

# **Blood Glucose Control, A1C, and the Role of Low GI Carbohydrate**

**Vikkie A. Mustad, Ph.D**

**Senior Abbott Nutrition Research Scientist**

Diabetes is a common metabolic disorder marked by elevated blood glucose levels, which are the result of defects in insulin production, insulin action, or both. Diabetes can lead to serious, chronic complications such as nephropathy, neuropathy, retinopathy, and peripheral and central vascular disease. The prevalence of diabetes in the United States is estimated to be 23.6 million, or 8% of the population, with type 2 diabetes accounting for 90% to 95% of all cases of diagnosed diabetes.<sup>1</sup> The World Health Organization estimated that in 2000, 171 million people had diabetes, representing 2.8% of the world's population, and predicted that this number will increase to 366 billion (4.4 %) by 2030.<sup>2</sup> In addition, diabetes places a tremendous burden on society. In 2007, this disease cost the United States an estimated \$174 billion in medical expenditures and lost productivity.<sup>3</sup> This dollar figure does not account for other costs such as pain and suffering, care provided by nonpaid caregivers, and higher rates of health care utilization and spending. Higher rates of health care utilization among the diabetic population may be attributed to the long-term complications of diabetes.

Blood glucose control is the primary goal for diabetes management, and optimal glucose control requires targeting all aspects of glycemia: fasting and postprandial glucose and

A1C. The percent A1C is a key indicator of glycemic control as the value indicates the non-enzymatic attachment of glucose to hemoglobin and reflects the *average daily blood glucose (ADBG) level* over the previous 3 months (the time period being dictated by the 120-day lifespan of the erythrocyte). Both fasting and postprandial blood glucose contribute to ADBG, and the relationship between ADBG to A1C has been confirmed in recent studies using continuous glucose monitoring (CGM) technology.<sup>4</sup> These studies confirm that a higher ADBG corresponds to higher A1C; conversely, a lower ADBG corresponds to a lower A1C.

Diabetes is a progressive disease, requiring regular medical care and tremendous patient self-management to prevent acute complications and to reduce the risk of long-term complications resulting from elevated blood glucose. Structured interventions including diet, lifestyle and self-care behaviors, in combination with use of anti-hyperglycemic medications, is important to achieving and maintaining better blood glucose control. Careful attention to diet is an important way of improving postprandial glucose, and both the amount and type of dietary carbohydrate are the main dietary components affecting post-prandial glycemia.<sup>5</sup> Meal spacing with smaller, more frequent meals with snacks, spread across the day, can help reduce total carbohydrate intake (or load) at any one meal, and would be expected to contribute to reduced postprandial blood glucose levels and lower ADBG. The type of carbohydrate, such as those that are rapidly digested/rapidly absorbed compared to those that are slowly digested/slowly absorbed, also contributes to the post-prandial glucose level. Because both amount and type of dietary carbohydrate are the main dietary components affecting postprandial glycemia

and insulin secretion, the glycemic index (GI) and glycemic load (GL) have been developed as way to categorize foods based on their glycemic and insulinemic responses.<sup>6,7</sup> Studies show that the lower the GI/GL, the lower the expected elevation in postprandial blood glucose responses.<sup>8</sup> In addition, low-GI foods suppress free fatty-acid concentration, further improving glucose uptake by tissues. A recent meta-analysis of randomized trials concludes that replacing high-GI carbohydrates with low-GI alternatives improves glycemic control over long-term consumption<sup>9</sup>, providing further support for the benefits of the type of carbohydrates in diets for people with diabetes.

## **Conclusion**

Nutrition plays a key role in the prevention and management of type 2 diabetes. Both the amount and type of carbohydrate are major dietary factors affecting acute glycemic response and average glucose and, thus, A1C over the long term. Additional research is needed to understand how to increase patient understanding of the importance of carbohydrate to enhance the nutritional management of type 2 diabetes.

## References

1. American Diabetes Association: Diabetes Statistics, 2009. Available from <http://www.diabetes.org/diabetes-statistics/prevalence.jsp>
2. Wild S, Roglic G, Green A, et al: Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004; 27:1047-1053.
3. American Diabetes Association: Direct and indirect costs of Diabetes in the US, 2009. Available from: <http://www.diabetes.org/diabetes-statistics/cost-of-diabetes-in-us.jsp>
4. Nathan DM, Turgeon H, Regan S: Relationship between glycosylated haemoglobin levels and mean glucose levels over time. *Diabetologia* 2007;50:2239-2244.
5. American Diabetes Association. Nutrition Recommendations and Interventions for Diabetes. A position statement of the American Diabetes Association. *Diabetes Care* 2008; 31:S61-S78.
6. Foster-Powell K, Holt SH, Brand-Miller JC: International table of glycemic index and glycemic load values: 2002. *Am J Clin Nutr* 76:5-56, 2002.
7. Jenkins DJ: Dietary carbohydrates and their glycaemic responses. *JAMA* 1984; 2829-31.
8. Wolever, TM: Carbohydrate and the regulation of blood glucose and metabolism. *Nutr Rev* 2003;61:s41-s48.
9. Barclay AW, Petocz P, McMillam-Price J: Glycemic index, glycemic load, and chronic disease risk- a meta-analysis of observational studies. *Am J Clin Nutr* 2008; 87:627-637.
10. Atkinson FS, Foster-Powell K, Brand-Miller JC: International tables of glycemic index and glycemic load values: *Diabetes Care* December 2008 31:2281-2283.

11. Belfort R, Mandarino L, Kashyap S, et al: Dose-response effect of elevated plasma free fatty acid on insulin signaling. *Diabetes* 2005; 54:1640–1648.
12. Heine RJ, Balkau B, Ceriello A, et al: What does postprandial hyperglycemia mean? *Diabet Med* 21:208-213, 2004.