



Examination of Current Dietary Recommendations for Individuals with Diabetes Mellitus

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The dietary recommendations recently published by the American, British, and Canadian diabetes associations reflect unanimity among the organizations as regards decreasing the fat content and increasing the carbohydrate with fiber content in diabetic meal plans. Each organization suggests that moderation in sodium intake is appropriate. Furthermore there is agreement that dietary strategies for the two major clinical classes of diabetes differ. *DIABETES CARE* 5: 59-63, JANUARY-FEBRUARY 1982.

The nutrition committees of the American, British, and Canadian Diabetes Associations have published recent reports that call attention to disadvantages of "traditional" diabetic diets.¹⁻³ The reports suggest that, in light of recent evidence, other dietary strategies may be more effective in the long term. All three organizations emphasize lowering the fat content of diabetic diets from the typical 40-45% of calories to 30-35% and each suggests that, with appropriate calorie control, carbohydrates can fall within a range of 45-60% of the energy value of the diets.

For the first time, the three organizations are emphasizing the desirability of including complex carbohydrates and carbohydrate sources with associated fiber for the major proportion of carbohydrate calories. All three reports mentioned the desirability of moderation in salt intake for individuals with diabetes as part of the total approach to dietary management. In addition, each association has formulated a position relative to the use of alcohol and alternative nutritive sweeteners (e.g., fructose, sorbitol) and nonnutritive sweeteners, which are addressed in these reports and in greater detail elsewhere.¹⁻⁶ The recommendations from the three organizations consistently emphasize a dietary approach that focuses on the specific needs of each of the two major clinical classifications of diabetes.

Weight reduction is the primary objective of therapy in the majority of type II diabetic individuals who are obese and non-insulin-dependent. Timing of meals and consistency of intake are emphasized for type I (insulin-dependent) diabetic individuals.

FAT

Atherosclerosis is the major nemesis in individuals with diabetes in affluent western societies.⁷⁻⁹ Roughly three-quarters of American diabetic patients die from atherosclerosis.⁷ In type II diabetic patients the risk is excessive by a factor of about 2, and most of the increased mortality risk is due to the excess of coronary disease.¹⁰ When compared with people who are free of clinical diabetes, the risk of coronary heart disease is double in diabetic men and triple in women with diabetes.^{11,12}

Although the pathogenesis of CVD in diabetes is not completely understood, diabetes is frequently associated with hyperlipidemia. Hyperlipidemia is often considered a major determinant of atherosclerosis.¹² Hyperglycemia may function as an independent risk factor.⁷ Possible etiologic factors in diabetic macrovascular disease include diets high in saturated fat, obesity,^{7,12} hyperinsulinemia,^{7,12} and physical indolence, as well as the risks inherent in hyperlipidemia, hypertension, and hyperglycemia.⁷ The majority of these risk factors can be influenced by dietary manipulations.

In the 1930s Himsworth et al. reported that diabetic patients routinely consumed a diet higher in calories and proportion of fat in contrast with nondiabetic patients before the diagnosis of diabetes.¹³ Subsequent epidemiologic studies suggested that increased fat consumption favors the development of obesity under some conditions and this, rather than a direct effect of fat, probably increased the risk of diabetes.⁷ The degree of aberrations of lipid metabolism is influenced by the level of insulin insufficiency and glycemia. Hypergly-

cemia usually intensifies lipidemia and atherosclerosis. It was recently reported by the National Diabetes Data Group that some studies have shown increased susceptibility to atherosclerotic disease in the presence of nondiagnostic fasting glucose levels and glucose intolerance of a degree between normal and diabetic.¹⁴

Mitigation of hyperglycemia has substantial normalizing effects on cholesterol metabolism.¹⁵ The excessive morbidity and mortality from atherosclerosis, in obese type II diabetes, is best treated through control of hyperglycemia by limiting calorie intake with the composition of the diet of secondary importance.

It is well established that cholesterol is the predominant lipid constituent of the atherosclerotic lesion and this necessitates examination of serum cholesterol and its subfractions. Evaluation of the data from the Framingham study has shown a gradual increase in CHD risk with increasing serum cholesterol levels.¹⁶ Evidence indicates that the increased risk of CHD is associated principally with an elevation of the low density lipoprotein (LDL) subfraction of cholesterol while the high density lipoprotein (HDL) cholesterol appears to be inversely related to CHD risk, with low HDL cholesterol associated with increased risk.^{11-13,16-17} Although the normal range of cholesterol levels in the general population is broad and influenced by genetic factors, the high average level in western society is believed to be of dietary origin.¹¹

Dietary studies in normal and diabetic subjects have shown that serum cholesterol can be lowered by reducing the intake of saturated fat whether or not there is a concomitant weight loss.^{11,17-20} However, weight loss appears to affect the HDL cholesterol subfraction. It is thought that HDL cholesterol blood levels may be increased by weight reduction and physical exercise.¹¹ However, there has been limited research showing the effects of modest increases in physical activity and/or weight reduction. Groups of diabetic patients that escape atherosclerosis have low levels of serum cholesterol, and they consume diets low in saturated fat, usually high in starch.¹⁰

The debate continues about the efficacy and the desirable amount of polyunsaturated fat to be consumed and the degree to which dietary cholesterol should be limited. However, there is consensus among the three diabetes associations that saturated fat should be decreased, with some replacement of saturated fat with polyunsaturated fat, and moderate amounts of cholesterol in diabetic diets.¹⁻³ The specific recommendations of the American Diabetes Association, in terms of dietary fat, are basically consistent with those of the American Heart Association.¹ Only the Canadian Diabetes Association recommended a level of restriction for the cholesterol intake. The American Diabetes Association recommended a limited intake of cholesterol with no specified level, while the British report made no specific recommendation relative to cholesterol intake. A recent study of Western Electric employees indicated that a higher cholesterol intake may function independent of serum cholesterol in increase CHD risk.²¹

SODIUM

It has been reported that 40–80% of the diabetic population is hypertensive,²² and that frequency increases with increased duration of diabetes.⁷ In addition, there appears to be synergism between elevated blood sugar and blood pressure that is greater than the cumulative effect of each on cardiovascular risk.²³ Since elevation of blood pressure in diabetic patients can rapidly accelerate the rate of lesion formation in blood vessel walls, it is necessary to carefully examine the effect of dietary intake on blood pressure in diabetic patients. Evidence indicates that among various cultures the average salt intake correlates with the prevalence of hypertension, although this relationship has not been demonstrated for individuals within the population.²⁴

In western societies consumption of processed foods provides a substantial portion of the food intake. It is estimated that 70% of the sodium in American diets is derived from prepared foods. Thus, mean salt intakes are estimated to be 8–12 g of sodium chloride per person per day.²⁴ Food processing tends to add sodium and reduce potassium, thus further increasing the ratio of sodium over potassium in the diet.²⁴ Reduction of salt intake has been established by the select senate committee on nutrition as one of the national dietary goals. The current American Diabetes Association nutrition and dietary recommendations¹ suggest “that modest restriction of salt intake be considered in well-controlled diabetic persons without other medical problems.” To restrict salt intake requires reduced use of table salt and a decrease in the consumption of “convenience” foods.

CARBOHYDRATE

In the pre-insulin era low carbohydrate, high fat, calorically restricted diets were the cornerstone of diabetes therapy. The improvement of diabetes with restricted carbohydrate was attributable to the reduction in calories that attended the regimen. The role of overproduction of glucose by the liver in diabetes has been inadequately appreciated. The liver can make glucose from a variety of energy sources and blood glucose levels are more a function of total fuel supply than of qualitative features of the diet.¹⁰

More than forty years ago it was demonstrated that reduction of dietary carbohydrate without change in total calories impaired glucose tolerance, while increased carbohydrate improved oral glucose tolerance in normal persons.²⁵ These earlier observations have recently been confirmed in normals, and in type I^{26,27} and type II diabetes.²⁶⁻³⁰ Among type II diabetic patients who remain uncontrolled, higher carbohydrate diets appear to worsen glucose tolerance.^{30,31} It appears that available insulin, either endogenous or exogenous, is necessary for improved glucose metabolism on high carbohydrate diets.^{30,31}

In contrast with reports of insulin-dependent diabetic patients who can be controlled on the higher carbohydrate diets without an increase in insulin, there appears to be some who have difficulty normalizing blood sugars on “traditional”

carbohydrate levels. This anecdotal evidence has generally come from individuals on home glucose monitoring programs.^{32,33} Whether there is a sizeable subgroup of diabetic individuals who must be maintained on a lower carbohydrate intake remains to be determined.

A major concern is that advocacy of high carbohydrate diets may be translated into increased intake of simple sugars.³⁴ Ingestion of concentrated, simple carbohydrates (mono and disaccharides) aggravates hyperglycemia and causes wide fluctuations in blood glucose.³⁵ Glycemic responses to food containing complex carbohydrates (e.g., potatoes, rice) are different. Equivalent quantities of complex carbohydrates do not induce equivalent increments in plasma, glucose, or insulin. The reasons for this variation are unknown at this time.³⁵

Another source of concern is that high carbohydrate diets might tend to raise serum triglyceride. In general, 24-h levels of serum triglyceride, in contrast with fasting levels, do not rise with increased carbohydrate intake.^{18,27,30,36} On the other hand, high calorie regimens do tend to raise serum triglyceride irrespective of the source of calories.¹⁰ The American, British, and Canadian Diabetes Associations' specific recommendations relative to the proportion of carbohydrate calories are 50–60%, 50–55%, and 45% or higher, respectively.

FIBER

Over the past several years there has been a renewed interest in the fiber content of the diet. During the past century, in

the United States, there has been a substantial decline in the fiber content of the diet with a 20% decrease in fiber consumption from fruits and vegetables and 50% less fiber from cereals and grains.³⁷ Dietary fiber is thought to have both homeostatic and therapeutic functions.³⁸ It has been demonstrated, in diabetic subjects, that a mixture of carbohydrate and fiber, and the level of carbohydrate, high rather than low, is important for achieving the blunting effects on blood glucose and lowering effects on serum lipids observed.^{39–42} There is active research on the effect of both major forms of fiber, insoluble (vegetables, grains) and soluble or gel-forming (fruits, certain legumes). These fibers are of current interest because they absorb water and other substances and they act as a cation exchange resin.^{37,43}

The American Diabetes Association includes the following statement relative to fiber in their report: "Wherever acceptable to the patient, natural foods containing unrefined carbohydrate with fiber should be substituted for highly refined carbohydrates which are low in fiber." This statement indicates that in the light of current research, the use of whole grain products, vegetables, and fruits with edible skins and seeds is indicated. Additional evidence is needed before recommending the pharmacologic use of fiber supplements.

DIETARY STRATEGIES

Type II diabetes. The strength of the relationship between adiposity and diabetes has only recently been appreciated. It has been observed that a substantial majority of people with gross obesity of long duration develop diabetes irrespective of

TABLE 1
American, British, and Canadian dietary recommendations for diabetic patients

Protein	12–20% calories	Exact amount not specified (up to 20%)	Exact amount not specified (up to 25%)
Fat	30–38% calories modified fat (limit intake of cholesterol)	Maximum 35% calories modified fat (no cholesterol limitation recommended)	30–35% calories modified fat (restrict cholesterol to 400 mg)
Carbohydrate	50–60% calories. Emphasis on complex CHO (restriction of simple CHO)	50–55% calories. Emphasis on complex CHO (restriction of simple CHO)	Minimum 45% calories. Emphasis on complex CHO (restriction of simple CHO)
Sodium	Moderation	Moderation	Moderation
Fiber	Encouraged from food sources	Encouraged from food sources	Encouraged from food sources
Alcohol	Limited use with approval of physician (in separate report)	No specific recommendation	Limited use with approval of physician
Nutritive sweeteners	Advisability of use varies with control and weight (in separate report)	Considered to be of little benefit	Moderation advised
Nonnutritive	Currently considered acceptable in diabetic dietary patterns (in separate report)	Currently considered acceptable in diabetic dietary patterns	Moderation advised
"Standard" or preprinted diets	Use discouraged (individualization* and flexibility encouraged)	Use discouraged (individualization and flexibility encouraged)	Individualization and flexibility encouraged

* Methodology for individualization of nutritional care is described in *A Guide for Professionals. The Effective Application of Exchange Lists for Meal Planning*. New York, American Diabetes Association, 1977.

race or genetic status,⁷ and approximately 80% of type II diabetic patients are obese. Obesity is associated with hyperinsulinism and a reduced tissue sensitivity to insulin. These are reversed by weight reduction. Caloric restriction per se seems to result in a fall in blood glucose in the early phases of a weight reduction program even before significant weight loss.⁴⁴ In obese type II diabetes, weight reduction has the potential not only for controlling diabetes, but even for reversing the disease when it has been present only a few years.¹⁰ In type II diabetes, obese subtype, the main objective of diet therapy is to achieve and maintain a desirable body weight. The appropriate strategies to achieve this objective include a hypocaloric, low-saturated fat diet and regular exercise. In lean type II diabetes, the emphasis is on small, frequent feedings, low in saturated fat and high in complex carbohydrate and regular exercise.

Type I diabetes. In type I diabetes, dietary strategies focus on supplying adequate energy to insure normal growth and subsequent weight maintenance, and the intake of calories is synchronized with the action of the insulin. This is insured by keeping the time, number, and composition of meals consistent from day to day.

SUMMARY

The dietary recommendations of the American, Canadian, and British Diabetes Association are remarkably similar (Table 1) with emphasis on decreasing the total fat and increasing the complex carbohydrate content of the diabetic diet. These recommended changes are based on evidence that atherosclerosis is prompted by a high-saturated-fat diet and that a higher car-

bohydrate intake is consistent with the goal of achieving normal blood sugars. In addition, each of the diabetes associations has included specific recommendations (Table 2) for the major classification of diabetes, with emphasis on weight control in obese type II diabetes and emphasis on synchrony between food and exogenous insulin action in type I diabetes.

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TABLE 2
Strategies for normalizing blood sugar in diabetic patients

Type I diabetes (insulin-dependent diabetes; exogenous insulin required for survival)	Type II diabetes (sufficient endogenous insulin for survival; treatment focuses on maximizing efficiency of endogenous insulin)
Approximate frequency in the U.S.: 10% cases	Approximate frequency in the U.S.: 90% cases
Synchronize food intake and insulin action	Obese, approximately 80%
Frequent meals and snacks recom- mended for conventional therapy	Weight reduction is primary therapy
Consistency of eating time and meal composition emphasized for conventional therapy	Hypocaloric diet, low in saturated fat
Fiber-containing foods may minimize postprandial blood sugar rises	Regular exercise
Regular exercise encouraged	Nonobese, approximately 10%
	Small meals
	Fiber-containing foods may reduce postprandial blood sugar rise
	Regular exercise encouraged. If insulin treated the strategies for type I apply

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