

ignored. However, the strict avoidance of sucrose-containing foods might interfere with fat restriction, which is, in our experience, more difficult to enforce (7).

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#### REFERENCES

1. Hollenbeck CB, Coulston AM, Reaven GM: Glycemic effects of carbohydrates: a different perspective. *Diabetes Care* 9:641-47, 1986
2. Bantle JP, Laine DC, Thomas JW: Metabolic effects of dietary fructose and sucrose in types I and II diabetic subjects. *JAMA* 256:3241-46, 1986
3. Jellish S, Emanuele MA, Abaira C: High sucrose carbohydrate diets vs. sucrose restricted diets in overt diabetics. *Am J Med* 77:1015-22, 1984
4. Emanuele MA, Abaira C, Jellish S, DeBartolo M: A cross-over trial of high and low sucrose diets in type II diabetics with hypertriglyceridemia. *J Am Coll Nutr* 5:429-37, 1986
5. Peterson DB, Lambert J, Gerring S, Darling P, Carter RD, Jelfs R, Mann JI: Sucrose in the diet of diabetic patients—just another carbohydrate? *Diabetologia* 29:216-20, 1986
6. Coulston AM, Hollenbeck CB, Donner CC, Williams RA, Chiou YAM, Reaven GM: Metabolic effects of added dietary sucrose on individuals with noninsulin-dependent diabetes mellitus (NIDDM). *Metabolism* 34:962-66, 1985
7. Gallagher A, Abaira C, Henderson WG: A four-year prospective trial of unmeasured diet in lean diabetic adults. *Diabetes Care* 7:557-65, 1984

## Sucrose in the Diabetic Diet: A Reply

We appreciate the comments on our recent special article (1) expressed by Abaira and Emanuele. They raise important questions relevant to the use of sucrose in the diets of individuals with diabetes. In particular, they pointed out that we have overlooked four important recent papers that reported "no alleged adverse effects on glycemic control when sucrose was consumed in moderate to large amounts over 1 (2), 4 (3,4), or 6 (5) wk." We apologize for not quoting the results of a paper published in 1984 from Dr. Abaira's laboratory (3). However, note that the paper in question found that plasma triglycerides varied in patients with non-insulin-dependent diabetes mellitus (NIDDM) as a function of dietary sucrose content, and fasting hypertriglyceridemia was seen on the high-sucrose diet. With regard to the other three

papers cited by Abaira and Emanuele, they were not published when we wrote and submitted our paper for peer review, nor had they been published when our contribution was finally accepted for publication. Most important, when we review them now, we arrive at a somewhat different interpretation of their significance than did Abaira and Emanuele. In one of the recently published studies (5), the authors reported no significant metabolic effects of replacing 45 g of complex carbohydrate with an equal amount of sucrose. However, in this study, dietary sucrose intake was not controlled. Patients were merely given dietary advice and asked to alter their consumption of sucrose. We feel that without control of dietary intake it is difficult to accept these results as proof that increased dietary sucrose has no adverse metabolic effects. In another study cited by Abaira and Emanuele (4), the nature of the experimental design makes comparison between the high- and low-sucrose diets difficult. Specifically, the effects of two diets were evaluated ~11 mo apart, and the degree of metabolic control in these individuals before the experimental diets differed between the two periods. For example, mean ( $\pm$ SE) fasting plasma glucose concentration was  $187 \pm 25$  mg/dl before the low-sucrose diet and  $237 \pm 26$  mg/dl before the high-sucrose diet. The effect of this difference on the glycemic response is difficult to evaluate. More important, fasting hypertriglyceridemia was again seen in patients on the high-sucrose diet. The third study cited by Abaira and Emanuele (2) was well designed and did not show any deleterious effect of sucrose on either plasma glucose or triglyceride concentrations. However, fasting, 1- and 2-h postprandial, and overall mean plasma glucose concentrations were slightly higher after the added sucrose diet in individuals with either insulin-dependent diabetes mellitus or NIDDM. In addition, fasting and postprandial peak triglyceride concentrations increased on the sucrose-containing diet in both groups. The differences reported did not reach levels of significance possibly because of the specific statistical analysis used. Furthermore, the study lasted only 8 days, and the magnitude of these metabolic changes may have increased with duration of diet. Thus, we do not believe that the four papers cited by Abaira and Emanuele demonstrate that patients with NIDDM may consume sucrose with impunity.

The thrust of our article that drew the attention of Abaira and Emanuele was that substantial evidence existed that showed that the consumption of moderate amounts of sucrose can result in increased plasma concentrations of postprandial glucose and insulin, fasting and postprandial triglyceride, fasting cholesterol, and decreased fasting high-density lipoprotein cholesterol concentration. Our concern was that the sum total of these changes would result in an increased risk for coronary artery disease (CAD) and that it seemed crucial that these issues be faced by appropriate experimental study before patients with NIDDM were encouraged to increase their intake of refined sugar. We think the situation has not been changed by the evidence in the four papers cited by Abaira and Emanuele. In fact, the only well-controlled study

indicating that sucrose does not have any adverse metabolic effects in patients with NIDDM was carried out in 12 subjects and lasted 8 days. When these observations are put into the context of the data we summarized in our article (1), we still feel justified in concluding that "the Council on Nutrition of the ADA should withdraw its recommendation concerning sucrose consumption in diabetes until long-term clinical studies can demonstrate the lack of harmful metabolic events."

The final issue raised by Abaira and Emanuele is that the liberalization of sucrose will enable patients with diabetes to comply more easily to the recommendation to decrease total fat. The presumed advantage of this dietary manipulation would be to reduce the risk for the development of CAD. However, as we have pointed out, this dietary manipulation in patients with NIDDM may in fact lead to metabolic events that would increase the risk of developing CAD (1,6). The first objective of the policy statement of the ADA that prompted our article was that one should strive to achieve control of plasma glucose and lipid levels in patients without compromising overall nutrition and health (7). We have no quarrel with these precepts but only with the means of achieving them. Above all, we believe that dietary advice should not be given until it is based on firm experimental evidence.

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## REFERENCES

1. Hollenbeck CB, Coulston AM, Reaven GM: Glycemic effects of carbohydrates: a different perspective. *Diabetes Care* 9:641-47, 1986
2. Bantle JP, Laine DC, Thomas JW: Metabolic effects of dietary fructose and sucrose in types I and II diabetic subjects. *JAMA* 256:3241-46, 1986
3. Jellish S, Emanuele MA, Abaira C: High sucrose carbohydrate diets vs. sucrose restricted diets in overt diabetics. *Am J Med* 77:1015-22, 1984
4. Emanuele MA, Abaira C, Jellish S, Debartolo M: A cross-over trial of high and low sucrose diets in type II diabetics with hypertriglyceridemia. *J Am Coll Nutr* 5:429-37, 1986
5. Peterson DB, Lambert J, Gerring S, Darling P, Carter RD, Jelfs R, Mann JI: Sucrose in diet of diabetic patients—just another carbohydrate? *Diabetologia* 29:261-20, 1986
6. Coulston AM, Hollenbeck CB, Swislocki ALM, Chen Y-DI, Reaven GM: Deleterious metabolic effects of high-carbohydrate, sucrose-containing diets in patients with non-insulin-dependent diabetes mellitus. *Am J Med* 82:213-20, 1987
7. American Diabetes Association: Glycemic effects of carbohydrates. *Diabetes Care* 7:607-608, 1984