy quality of food solely based on GI is kind of one-sided. Therefore, this study will sort out the characteristics and mechanism of action of

low GI foods, and on the basis of that, it will further explore the roles of low GI foods in blood sugar control, weight management, and cardiovascular health, and will provide new public health perspectives in combination with the current research situation.

2. Understanding Low-GI Foods and Characteristics

The glycemic index (GI) is used to characterize the rate of carbohydrate absorption after a meal. It refers to after taking in foods that contains 50g available carbohydrates within 2 hours, the ratio of the area under the blood sugar response curve to the blood sugar response curve after consuming an equivalent amount of a standard food. The standard food could be white bread containing 50g of starch, or just 50g of glucose [4]. Usually, we use glucose as standard, which GI value is 100, to measure what's the blood glucose raising speed and extent caused by taking in other food. Also, GI value is classified into three groups: low GI value (≤ 55), medium GI value (56-69), and high GI value (≥ 70) [5, 6]. If it apply these classifications into actual food in our lives, low-GI food will cause a slow and controllable rise in blood sugar, but high-GI food will lead to a rapid and sudden increase in blood sugar.

There are multiple factors that cause the difference in food GI value. First, food components have a large impact on its GI value. Carbohydrates absorption is the root cause of the increasing in blood sugar level, since it could directly or indirectly lead to the release of insulin in human body. The crystal structure of starch, the content of amylose and amylopectin and the length of its molecular chains determines the GI value of food, as it can influence the rate at which starch is decomposed by amylase. Mainly, simple sugar including glucose and sucrose can easily be hydrolyzed and absorbed, while carbohydrates containing more amylose and resistant starch have lower GI value compared to other carbohydrates. Dietary fiber in food can actually lower the GI value of food because dietary fiber can significantly lower the digestibility of starch by reducing the contact between starch and digestive enzymes. What's more, adding additives could alter food GI value. For example, natural antioxidants such as tea polyphenols and grape seed extract is useful in lowering food GI value. Second, even for the same type of food, there may be significant variations in their GI value due to the differences in food processing and cooking methods. As for processing methods, ultrasonic processing, wet heat treatment and extrusion processing all could lower food GI value through increasing resistant starch content or amylose content and density [1]. Also, focusing on the cooking methods, some methods and temperature control will influence the content of amylose and resistant starch, thus further influence food GI value. To be exact, appropriate baking conditions and low temperature storage are efficient in lowering food GI value, which is important for guiding the diet of diabetic and prediabetic patients [1]. The categories of low GI foods show significant diversity: Whole grains, dairy products, fruits and fruit products including fruit and vegetable juices, fruit spreads and jams, legumes, nuts, non-starchy vegetables, nutritional support products, some snack bars and so on. All of those sources above and even more food are considered as low-GI food [6].

3. The Importance of low-GI Foods for Blood Sugar Control

The role of low glycemic index foods in blood sugar control mainly lies in their unique digestion and absorption mechanism. Studies show, when high-GI food enters the gastrointestinal tract, they are digested quickly, absorbed in a high rate and release glucose rapidly, which makes the glucose rapidly enters the bloodstream and reaches the peak blood glucose level [3]. And this often happens with the large amount secretion of insulin. If such rapid fluctuations in blood sugar and peak insulin secretion occur repeatedly in the long term, the risk of insulin resistance in the body will increases, and it will also add to the burden on pancreatic β cells that are responsible for producing insulin. This is really unfavorable for both the diabetic patients and normal people. However, low-GI food always acts in the opposite way. Since low-GI food contains more soluble dietary fiber, resistant starch, amylose and complex polysaccharides, its digestive rate will significantly decrease, the process of

glucose being released into the bloodstream will become more gradual, and the blood sugar rise curve is more stable, thus avoiding the excessive insulin secretion and the high burden on pancreatic cells, which is favorable for most people who want to maintain good blood sugar level.

Meta-analysis and the results of randomized controlled trials consistently support this claim. Multiple clinical studies have found that low-GI diets could significantly reduce the glycated Hb (HbA1c) levels, showing improvement in blood sugar control [7]. Compared with conventional or high-GI diets, the average reduction and reach 0.4%, which is comparable to the effect of drug treatment for newly diagnosed type 2 diabetes [7]. This improvement is clinically significant and can reduce the risk of diabetic microvascular complications at the same time [7]. Additionally, low glycemic index diets have been shown to improve HbA1c levels in children. For individuals with type 2 diabetes, such diets have been demonstrated to enhance insulin sensitivity and reduce the need for medication [7]. Furthermore, low glycemic index diets exhibit efficacy in lowering short-term glycemic markers (such as fructosamine and glycated albumin), confirming their positive role in blood glucose control [7]. Animal studies indicate that high-GI diets lead to impaired glucose tolerance, hypertriglyceridemia, and microscopically detectable β -cell damage, whereas low-GI diets mitigate these harmful changes and protect pancreatic function [8].

Thus, the advantage of low-GI foods lies not only in delaying blood glucose elevation but also in achieving long-term stable blood glucose levels through more scientifically regulated metabolic processes. This alleviates the metabolic burden on β -cells and enhances insulin efficiency, thereby improving glycemic control. Clinical observations indicate reduced HbA1c levels and a corresponding decrease in the risk of metabolic complications. A series of mechanisms and evidence demonstrate that the benefits of low-glycemic index foods in regulating blood glucose levels and treating diabetes cannot be overlooked.

4. Low-GI Foods for Weight Regulation

Low glycemic index foods are crucial for weight management because they influence insulin secretion, appetite regulation, and overall energy metabolism. The rapid increase and decrease of insulin levels caused by high-GI food not only lead to the early return of hunger but also promote the conversion of glucose into fat for storage, resulting in energy surplus and obesity in the long term if this process occurs repeatedly over a long period of time [3]. The rapid fluctuations in blood sugar and insulin levels increase the feeling of hunger, while low-GI foods are usually rich in dietary fiber, which expands in the gastrointestinal tract and enhances a feeling of fullness [3]. In simple words, the insulin responses of different food are negatively correlated with satiety scores, so low-GI foods can increase satiety, delay the return of hunger or reduce the amount of food consumed freely [9].

In further details to explain, high-GI meals cause a rapid absorption of glucose, causing the insulin level to strongly increase, while reducing the glucagon levels at the same time [9]. This hormonal change promotes the uptake of glucose by muscle, liver and fat tissues, inhibits hepatic glucose output and fat breakdown, thereby resulting in an insufficient supply of available metabolic fuel, and nutrients shift from muscle oxidation to fat storage, both increasing food intake and lead to weight gain [9]. Since low-GI meals act in the opposite way, it will help us increase satiety, eat less and have a better control on body weight.

Both clinical studies and animal experiments provide evidence for this claim. Population studies found that, low-GI diet could significantly increase satiety: Obese male adolescents who consumed high, medium, and low GI meals with the same calorie content, the low-GI meal groups had a 53% and 81% reduction in freely food intake after 5 hours, compared to high-GI meal groups, suggesting that low-GI food could prolong the feeling of fullness and inhibit overeating [3]. Meanwhile, animal experiments have shown that mice on a long-term high-GI starch diet have a significant increase in body fat, while a low-GI starch diet significantly increase fat cell volume and number growth [3]. In addition, a low GI diet is also associated with a higher fat oxidation rate, especially under exercise conditions. Having diet with low-GI foods within can promote the utilization of fatty acids as energy

substrates, thus contributing to an improvement in body composition [8]. Therefore, foods with low-GI value could slow down the carbohydrate digestion rate and absorption rate, reduce insulin fluctuations, increase satiety, decrease the amount of food intake and promote fat oxidation rate, playing an important role in weight management and obesity prevention.

5. Low-GI Foods Protect Cardiovascular Health

Low-GI foods play a significant role in cardiovascular health. A large amount of clinical evidence indicates that a high GI diet can lead to rapid fluctuations in blood glucose level and insulin secretion, which are closely related to insulin resistance, dyslipidemia and the process of atherosclerosis [10]. In contrast, a low-GI diet could lead to a more stable glucose response and a milder insulin secretion, improving multiple cardiovascular risk factors.

Firstly, large-scale cohort studies have shown that dietary GI is significantly associated with the incidence of coronary heart disease. The results of a 10-year follow-up cohort study over 75,000 women indicates that a high-GI diet still significantly increase the risk of developing coronary heart disease, while a low-GI diet could reduce the risk of developing coronary heart disease, even after adjusting for known risk factors [10]. This conclusion is supported in different populations by epidemiological analyses.

Secondly, low-GI diet also stands out in improving lipid profiles. Different studies have shown that the value of GI is negatively associated with high-density lipoprotein cholesterol (HDL-C) levels, suggesting that low-GI foods help to maintain higher level of HDL-C level, which is favorable of our body and can reduce the risk of developing cardiovascular diseases [10]. A 12-week study involving 59 postmenopausal women demonstrated that a low-GI diet combined with 30g legume protein and 4g plant sterol foods daily can reduce total cholesterol by 15.8%, reduce low-density lipoprotein cholesterol by 14.8%, and reduce triglycerides by 44.8%, which indicates that low-GI diet pattern can lower the risk of cardiovascular disease in postmenopausal women by significantly improving lipid profiles [3].

Furthermore, clinical studies confirm that a low glycemic index diet reduces total cholesterol, low-density lipoprotein, and apolipoprotein B while lowering plasmin activator inhibitor-1 (PAI-1) levels, indicating that low-GI foods improve lipid profiles and fibrinolytic function [10]. These changes not only delay the progression of atherosclerosis but also enhance insulin sensitivity by reducing levels of inflammatory mediators such as TNF- α and improving adipose tissue function [10].

In short, low-GI foods plays a positive role in cardiovascular health through stabilizing blood sugar response, reducing insulin fluctuations, improving lipid profiles and reducing inflammatory factors. Its clinical meaning not only lies in reducing the risk of developing coronary heart disease and ischemic heart disease, but also provides important dietary intervention value for high-risk groups including diabetic patients, postmenopausal women and those with a family disease history.

6. Limitations and Persistent Misconceptions

Although glycemic index (GI) is a good indicator of explaining the health value of food, it's easy to have bias in its explanation and application process. A common bias is equalizing low GI with absolute health. For example, gelato seems to have a lower GI value due to their high-fat burning effect, but it contains too much saturated fat and is a calorie-density product, which may add metabolic burden to our body. In contrast, some fruits like watermelon usually have high GI value, but at the usual consumption levels, their glycemic load can be ignored, while they can also provide abundant vitamins, minerals and antioxidant substances. Another issue that worths attention is the ignorance of glycemic load (GL). GL is a derived indicator of GI, which is its corresponding GI value multiplied the amount of digestible carbohydrates in each serving of food and divided by 100 [11]. GL combines the quality and quantity of carbohydrates to predict blood sugar responses more comprehensively. If people ignore GL and only relying on GI tables to decide their diets, it may lead

to short-sightedness in diet, fostering a tendency where numerical value takes precedence over nutritional value. In reality, people's daily dietary habits are quite complex. Therefore, to determine the actual nutritional value of foods, it is essential to comprehensively consider various influencing factors. This complexity underscores a fundamental principle: the GI value serves only as a reference indicator, not as a definitive standard. Optimal nutrition requires balancing multiple factors, such as integrating GI and GL, considering nutrient density, energy intake control, and dietary context. Only through this multidimensional approach can the GI concept fully realize its potential.

7. Conclusion

This study conducted comprehensive research of low glycemic index (GI) foods, aiming to explore their physiological characteristics and health impacts from multiple perspectives. Results indicate that low GI foods play a crucial role in maintaining blood glucose balance by delaying glucose absorption, reducing insulin burden, and prolonging the time of feeling fullness. That way, low-GI foods not only significantly decrease the risk of developing type 2 diabetes but also helps diabetic patients and risk groups to prevent obesity and regulate their weight better. Regarding cardiovascular health, a low-GI diet improves lipid profiles, decreases the factor of inflammation and reduces the risk of developing coronary heart disease or atherosclerosis, offering substantial long-term protective effects on the cardiovascular system. This study's significance lies in further validating the value of low-GI foods for metabolic health and chronic disease prevention, providing scientific grounds for dietary intervention strategies. Simultaneously, the study cautions the public to adopt a comprehensive assessment approach, moving beyond a narrow focus on GI alone to consider glycemic load (GL). However, this research carries several limitations: on one hand, the effectiveness of a low-GI diet may vary among individuals depending on personal dietary habits; on the other hand, existing studies remain predominantly focused on short-term interventions, lacking long-term follow-up data. Future research should focus on establishing more comprehensive GI food databases, conducting larger-scale randomized controlled trials, and exploring personalized dietary interventions based on low-GI foods. Through interdisciplinary research, low-GI diets hold promise for playing a more significant role in public health and clinical practice.

References

- [1] Ding Yan, Wang Yuxing, Yang Yuchan, Lin Jiacong, Wang Dongxu & Guo Yuanxin. Research Status and Progress of Low Glycemic Index Foods. Food Industry Science and Technology, 1-16. <https://doi.org/10.13386/j.issn1002-0306.2025010200>.
- [2] Jenkins D J, Wolever T M, Taylor R H, et al. Glycemic index of foods: a physiological basis for carbohydrate exchange [J]. The American Journal of Clinical Nutrition, 1981, 34 (3): 362-366.
- [3] Zhe Wei & Ding Hong. (2007). Research Progress on Glycemic Index and Its Relationship with Certain Diseases. Journal of Health Research, (06), 769-771.
- [4] Ludwig, D. S. (2000). Dietary glycemic index and obesity. The Journal of nutrition, 130 (2), 280S-283S.
- [5] Kaur J, Kaur K, Singh B, et al. Insights into the latest advances in low glycemic foods, their mechanism of action and health benefits [J]. Journal of Food Measurement and Characterization, 2021: 1-14.
- [6] Atkinson, F. S., Brand-Miller, J. C., Foster-Powell, K., Buyken, A. E., & Goletzke, J. (2021). International tables of glycemic index and glycemic load values 2021: a systematic review. The American journal of clinical nutrition, 114 (5), 1625-1632.
- [7] Thomas, D. E., & Elliott, E. J. (2010). The use of low-glycaemic index diets in diabetes control. British journal of nutrition, 104 (6), 797-802.
- [8] Brand-Miller, J., McMillan-Price, J., Steinbeck, K., & Caterson, I. (2009). Dietary glycemic index: health implications. Journal of the American College of Nutrition, 28 (sup4), 446S-449S.
- [9] Ludwig, D. S. (2000). Dietary glycemic index and obesity. The Journal of nutrition, 130 (2), 280S-283S.

- [10] Leeds, A. R. (2002). Glycemic index and heart disease. *The American journal of clinical nutrition*, 76 (1), 286S-289S.
- [11] Riccardi, G., Rivellese, A. A., & Giacco, R. (2008). Role of glycemic index and glycemic load in the healthy state, in prediabetes, and in diabetes. *The American Journal of Clinical Nutrition*, 87 (1), 269S-274S.