Diet in Diabetes

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HISTORY

Attempts to alleviate diabetes mellitus by diet were first made by the Egyptians as early as 3500 BC. In India, about 2500 years ago, Susruta and Charaka had recognized the importance of dietary regulation in the treatment of diabetes and many of the principles suggested by these eminent physicians hold good even today. In the 20th Century, prior to discovery of insulin, the treatment of diabetes mellitus included intermittent fasting, undernutrition and carbohydrate restriction. With the advent of insulin and oral antidiabetic drugs, there was a tendency to prescribe liberal diets.

Principles of Medical Nutrition Therapy (MNT)

With medical nutrition therapy (MNT), dietician discusses meal plan options with the person with diabetes and guides behavior change to successfully incorporate the mutually negotiated goals into patient’s lifestyle. The process includes developing communication with the patient, nutrition assessment, evaluating data and planning intervention. MNT is an art as well as science. A clinician without nutrition background might not be comfortable answering all diet-related questions, and referral to a dietician is appropriate.

MNT : General Recommendations

Refer Table I, II & III

MNT is an integral component of diabetes prevention, management, and self management education. Individuals who have pre-diabetes or diabetes should receive individualized MNT as needed to achieve treatment goals.

Table I. MNT Recommendations -2010

<table>
<thead>
<tr>
<th>Energy balance, overweight, and obesity</th>
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<tbody>
<tr>
<td>In overweight and obese insulin resistant individuals, modest weight loss has been shown to reduce insulin resistance. Thus, weight loss is recommended for all overweight or obese individuals who have or are at risk for diabetes.</td>
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<tr>
<td>For weight loss, either low-carbohydrate or low-fat calorie-restricted diets may be effective in the short-term (up to 1 year).</td>
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<tr>
<td>For patients on low-carbohydrate diets, monitor lipid profiles, renal function, and protein intake (in those with nephropathy) and adjust hypoglycaemic therapy as needed.</td>
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<tr>
<td>Physical activity and behavior modification are important components of weight loss programs and are most helpful in maintenance of weight loss.</td>
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Primary prevention of diabetes

Among individuals at high risk for developing type 2 diabetes, structured programs emphasizing lifestyle changes that include moderate weight loss (7% body weight) and regular physical activity (150 min/week) with dietary strategies including reduced calories and reduced intake of dietary fat can reduce the risk for developing diabetes and are therefore recommended.
Clinical trials/outcome studies of MNT have reported decreases in A1C at 3-6 months ranging from 0.25 to 2.9% with higher reductions seen in type 2 diabetes of shorter duration. Meta-analyses of studies in nondiabetic, free living subjects report that MNT reduces LDL cholesterol by 15-25 mg/dl or by up to 16%, while clinical trials support a role for lifestyle modification in treating hypertension. Short-term studies have demonstrated that moderate weight loss (5% of body weight) in subjects with type 2 diabetes is associated with decreased insulin resistance, improved measures of glycemia and lipemia, and reduced blood pressure; longer term studies (≥52 weeks) showed mixed effects on A1C in adults with type 2 diabetes, and results were confounded by pharmacologic weight loss therapy. A systematic review of 80 weight loss studies of ≥1 year duration demonstrated that moderate weight loss achieved through diet alone, diet and exercise, and meal replacements can be achieved and maintained over the long term (4.8-8% weight loss at 12 months). The multifactorial intensive lifestyle intervention used in the Diabetes Prevention Program (DPP), which included reduced intake of fat and calories, led to weight loss averaging 7% at 6 months and maintenance of 5% weight loss at 3 years, associated with a 58% reduction in incidence of type 2 diabetes. Look AHEAD (Action for Health in Diabetes) is a large clinical trial designed to determine whether long-term weight loss will improve glycemia and prevent cardiovascular events in subjects with type 2 diabetes. One-year results of the intensive lifestyle intervention in this trial show an average of 8.6% weight loss, significant reduction of A1C, and reduction in several CVD risk factors. When completed, the Look AHEAD study should provide insight into the effects of long-term weight loss on important clinical outcomes. The optimal macronutrient distribution of weight loss diets has not been established. Although low-fat diets have traditionally been promoted for weight loss, several randomized controlled trials found that subjects on low-carbohydrate diets (<130 g/day of carbohydrate) lost more weight at 6 months than subjects on low-fat diets; however, at 1 year, the difference in weight loss between the low-carbohydrate and low-fat diets was not significant and weight loss was modest with both diets. Another study of overweight women randomized to one of four diets showed significantly more weight loss at 12 months with the Atkins low-carbohydrate diet than with higher-carbohydrate diets. A recent meta-analysis showed that at 6 months, low-carbohydrate diets were associated with greater improvements in triglyceride and HDL cholesterol concentrations than low-fat diets; however, LDL cholesterol was significantly higher with the low-carbohydrate diets.

### Table II. MNT Recommendations -2010

**Dietary fat intake in diabetes management**
- Saturated fat intake should be <7% of total calories. PUFA, MUFA
- Reducing intake of trans fat lowers LDL cholesterol and increases HDL cholesterol; therefore intake of trans fat should be minimized.

**Carbohydrate intake in diabetes management**
- Monitoring carbohydrate intake, whether by carbohydrate counting, exchanges, or experience-based estimation, remains a key strategy in achieving glycemic control.
- For individuals with diabetes, use of the glycemic index and glycemic load may provide a modest additional benefit for glycemic control over that observed when total carbohydrate is considered alone.

### Table III. MNT Recommendations -2010

**Other nutrition recommendations**
- Sugar alcohols and nonnutritive sweeteners are safe when consumed within the acceptable daily intake levels established by the Food and Drug Administration (FDA). If adults with diabetes choose to use alcohol, daily intake should be limited to a moderate amount (one drink per day or less for adult women and two drinks per day or less for adult men).
- Routine supplementation with antioxidants, Eg. vitamins E,C & carotene, is not advised because of lack of evidence of efficacy & concern related to long-term safety.
- Benefit from chromium supplementation in people with diabetes or obesity has not been conclusively demonstrated and therefore cannot be recommended.
- Individualized meal planning should include optimization of food choices to meet recommended dietary allowances (RDAs)/dietary reference intakes (DRIs) for all micronutrients.
The Recommended Daily Allowance (RDA) for digestible carbohydrate is 130 g/day and is based on providing adequate glucose as the required fuel for the central nervous system without reliance on glucose production from ingested protein or fat. Although brain fuel needs can be met on lower-carbohydrate diets, long-term metabolic effects of very-low carbohydrate diets are unclear, and such diets eliminate many foods that are important sources of energy, fiber, vitamins, and minerals that are important in dietary palatability. Although numerous studies have attempted to identify the optimal mix of macronutrients for meal plans of people with diabetes, it is unlikely that one such combination of macronutrients exists. It must be clearly recognized that regardless of the macronutrient mix, the total caloric intake must be appropriate to the individual’s weight management goal. The primary goal with respect to dietary fat in individuals with diabetes is to limit saturated fatty acids, trans fatty acids, and cholesterol intake so as to reduce risk for CVD. Saturated and trans fatty acids are the principal dietary determinants of plasma LDL cholesterol.

Artificial Sweeteners
The FDA has approved five non-nutritive sweeteners for use in the U.S.: acesulfame potassium, aspartame, neotame, saccharin, and sucralose. Before being allowed on the market, all underwent rigorous scrutiny and were shown to be safe when consumed by the public, including people with diabetes and women during pregnancy. Reduced calorie sweeteners approved by the FDA include sugar alcohols (polyols) such as erythritol, isomalt, lactitol, maltitol, mannitol, sorbitol, xylitol, tagatose, and hydrogenated starch hydrolysates. The use of sugar alcohols appears to be safe; however, they may cause diarrhea, especially in children. Stevia (Rebaudioside A) has been designated by the FDA as being generally recognized as safe.³ Commonly available diabetic sweets prepared by artificial sweeteners are often rich in calories due to high fat content, thus should be used with caution.

Carbohydrates
Both the quantity and quality of carbohydrates play a crucial role in the management of diabetes. The carbohydrate allowance may vary from 55% to 70% depending upon the severity of hyperglycemia, weight, type of drugs/insulin, activity pattern, age and gender of the patient. Carbohydrate intake of <100gms may cause starvation ketosis due to hypoglycemia.

Carbohydrate Counting
It is a meal-planning system that focuses on consistent intake of foods that contain carbohydrate. It is used to make adjustment in food, insulin dose and physical activity based on observed blood glucose pattern. It is the only method that can accurately recommend insulin to carbohydrate ratio, when analyzed with premeal and postmeal blood glucose. Refer Table IV.

Dietary Protein
Protein recommendation vary little from 10% to 20% of total calories for patient with or without microalbuminuria. A protein intake of 0.6 to 0.8 gm /kg body weight / day is recommended for diabetics. Subjects with overt nephropathy may be given protein of 0.8 gm /kg /day but once GFR (Glomerular Filtration rate) falls, it should be restricted to 0.6 gm/kg/day. However data from South India amongst vegetarian and non vegetarian Type 2 diabetics have shown that protein intake in Indian subject, even with nephropathy doesn’t exceed the recommended limits of 0.6-0.8 gm/kg/day and it appears that marked reduction in protein is unnecessary for Indian diabetics. But in non

Table IV. Carbohydrate Counting

<table>
<thead>
<tr>
<th>One Method for Determining the Insulin - to Carbohydrate Ratio</th>
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<tbody>
<tr>
<td>▪ Using food records, determine the total amount of carbohydrate eaten, and then calculate the average daily intake of carbohydrate and the average amount for each meal and snack.</td>
</tr>
<tr>
<td>▪ Have the patient eat consistent amounts of carbohydrate at meals, and if possible, include a variety of foods and resources the calculate the carbohydrate content of the meals or snakes. The nutrition facts panel of packaged food products is the most ubiquitous source of this information.</td>
</tr>
<tr>
<td>▪ Review blood glucose records with carbohydrate (grams), premeal and postmeal blood glucose.</td>
</tr>
<tr>
<td>▪ results, and the amount of meal time insulin used.</td>
</tr>
<tr>
<td>▪ Calculate the insulin-to-carbohydrate ratio by dividing the no. of grams of carbohydrate by the units of mealtime insulin used. For example: The patient consumes 60grams of carbohydrate and takes 6 units of rapid-acting insulin administered. 60/6=10.</td>
</tr>
</tbody>
</table>
vegetarians, restriction of animal protein may be necessary in stage of overt nephropathy.

**Dietary Fat**
Total dietary intake for normal weight diabetic with normal lipids can be up to 15-20% of total calories. But patients with overweight or dyslipidemia should take 15% of calorie from fat.

**Recommendation for quantity & quality of Macronutrients & Energy Requirements for Diabetic Patients**: Refer Table V & VI

**Fish and n-3 fatty acid**
Although several reports have shown antiatherogenic benefit of Omega-3 fatty acid (e.g., Fish oil, wheat gram oil, green leafy vegetables, common beans etc.,) in normal and dyslipidemic individuals however clinical utility of them has been questioned Fish oil also found to impair glycemic control in diabetics, still two to three serving per week of fish can be recommended in diabetics.\(^8\)

**Trans Fatty Acid**
Trans fatty acids are formed when vegetable oils are hardened by partial hydrogenation. They raise level of LDL-Cholesterol, and triglyceride and decrease HDL-C, thus increase the risk of CHD. In the Nurse Health Study, a high intake of trans fatty acids was associated with higher risk of type 2 diabetes during 14 yrs. of follow up\(^9\). Major source of trans FA are margarine, commercially baked products, deep fried fast food (e.g. samosa, kachori, khari etc), their consumption should be limited in diabetics.

**Dietary Fibre**
Soluble Pectin’s, gums, mucilages and hemicelluloses, such as in oats, fruits and psyllium lowers serum cholesterol by binding the bile acids and by colonic fermentation by bacteria, inhibiting cholesterol synthesis. A meta-analysis have recently concluded that increasing daily intake of green leafy vegetables could significantly reduce the risk of Type 2 Diabetes Mellitus and Gestational Diabetes Mellitus.\(^10\)

**Glycemic Index (GI) and Glycemic Load (GL)**
The Glycemic Index (GI) ranks foods containing different types of carbohydrates according to the blood glucose response; glucose or white bread is the reference. The GI depends on the rate of digestion and absorption of the carbohydrate; typical low GI foods are whole-grain foods, legumes, fruit and nuts. Since the blood glucose response is also determined by the amount of carbohydrate in food, the Glycemic Load (GL) has been used as a measure of quality and quantity. White rice and potatoes, for example, have a high GI and carbohydrate content, and thus have high GL.\(^11\)

**Diet in Gestational Diabetes Mellitus**
Women with Gestational Diabetes Mellitus (GDM) will need additional 300cal high protein diet micronutrient rich from 2nd trimester till early post-partum period. Using a low glycemic index diet for GDM women effectively halved the number needing to use insulin with no compromise of obstetric or fetal outcomes\(^12\). One recently published prospective study concluded that pre-pregnancy higher consumption of sugar-sweetened cola (>5 serving/week) is associated with an elevated GDM risk whereas such association was not observed for other sugar-sweetened beverages and diet beverages.\(^13\)

**Alcohol**
Alcohol’s protective effect against CHD in general population is well established\(^14\). Over 40 studies in diverse populations have documented a 10-40% reduction in risk associated with

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**Table V. Macro & Micronutrients Recommendations**
(Ghafoorunissa & kamlakrishnaswami NIN, 2004)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>Sufficient to maintain Ideal body weight</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>55 to 60% of total calories</td>
</tr>
<tr>
<td>Proteins</td>
<td>15-20% of total calories</td>
</tr>
<tr>
<td>Fats</td>
<td>15-20% of total calories</td>
</tr>
<tr>
<td>SFA</td>
<td>&lt; 7% of total fat intake</td>
</tr>
<tr>
<td>PUFA</td>
<td>10% of total fat intake</td>
</tr>
<tr>
<td>MUFA</td>
<td>10-13% of total fat intake</td>
</tr>
<tr>
<td>MUFA:PUFA:SFA</td>
<td>1.2 : 1 : 0.8</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>&lt; 300 mg / day</td>
</tr>
<tr>
<td>Fibre</td>
<td>30-40 gm / day</td>
</tr>
</tbody>
</table>

**Table VI. Energy requirements for diabetic patients**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Obese</th>
<th>Normal</th>
<th>Underweight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>20-25</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Moderate</td>
<td>30</td>
<td>35</td>
<td>40</td>
</tr>
<tr>
<td>Heavy</td>
<td>35</td>
<td>40</td>
<td>45-50</td>
</tr>
</tbody>
</table>
intakes of one to three drinks/day. Studies suggest that flavonoids and polyphenols from wine have antioxidant and anticoagulant properties. Alcohol is likely to increase HDL-C, decreased coagulation (decreased platelet aggregation, decreased fibrinogen, increased tissue plasminogen activator (t-PA), decreased plasminogen activator inhibitor type 1 PAI-1) and enhance insulin sensitivity. Moderate alcohol consumption may give CHD benefit, improve insulin sensitivity and lower risk of type 2 diabetes. A major concern is the potential danger of hypoglycemia, especially those who use sulphonylureas. Heavy drinking is associated with neuropathy and retinopathy. A diabetic subject who choose to drink light to moderate drinking (1g-1 to 2 glasses of wine per day) with meals should not be discouraged.

Excess refined grain (rice) intake: Is it a risk factor for diabetes/cardiovascular disease epidemic in India

The traditional cereal-based Asian Indian diets were not only rich in dietary fibre, but also in other micro and phytonutrients. Use of unrefined carbohydrates, derived mainly from whole grains (unpolished / brown rice or whole wheat) could possibly explain the lower rates of CVD and type 2 diabetes mellitus in India in the 1960s-70s. The prevalence of diabetes has increased from 8 per cent (1980) to 16 per cent (2006) in urban India, specifically in South India. The outer bran and germ portions of intact rice (i.e., brown rice) grains were removed to produce white rice that primarily consists of starchy endosperm.

Author has hypothesized that this could reflect changes in the quality of grains consumed today i.e., use of refined (e.g., highly polished rice) instead of the whole grains (less polished, hand pounded rice) consumed earlier. Rice is the major source of energy contributing to 66 per cent of the total GL in south Indian Diet (Chennai). The highly polished white rice has an extremely high GI value (approximately 75-80) and the refining process leads to loss of fibre, vitamins, magnesium and other minerals, lignans, phytoestrogens, and phytic acid, many of which may be protective factors for diabetes and CVD. However, other confounders, including other dietary factors, physical activity, obesity and genetic differences, should be considered before any conclusions regarding rice intake and prevalence rates of diabetes/CVD are drawn and, this is obviously an exciting area for future epidemiological research.

CONCLUSION

Dietary and lifestyle modification play an important role in the management of diabetes. The objective is to maintain normal glucose, lipid profile and ideal body weight, to maintain optimal nutrition, to relieve symptoms and minimize chronic degenerative vasculopathies. Diabetic diet is good for healthy nondiabetic subjects too. Dietary recommendations are evidence based and have emphasized more on quality of fat and carbohydrate, than quantity alone. “Mass awareness campaign for Healthy Diet & Life Style” may be one of the best way for prevention of diabetes in India.

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