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Glycemic Index and Glycemic Load in Children and Adolescents and its Association with Obesity and Diabetes

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Abstract

Insulin resistance acts as the link between different pathologies, such as obesity, dyslipidemia, hypertension and type 2 diabetes. In this context, the consumption of diets with a high glycemic index and glycemic load are associated with the development of these chronic non-comuncable diseases. Recently, children and adolescents are being affected by these diseases. This raises the questioning if controlling the glycemic index and glycemic load of the diet would be preventing the future development of these pathologies. This review discusses this controversial topic.

Keywords: Glycemic index; Glycemic load; Diabetes; Obesity

Introduction

The prevalence of overweight and obesity has dramatically increased in the last 30 years and been regarded as a pandemic disease. In many countries, more than half of the adult population is overweight or obese [1]. Although genetic factors may contribute to these conditions, they do not explain such drastic change in nutritional epidemiology. Decrease in physical activity, combined with increased access to highly energetic, palatable, and relatively cheap foods of low nutritional value, and decreased consumption of whole foods, may explain this nutrition transition [2].

Obesity and diabetes in children and adolescents

This process has been witnessed not only in adults, but also among children and adolescents. Chronic non-communicable diseases, which until very recently were considered typical of adult and elderly population, have been increasingly common in young individuals. Obesity, type 2 diabetes, dyslipidemias and hypertension have been reported in children and adolescents in several reports [3,4]. Eating habits exert an important influence on the cause of these diseases, which have insulin resistance as a common starting point. Childhood is a crucial stage in the development of healthy dietary habits. Nevertheless, high consumption of high-sugar, processed foods, low in fiber and micronutrients, including candies, processed juice, salty snacks, sweets, cake, and refined cereals, all with a high glycemic index (GI), has been reported during this age.

Glycemic index and glycemic load

Since glucose levels are directly related with insulin production, GI was created as a tool to help control diet quality, and thereby prevent or delay the progression of chronic diseases associated with altered insulin production and insulin resistance, such as diabetes mellitus [5,6], metabolic syndrome [7], obesity [8] and some cancers [9].

Nevertheless, the standardized method to calculate GI, i.e., based on a fixed (50g) amount of carbohydrates, received criticism, since most carbohydrate-containing foods do not provide 50g of carbohydrate in their typical serving size [10]. Thus, since in a real-life situation, neither the amount of carbohydrate consumed nor the time for its ingestion is controlled, another parameter, named glycemic load (GL), was proposed [11] to estimate blood glucose response to carbohydrate consumption, considering food serving portions typically consumed in daily life [12].

Clinical studies have suggested an important role of GI in energy metabolism [5,13]. Consumption of high GL and GI

foods induces a high glycemic and insulin response, resulting in greater cellular glucose uptake and fall in circulating glucose level, which may be associated with higher hunger sensation and consequently greater food consumption [13-15]. Besides, consumption of high GI and high GL diets can alter lipid profile and favor the development of cardiovascular diseases. Insulin resistance has been suggested as the triggering event for LDL uptake from the blood, body weight gain, and peripheral vascular resistance, common in diabetes mellitus, obesity, hypertension and dyslipidemias [5,16,17].

On the other hand, low GI diets have been associated with slower glucose removal rates and hence lower glucose fluctuation, which in turn, leads to a better glycemic control. In type 2 diabetes, low GI diets were associated with lower glycated hemoglobin and fructosamine levels, two key biomarkers of glycemic control [16,18]. In addition, consumption of low GI foods leads to the release of counterregulatory hormones-cortisol, growth hormone and glucagon. Body fat mass regulation associated with the consumption of low GI diets seems to be correlated with the activation of some genes. For example, these diets seem to decrease the expression of ob gene, resulting in lower postprandial insulin secretion [13, 19]. In a review article [20], the adoption of a low GL diet is suggested as a dietetic strategy to prevent metabolic syndrome.

Several studies have investigated the impact of GI and GL on health [13,16,19,21]. However, despite their established importance, the use of these parameters is not a consensus and results of clinical studies are still conflicting [10,13,21]. Glucose absorption is also influenced by other dietary components, including lipid, protein and fiber. In addition to its chemical composition, other factors such as the size of carbohydrate particles and food processing methods may also affect carbohydrate digestion and absorption rates [23].

In general, high GI diets are rich in refined carbohydrates, and poor in fiber, protein and micronutrients, in contrast to low GI diets, rich in micronutrients and fibers. This makes it practically impossible to conduct comparative studies on diets with the same amounts of these nutrients and different GI and GL [24]. However, it is worth pointing out that this relationship between GI/GL and other nutrients may vary between different cultures. In a study on Japanese children, low GI/GL was positively correlated with salt and saturated fat intake [25]. In another study involving adults in Spain, GL was positively correlated with lower BMI [26]. Therefore, despite beneficial effects of low GI/GL diets on nutrient incorporation and glycemic control, one should also consider different dietary patterns adopted in the countries. For example, although the incidence of obesity and diabetes is known to be lower in Japan than in Western countries, a recent study showed that Japanese children follow relatively higher GI/GL diets as compared with these countries [25].

Conclusion

Nationwide studies on GI and GL diets in children and adolescents have been conducted in few countries and are still scarce [27-29]. More attention should be addressed to the theme to clarify whether the adoption of low GI and GL diets in children could actually contribute to stopping the expansion of diabetes and obesity in the world.

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