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Facts and Fiction of a Diabetes Diet

BY DANA WHITHAM, RD, MSC, CDE

Nutrition therapy is considered an essential component of diabetes management, yet people with diabetes are often given advice that is not based on scientific evidence. Since most individuals get their nutritional information from television and magazines, and not a physician or dietitian, many myths and misconceptions abound. Several of the facts, as well as the myths, surrounding a "diabetes diet" are discussed in this issue of *Endocrinology Rounds*.

FACT – *There is no such thing as a diabetes diet*

The nutritional management of diabetes has developed greatly over the last 10 years. In the past, it was common practice to place all patients on a low-calorie diabetic diet, meticulously balanced with respect to carbohydrates, proteins, and fat. Sugars and sweets were considered forbidden foods and even milk and fruit were allowed only under certain conditions. It was theorized that foods composed mostly of mono- or disaccharides (fruit or milk) would increase blood glucose more rapidly than polysaccharides (starches). The diabetes meal plan generally focused on the need for weight loss in most individuals with type 2 diabetes (T2DM) and maintenance of appropriate carbohydrate consistency and strict distribution. This very artificial and rigid way of eating was often centered around medication and insulin timing.

In 1997, with the greater understanding and acceptance of the physiology behind the absorption of carbohydrates into the bloodstream, sugar (up to a maximum of 10% of calories per day) was added to the diabetes diet regimen. With this liberalization in diet came a less restrictive and broader range of food choices for people with diabetes. The concept that carbohydrates affected postprandial glycemia in a different way than previously thought challenged traditional diabetes education practices.

Today, nutritional management focuses on healthy eating for diabetes, with diets that are individualized for each patient and based on their need for weight loss, co-morbidities, and personal and cultural preferences. Both the Canadian and American Diabetes Associations renamed the "Diabetes Diet" as "Nutritional Management of Diabetes," and "Medical Nutrition Therapy," respectively. In an effort to reduce the feeling of deprivation, moderation is now considered the "key" to following a healthy diet and no foods are considered forbidden. There are just healthier food choices. Ultimately, there is no such thing as a "diabetes diet."

Healthy eating for diabetes is centered on the same principles as Canada's Guidelines for Healthy Eating that encourage eating a variety of foods, maintaining or achieving a healthy body weight, and consuming low-fat and high-fibre foods (eg, whole grains, fruits, and vegetables). Weight loss is still encouraged, but caloric restriction is generally centered on foods that are currently eaten in excess, regardless of whether they are carbohydrate, protein, or fat.

A large component of diabetes education stems around appropriate serving portions. "Portion distortion" is currently a common phrase to describe the excessive intake of food by many individuals. When newly-diagnosed patients with diabetes go

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to an education session with a registered dietitian, they learn about appropriate portion sizes and are encouraged to consume more fibre and lower glycemic-index carbohydrates, as well as to moderate their sugar and fat intake. They also learn that their diet is no different than the other members of their household, assuming that everyone else wants to eat a healthy diet too.

FICTION – *Approximately 50% of protein is converted to glucose, therefore, it may be beneficial to add protein to a snack to prevent hypoglycemia.*

As early as 1915, it was reported that excess protein could be converted to glucose by providing amino acids as gluconeogenic precursors. Janney calculated a protein-to-glucose conversion rate of approximately 50% with the ingestion of beef protein.[1] This theoretical calculation has been challenged in both normal and diabetic subjects, and no substantial impact on blood glucose has been found.[2,3] For years, and even today, total available glucose (TAG) is calculated based on this theory despite evidence to disprove its existence. In a study conducted by Nuttall in subjects with T2DM, 50 g of glucose was challenged against 50 g of protein or 50 g glucose plus 50 g protein. Blood glucose and insulin were measured every 30 minutes over a 5-hour period. No substantial rise in plasma glucose was demonstrated with the ingestion of protein alone. During the first 2 hours, both the glucose-alone and the glucose plus protein group raised their blood glucose to the same extent. During the 3- to 5-hour period, the glucose plus protein group had a significant reduction in blood glucose compared to the glucose-alone group. This effect was explained by examining insulin levels during the study. Adding protein to glucose nearly doubled the insulin response of either the glucose or protein taken alone.[4] Therefore, it appears that, in the context of T2DM, the increase in the insulin-stimulated response to protein either assists to rapidly absorb any increase in gluconeogenesis or, if gluconeogenesis does occur, its effect is minimal and likely does not prevent hypoglycemia.

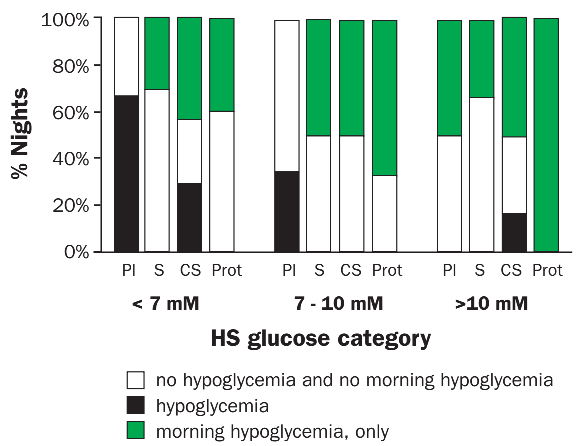
The situation in type 1 diabetes, however, is more intricate. The Diabetes Control and Complications Trial (DCCT) clearly demonstrated that as the A1C decreases, the risk of hypoglycemia increases.[5] Approximately 40% of "lows" occur overnight and up to 67% are considered asymptomatic.[6] Nocturnal hypoglycemia is considered particularly dangerous for individuals with type 1 diabetes because, in many cases, the counter-regulatory response to hypoglycemia is impaired.[6] In a recent study using the Continuous Glucose Monitoring System (CGMS), individuals whose fasting glucose levels were in the normal range had the greatest likelihood of hypoglycemia overnight. Those with fasting glucose levels in the mid- to high-teens, had the least risk.[7]

One of the best strategies to reduce hypoglycemia risk overnight is to avoid the use of insulin that peaks when blood glucose is at its lowest (between 11 pm and 3 am). Unfortunately, many health professionals encourage patients to take their overnight dose of insulin at "bedtime" and do not generally specify a time. Based on the action profile of an intermediate insulin, which tends to peak in 4-6 hours, it would be prudent not to take this type of insulin until at least 11 pm.[8] In head-to-head studies with intermediate-insulin and the newer long-acting insulins (glargine or levemir), hypoglycemia was reduced by approximately 30%, but not eliminated altogether. In individuals taking insulin glargine, nocturnal hypoglycemia still occurred in approximately 18% of subjects.[9] Prevention of nocturnal hypoglycemia by altering insulin dosage, time, or type, is of the utmost importance for reducing risk, and adding a bedtime snack can be of further benefit.

In a study of hospitalized type 1 diabetes patients who did *not* consume a bedtime snack, hypoglycemia occurred in >60% of cases when the bedtime blood glucose was <7 mmol/L, in 30% of cases when the bedtime glucose was between 7-10 mmol/L, but not at all when the bedtime blood glucose was >10 mmol/L.[10]

To determine the most effective type of snack to prevent hypoglycemia, 3 snacks were tested; a standard snack (30 g carbohydrate/11 g protein), a protein snack (15 g carbohydrate/24 g protein), and a cornstarch snack (30 g carbohydrate [50% as cornstarch]/ 11 g protein). The 3 snacks all contained the same amount of TAG to control for the possibility that approximately 50% of the protein would be converted to carbohydrate in a slow process lasting many hours. The main goal was to prevent nocturnal hypoglycemia without causing fasting hyperglycemia. Of the 3 snacks tested, both the standard snack and high-protein snack prevented hypoglycemia more than placebo. It is also noteworthy that the cornstarch snack did not prevent hypoglycemia any better than the standard or protein snack (Figure 1). The authors reported that a large and sustained increase in blood glucose was observed following the protein snack and hypothesized that this was likely due to an increase in plasma glucagon.

Figure 1: Frequency of nights with hypoglycemia and morning hypoglycemia



Pl = placebo; S = standard snack; CS = cornstarch snack; Prot = protein snack. Data represent the percentage of nights when there was nocturnal hypoglycemia, morning hypoglycemia (with no nocturnal hypoglycemia), and neither one with all four snack conditions according to three categories of HS glucose.

A similar study assessed either 30 grams of carbohydrate alone or 30 grams of carbohydrate plus 14 grams of protein. At 3 hours post-ingestion, the mean change in blood glucose was significantly higher following the protein-added snack (2.4 mmol/L vs. 0.9 mmol/L, respectively).[11] Based on these studies, it appears that protein added to a bedtime snack in type 1 diabetes may, in fact, be beneficial in preventing nocturnal hypoglycemia by stimulating glucagon.

The 2003 *Clinical Practice Guidelines for the Prevention and Treatment of Diabetes* recommends consumption of 15 grams of carbohydrate plus 15 grams of protein if the bedtime blood glucose is <7 mmol/L to prevent nocturnal hypoglycemia.[12] It appears prudent to recommend a snack if the bedtime blood glucose is <10 mmol/L and, perhaps, an even larger snack if the glucose is <7 mmol/L in patients on either intermediate- or long-acting insulin. Other factors that influence hypoglycemia need to be taken into consideration and used to make the best decision regarding the need for and amount of a bedtime snack. In the DCCT, individuals with a longer duration of diabetes, a lower A1C, and hypoglycemia unawareness had an increased frequency of hypoglycemia. In addition, alcohol use and exercise need to be considered as additional risks for nocturnal hypoglycemia.

In summary, the addition of protein to a snack may be beneficial in preventing nocturnal hypoglycemia in patients with type 1, but not T2DM.

Table 1: The glycemic index (GI) for some common fruits and other foods

Low GI (≤55)	**Medium GI** (55-69)	**High GI** (≥70)
Fruit	**Fruit**	**Fruit**
Grapefruit	Cantaloupe	Watermelon
Apples	Pineapple	
Oranges	Raisins	
Grapes		
Cherries/Berries		
Banana		
Other	**Other**	**Other**
Barley	Basmati rice	White flour bread
Oatmeal	Shredded wheat	Rice krispies
Legumes	Pita bread	Soda crackers
Sweet potato	Popcorn	Pretzels

FACT – *People with diabetes can consume fruit with a meal or as a snack*

In 1981, David Jenkins and colleagues were anxious to clinically validate that different foods containing an equal amount of carbohydrates result in different glycemic responses. The glycemic response (incremental area under the curve [AUC]) of a food is characterized as a percentage against 50 grams of available carbohydrate from either white bread or glucose as standards and ranked as the glycemic index (GI).[13] The GI is calculated by using the AUC for the test food, dividing it by the AUC for the standard, and multiplying the result by 100. Foods with a low GI result in slower digestion and absorption of carbohydrate, leading to a lower postprandial response and insulin requirement.[14] The GI has helped to identify foods, previously thought of as "simple" or "complex", did not all act as expected at a physiological level. In 1997, the World Health Organization (WHO) suggested that carbohydrates be renamed according to their chemical composition.

Fruit and milk are excellent examples of how the GI revolutionized the concept of the diabetes diet. Most fruit (with few exceptions, but watermelon in particular) have a low GI. This may be a function of the type of sugar (fructose) or the fibre content of the fruit or a combination of both. In either case, fruit converts to glucose slowly and this is demonstrated by its low GI (Table 1). Therefore, fruit can be considered an excellent choice for daytime snacks. In fact, the addition of fruit may be beneficial for blood pressure control, cancer prevention, and for providing fibre, plant sterols, and antioxidants for heart protection. A final benefit of a small fruit (roughly the size of a tennis ball) as a snack may be its calories. Consider the calories in 1 apple (60 kcals) compared to an equivalent amount of carbohydrate from two cookies. The apple contains 60 kilocalories and 20 grams of carbohydrate, whereas a low-fat cookie contains 20 grams of carbohydrate and approximately 120 kilocalories. To summarize, because the GI of fruit is actually quite low, there is no reason to limit fruit consumption to mealtimes only.

FICTION – *Low-carbohydrate diets are more effective than traditional diets for long-term weight loss in diabetes*

Low-carbohydrate diets are used by people in all walks of life… for those wanting to lose weight and those who don't, for the young and the elderly, and even for those with diabetes.

Most low-carbohydrate diets restrict the intake of carbohydrate to <60 grams per day, some to as low as 20 grams.[15] This restriction applies not only to foods that contain added sugar, but also to foods with natural sugars such as grain products, fruit and some vegetables, milk, yogurt, beans, and lentils. Protein and fat are used to replace carbohydrates in an effort to increase satiety, decrease insulin requirements, and switch the body's preferred fuel source from carbohydrates to fat.

Since carbohydrates contribute more to blood glucose than other macronutrients, reducing their intake results in a reduction in blood glucose that may potentially lead to an increase in hypoglycemic events. Significant reductions in the use of insulin and antihyperglycemic medications have been documented with low-carbohydrate diets,[16] highlighting the importance of close medical supervision of weight loss in patients with diabetes.

As heart disease risk in people *with* diabetes is 2-4 times higher than that in people *without* diabetes, assessment of cardiac risk factors is of paramount importance. Low-carbohydrate diets have been shown to reduce blood pressure,[17,18] triglycerides,[17,19-21] and insulin levels.[17,19,20] The latter, however, is not surprising, since insulin is released in response to carbohydrate intake. Both total cholesterol and low-density lipoprotein (LDL) cholesterol tend to decrease initially[20] in the low-carbohydrate diet group or return to baseline during follow-up,[22] while high-density lipoprotein (HDL) cholesterol levels generally increase[17-20,23] or do not change at all[24] in people on a low-carbohydrate diet.

In studies assessing the effects of a low-carbohydrate, high-protein diet on renal function, both creatinine clearance and glomerular filtration rates were not affected to any significant degree.[25]

It is worthwhile to note that while it appears that low-carbohydrate diets pose no specific detriment to people with diabetes in the short-term, the long-term effects are still unknown.[26] It is also important to highlight that the majority of these studies were conducted in normal subjects, without diabetes, and that the study durations were <6 months. Close monitoring of cardiac risk factors, markers of renal impairment, and blood glucose are necessary.

Improvements in blood glucose control through the use of low-carbohydrate diets were demonstrated in both short-[27-9] and long-term trials[30] in subjects with T2DM. In terms of weight loss, low-carbohydrate diets lead to significantly greater weight loss (approximately 3 kg) than high-carbohydrate diets in studies lasting <6 months. In the long-term (lasting >1 year), a difference exists only in the "pattern" of weight loss. Low-carbohydrate dieters lost most of their weight in the first 6 months, while the high-carbohydrate group lost their weight gradually, over a period of a year.[21]

In most studies assessing iso-caloric diets, no differences in total weight loss were demonstrated.[17,24] One exception is a recent study in which a low-carbohydrate diet produced greater weight loss than a high-carbohydrate diet despite containing, on-average, 300 additional calories per day.[31] While the exact mechanism remains unknown, one study reports that weight loss does not appear to be explained by differences in resting-energy expenditure or the thermic effect of food as hypothesized.[18] Methodological issues are cited as the main cause for the difference. The use of different calorie levels or energy deficits,[22] small sample sizes with high attrition rates, and confounders (eg, exercise) compromise the impact of the results.

Summary

In summary, while low-carbohydrate diets may provide greater short-term weight loss without exacerbation of cardiac or renal risk factors, they appear to offer no additional benefit over high-carbohydrate diets in the long-term.

In addition, high-carbohydrate diets (50%-55% of total calories) have been shown in long-term studies to produce significant weight losses for up to 3 years.[31] This has not been documented with low-carbohydrate diets as yet. Low GI and high-fibre diets have been demonstrated to improve blood lipids and glycemia and reduce cardiovascular risk.[18] Therefore, until further studies confirm long-term benefits, it appears that the high-carbohydrate, high-fibre, low-GI diet supported by the Canadian Diabetes Association remains the most ideal choice for weight loss and glucose control in people with diabetes.

The goal for the dietary treatment of diabetes is to prevent both the short- and long-term complications of diabetes, in particular, cardiovascular disease. While no single weight loss approach can be applied to all patients, all weight loss in diabetes patients should be under medical supervision. Until further studies confirm the long-term safety in an already at-risk population, the use of low-carbohydrate diets is not recommended.

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References

1. Franz MJ. Protein controversies in diabetes. *Diabetes Spectrum* 2000;13(3):132-141.
2. Malik RL, Jaspan JB. Role of protein in diabetes control. *Diabetes Care* 1989;12:39-40.
3. Franz MJ. Protein: Metabolism and effect on blood glucose levels. *Diabetes Educ* 1997;23:643-51.
4. Nuttall FQ, Mooradian AD, Gannon MC, Billington C, Krezowski P. Effect of protein ingestion on the glucose and insulin response to a standardized oral glucose load. *Diabetes Care* 1984;7:465-70.
5. DCCT Research Group. Hypoglycemia in the Diabetes Control and Complications Trial. *Diabetes* 1997;46(2):271-286.
6. Jones H. Hypoglycemia. Chapter 12. In: *Approach to the Management of Diabetes Mellitus* (6th Edition): Accessed: April 25, 2006. http://www.bbdc.org/diabetesmanagement/ch12.htm. Banting and Best Diabetes Centre; 2005.
7. Hoi-Hansen T, Pederson-Bjergaard U, Thorsteinsson B. The Somogyi phenomenon revisited using continuous glucose monitoring in daily life. *Diabetologia* 2005;48(11):2437-8.
8. Yale JF. Nocturnal hypoglycemia in patients with insulin treated diabetes. *Diabetes Res Clin Pract* 2004;65(Suppl.1):S41-6.
9. Ratner RE. Less hypoglycemia with insulin glargine in intensive insulin therapy for type 1 diabetes. US Study Group of Insulin Glargine in Type 1 Diabetes. *Diabetes Care* 2000;23(5):639-643.
10. Kalergis M, Schiffrin A, Gougeon R, Jones PH, Yale JF. Impact of bedtime snack composition on prevention of nocturnal hypoglycemia in adults with Type 1 Diabetes undergoing intensive insulin management with lispro insulin before meals. *Diabetes Care* 2003;26:9-15.
11. Hess A, Beebe CA. Glycemic effect of a small amount of protein added to an evening snack in people with type 1 diabetes. *Diabetes*;1999.
12. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. Canadian Diabetes Association 2003 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. *Can J Diabetes* 2003;27(2):34. Guidelines available online at: http://www.diabetes.ca/cpq2003/download.aspx. Accessed: April 25, 2006.
13. Wolever TMS, Jenkins DJA, Collier GR, Lee R, Wong GS, Josse RG. Metabolic response to test meals containing different carbohydrate foods: Relationship between rate of digestion and plasma insulin response. *Nutr Res* 1988;8:573-81.
14. Wolever TMS. The Glycemic Index. *World Rev Nutr Diet* 1990; 62:120-85.
15. Kennedy RL, Chokkalingam K, Farshchi HR. Nutrition in patients with type 2 diabetes: are low carbohydrate diets effective, safe or desirable? *Diabet Med* 2005;7:821-32.
16. Boden G, Sargrad K, Homko C Mozzoli M, Stein TP. Effect of a low carbohydrate diet on appetite, blood glucose levels, and insulin resistance in obese patients with type 2 diabetes. *Ann Intern Med* 2005;142:403-411.
17. Meckling KA, O'Sullivan C, Saari D. Comparison of a low fat diet to a low carbohydrate diet on weight loss, body composition and risk factors for diabetes and cardiovascular disease in free-living overweight men and women. *J Clin Endocrinol Metab* 2004;89(6):2717-2723.
18. Brehm BJ, Spang SE, Lattin BL, Seeley RJ, Daniels SR, D'Alessio DA. The role of energy expenditure in the differential weight loss in obese women on low fat and low carbohydrate diets. *J Clin Endocrinol Metab* 2005;90:1475-1482.
19. Dansinger ML, Gleason JA, Griffith JL, Selker HP, Schaefer EJ. Comparison of the Atkins, Ornish, Weight Watchers, and Zone Diets for weight loss and heart disease risk reduction: A Randomized Trial. *JAMA* 2005;293(1):43-53.
20. Luscombe-Marsh ND, Noakes M, Wittert GA, Keogh JB, Foster P, Clifton PM. Carbohydrate restricted diets high in either monounsaturated fat or protein are equally effective at promoting fat loss and improving blood lipids. *Am J Clin Nutr* 2005;81:762-772.
21. Stern L, Iqbal N, Seshdri P, et al. The effects of low carbohydrate versus conventional weight loss diets in severely obese adults: One year follow-up of a randomized trial. *Ann Intern Med* 2004;140(10):778-785.
22. Foster GD, Wyatt HR, Hill JO, et al. A randomized trial of low carbohydrate diet for obesity. *N Engl J Med* 2003;348:2083-2090.
23. Miyashita Y, Koide N, Ohtsuka M, Ozaki H, Itoh Y, Oyama T. Beneficial effect of low carbohydrate in low calorie diets on viscera fat reduction in type 2 diabetic patients with obesity. *Diabetes Res Clin Pract* 2004;65:235-241.
24. Bravata DM, Sanders L, Huang J, Krumholz HM, Olkin I, Gardner CD. Efficacy and safety of low carbohydrate diets: A systematic review. *JAMA* 2003;289(14):1837-1850.
25. Sargrad KR, Homko C, Mozzoli M, Boden G. Effect of high protein vs. high carbohydrate intake on insulin sensitivity, body weight, hemoglobin A1C, and blood pressure in patients with type 2 diabetes mellitus. *JAMA* 2005;105(4):573-580.
26. Panzer C, Apovian CM. Aggressive diets and lipid responses. *Curr Cardiol Rep* 2004;24(3):273-82.
27. Gannon MC, Nuttall FQ, Saeed A, Jordan K, Hoover H. An increase in dietary protein improves the blood glucose response in persons with type 2 diabetes. *Am J Clin Nutr* 2003;78:734-741.
28. Gutierrez M, Akhavan M, Jovanovic L, Peterson CM. Utility of a short term 25% carbohydrate diet on improving glycemic control in type 2 diabetes mellitus. *J Am Coll Nutr* 1998;17: 595-600.
29. Gannon MC, Nuttal FQ. Effect of a high protein low carbohydrate diet on blood glucose control in people with type 2 diabetes. *Diabetes* 2004; 53:2375-2382.
30. Nielsen JV, Jonsson E, Nilsson AK. Lasting improvement of hyperglycaemia and bodyweight: low carbohydrate diet in type 2 diabetes – a brief report. *Ups J Med Sci* 2005;110:69-73.
31. Avenell A, Brown TJ, McGee MA, et al. What are the long-term benefits of weight reducing diets in adults? A systematic review of randomized controlled trials. *J Hum Nutr Diet* 2004;17:317-355.

Abstracts of interest

Nocturnal hypoglycemia in patients with insulin-treated diabetes

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While use of intensive insulin therapy has proven effective for reducing risk of long-term complications of hyperglycemia in people with diabetes, overnight hypoglycemia remains a significant barrier to intensive therapy. Findings from numerous studies indicate that nocturnal hypoglycemia is a frequent event among patients with type 1 diabetes, while severe hypoglycemic episodes are approximately three times more likely in patients on intensive insulin therapy than in those on conventional therapy.

Nocturnal hypoglycemia remains frequent, even when specific approaches—use of short-acting insulin analogues to manage postprandial glucose surges, peakless long-acting insulin analogues as basal therapy, and strategically selected bedtime snacks—aim to avert this problem. Thus, nocturnal hypoglycemia continues to threaten the well-being of patients with diabetes and cause concerns for their family members and caregivers. Continuing research is required to improve methods for detection and prompt correction of hypoglycemia in order to achieve a safe level of euglycemia in people with diabetes.

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Effect of high protein vs high carbohydrate intake on insulin sensitivity, body weight, hemoglobin A1c, and blood pressure in patients with type 2 diabetes mellitus

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BACKGROUND: Extremely low carbohydrate/high protein diets are popular methods of weight loss. Compliance with these diets is poor and long-term effectiveness and the safety of these diets for patients with type 2 diabetes is not known.

OBJECTIVE: The objective of the current study was to evaluate effects of less extreme changes in carbohydrate or protein diets on weight, insulin sensitivity, glycemic control, cardiovascular risk factors (blood pressure, lipid levels), and renal function in obese inner-city patients with type 2 diabetes.

DESIGN: Study patients were admitted to the General Clinical Research Center for 24 hours for initial tests including a hyperinsulinemic-euglycemic clamp (for measurement of insulin sensitivity), bioelectrical impedance analysis (BIA) and anthropometric measurements (for assessment of body composition), indirect calorimetry (for measurement of REE), electronic blood pressure monitoring, and blood chemistries to measure blood lipids levels along with renal and hepatic functions. Six patients with type 2 diabetes (five women and one man) were randomly assigned to the high-protein diet (40% carbohydrate, 30% protein, 30% fat) and six patients (four women and two men) to the high-carbohydrate diet (55% carbohydrate, 15% protein, 30% fat). All patients returned to the General Clinical Research Center weekly for monitoring of food records; dietary compliance; and measurements of body weight, blood pressure, and blood glucose. After 8 weeks on these diets, all patients were readmitted to the General Clinical Research Center for the same series of tests.

INTERVENTION: Twelve study patients were taught to select either the high-protein or high-carbohydrate diet and were followed for 8 weeks.

MAIN OUTCOME MEASURES: Insulin sensitivity, hemoglobin A1c, weight, and blood pressure were measured.

STATISTICAL ANALYSES: Statistical significance was assessed using two-tailed Student's t tests and two-way repeated measures analysis of variance.

RESULTS: Both the high-carbohydrate and high-protein groups lost weight (-2.2±0.9 kg, -2.5±1.6 kg, respectively, P<.05) and the difference between the groups was not significant (P=.9). In the high-carbohydrate group, hemoglobin A1c decreased (from 8.2% to 6.9%, P<.03), fasting plasma glucose decreased (from 8.8 to 7.2 mmol/L, P<.02), and insulin sensitivity increased (from 12.8 to 17.2 µmol/kg/min, P<.03). No significant changes in these parameters occurred in the high-protein group, instead systolic and diastolic blood pressures decreased (-10.5±2.3 mm Hg, P=.003 and -18±9.0 mm Hg, P<.05, respectively). After 2 months on these hypocaloric diets, each diet had either no or minimal effects on lipid levels (total cholesterol, low-density lipoprotein, high-density lipoprotein), renal (blood urea nitrogen, serum creatinine), or hepatic function (aspartate aminotransferase, alanine aminotransferase, bilirubin).

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