

Nutritional Recommendations for Individuals with Diabetes

Alison Gray, RDN, MBA and Rebecca J Threlkeld, MS, RDN, LDN.

Author Information and Affiliations

Last Update: October 13, 2019.

ABSTRACT

The chapter summarizes current information available from a variety of scientifically based guidelines and resources on nutritional recommendations for adult people with diabetes (PWD). It is designed to take these guidelines and provide an overview of practical applications and tips in one place for health care practitioners who treat PWD. The sections are divided into components of nutritional content, with associated goals for PWD, as well as reviews of present nutritional topics of interest, including weight loss diets in the current press. The information also includes sources for further review, and resources that can be utilized for PWD. A main message is that nutrition plans should be individualized and flexible to meet the specific needs of the PWD, in consideration of their ability to implement the changes. Education is best given by a team approach and should not simply be delivered by giving a person a one-size-fits all diet sheet. Referral to a diabetes self-management education (DSMES) program that includes counseling and instruction on nutrition therapy by a Registered Dietitian Nutritionist (RDN) is highlighted. For complete coverage of all related areas of Endocrinology, please visit our on-line FREE web-text, WWW.ENDOTEXT.ORG.

INTRODUCTION

This chapter will summarize current information available from a variety of scientifically based guidelines and resources on nutritional recommendations for persons with diabetes (PWD) for health care practitioners who treat them. The provided information provides sources for further review and study. The key take home message is that nutrition plans should be individualized to meet the needs of the PWD, in consideration of their lifestyle, socioeconomic factors, cultural background, and motivation. The modern diet for the individual with diabetes is based on concepts from clinical research, portion control, and individualized lifestyle changes. It cannot simply be delivered by giving a person a diet sheet in a one-size-fits-all approach. The lifestyle modification guidance and support needed requires a team effort, best led by an expert in this area; a registered dietitian (RD) or registered dietitian nutritionist (RDN), or a referral to a diabetes self-management education (DSMES) program that includes instruction on nutrition therapy. Dietary recommendations need to be individualized for and accepted by the given PWD. It's important to note that the nutrition goals for diabetes are similar to those that healthy individuals should strive to incorporate into their lifestyle.

Leading authorities and professional organizations have concluded that proper nutrition therapy is an important part of the foundation for the treatment of diabetes. However, appropriate nutritional intervention, implementation, and ultimate compliance with the plan remain some of the most vexing problems in diabetes management for three major reasons: First, there are some differences in the dietary structure to consider, depending on the type of diabetes and medication

the PWD is taking. Second, a plethora of dietary information is available from many sources to the PWD and healthcare provider. Nutritional science is constantly evolving, so that what may be considered true today may be outdated in the near future. Nutritional intervention may vary based on the type of diabetes; however, many of the basic dietary principles are similar for all PWD, prediabetes, metabolic syndrome or who are overweight or obese. Lastly, there is not perfect agreement among professionals as to the best nutritional therapy for individuals with diabetes, and ongoing scientific debate reported in the popular press may confuse PWD and health care providers.

The following recommendations are consensus-based, and they emphasize practical suggestions for implementing nutritional advice for most individuals with diabetes.

Ali et al, reported that although there have been improvements in risk factor control and adherence to preventative practices, almost half of U.S. adults with diabetes did not meet the recommended goals for diabetes care from 1999-2010. (1) Thus, still more needs to be done to improve overall care of PWD.

GENERAL GOALS

The nutrition therapy goals for the individual with diabetes have evolved and have become more flexible and patient centered. The goals from the American Diabetes Association (ADA) 2019 include the following: (2)

1. To promote and support healthful eating patterns, emphasizing a variety of nutrient dense foods in appropriate portion sizes in order to improve overall health and:
 - Achieve and maintain body weight goals
 - Attain individualized glycemic, blood pressure, and lipid goals
 - Delay or prevent complications of diabetes
2. To address individual nutrition needs based on personal and cultural preferences, health literacy and numeracy, access to healthful food choices, willingness and ability to make behavioral changes, as well as barriers to change
3. To maintain the pleasure of eating by providing nonjudgmental messages about food choices
4. To provide an individual with diabetes the practical tools for day-to-day meal planning rather than focusing on individual macronutrients, micronutrients or single foods

The American Association of Clinical Endocrinologists (AACE) guidelines have similar goals for people with type 2 diabetes. (3)

PUTTING GOALS INTO PRACTICE

How should these goals best be put into practice? The following guidelines summarized from the ADA Standards of Care will address the above goals and provide guidance on nutrition therapy based on numerous scientific resources. The Diabetes Control and Complications Trial (DCCT) and other studies demonstrated the added value individualized consultation with a registered dietitian familiar with diabetes treatments, along with regular follow-up, has on long-term outcomes and is highly recommended to aid in lifestyle compliance. (4) Medical nutrition

therapy (MNT) implemented by a registered dietitian is associated with A1C reductions of 1.0–1.9% for people with type 1 diabetes and 0.3–2% for people with type 2 diabetes (2)

TARGET GUIDELINES FOR MACRONUTRIENTS: THE 3 MAJOR COMPONENTS OF DIET

Many studies have been completed to attempt to determine the optimal combination of macronutrients. Based on available data, the best mix of carbohydrate, protein, and fat depends on the individual metabolic goals and preferences of the person with diabetes. It's most important to ensure that total calories are kept in mind for weight loss or maintenance. (2)

CARBOHYDRATES

The primary goal in the management of diabetes is to achieve as near normal regulation of blood glucose (postprandial and fasting) as possible. The total amount of carbohydrate (CHO) consumed has the strongest influence on glycemic response (2). Yet the ideal amount of CHO in the diet is unclear. The majority of persons with type 1 or type 2 diabetes in the U.S. report eating moderate amounts of carbohydrate (~45% of total energy intake). (5) There are differing opinions in the literature regarding recommendations for low CHO diets in the treatment of diabetes. There have been many studies over the years looking at use of diets with lower CHO content and improvement in blood glucose without detrimental effects. (6) In a major change, the ADA in their 2019 position statement now states “research indicates that low carbohydrate eating plans may result in improved glycemia and have the potential to reduce antihyperglycemic medications for individuals with type 2 diabetes”. Further, low CHO diets are not recommended for pregnant and lactating women, those who have or are at risk for disordered eating, and those with renal disease. The ADA recommends caution in people taking sodium–glucose cotransporter 2 (SGLT2) inhibitors due to the potential risk of ketoacidosis. (2) The most compelling reasons limiting adoption may be that the definitions of low CHO diets vary and that diets lower in CHO are difficult to maintain in the long term with few longer-term studies to support extended benefits. The ADA recommends the following: (2)

- Carbohydrate intake should emphasize nutrient-dense carbohydrate sources that are high in fiber, including vegetables, fruits, legumes, whole grains, as well as dairy products.
- For people with type 1 diabetes and those with type 2 diabetes who are prescribed a flexible insulin therapy program, education on how to use carbohydrate counting, and in some cases how to consider fat and protein content to determine mealtime insulin dosing is recommended to improve glycemic control.
- For individuals whose daily insulin dosing is fixed, a consistent pattern of carbohydrate intake with respect to time and amount may be recommended to improve glycemic control and reduce the risk of hypoglycemia.
- People with diabetes and those at risk are advised to avoid sugar-sweetened beverages (including fruit juices) in order to control glycemia and weight and reduce their risk for cardiovascular disease and fatty liver and should minimize the consumption of foods with added sugar that have the capacity to displace healthier, more nutrient-dense food choices

Nutritive Sweeteners

Sucrose, also known as “table sugar,” is a disaccharide composed of one glucose and one fructose molecule and provides 4 kcal/gm. Available evidence from clinical studies shows dietary sucrose has no more effect on glycemia than equivalent caloric amounts of starch. It’s important to note that excess energy intake from nutritive sweeteners or foods and beverages containing high amounts of nutritive sweeteners should be avoided, since they provide “empty” calories and can lead to weight gain. (7)

Fructose is a common naturally occurring monosaccharide found in fruits, some vegetables and honey. High fructose corn syrup is high in processed fructose and is used abundantly in processed foods as a less expensive alternative to sucrose.

- Fructose consumed as “free fructose” (i.e., naturally occurring in foods such as fruit, (that also contain fiber) may result in better glycemic control compared with isocaloric intake of sucrose or starch, and free fructose is not likely to have detrimental effects on triglycerides as long as intake is not excessive (12% energy).
- People with diabetes should limit or avoid intake of sugar-sweetened beverages (SSBs) (from any caloric sweetener including high-fructose corn syrup and sucrose) to reduce risk for weight gain and worsening of cardio metabolic risk profile. (7)

A recent meta-analysis of 18 controlled feeding trials in people with diabetes compared the impact of fructose with other sources of carbohydrate on glycemic control. The analysis found that an isocaloric exchange of fructose for carbohydrates did not significantly affect fasting glucose or insulin and reduced glycated blood proteins in these trials of less than 12 weeks duration. The short duration is a potential limitation of the studies. (8) Strong evidence exists that consuming high levels of fructose-containing beverages may have particularly adverse effects on selective deposition of ectopic and visceral fat, lipid metabolism, blood pressure, and insulin sensitivity compared with glucose-sweetened beverages. (7) Thus, recommendations about the optimal amount of dietary fructose remain controversial due to potential metabolic consequences that could lead to further insulin resistance and obesity.

Non-Nutritive Sweeteners

Non-nutritive sweeteners provide insignificant amounts of energy and elicit a sweet sensation without increasing blood glucose or insulin concentrations. There are currently seven non-nutritive, FDA-approved sweeteners found to be safe when consumed within FDA acceptable daily intake amounts (ADI): (9)

1. Sucralose (Splenda®) is synthesized from regular sucrose, but altered such that it is not absorbed. Sucralose is 600 times sweeter than sucrose. It is heat stable and can be used in cooking. It was approved for use by the FDA in 1999
2. Saccharine (Sugar Twin®, Sweet ‘N Low®) is 200 to 700 times sweeter than sugar. A cancer-related warning label was removed in 2000 after the FDA determined that it was generally safe.
3. Acesulfame K (Ace K, Sunette) is 200 times sweeter than sucrose. It can be used in cooking. The bitter aftertaste of acesulfame can be greatly decreased or eliminated by combining acesulfame with another sweetener. [
4. Neotame is a derivative of the dipeptide phenylalanine and aspartic acid. It is 7,000-13,000 times sweeter than sucrose and does not have a significant effect on fasting glucose or insulin

levels in persons with type 2 diabetes.

5. Aspartame (Equal®, NutraSweet®) is a methyl ester of aspartic acid and phenylalanine dipeptide, both amino acids. The FDA approved it in 1981 for use in certain foods, in 1983 for use in soft drinks, and in 1996 as a general use sweetener. Although aspartame provides 4 kcal/g, the intensity of the sweet taste means that very small amounts are required to achieve desired sweetness levels, as it is 200x sweeter than sucrose. Aspartame yields phenylalanine, aspartic acid and methanol when hydrolyzed in the intestine. These breakdown products naturally occur in much higher levels in many foods. The FDA requires any foods containing aspartame to have an informational label statement: “Phenylketonurics: contains phenylalanine.” Patients with phenylketonuria should avoid products containing Aspartame.

With close to 200 studies conducted in humans and animals on the use of common levels of aspartame in food, the safety is considered to be established, and does not suggest any long-term adverse effects. The European Food Safety Authority (EFSA) recently conducted the most comprehensive review of available animal and human data, both published and unpublished and concluded that in current levels of exposure, no safety issues were noted leading to increased risk of cancer, gene or neurologic damage. (109) An adult weighing 60 kg (132 lb.) would have to consume over 12 cans of soda containing aspartame daily to reach the Acceptable Daily Intake (ADI) of 40 mg/kg/day, lower than the ADI recommended by the FDA of 50 mg/kg/day. The American Cancer Society and the National Cancer Institute in the U.S. agree that no excessive link to increased cancer risk exists with use of aspartame in food products at current levels. (110) Some controversy has existed for many years around safety of the sweetener, but not from any major organizations. The most prudent advice to give to patients is to use non-nutritive sweeteners sparingly.

6. Stevia (Truvia®) derived from the plant *stevia rebaudiana*, is a non-caloric, natural sweetener. Stevia has been used as a sweetener and as a medicinal herb since ancient times and appears to be well-tolerated. It has an intensely sweet taste. Five randomized controlled trials showed minimal effects on blood glucose, insulin, blood pressure or weight.

7. Luo han guo is the most recently approved GRAS (generally recognized as safe) sweetener. It is also known as monk fruit or Swingle fruit extract. It is 150-300 times sweeter than sucrose, and may have an aftertaste at high levels.

A recent review of 29 randomized controlled trials which included 741 people, 69 of which have type 2 diabetes, showed that artificial sweeteners on their own do not raise blood glucose levels, but the content of the food or drink containing the artificial sweetener must be considered, especially among PWD. (10)

Sugar Alcohols (Polyols)

Polyols are hydrogenated monosaccharides, and include such sugars as sorbitol, mannitol, erythritol, xylitol and D-tagatose as well as the hydrogenated disaccharides isomalt, maltitol, lactitol and trehalose. The polysaccharide derived hydrogenated starch hydrolysates [HSH] are also included in this category. Polyols are used as sweeteners and bulking agents, and designated GRAS by the FDA. Polyols are only partially absorbed from the small intestine, allowing for the claim of reduced energy per gram. Polyols contain, on average, 2 kcals/gm, or 1/2 the calories of other nutritive sweeteners. Studies of subjects with and without diabetes have shown that sugar alcohols cause less of a postprandial glucose response than sucrose or glucose. (7) However,

polyols can cause diarrhea at ≥ 20 grams, especially in children. Although a diet high in polyols could reduce overall energy intake or provide long-term improvement in glucose control in diabetes, such studies have yet to be conducted.

Fiber

Patients with DM should consume 20 to 35 g of fiber from raw vegetables and unprocessed grains (or about 14 g of fiber per 1,000 kcal ingested) per day (the same as the general population) (2). The definition and understanding of fiber have changed in past years. *Dietary fiber* is defined as the carbohydrate and lignin found in plants that is not digested by the stomach or absorbed in the GI tract. *Functional fiber* is the portion of fiber attributed to have beneficial physiologic effects in humans. *Total fiber* is the sum of both dietary and functional fiber.

Although solubility of fiber was thought to determine physiological effect, more recent studies suggest that other properties of fiber, such as fermentability or viscosity may be more important. (11) Intake of dietary fiber is associated with lower all-cause mortality in people with diabetes. (12) A fiber rich meal is processed more slowly, which promotes satiety, may be less caloric, and lower in added sugars, which can help combat obesity and also may prevent risk of heart disease, type 2 diabetes, and colon cancer. (11) The FDA advocates consumption of 25 g dietary fiber per 2,000 calories consumed. (13) This recommendation is based on epidemiologic studies showing protection against cardiovascular disease. According to the latest NHANES survey, intake of dietary fiber in individuals in the United States from 2009-10 averaged 16 gms/day. (14) Fiber supplements and bulk laxatives are used frequently as additional dietary fiber sources, but since few fiber supplements have been studied for physiological effectiveness, the best advice is to consume foods that are high in fiber. (11) A recently published systematic review of the literature concluded that the consumption of whole grains was not associated with significant improvements in glycemic control in individuals with type 2 diabetes; however, it may have other benefits, such as reductions in systemic inflammation. (15)

As with the general population, individuals with diabetes should consume at least half of all grains as whole grains. High fiber containing carbohydrate sources (>5 g/serving) include legumes, whole grain breads and cereals, whole fruits and vegetables and should be included as part of the daily carbohydrate intake. The goal of 25 gms or greater of daily fiber intake may be difficult to achieve for some people, as large amounts of fiber can cause negative GI effects, such as bloating and gas. If the person is not accustomed to larger amounts of fiber in their diet, it should be added slowly.

The ADA has a website featuring recipes high in fiber to help meet fiber goals.

<https://www.diabetesfoodhub.org/search-results.html?keywords=fiber+content> (16)

The website below contains links to a comprehensive table listing fiber content of foods, and a calculator to help select foods with higher fiber content to help reach daily fiber goals.

<http://www.webmd.com/diet/healthtool-fiber-meter> (17)

Resistant Starches and Fructans

Resistant starches are starch enclosed within intact cell walls. These include some legumes, starch granules in raw potato, retrograde amylose from plants modified to increase amylose content, or high-amylose containing foods, such as specially formulated cornstarch, which are not digested and absorbed as glucose. Resistant starches are completely fermented in the colon. It

has been proposed that resistant starches may affect postprandial glucose response, reducing hypo and hyperglycemia. However, there are no published long-term studies in subjects with diabetes to prove benefit from the use of resistant starch. (7)

Fructans are an indigestible fiber that has been suggested to have a glucose-lowering effect. Inulin is a fructan commonly added to many processed foods in the form of chicory root. A recent review and meta-analysis of 20 randomized clinical trials revealed that the use of inulin-type fructans demonstrated HDL-c improvement and glucose control in the T2DM subgroup. More well-powered, long-term, randomized clinical trials are required for a definitive conclusion on inulin-type fructan supplementation in improving lipid profile and glucose metabolism. (18)

Gluten Free

Gluten is a protein commonly found in wheat, barley, rye and other grains. A gluten free diet is used to treat people with celiac disease, an inflammatory condition in persons who are intolerant to gluten and suffer inflammatory and gastrointestinal side effects when gluten is consumed, leading to damage of the small intestine. It is noted that approximately 10% of people with type 1 diabetes also have celiac disease, which is significantly higher than the population in general. There seems to be no connection with Celiac disease and type 2 diabetes. (19) There is some data in the literature describing benefit of a gluten free diet in preventing T1D in animals and newly diagnosed children with T1D. (20)

The gluten free diet has recently grown in popularity in persons who may be gluten sensitive, but don't have celiac disease. Gluten in sensitive individuals, causes inflammation, leading to depression and other symptoms. More data is needed in this area in people with diabetes.

According to the ADA, the person with T1D can follow a gluten free diet, but it may provide additional challenges. Some common CHO containing foods that do not contain gluten include:

White and sweet potatoes, brown and wild rice, corn, buckwheat, soy, quinoa, sorghum and legumes. These foods can be used in place of other CHO containing grains.

Practical Tips on CHO Intake

- Include a good source of fiber containing food with every meal or snack.
- Add some whole grain to the morning meal. Hot cereals - Old-fashioned or steel-cut oats. Cold cereals - Look for those that list whole wheat, whole oats, or other whole grain first on the ingredient list without added sugars
- Use whole grain breads for lunch or snacks. Check the label to make sure that whole wheat or another whole grain is the first ingredient listed.
- Eat less potatoes. Instead, try brown rice or less well-known grains like bulgur, wheat berries, millet, hulled barley, faro, or quinoa.
- Switch to whole grain pasta. If the whole grain products are too chewy, look for those that are made with half whole wheat or brown rice or other whole grain flour. Newer pasta products made from legumes such as chickpeas are now available.
- Include beans/legumes which are an excellent source of slowly digested carbohydrate as well as a great source of lean protein. Substitute for meat as a protein and fiber source.
- Strive to include a variety of fresh fruits and vegetables in meals every day.

FAT

Evidence is inconclusive for an ideal amount of total fat intake for people with diabetes; therefore, goals should be individualized; fat quality appears to be far more important than quantity.

Due to the high risk of CVD (cardiovascular disease) in individuals diagnosed with diabetes, the goal for dietary fat intake (amount and type) for PWD is similar to that of people with CVD but without diabetes. Recent studies have found that decreasing the amount of saturated fatty acids and trans fatty acids, the principal dietary fatty acids linked to elevating LDL cholesterol, reduces the risk of CVD. (7) The American Heart Association, and American College of Cardiology currently recommend limiting the amount of dietary saturated and trans-fat intake. (2,21) Recommendations from the Institute of Medicine and the Academy of Nutrition and Dietetics for healthy individuals are that 20% to 35% of total calories should come from fat. (22,23) Currently, limited research on recommendations on percent of total calories coming from fat exists for individuals with diabetes. An individualized approach to fat content is the current guidance. (2)

The 2019 Lifestyle Management: Standards of Medical Care for Diabetes from the American Diabetes Association recommends: (2)

- Data on the ideal total dietary fat content for people with diabetes are inconclusive, so an eating plan emphasizing elements of a Mediterranean-style diet rich in monounsaturated and polyunsaturated fats may be considered to improve glucose metabolism and lower CVD risk and can be an effective alternative to a diet low in total fat but relatively high in carbohydrates.
- Eating foods rich in long-chain n-3 fatty acids, such as fatty fish (EPA and DHA) and nuts and seeds (ALA), is recommended to prevent or treat CVD; however, evidence does not support a beneficial role for the routine use of n-3 dietary supplements.

The American Heart Association has developed the *Fat Facts* to help individuals learn more about healthy vs. unhealthy fats. Among the campaign's top priorities is to encourage replacing high trans-fat partially hydrogenated vegetable oils, animal fats and tropical oils with healthier oils and foods higher in unsaturated fats — monounsaturated and polyunsaturated. (24)

Monounsaturated Fatty Acids

Monounsaturated fats (MUFA) are typically found in vegetable oils such as olive, peanut, avocado, and canola oil and remain liquid at low temperatures. Foods high in MUFA include avocado, some fatty fish, and nuts and nut butters. Several large prospective observational studies have documented that diets rich in MUFA or PUFA and lower in saturated fat are associated with a reduced risk of CVD. (25) A recent meta-analysis of RCTs comparing diets higher in MUFA vs CHO or PUFA demonstrated that high MUFA containing diets can improve metabolic parameters in people with T2D. (26)

Polyunsaturated Fatty Acids

Polyunsaturated fats (PUFAs) are usually liquid at room temperature, and are found in vegetable oils such as corn oil, safflower oil, and soybean oil. Controversy exists on the best ratio of omega-6 to omega-3 fatty acids. A recent meta-analysis of RC feeding trials provided some

evidence that dietary macronutrients have diverse effects on glucose-insulin homeostasis. Most consistent positive effects were seen with PUFA compared to CHO, MUFA, or saturated fat. Replacement with PUFA was linked to improved glycemia, insulin resistance, and insulin secretion capacity. (27)

Omega-3 Fatty Acids

Eating foods rich in long-chain n-3 fatty acids, such as fatty fish (EPA and DHA) and nuts and seeds (ALA), is recommended to prevent or treat CVD; however, evidence does not support a beneficial role for the routine use of n-3 dietary supplements. (2) There are two kinds of omega-3 fatty acids in fish — eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). The form of omega-3 in plants is called alpha-linolenic acid (ALA). Some types of fatty fish and certain nuts/seeds contain these unique polyunsaturated fats, one of the most studied areas in nutrition science. The consumption of 2 servings (8 ounces) per week of fish high in EPA and DHA is associated with a reduced risk of both sudden death and death from coronary artery disease in healthy adults. (28) Studies on the effect of omega-3 fatty acids (both from food and supplements) in persons with diabetes are limited and have been inconclusive. (7) In addition to providing EPA and DHA, regular fish consumption may help reduce triglycerides by replacing other foods higher in saturated and trans fats from the diet, such as fatty meats and full-fat dairy products. Preparing fish without frying or adding cream-based sauces is recommended. Fish with high amounts of omega-3 include salmon, albacore tuna, mackerel, sardines, herring and lake trout. Nuts and seeds high in ALA include walnuts, flax seeds, chia seeds and soybeans. (29)

Saturated Fats

Saturated fats are usually solid or almost solid at room temperature. All animal fats, such as those in meat, poultry, and dairy products, are saturated. Processed and fast foods contain high amounts of saturated fats. Some vegetable oils also can be saturated, including palm, palm kernel, and coconut oils. Oil such as coconut and palm (sometimes referred to as tropical oils) are touted as healthful saturated fats since they are derived from plants however this is not accurate. The American Heart Association recommends limited consumption of saturated fats and when cooking with oil, to choose nontropical vegetable oils such as canola, corn, olive, peanut, safflower, soybean, and sunflower oils. (101)

Few research studies have been undertaken to look at the difference between the amount of saturated fatty acids (SFA) in the diet and glycemic control and CVD risk in people with diabetes. The ADA nutrition position paper recommends people with diabetes follow the guidelines for the general population. (7) The Dietary Guidelines for Americans, 2015-2020 recommends consuming less than 10% of calories from SFAs to reduce CVD risk. (30)

In general, saturated fats are discouraged because they increase LDL-cholesterol and total cholesterol concentrations. Diets high in saturated fats have been implicated in an increased risk of cardiovascular disease. Three randomized controlled trials found that diets containing $\leq 7\%$ SFA and ≤ 200 mg/day cholesterol reduced LDL cholesterol level from 9% to 12% compared to baseline values or to a more standard Western-type diet. (31) As saturated fats are progressively decreased in the diet, they should be replaced with unsaturated fats and not with refined carbohydrates. PWD should strive to limit saturated fat intake to less than 10% of total calories.

Trans Fats

Trans fatty acids (TFA) are also called hydrogenated fats, which are fats created when oils are "partially hydrogenated". The process of hydrogenation changes the chemical structure of unsaturated fats by adding hydrogen atoms, or “saturating” the fat. Hydrogenation converts liquid oil into stick margarine or shortening. Manufacturers use hydrogenation to increase product stability and shelf-life. Thus, a larger quantity can be produced at one time, saving manufacturing costs. Research studies show that synthetic TFA can increase LDL cholesterol and lower HDL cholesterol. With the mandatory TFA labeling in 2006, a big push has been made by food manufacturers to remove it from processed and baked goods. Although the TFA content in foods has decreased recently (through food reformulation), it is important to monitor the type of fat used to replace TFA, as it might be saturated fat. Also, the FDA recently determined that trans fats are no longer considered generally recognized as safe (GRAS). For the majority of uses of TFAs, June 18, 2018, was the date after which manufacturers cannot add TFAs to foods. However, to allow for an orderly transition in the marketplace, FDA is allowing more time for products produced prior to June 18, 2018 to work their way through distribution. FDA is extending the compliance date for these foods to January 1, 2020. (32)

Cholesterol

The body makes enough cholesterol for physiological functions, so it is not needed through foods. The most recent Dietary Guidelines for Americans states that available evidence does not support a recommendation to limit cholesterol for the general population, and recommendations for dietary cholesterol for other populations, such as PWD, are not clear. Cholesterol intake correlates with serum cholesterol levels but it has not been well correlated with CVD events. Therefore, additional research is needed regarding the relationship between dietary cholesterol, blood cholesterol, and CVD events in PWD. (108) The most current practical advice to give to PWD regarding dietary cholesterol is to follow the guidelines for limiting saturated fat intake, as these foods are usually highest in dietary cholesterol content.

Table 1.

DIETARY FATS

Type of Fat	Main Source
Monounsaturated	Canola, peanut, and olive oils; avocados; nuts such as almonds, hazelnuts, and pecans; and seeds such as pumpkin and sesame seeds.
Polyunsaturated	Sunflower, corn, soybean, and flaxseed oils, and also in foods such as walnuts, flax seeds, and fish.
Saturated	Whole milk, butter, cheese, and ice cream; red meat; chocolate; coconuts, coconut milk, coconut oil and palm oil
Trans	Some margarines; vegetable shortening; partially hydrogenated vegetable oil; deep-fried foods; many fast foods; some commercial baked goods (check labels)

Stanols and Sterols

Individuals with diabetes and dyslipidemia may be able to modestly reduce total and LDL cholesterol by consuming 1.6–3 g/day of plant stanols or sterols typically found in enriched foods. (7) Plant sterols are naturally occurring cholesterol derivatives from vegetable oils, nuts,

corn, woods and beans. Hydrogenation of sterols produces stanols. The generic term to describe both sterols, stanols and their esters is phytosterols. An important role of phytosterols is their ability to block absorption of dietary and biliary cholesterol from the gastrointestinal tract. The LDL lowering property of both sterols and stanols is considered equivalent in short term studies. (33) The amounts of sterols and stanol esters found naturally in a normal diet are insufficient to have a therapeutic effect. Thus, many manufacturers add them to various foods for their LDL cholesterol lowering effects. You can find added phytosterols in margarine spreads, juices, yogurts, cereals, and even granola bars.

A recent meta-analysis reviewing well controlled studies found that the short-term use of food supplements high in plant sterols is a safe and effective strategy to help maximize the benefits of dietary and lifestyle treatment, either with or without statin therapy, among the majority of dyslipidemic individuals with a need for further lipid-lowering. Products that contain plant sterols can help reduce LDL cholesterol by more than 10 percent. The amount of daily plant sterols needed for results is at least 2 grams — which equals about two 8-ounce (237-milliliter) servings of plant sterol-fortified orange juice a day. (33) The evidence on long term use and in people with diabetes is less substantiated, as not many studies have been completed. (33,34) The Evidence Analysis Library (EAL) from the Academy of Nutrition and Dietetics advocates use of plant sterol/stanol esters in amounts of 2 g/day, which equates to approximately 2 tablespoons/day as part of a cardioprotective diet. (35) The taste of these fortified margarines is comparable to regular margarine, but they cost 3-4 times more than regular spreads. It is also important to keep in mind that these fortified foods should be used as a substitute for regular foods, not as an additive, as more is not better and will provide extra calories which can lead to weight gain.

Practical Tips on Fat Intake

- Try to eliminate trans fats from partially hydrogenated oils. Check food labels for trans fats; limit fried fast foods.
- Limit intake of saturated fats by cutting back on processed and fast foods, red meat, and full-fat dairy foods. Try replacing red meat with beans, nuts, skinless poultry, and fish whenever possible, and switching from whole milk and other full-fat dairy foods to lower fat versions.
- In place of butter or margarine, use liquid vegetable oils rich in polyunsaturated and monounsaturated fats in cooking and at the table.
- Eat one or more good sources of omega-3 fats every day—fatty fish, walnuts, soybean oil, ground flax seeds or flaxseed oil

PROTEIN

In individuals with type 2 diabetes, ingested protein can increase insulin response without increasing plasma glucose concentrations. Therefore, carbohydrate sources high in protein should not be used to treat or prevent hypoglycemia. (2)

The ADA Standards of Medical Care in Diabetes-2019 states that there is no evidence that adjusting the daily level of protein intake (typically 1–1.5 g/kg body weight/day or 15–20% total calories) will improve health in individuals without diabetic kidney disease, and research is inconclusive regarding the ideal amount of dietary protein to optimize either glycemic control or

cardiovascular disease (CVD) risk. Therefore, protein intake goals should be individualized based on current eating patterns. Some research has found successful management of type 2 diabetes with meal plans including slightly higher levels of protein (20–30%), which may contribute to increased satiety. Those with diabetic kidney disease (with albuminuria and/or reduced estimated glomerular filtration rate) should aim to maintain dietary protein at the recommended daily allowance of no more than 0.8g/kg desirable body weight/day. (35) Reducing the amount of dietary protein below the recommended daily allowance is not recommended because it does not alter glycemic measures, cardiovascular risk measures, or the rate at which glomerular filtration rate declines. (2)

The National Kidney Foundation recommends 0.8 g protein/kg desirable body weight for people with diabetes and stages 1–4 chronic kidney disease as a means of reducing albuminuria and stabilizing kidney function (36). The Joslin Diabetes Center, advocates a protein intake of 20–30% of total energy intake (for those without kidney disease). (37)

Two misconceptions about dietary protein in diabetes management are that a certain amount of protein consumed is converted into blood glucose and that consuming too much protein can lead to diabetic kidney disease. Also, limited evidence exists to suggest a difference in animal or plant protein sources and diabetes outcomes. Although several prospective cohort studies suggested differences between protein source and T2D-related outcome, there is limited evidence from randomized controlled trials to suggest that protein source is important. (38)

Further research is still needed to define the optimal macronutrient content for fat (SFA, MUFA, PUFA), protein, and carbohydrate to attain the most beneficial lipid and lipoprotein profile in the general population and in those with diabetes at increased risk for CVD.

Practical Tips for Protein Intake

- Include a source of lean protein with each meal (8-12 oz/day)
- Good sources of lean animal protein, such as skinless poultry, lower fat cuts of beef or pork, fish or egg (1 egg = 1 oz protein), and reduced fat dairy products (1 c low fat or skim milk/yogurt, 1 oz cheese = 1 oz protein)
- Plant protein sources such as tofu, tempeh, legumes, (1/2c = 2 oz protein) or meat alternative products are options but be aware of possible higher sodium content
- Nuts or seeds: 1 oz equals 24 almonds, 18 medium cashews, 12 hazelnuts or filberts, 8 medium Brazil nuts, 12 macadamia nuts, 35 peanuts, 15 pecan halves and 14 English walnut halves
- Nut butters 2 Tbsps. equals 1oz protein
- Protein should be a supplement to vegetables, fruits and whole grains in a meal, not the entire meal

TARGET GUIDELINES FOR MICRONUTRIENTS

There is no clear evidence that dietary supplementation with vitamins, minerals (such as chromium and vitamin D), herbs, or spices (such as cinnamon or aloe vera) can improve outcomes in PWD who do not have underlying deficiencies and they are not generally recommended for glycemic control (2)

In PWD who have no underlying deficiencies, there is no clear scientific evidence of benefit from vitamin or mineral supplements, either in preventing or treating progression or complications. It is, however, important to establish that no deficiencies exist. People with diabetes should be aware of the necessity for meeting vitamin and mineral needs from natural food sources through intake of a balanced diet. Specific populations, such as older adults, pregnant or lactating women, strict vegetarians or vegans, and individuals on very low calorie or very low carbohydrate diets may benefit from a multivitamin mineral supplement. (2) Excessive doses of certain vitamin or mineral supplements when there is no deficiency has been shown to be of no benefit and may even be harmful. There is some evidence that those on metformin therapy are at higher risk of B12 deficiency, and may need Vitamin B12 supplementation if tests indicate a deficiency. (2, 39)

VITAMINS

Since type 2 diabetes is a state of increased oxidative stress, interest in recommending large doses of antioxidant vitamins has been high. Current studies demonstrate no benefit of carotene and Vitamins E, and C in respect to improved glycemic control or treatment of complications.

Routinely supplementing the diet with antioxidant supplements is not recommended due to lack of evidence showing benefit in large, placebo-controlled clinical trials and concerns regarding potential long-term safety. (2,39) There is also not adequate evidence to recommend routine Vitamin D supplementation without deficiency (2,40)

MINERALS

Sodium

As for the general population, PWD should limit sodium consumption to 2,300 mg/day. (2)

Since few studies have been undertaken on sodium restriction in PWD, the 2019 ADA standards of medical care recommendation is to follow the guidelines for sodium intake for the general population, which is to limit sodium intake to 2300 mg/day. (2) Food manufacturers and restaurants will need to provide additional reduced sodium alternatives to help accomplish this goal. It requires not adding salt to foods during cooking or at the table, as well as decreasing consumption of most pre-prepared and pre-packaged foods. Some studies in people with type 1 and type 2 diabetes measuring urine sodium excretion have actually shown increased mortality associated with very low sodium intakes, potentially requiring caution for universal sodium restriction to 1,500 mg in the diabetes population without hypertension (7) Other lifestyle modifications, including loss of excess body weight; increasing consumption of fruits and vegetables (8 –10 servings/day), and low-fat dairy products (2–3 servings/day); avoiding excessive alcohol consumption (no more than 2 servings/day in men and no more than 1 serving/day in women); and increasing activity levels can be helpful in people with hypertension and diabetes. These nonpharmacological strategies may also positively affect glycemia and lipid control. (7) The DASH (Dietary Approaches to Stop Hypertension) diet, which is high in fruit and vegetables, low-fat dairy products, and low in saturated and total fat; has been shown in large, randomized, controlled trials to significantly reduce blood pressure. (41) The DASH diet was rated second overall and tied for best diet for diabetes in a recent report published in US News and World Report. (42) The report was based on scores of 41 diets rated by nutrition and diet, diabetes and cardiac experts. (2)

Magnesium

Studies in support of magnesium supplementation to improve glycemic control are unclear and complicated by differences in study designs as well as baseline characteristics. There is some evidence that higher dietary intake of magnesium may help prevent type 2 diabetes in both middle aged men and women at higher risk for developing the disease. (43) Additional long-term studies are needed to determine the best way to assess magnesium status and how magnesium deficiency impacts PWD. (100) Dietary sources of magnesium include nuts, whole grains, and green leafy vegetables.

Chromium

Several studies have demonstrated a potential role for chromium supplementation in the management of insulin resistance and type 2 diabetes. According to the ADA position statement, the findings with more significant effects were mainly found in poorer quality studies, limiting transferability of the results. Routine supplementation of chromium is therefore currently not recommended for treating diabetes or obesity. (2)

HERBAL SUPPLEMENTS

There has been interest in the past several years on the effect of cinnamon, curcumin, and other herbs and spices in individuals with diabetes. The most recent ADA Lifestyle Management recommendations conclude that after a review of the evidence, there is not enough clear data to substantiate recommending the use of herbs or spices as treatment for T2D. (2) The ADA also states that the use of any herbal supplements, which are not regulated and vary in content, may provide more risk than benefit, in that herbs may interact with other medications that are taken to control diabetes. (7)

A good resource to determine general calorie, macro and micronutrient needs based on the DRI is: Dietary Reference Intake Calculator for HCPs: fnic.nal.usda.gov/fnic/dri-calculator/index.php (44)

PROBIOTICS

Probiotics (from *pro* and *biota*, meaning "for life"), are certain kinds of "good" bacteria found in fermented foods, such as yogurt, kefir, and kimchi and are available as supplements. They are naturally found in the gut and may be depleted due to poor diet, use of antibiotics, stress, etc. Probiotics have been studied extensively to improve gut flora for use in treatment and possibly prevention of various disorders, including irritable bowel syndrome, diarrhea, constipation, and genitourinary infections, to name a few. Different strains and amounts may work better for some conditions over others, but the FDA does not oversee the supplements, so content and effectiveness are not regulated. They are generally considered safe, as they are found naturally in the digestive tract. (105)

Some research has been done in people with gestational and type 2 diabetes using probiotic supplements and foods to determine if chronic inflammatory and glycemic markers can be improved. The premise is that the microbiome flora may be connected to glucose metabolism by altering insulin sensitivity and inflammation. The microflora in the gut of those with and without T2DM is different and altering the gut flora with certain probiotic strains may be helpful. A recent review of 12 randomized controlled studies of probiotic supplements in people with T2DM demonstrated a moderate improvement in glycemic and lipid parameters in the majority

of the trials. The authors noted that lactobacillus and Bifidobacterium species were most commonly used in the studies and that more studies of longer duration, exact strain and therapeutic dose should be pursued. (106)

A recent meta-analysis of probiotic yogurt as a method to improve glycemic control in type 2 and obesity showed that compared to conventional yogurt, the probiotic containing yogurt did not yield improvement in glycemic markers. The authors comment that larger randomized trials longer than 12 weeks should be undertaken. (107)

CHOCOLATE

Chocolate is a favorite food of many people. Chocolate and cocoa are often touted as having healthful benefits. Some studies in healthy individuals and in hypertensive patients with impaired glucose tolerance have shown an improvement in endothelial function with consumption of dark chocolate compared to white chocolate. The improvement in endothelial function is thought to be due to the flavonoids in cocoa and dark chocolate. The improvement in endothelial function may alter glucose metabolism and increase insulin sensitivity.

There has not been any long term randomized controlled trials in people with diabetes to determine the long-term effects of a diet rich in dark chocolate or cocoa. (102) Chocolate is often combined with sugar, fat, and other ingredients to create a snack or candy that is energy dense with low nutritional value. This may cause an increase in weight that would be detrimental to a person with diabetes. The overall nutrient content of the chocolate containing food or product, daily calorie intake and energy balance should be considered and if incorporated into their diet, should be offset by adjustments of other energy dense, low nutritional value foods to maintain a healthful diet and energy balance.

ALCOHOL

Adults with diabetes who drink alcohol should do so in moderation (no more than one drink per day for adult women and no more than two drinks per day for adult men). Alcohol consumption may place people with diabetes at increased risk for hypoglycemia, especially if taking insulin or insulin secretagogues. Education and awareness regarding the recognition and management of delayed hypoglycemia due to alcohol with or without a meal are warranted.

The ADA position paper states that moderate alcohol consumption has minimal detrimental short- or long-term effects on blood glucose in people with diabetes, with some epidemiologic data showing improved glycemic control with moderate intake. Moderate intake may also contribute to cardiovascular risk reduction and mortality benefits in people with diabetes, no matter the type of alcohol. Thus, the recommendations for alcohol consumption for people with diabetes are the same as for the general population (2)

Risks of excessive alcohol intake include hypoglycemia (particularly for those using insulin or insulin secretagogue therapies), weight gain, and hyperglycemia (for those consuming excessive amounts). Hypoglycemia can occur through several mechanisms, including the inability of alcohol to be converted into glucose, the inhibitory effect of alcohol on gluconeogenesis, and its interference in normal counter regulatory hormonal responses to impending hypoglycemia. However, one drink for women and two drinks for men per day can usually be incorporated into the diet for individuals with type 1 diabetes with no major effect on blood glucose. One drink is defined as 12 oz beer, 5 oz wine or 1.5 oz of hard liquor. To decrease the risk of hypoglycemia, it is best to have the alcohol with food. Consuming alcohol in a fasting state may contribute to

hypoglycemia in people with type 1 diabetes. Symptoms of hypoglycemia can be similar to drunkenness, so advise others that the person has diabetes so proper treatment for hypoglycemia can be undertaken. When calculating the need for meal related boluses of insulin, one should account for the carbohydrate content of the alcohol if drinking sweet wines, liqueurs, or drinks made with regular juice or soda. Selecting dry wine, light beer or hard liquor made with noncaloric mixers is preferable. (45)

PUTTING IT ALL TOGETHER- FOR TYPE 1 DIABETES AND THOSE ON INSULIN

People taking insulin should be counseled on the importance of balancing food and beverage intake with timing and dosing of insulin. This is especially important for individuals with varied or hectic schedules such as shift workers, people that travel frequently, or anyone who has a schedule in which timing of meals and access to food is irregular. (2) Numerous materials and resources are available that can be provided to PWD to help them consider portion control, consistency in food intake and medication dosing, as well as planning to allow some flexibility in their daily self-care regimen. (46) The health care provider should provide individualized guidelines for a target blood glucose range, considering safety and health. For motivated people, teaching an insulin to CHO ratio, and blood glucose correction factor may assist them with achieving blood glucose targets and achieving better glycemic control. (2,47)

Carbohydrate Counting

Carbohydrate (CHO) from any food affects blood glucose levels. Monitoring carbohydrate, whether by carbohydrate counting, using the exchange method, or experienced-based estimation, remain an important strategy used in timing of medication administration and improving glycemic control. (7) CHO counting methodology is based on the concept that each serving of CHO equals approximately 15 gms of CHO. Generally, blood glucose response to carbohydrate is similar for most foods, however PWD should be educated on more healthful carbohydrate sources including legumes, whole grain or multi-grain foods and whole fruits rather than highly processed foods, fruit juices, and sweetened beverages. The average woman needs about 3 to 4 choices (45-60 gms), while men may need 4-5 choices (60-75 grams) of CHO at each meal. (46) This number could vary more or less depending on individual calorie needs (i.e., pregnant/nursing, ill, etc.), medication, and level of physical activity.

Carbohydrate counting is a tool that can be taught to motivated PWD, so that they can more easily estimate the amount (grams) of CHO in a particular food. Furthermore, setting a target CHO intake for each meal allows the PWD to more easily match their CHO intake to the appropriate mealtime insulin dose. Potential advantages of CHO counting include improved glucose control, flexibility in food choices, a better understanding of how much insulin to take, and simplification of meal planning. Review with the PWD the understanding of CHO counting and reinforce the importance of choosing foods that are less processed, and contain whole grains and fiber on a regular basis. There are no evidence-based studies showing superiority of different approaches to dietary management methods. CHO counting requires motivation on the PWD's part. (48) Approaches that are individualized based on the PWD's capacity and resources are recommended to develop an individualized eating plan (2)

A good online resource for basic carbohydrate counting can be found on the UCSF website:

Glycemic Index (GI) and Load (GL)

Substituting low-glycemic load foods for higher-glycemic load foods may modestly improve glycemic control.

The use of the glycemic index (a scale that ranks carbohydrate rich foods by how much they raise blood glucose levels) has been developed to identify and classify over 600 foods and their blood glucose raising potential. It has been demonstrated that high fiber, low GI foods can help delay the absorption of glucose into the bloodstream, consequently helping to control blood glucose levels. As a rule, refined grain products and potatoes have a higher GI, legumes and whole grains have a moderate GI, and non-starchy fruits and vegetables have a low GI. Many factors can influence the GI of a food, such as methods of cooking, physical state of a food, and how much fat and protein are consumed in conjunction with that food. (50) The ADA states 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. The reasoning behind a less than robust recommendation is that the literature on GI and GL in individuals with diabetes is complex, and it is often difficult to separate the independent effect of fiber compared with that of the GI on glycemic control and other outcomes. Other organizations more highly advocate its use, including the Diabetes and Nutrition Study Group (DNSG) of the European Association and the Diabetes UK Nutrition Working Group. (7) It is important that persons with diabetes who want to use the GI to better manage their glucose control are taught how specific foods and meals affect their own blood glucose levels, rather than adhering only to the existing GI. For example, a person could compare a low GI food, such as oatmeal (GI = 50) with cornflakes (GI = 84) to determine the relative effect of each on their own blood glucose.

The basic technique for following low GI guidelines is simply a "this for that" approach – i.e.: replacing high GI foods with low GI foods. One need not count numbers or do any sort of mental arithmetic to make sure they are eating a healthy, low GI diet. Some tips include:

- Increasing the consumption of whole grains, nuts, legumes, fruit, and non-starchy vegetables
- Decreasing the consumption of starchy high-glycemic index foods like potatoes, white rice, and white bread
- Decreasing the consumption of sugary foods like cookies, cakes, candy, and soft-drinks

The glycemic load (GL) combines the GI and the total CHO content of an average serving of a food. It is defined as the GI multiplied by the amount of carbohydrate per serving of food in grams and dividing the total by 100. It was introduced as a measure of the overall effect of a food on blood glucose and insulin levels. Lowering the GL of the diet may be an effective method to improve glycemic control in individuals with type 2 diabetes. This approach is not currently included in the overall strategy of diabetes management in the US. (51)

A 2011 review article on GI and GL in the diabetes diet by Marsh, et al concludes that both the amount and type of carbohydrate are important in predicting glycemic response to a meal. Diets based on low GI carbohydrate containing foods have been associated with a reduced risk of type 2 and CVD, and intervention studies have shown improvements in insulin sensitivity and A1C in

those with diabetes. Low GI diets may also assist with weight management through effects on satiety and fuel partitioning. Since no demonstrated negative effects of a low GI diet have been demonstrated, the GI can be an important consideration in the dietary management of diabetes. (52)

Special Considerations for PWD Treated with Intensive Insulin Regimens

The following guidelines are the starting point for the nutritional component of PWD on intensified insulin management regimens, regardless of what meal plan approach is chosen: (2,53)

1. The initial diabetes meal plan should be based on the PWD normal intake with respect to calories, food choices, and times meals eaten.
2. Choose an insulin regimen that is compatible with the PWD normal pattern of meals, sleep and physical activity.
3. Synchronize insulin with meal times based on the action time of the insulin(s) used.
4. PWD should measure blood glucose levels prior to meals and snacks and at bedtime and adjust the insulin doses as needed based on intake.
5. Monitor A1C, weight, lipids, blood pressure, and other clinical parameters, modifying the initial meal plan as necessary to meet goals
6. It is also important to educate the PWD on adjustment of prandial insulin considering premeal glucose levels, carbohydrate intake, and anticipated physical activity.
7. For PWD who are overweight on insulin, counseling on nutrition, weight management and monitoring blood glucose continue to be important components of treatment. Medical nutrition therapy (MNT) for PWD is recommended with continued emphasis on making lifestyle changes to achieve a weight loss of 5% or more to reduce the risk of chronic complications associated with diabetes, CVD and other risk factors that contribute to early mortality.

Children and Adolescents

While medical nutrition therapy provided by registered dietitians resulted in better glycemic control in children with newly diagnosed type 1 diabetes, a survey of 45 pediatric clinics revealed that only 25 clinics had an experienced pediatric/adolescent dietitian available for children with diabetes. (54) Registered Dietitian Nutritionists who are trained and experienced with children and adolescent diabetes management should be involved in the multidisciplinary care team (55). The goals of nutrition therapy for children and adolescents with diabetes include the following (2,55):

1. Provide individualized nutrition therapy with guidance on appropriate energy and nutrient intake to ensure optimal growth and development.
2. Assess and consider changes in food preferences over time and incorporate changes into recommendations.
3. Promote healthy lifestyle habits while considering and preserving social, cultural, and physiological well being

4. Achieve and maintain the best possible glycemic control
5. Achieve and maintain appropriate body weight and promote regular exercise

Dietary advice should start gradually:

1. Emphasis should initially be on establishing supportive rapport with the child and family with simple instructions. More detailed guidelines should be administered later by the entire team, with focus on consistency in message and should include dietary guidelines to avoid hypoglycemia. Instruction on carbohydrate counting should be provided as soon as possible after diagnosis. (55) Nutritional advice needs to be given to all caregivers; babysitters, and extended family who care for the child.
2. Nutrition guidelines should be based on dietary history of the family and child's meal pattern and habits prior to the diagnosis of diabetes and focus on nutritional recommendations for reducing risk of associated complications and cardiovascular risk that are applicable to the entire family.
3. Activity/exercise schedules need to be assessed, along with 24-hour recall and 3-day food diary to determine energy intake. Growth patterns and weight gain need to be assessed every 3-6 months and recommended dietary advice adjusted accordingly. (54)

Dietary recommendations can be illustrated by use of the Plate method. There are numerous resources for visuals and educational materials using the plate method and some are specific to diabetes. Half the plate should consist of fruits and vegetables, while the other half is divided between whole grains and lean sources of protein. The dairy is represented by a glass of nonfat or 1% milk or other nonfat or low-fat dairy source. The general guidelines for macronutrients are similar to that of the adult population with diabetes. (56)

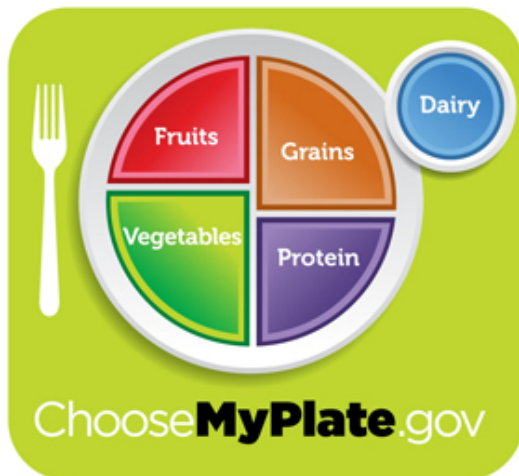


Figure 1.

Choosemyplate.gov. Video and print materials can be found on the website

Special Considerations

Prevention of Hypoglycemia

Hypoglycemia usually occurs more frequently in PWD taking insulin, but can occur in those taking oral antihyperglycemic agents, especially a sulfonylurea. To help prevent hypoglycemia, the following guidelines should be discussed: (57)

1. Don't skip or delay meals or snacks. If taking insulin or oral diabetes medication, be consistent about the amount eaten and the timing of meals and snacks.
2. Monitor blood sugar. Depending on treatment plan, check and record blood sugar level several times a week or several times a day. Careful monitoring is the only way to make sure that blood sugar level remains within the individual target range.
3. Measure medication carefully, and take it on time. Take medication as recommended by the physician coordinating diabetes care.
4. Adjust medication or eat additional snacks if physical activity increases. The adjustment depends on the blood sugar test results and on the type and length of the activity.
5. Eat a meal or snack if choosing a drink with alcohol. Drinking alcohol on an empty stomach can contribute to hypoglycemia.
6. Record low glucose reactions. This can help the health care team identify patterns contributing to hypoglycemia and find ways to prevent them.
7. Carry some form of diabetes identification so that in an emergency others will know you have diabetes. Use a medical identification necklace or bracelet and wallet card.

Sick Day Management

Eating and drinking can be a challenge when the PWD is sick. The main rules for sick day management are:

1. Continue to take diabetes medication (insulin or oral agent)
2. Self-monitor blood glucose
3. Test urine ketones
4. Eat the usual amount of carbohydrate, divided into smaller meals and snacks if necessary; try to take the normal number of calories by eating easy-on-the-stomach foods like regular (non-diet) gelatin, crackers, soups, and applesauce. (if glucose is 250 mg/dL or >, all the usual amount of carbohydrate may not be necessary)
5. If even these mild foods are too hard to eat, drink liquids that contain carbohydrates. Aim for 50 grams of carbohydrate every three to four hours. This may include regular (not diet) soft drinks. Other high-carbohydrate liquids and almost-liquids are juice, frozen juice bars, sherbet, pudding, creamed soups, and fruit-flavored yogurt. Broth is also a good choice to help stay hydrated, but does not provide a significant amount of CHO
6. Drink non caloric, caffeine free fluids frequently. Call the diabetes care team
7. A list of sick foods, including sugar containing items, such as soft drinks and gelatin, should be provided. See more at:

<http://www.diabetes.org/living-with-diabetes/treatment-and-care/whos-on-your-health-care-team/when-youre-sick.html> (58)

Exercise

Exercise for individuals with diabetes has many benefits; for most, benefits outweigh risks. Exercise and resistance training may improve glycemic control (2). PWD should be encouraged to exercise to improve cardiovascular and overall fitness, weight control, and for improved psychological well-being and quality of life. (7) There are several factors that can affect the blood glucose response to exercise: (59)

- Individual response to exercise varies
- Type, amount, and intensity of exercise
- Timing and type of the previous meal
- Timing and type of the insulin injection or other diabetes agent
- Pre-exercise blood glucose level
- Person's fitness level

In individuals with type 1 diabetes, and PWD with T2 taking insulin, blood glucose monitoring is necessary to adjust insulin dosing and carbohydrate intake to reduce hypoglycemia during exercise. To reduce the risk of hypoglycemia, when exercise is planned, it may be preferable to adjust the dose of insulin before the exercise begins. On the other hand, if the exercise is unplanned, blood glucose should be checked and a carbohydrate snack may be eaten as needed before the exercise begins. If the blood glucose is less than 100mg/dL, a 15- to 30-g carbohydrate snack should be consumed, and glucose should be rechecked in 30 to 60 minutes. If glucose levels are less than 70 mg/dL, exercise should be postponed. Depending on the blood glucose level at the start of exercise, as well as length and intensity of the activity, a snack may need to be consumed before, during and after the exercise. Moderate intensity exercise can increase glucose uptake significantly, which may require an additional 15 gms of carbohydrate for every 30-60 minutes of exercise above the normal routine. (59)

To better help with weight management, and avoid hypoglycemia, exercise should be scheduled post-meals when blood glucose levels are higher. If this is not possible, it may be necessary to decrease medication dose to facilitate exercise without increasing caloric intake. (60)

Exercise can increase the rate of absorption of insulin into exercising limbs, especially when it is started immediately after the insulin injection. Inject insulin into a non-exercising area, such as the abdomen, to minimize the effect of exercise on insulin absorption. The response to exercise varies greatly in every individual, so adjustment in medication and food should be based on individual responses. Blood glucose monitoring is very important in understanding response patterns and tailoring an exercise program. (60)

Timing of Insulin and Meals

The greatest risk for hypoglycemia results when the peak insulin action does not coincide with the peak postprandial glucose. For example, the longer duration of action of regular insulin may lead to increased risk of late postprandial hypoglycemia, compared with rapid-acting insulin analogs, which peak closer to meal consumption. In addition, when the pre-meal insulin dose is too large for a particular meal relative to its CHO content, hypoglycemia can result. Such a mismatch may occur due to errors in estimating CHO or food intake in PWD on multiple daily injections (MDI) or on insulin pumps. Insulin calculations can be based on exchanges,

carbohydrate counting, or predefined, set menus. If meals and the insulin regimen remain constant, then no problems will usually result. However, any changes in insulin or food intake require adjustment of one or the other, or both. Whatever regimen is employed, it must be individualized to the PWD. Those taking rapid-acting insulin may choose to give their insulin dose after the meal, if unsure of amount of food to be consumed. This approach can be especially helpful in children, nausea related to pregnancy, or other illness. If a smaller than normal meal is eaten, guidelines are available for reducing the insulin dose, or carbohydrate replacement in the form of fruit or fruit juice can be given, depending on the PWD's particular insulin regimen. (61)

Hypoglycemia Treatment Guidelines

Hypoglycemia is defined as a low blood glucose level ≤ 70 mg/dL. Symptoms include anxiety, irritability, light-headedness and shakiness. Advanced symptoms include headache, blurred vision, lack of coordination, confusion, anger and numbness in the mouth. Hypoglycemia must be treated immediately with glucose. Follow the 15/15 rule: take 15 gms of simple carbohydrate which should increase blood glucose by 30-45 mg/dL within 15 minutes. When blood glucose dips below 70 mg/dL, PWD should be advised to have one of the following "quick fix" foods right away to raise the glucose: (2)

- Glucose tablets (see instructions)
- Gel tube (see instructions)
- 4 ounces (1/2 cup) of juice or regular soda (not diet)
- 1 tablespoon of sugar, honey, or corn syrup
- Hard candies, jellybeans, or gumdrops—see food label for how many to consume

High-fat foods will delay peak of glucose levels from carbohydrate intake and should be avoided (e.g., treatment of hypoglycemia with chocolate bars). After 15 minutes, blood glucose should be checked again to make sure that it is increasing. If it is still too low, another serving is advised. Repeat these steps until blood glucose is at least 70 mg/dL. Then, a snack should be consumed if it will be an hour or more before the next meal. (62)

Those who take insulin or an oral antidiabetic drug that can cause hypoglycemia, such as a sulfonylurea, should be advised to always carry one of the quick-fix foods with them, when driving, and also available nearby when sleeping. Wearing a medical ID bracelet or necklace is also a good idea, as well as having a glucagon emergency kit handy.

PUTTING IT ALL TOGETHER FOR TYPE 2 DIABETES: NUTRITION FOR THE DYSMETABOLIC SYNDROME

Driven by the explosive increase in the prevalence of obesity, the number of PWD with known diagnosis of type 2 diabetes has reached massive proportions in the U.S. and worldwide. The number of persons worldwide with diabetes has more than tripled since 1980. According to the 2017 National Diabetes Statistic report, diabetes affects 30.3 million people of all ages or 9.4% of the U.S. population. This includes 23.1 million diagnosed, and an undiagnosed population of 7.2 million people. 90 to 95% of these people have type 2 diabetes. Another estimated 84.1million people, that's 1 out of every 4 Americans 18 years of age and older have prediabetes. (63)

A lack of physical activity and an overabundance of readily available convenience foods (usually containing too many calories) can lead to obesity and in many cases the metabolic, or insulin-resistance syndrome. The metabolic syndrome combined with insulin resistance increases the chance of developing type 2 diabetes and heart disease. (64)

But adults are not alone in this problem, as there is also an increased rate of the diagnosis of type 2 diabetes in young people. Until 20 years ago, type 2 diabetes accounted for less than 3% of all cases of new-onset diabetes in adolescents, whereas now it has increased to over 45% of cases. (65)

Obesity and insulin resistance are key factors, but not the only variables, that can increase the risk of developing type 2 diabetes. In a study by Van Dam, et al, the Western dietary pattern (high in processed meat, red meat, French fries, refined grains, high-fat dairy products, and sweets), was associated with a 59% greater risk of diabetes in adult men, while a more “whole food” diet, deemphasizing processed foods (high in fruits and vegetables, whole grains, fish, and poultry) was associated with a 16% lower risk of diabetes in adult men. For men who ate a Western diet, the risk for diabetes was even greater if they were also obese or had a low level of physical activity. While these results do not prove that eating a Western diet causes type 2 diabetes, they certainly add to existing evidence that eating these types of food increases the risk for developing type 2 diabetes, and that being overweight, and lack of exercise increases the risk even further. (66)

Other widely publicized studies, the Finland Diabetes Prevention Study (67,68) and the one and two year community implementation results of the Diabetes Prevention Program [69,70,71], confirmed the importance of exercise and nutrition therapy as a preventative measure for development of type 2 diabetes and primary treatment after the initial diagnosis of type 2 diabetes is made.

What Weight Loss Plan is Best? Keys to Success

While the general principles discussed in the first section apply to all PWD, those people with type 2 diabetes who are overweight or obese (BMI 25.0 and greater) should have a major focus placed on weight loss and increased physical activity. With so many weight loss “diets” available, confusion abounds. Even the scientific literature is inconclusive. Most people are looking for the quickest and easiest way to lose weight, and most have unrealistic expectations. Obesity does not occur overnight, and its treatment requires lifetime adjustments to food (energy) intake and energy expenditure (increased activity). As much as one would like to find the magic bullet that leads to quick and sustained weight loss, the fact remains that there does not appear as yet to be a balance of macronutrients that consistently leads to the loss and maintenance of body weight, other than a reduction of total calories consumed. A study published in *Diabetologia* reported that a diet of only 600 calories a day for eight weeks may have helped reverse type 2 diabetes in newly diagnosed people. According to the study, the diet helped reduce hepatic and pancreatic lipid levels, which normalized insulin production and blood glucose levels. However, more studies are needed to determine whether the results will be permanent, (72) and maintaining a 600-calorie intake long term is very unrealistic. In Roy Taylor’s 2012 Banting Lecture, the twin cycle hypothesis concept was introduced, which postulates that chronic calorie excess leads to accumulation of liver fat with eventual spill over into the pancreas. He believes that type 2 diabetes is a reversible condition of intra-organ fat excess to which some people are more susceptible than others. This hypothesis is supported by both bariatric surgery and hypocaloric diet evidence demonstrating reversibility of type 2 diabetes. (73)

A plethora of randomized, controlled studies have been undertaken and published to ascertain which macronutrient combination leads to greater weight loss. A two-year head-to-head trial comparing four weight loss diets with differing macronutrient content concluded that all four reduced calorie diets, regardless of macronutrient content, led to comparable modest weight loss with weight regain over time. (74) Another 12-month trial of 259 participants with diabetes compared a low carbohydrate Mediterranean diet, a traditional Mediterranean diet, and a 2003 ADA diet. Greater weight loss, improved glycemic control, and improved HDL levels were demonstrated with the low carb Mediterranean diet. (75) Another study of 115 obese T2D people compared a low carb (LC), healthy fat versus a higher carb, lower fat diet. The outcome of this 52-week trial showed that both diets achieved substantial weight loss and reduced HbA1c and fasting glucose, though the LC diet achieved greater improvements in lipid profile, blood glucose stability, and reductions in diabetes medications. (76)

It seems that in the short term (1-2 years) a lower carb, moderate fat macronutrient intake will lead to weight loss and improved metabolic parameters for many people with T2D, but in the long run, it does not appear to make as much of a difference, leading one to believe that many other factors are in play. A prudent recommendation for losing weight or maintaining a healthy weight is to be aware of the amount of food eaten in relation to the number of calories expended in a day. Keeping a food and activity journal can help keep track and create awareness of the amount of food eaten. A moderate intake of fats, with an emphasis on healthful unsaturated fats, and complex carbohydrates is compatible with a weight-loss or weight-maintaining diet. The most important variable in selecting a weight loss plan is the ability of the individual to follow it and maintain weight loss over the long term.

Weight loss is a major challenge for most people who, in our fast-paced environment, don't eat properly and fail to establish patterns of regular physical activity. The key to success is having a PWD commit to establishing a healthy lifestyle they can live with that emphasizes and incorporates more healthful food choices on most days and a daily exercise routine, taking into account the presence of possible complications. Developing an individualized weight loss program, preferably guided by a registered dietitian nutritionist familiar with diabetes management, along with regular follow-ups, will help promote and maintain weight loss. Initial physical activity recommendations should be moderate, gradually increasing the duration and frequency to 30-45 min of moderate aerobic activity 3-5 days/week. It is always important that a person checks with their physician before starting an exercise program.

The individualized approach to dieting shows powerful proof through the National Weight Control Registry, a prospective study of successful long-term dieters established in 1994. To be included, members must have maintained a 30-pound weight loss for at least a year. Tracking over 10,000 members, the Registry is the largest collection to date of long-term weight-loss data. Most participants report keys to success are continuing to maintain a lower calorie diet and doing high levels of activity. Other common themes to losing weight and keeping it off, according to data from the registry, include: (77)

1. 78% eat breakfast every day.
2. 75% weigh themselves at least once a week.
3. 62% watch less than 10 hours of TV per week

90% exercise, on average, about 1 hour per day.

Children and Adolescents

Type 2 diabetes is becoming increasingly prevalent among young people who are driven, as is the case in adults, by lifestyle factors and food choices leading to increased body weight. The diabetogenic process may begin as early as fetal life, with maternal type 2 diabetes, abnormal birth weight and poor nutrition combined with sedentary lifestyle and dietary factors to produce an insulin-resistant phenotype that may accelerate the development of renal pathology and cardiovascular disease. (78) According to a recent paper, the incidence of both T1D and T2D among youths increased significantly in the 2002–2012 period, particularly among those of minority racial and ethnic groups. (79) It is important for children and adolescents to be physically active as well as following healthy eating guidelines to promote normal growth patterns, without exceeding recommended weight ranges for age and/or height.

MEAL PLANNING APPROACHES

There is no one “diet” for diabetes. There are, however, many meal planning guidelines available for the PWD. A meal plan should not be thought of as a diet, but more of an individualized guideline for more healthful eating. Listed in the information below are some of the basic guideline and more in-depth approaches. A brief explanation of the approaches, along with the resource list to obtain additional information, is included in this section.

BASIC NUTRITION AND GUIDELINE APPROACHES

Guideline approaches are less in-depth and complex, but they can offer the foundation for basic nutrition information. In some cases, guidelines alone may be enough to change eating behaviors in some PWD. Guideline approaches focus on making healthy food choices without weighing or measuring foods, using exchanges, or counting calories, fat or carbohydrate. Regardless of whether they are used alone, or in combination with a specific meal plan, guidelines are a good choice for beginning education about nutrition. Recognize that, due to education level, lack of motivation, etc. it may not be appropriate to move some PWD beyond this initial stage.

Choose My Plate

Choose My Plate replaces the retired USDA Food Pyramid (figure 2), and contains general, simple guidelines for healthy eating using a small plate to visually illustrate foods and portion control. An explanation and picture of the guide is listed earlier in this chapter. (56)

Print materials and videos from the USDA are available at www.choosemyplate.gov.

and The Joslin Diabetes Center <https://www.joslin.org/info/diabetes-and-nutrition.html> (80)

Mediterranean-Style Eating

The Mediterranean-style eating pattern derived from the Mediterranean region of the world has been observed to improve glycemic control and cardiovascular disease risk factors. The Mediterranean eating pattern includes: (81,82)

- Vegetables, fruits, nuts, seeds, legumes, potatoes, whole grains, breads, herbs, spices, fish, seafood and extra virgin olive oil. Emphasis is placed on use of minimally processed foods, seasonal fresh and locally grown foods
- Olive oil is the primary fat, replacing other fats and oils (including butter and margarine)

- Total fat ranging from 25% to 35% of total energy, with saturated fat no more than 7% of calories
- Low-to-moderate amounts of cheese and yogurt
- Twice-weekly consumption of fish and poultry; approximately seven eggs/week
- Fresh fruit as daily dessert; sweets only a few times/week
- Red meat a few times/month (limited to 12 oz to 16 oz per month)
- Regular physical activity to promote a healthy weight, fitness and well-being
- Moderate consumption of wine, normally with meals; approximately two glasses/day for men and one glass/day for women

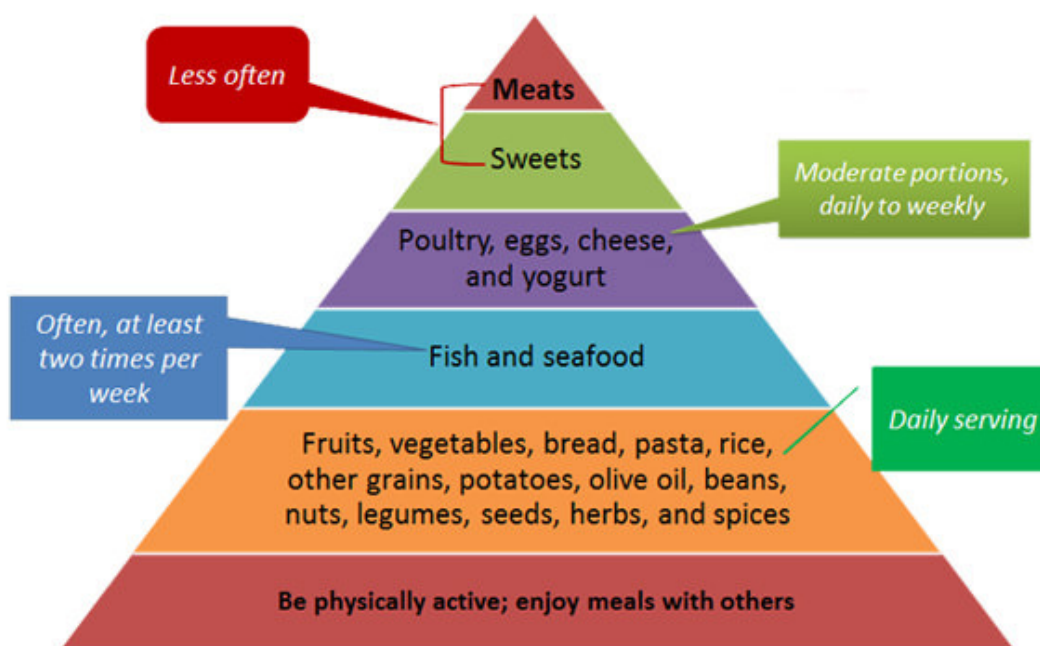


Figure 2.

Mediterranean Food Pyramid. For more information see

<https://oldwayspt.org/resources/oldways-mediterranean-diet-pyramid> Mediterranean Diet

Plan; Mediterranean Diet Pyramid from Oldways, and

<https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/> Mediterranean Diet

Pyramid and the Healthy Eating Plate from Harvard University School of Public Health

What Do I Eat Now?

What Do I Eat Now? A book primarily used for the initial stage of type 2 diabetes meal planning. It includes an overview of diabetes nutritional management within the framework of basic eating guidelines. Other resources may be added to this tool, as appropriate, to move the PWD toward more in-depth management. (83)

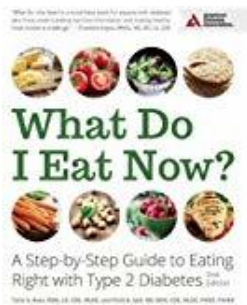


Figure 3.
What Do I Eat Now?

Diabetes Place Mat

Food List for Diabetes							
Starch & Bread	Fruit	Milk	More Carbs	Vegetables	Meat	Fat	Free Foods
<ul style="list-style-type: none"> • Bagel, 4 oz, 1/4 • Beans, dry, cooked, 1/2 cup • Bread, 1 slice • Cereal, cooked, 1/2 cup • Cereal, unsweetened, 3/4 cup • Corn, 1/2 cup • Crackers, snack, 4-5 • English muffin, 1/2 • Hamburger or Hot Dog Bun, 1/2 • Pancakes, 4" across, 1/4" thick, 1 • Pasta, cooked, 1/3 cup • Peas, cooked, 1/2 cup • Pita, 6" across, 1/2 • Popcorn, plain, unbuttered, 3 cups • Potato, 1/2 medium • Potato, mashed, 1/2 cup • Rice, cooked, 1/3 cup • Squash, winter, cooked, 1 cup • Tortilla or taco shell, 6" across, 1 • Waffle, 1 small square 	<ul style="list-style-type: none"> • Apple, 1 small • Apricots, 4 whole • Banana, 1 small • Blackberries/Blueberries, 3/4 cup • Canned fruit in juice or water, 1/2 cup • Dried fruit, 1/4 cup • Fruit juice, 1/3 to 1/2 cup • Grapefruit, 1/2 large • Grapes, 17 small • Kiwi, 1 • Mango, 1/2 small • Melon, 1 cup cubes • Nectarine, 1 small • Orange, 1 small • Peach, medium, fresh, 1 • Pear, large, fresh, 1/2 • Pineapple, fresh, 3/4 cup • Raisins, 2 Tbsp • Raspberries, 1 cup • Plums, 2 small • Strawberries, 1-1/4 cup, whole • Tangerines, 2 small 	<ul style="list-style-type: none"> • Buttermilk, 1 cup • Evaporated skim, 1/2 cup • Goat's milk, 1 cup • Kefir, 1 cup • Low fat or non fat, 1 cup • Soy milk, 1 cup • Yogurt, plain, sugar-free, fat-free, 2/3 cup • Yogurt, low fat, artificially sweetened, 3/4 cup 	<ul style="list-style-type: none"> • Cake, no icing, 2" square, 1 piece • Casserole or hot dish, 1/2 cup • Chili, 1/2 cup • Cookies, 2 small • Cupcake, frosted, 1/2 • Doughnut, glazed, 1/2 medium • Fruit juice bar, 1 • Gingersnaps, 3 • Ice cream, 1/2 cup • Maple syrup, honey, or table sugar, 1 Tbsp • Muffin, large 1/5 • Nonfat frozen yogurt, 1/3 cup • Pudding, sugar-free, 1/2 cup • Soup, broth, milk, or bean based, 1 cup • Spaghetti or pasta sauce, canned, 1/2 cup • Tortilla chips, 9 to 13 • Vanilla wafers, 5 	<ul style="list-style-type: none"> One serving is 1/2 cup cooked or 1 cup raw * • Asparagus • Beans • Broccoli • Cabbage • Carrots • Cauliflower • Celery • Green Beans • Greens (collard, kale, mustard, spinach) • Mixed vegetables, (without corn, peas or pasta) • Mushrooms • Onions • Pea pods • Peppers • Salad greens (lettuce, spinach) • Tomatoes • Tomato juice • Turnips • Zucchini 	<ul style="list-style-type: none"> • Beef, 1 oz • Chicken, no skin, 1 oz • Fish, 1 oz • Ham, 1 oz • Lamb, 1 oz • Pork, 1 oz • Seafood, 1 oz • Veal, 1 oz MEAT SUBSTITUTES • Cottage cheese, 1/4 cup • Cheese, 1 oz • Egg 1 • Egg substitute, plain, 1/4 cup • Egg whites, 2 • Peanut butter, 2 Tbsp • Salmon, water packed, 1/4 cup • Tampers, 1 oz • Tofu, 1/2 cup • Tuna, 1 oz 	<ul style="list-style-type: none"> • Avocado, med., 2 Tbsp • Bacon, 1 slice (20 slts) • Butter, stick, 1 Tbsp • Cream cheese, regular, 1 Tbsp • Cream cheese, low fat, 1-1/2 Tbsp • Cream, half & half, 2 Tbsp • Cottage cheese, 1 Tbsp • Margarine, regular, 1 Tbsp • Margarine, reduced-fat 1 Tbsp • Mayonnaise, regular, 1 Tbsp • Egg 1 • Egg substitute, plain, 1/4 cup • Oil, 1 Tbsp • Peanut, 10 nuts • Peanut butter, 2 Tbsp • Salad dressing, regular, 1 Tbsp • Salad dressing, reduced fat, 2 Tbsp • Sour cream, regular, 2 Tbsp • Sour cream, reduced-fat, 3 Tbsp 	<ul style="list-style-type: none"> UNLIMITED USE • Bouillon & broth • Club soda • Coffee or tea • Sugar-free soft drink • Sugar-free dessert • Sugar-free lemon juice • Mustard • Nonstick cooking spray • Popovers, sugar-free • Spices • Sugar substitutes • Talcott sauce • Tonic water, sugar free • Vinegar LIKELY TO, and spread intake throughout day! • Candy, hard, sugar-free, 1 candy • Cocoa powder, unsweetened, 1 Tbsp • Gelatin, 1 Tbsp • Cream cheese, fat-free, 1 Tbsp • Oil, 1 Tbsp • Jam or jelly, low sugar or light, 1 to 2 Tbsp • Mayonnaise, fat-free, 1 Tbsp • Salad, 1/4 cup • Soy cream, fat-free, 1 Tbsp • Soy sauce, 1 Tbsp • Syrup, sugar-free, 2 Tbsp • Taco sauce, 1 Tbsp • Yogurt, 2 Tbsp
<p>Write your meal or daily targets for each food choice in the section below. Plan your meals by choosing foods you like from this Food List for Diabetes.</p>							
<p>Food lists with a significant amount of carbohydrate are shown in yellow. These food groups are called "Carbohydrate Choices". Each food group listed contains approximately 15 grams of carbohydrate. See above for approximate accounting of carbohydrate, protein, and fat per serving in each food group. KEY: C = carbohydrate grams, P = protein grams, and F = fat grams.</p>							<p>How to use the Nutrition Place Mat</p> <ol style="list-style-type: none"> 1. Develop an individualized meal plan with your Registered Dietitian, Nurse, Physician or Health Educator. 2. Write your meal plan targets in the space below the food pictures. 3. For your upcoming meal or snack, circle the food item on the list that you will eat. To stay on your meal plan, eat only the total number of items allowed. 4. When your meal is completed, simply wipe off the laminated Nutrition Place Mat with a tissue! 5. Use the Nutrition Place Mat to help follow healthy nutrition guidelines and portion control. The food pictures will help you visualize well-balanced meals!
<p>Food lists with little to no carbohydrate are shown in green. Each food group has a different amount of carbohydrate, protein & fat. KEY: C = carbohydrate grams, P = protein grams, and F = fat grams.</p>							<p>Food Information Source: USDA Nutrient Database for Standard Ref., Release 19</p>
<p>To circle foods, use only wipe away crayons or non-toxic dry erase fluid markers.</p>							

Figure 4.
Nutrition PlaceMat for Diabetes. A sturdy, heavily laminated, 11" by 17" place mat that can be easily used over and over to apply the meal plan.

One side of the Diabetes Place Mat lists food choices and individual portion sizes for each food category of the meal plan. This list replaces easily misplaced or damaged paper lists, which are often given to PWD.

When planning the meal, a wipe-off marker is used to write down the number of servings for each food category, as indicated on the plan. Then circle or tally the food choices in each category to track progress toward the plan's targets. Carbohydrate categories - starch and bread, fruit, milk and other carbohydrates - which affect blood sugar and which can be exchanged for

each other, are color coded in yellow for easy identification and proper selection. Other food categories - vegetables, meat, fat and free foods - are individually color-coded.

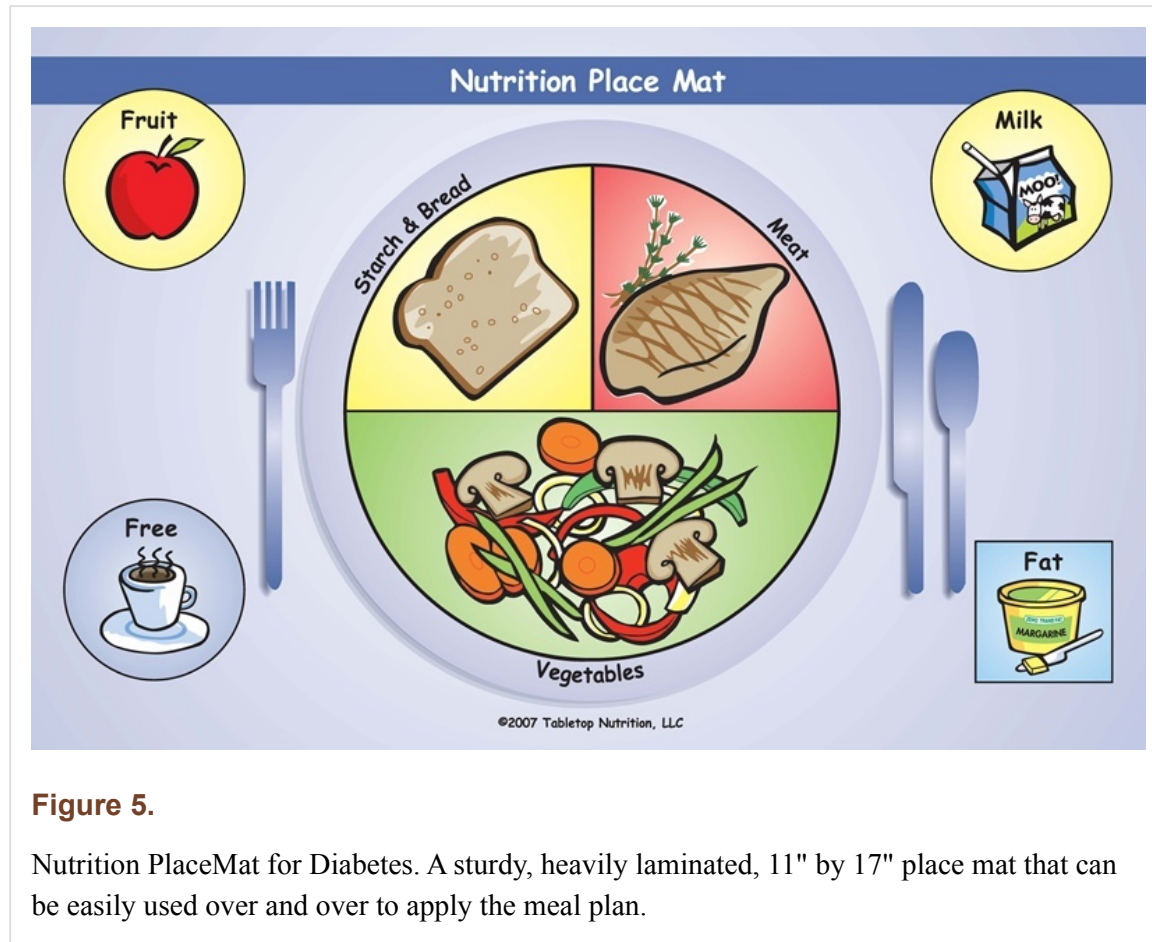


Figure 5.

Nutrition PlaceMat for Diabetes. A sturdy, heavily laminated, 11" by 17" place mat that can be easily used over and over to apply the meal plan.

The other side of the Diabetes Place Mat illustrates the "Plate Method" of managing a diet for proper nutrition and control of blood sugar and weight. It shows the proportions of each food category that are appropriate for a healthy, balanced diet. The food groups shown on the top half of the Plate Method side are carbohydrates, which affect blood sugar the most - fruit, milk, and starch & bread. These are colored in yellow to distinguish them from the other food groups that don't significantly affect blood sugar (meat, vegetables, fat and free foods). The food categories are shown in proportion to how much of each might be eaten in a healthy, balanced diet. The plate method is a great plan for PWD who have poor math or reading skills, or are non-English speaking. (84)

Create Your Plate: Meal Planning Tool Kit

On line portion control tools to make meal planning easier. (85)

DASH Eating Plan

Dietary Approaches to Stop Hypertension (DASH) is a flexible and balanced eating plan that is based on research studies sponsored by the National Heart, Lung, and Blood Institute (NHLBI). These studies showed that following the DASH plan lowers high blood pressure and improves levels of blood lipids which reduces the risk of developing cardiovascular disease. (86) The DASH plan was rated #2 by the US World News Report of all healthy dietary plans for 2019. U.S. News evaluated and ranked 41 popular diet plans with input from a panel of health experts.

To be top-rated, a diet had to be relatively easy to follow, nutritious, safe, effective for weight loss and protective against diabetes and heart disease. The government-endorsed Dietary Approaches to Stop Hypertension (DASH) tied for the #2 spot as best food plan for diabetes. (42). The DASH eating plan:

- Emphasizes vegetables, fruits, and fat-free or low-fat dairy products
- Is low in saturated and trans fats
- Includes whole grains, fish, poultry, beans, seeds, nuts, and vegetable oils
- Is high in potassium, calcium, magnesium, fiber and protein
- Limits sodium, sweets, sugary beverages, and red meats
- Is lower in sodium than the typical American diet. Contains 2,300 mg of sodium per day which has been shown to lower blood pressure. Further lowering to 1,500 mg/day can further reduce blood pressure

For more information go to <https://www.nhlbi.nih.gov/health-topics/dash-eating-plan>

Intermittent Fasting

The popularity of intermittent fasting has increased recently as a new way to lose weight and possibly lead to better control of Type 2 diabetes. There are many suggested types of intermittent fasts; some involve eating only on specific days, or not eating for a specified number of hours, alternated by day or hours in which food consumption is allowed. Others greatly restrict calories on some days but allow a more normalized diet on other days. There is no one specific intermittent fasting diet that has been proven to be beneficial. Since calories are restricted for certain periods of time, an individual with diabetes may lose weight over time if they maintain an overall calorie deficit in relation to energy expenditure as is seen with any successful weight loss method.

For a PWD who is interested in intermittent fasting, their current anti-hyperglycemic medications must be considered. For those on insulin or taking other anti-hyperglycemia medications, intermittent fasting may lead to frequent hypoglycemia that may become severe and result in death. (103) Careful monitoring of blood glucose is required, and medication adjustment may be necessary. A more traditional approach to increase physical activity with a lower calorie diet will produce consistent weight loss and may lead to a more realistic long-term weight maintenance plan.

Flexitarian Diet

This eating plan combines the words vegetarian and flexible. It is a mainly plant based plan, but meat can be added occasionally. This plan was tied for #2 spot with the DASH by USWNR. (42)

For more information see: <https://health.usnews.com/best-diet/flexitarian-diet> (87)

Ketogenic Diet

The ketogenic diet was originally used in the treatment of epilepsy. More recently it has been studied for use in patients with T2 diabetes and is also currently being studied as adjunctive treatment for a variety of conditions including pain and neurodegenerative diseases such as Alzheimer's and Parkinson's disease. The ketogenic diet induces ketosis through high protein,

typically high fat, and very low carbohydrate intake. Studies in people with T2 diabetes have shown a positive benefit on blood glucose, insulin sensitivity, and a lowering of anti-hyperglycemic medications with a sustained very low carbohydrate intake. There is disagreement on the negative effects of a higher protein intake in patients with T2 diabetes as some studies suggest possible kidney damage due to the high level of nitrogen excreted during protein metabolism. More studies are needed to determine the long-term effects of a ketogenic diet in PWD. Nutritional recommendations for a person considering this diet are to limit protein sources that are high in saturated fat and include more plant-based proteins for a more healthful approach. (104)

Volumetrics Plan

This plan uses a food's energy density, and works by cutting the energy density of your meals and making choices that fight hunger. Food is divided into four groups. Category one (very low-density) includes nonstarchy fruits and vegetables, nonfat milk and broth-based soup. Category two (low-density) includes starchy fruits and veggies, grains, breakfast cereal, low-fat meat, legumes and low-fat mixed dishes like chili and spaghetti. Category three (medium-density) includes meat, cheese, pizza, French fries, salad dressing, bread, pretzels, ice cream and cake. And category four (high-density) includes crackers, chips, chocolate candies, cookies, nuts, butter and oil. You'll go heavy on categories one and two, watch your portion sizes with category three, and keep category four choices to a minimum. Each day, you'll eat breakfast, lunch, dinner, a couple snacks and dessert. This plan was also tied for #2 for best diet plan for diabetes by USWNR (42). For more information see: <https://health.usnews.com/best-diet/volumetrics-diet> (88)

MAYO Clinic Diet

Developed by the Mayo Clinic, a two-phase approach to lose and maintain body weight using the Mayo Clinic food pyramid. Learn how to replace bad habits with good. This plan was also tied for #2 for diabetes by USWNR (42) For more information see: <https://diet.mayoclinic.org/diet/how-it-works> (89)

Jenny Craig®

The plan emphasizes restricting calories, fat and portions. Jenny's prepackaged meals and recipes do all three, plus emphasize healthy eating, an active lifestyle and behavior modification. Personal consultants guide members through their journeys from day one. You'll gain support and motivation, and learn how much you should be eating, what a balanced meal looks like and how to use that knowledge once you graduate from the program. By following the plan, you're expected to drop up to 2 pounds a week.

Jenny Craig offers two programs: its standard program and Jenny Craig for Type 2, which is designed for people with Type 2 diabetes by including a lower-carb menu, reinforcement of self-monitoring of blood sugar levels, consistent meals and snacks, and other self-management strategies for weight loss and support for diabetes control. This plan was voted #6 for best diabetes diet (42) and is good for those that need support from a group and ready-made meals. Because you buy foods, this program can be more expensive, but convenient. For more information see: <https://www.jennycraig.com/> (90)

Ornish Diet

The diet is low in fat, refined carbohydrates and animal protein. It also emphasizes exercise, stress management and relationships. On nutrition, for instance, Ornish categorizes food into five groups from most (group one) to least (group five) healthful. It tied for #6 for best diabetes diet. (42) The plan has been shown to reverse heart disease. For more information see: <https://www.ornish.com/proven-program/nutrition> (91)

Vegan Diet

Veganism excludes all animal products from the diet – including dairy and eggs. Fruits, vegetables, leafy greens, whole grains, nuts, seeds and legumes are the staples. It is restrictive, but beneficial for the cardiovascular system. It also tied for #6 best diet for diabetes (42)

For more information see: <https://health.usnews.com/best-diet/vegan-diet> (92)

Weight Watchers®

Its WW Freestyle program, launched in late 2017, builds on its SmartPoints system, which assigns every food and beverage a point value, based on nutritional content. The newest program expands dietary options that are 0 points from only fruits and vegetables to more than 200 foods. A backbone of the plan is multi-model access (via in-person meetings, online chat or phone) to support from people who lost weight using Weight Watchers, kept it off and have been trained in behavioral weight management techniques. It ranked #6 as well for best diet for diabetes. (42) Also good for those that need support group-based approach to losing and maintaining weight loss. For more information see: <https://health.usnews.com/best-diet/weight-watchers-diet> (93)

Technology

For individuals who rely on technology for assistance in managing their daily activities there are several diabetes specific as well as nutrition and physical activity smart phone applications (Apps) available at no charge or for a subscriber's fee. A list of some of the more popular are included here and are available either as downloads from the company website or the Apple and Android stores. There are many other Apps available on the Apple and Android stores. Each App has different data that is collected, and usefulness will depend on the individual user, their specific needs and interests and the potential to use and interact with their healthcare team.

• Cronometer	• Glooko	• Health2Sync
• DietSensor	• Glucose Buddy	• Nutritionix

IN-DEPTH APPROACHES

The following are approaches that are more in-depth for individuals who are motivated to follow a more structured, focused meal plan and who are able to more actively engage in meal planning and advanced carbohydrate counting.

Individualized Menus Provided by a RD/RDN

Many PWD like to have examples to follow when setting up meal plans. The menu describes in writing what foods and what quantities should be consumed over a period of days. A dietitian

creates an individualized menu based on the specific nutritional counseling plan and incorporates the PWD's unique preferences, schedule, etc. The person then has written examples to follow, and over time may learn how to independently create their own menus and substitutions to fit their individual lifestyle.

Month of Meals

These menus were created by committees of the Council on Nutritional Science and Metabolism of the American Diabetes Association, and staff of the American Diabetes Association National Service Center in response to frequent requests for menus from PWD and their families. The menus are designed to follow the exchange groups and provide 45-50% of calories from CHO, 20% protein, and about 30% fat. The menus provide 1200 or 1800 calories, and instructions are provided on how to adjust caloric levels upward or downward. Each menu provides 28 days of breakfast, lunch, dinner and snacks with a different focus to help make planning meals easier.

(94)

Exchange List Approach

The Exchange Lists for Meal Planning were developed by the American Diabetes Association and the Academy of Nutrition and Dietetics, and have been in existence since 1950. It's now in its seventh edition as *Choose Your Foods: Food Lists for Diabetes*. The concept is that foods are grouped according to similar nutritional value, and can be exchanged or substituted in the portion size listed within the same group. In 1995, the exchange lists were revised from 6 food groups to 3. They include:

- Carbohydrate group – includes starches, fruit, milk and vegetable
- Meat and Meat Substitutes group – four meat categories based on the amount of fat they contain.
- Fat group – contains three categories of fats based on the major source of fat contained: saturated, polyunsaturated or monounsaturated.

The exchange lists also give information on fiber and sodium content. They can be utilized for people with type 1 or 2 diabetes. The emphasis for type 1 is on consistency of timing and amount of food eaten, while for type 2, the focus is on controlling the caloric values of food consumed.

(95) Use of the exchange list may be helpful for some PWD while others may benefit by learning from other carbohydrate counting resources available online and through numerous publications and resources.

Advanced Carbohydrate Counting

Although CHO counting has been used seemingly effectively for many people with type 1 diabetes, very few clinical trials have been undertaken to report actual outcomes. The results of the first randomized clinical trial designed to test the effects of CHO counting in adults with type 1 diabetes treated with continuous subcutaneous insulin infusion (CSII) concluded that there was an improved Diabetes-Specific Quality-of-Life Scale score related to diet restrictions, and CHO counting was also associated with a modest, although significant, decrease in BMI and waist circumference. When PWD who did not continuously use CHO counting or CSII during the study were excluded from the analyses, CHO counting was also associated with a significant reduction in A1C without an increase in hypoglycemic events. (96) A more recent published

meta-analysis on effects of advanced CHO counting revealed a trend toward reduction in A1C, but no significant evidence to definitively determine the effects on glycemic control, weight, psychosocial measures, or hypoglycemic events. (97)

For those PWD managed by insulin and at a more advanced level, the focus is to finely tune food intake, medication and activity based on patterns from daily food intake and blood glucose records. Record keeping is an important first part of advanced CHO counting. The mealtime, amount and type of food eaten, estimates of CHO intake for each food item containing CHO, and total amount of CHO for each meal and snack must be recorded. Also, insulin dose, physical activity, and blood glucose levels must be accurately documented for several weeks. Any unusual circumstances should be noted such as illness, stress, menstrual cycle, etc.

Ratio and correction factor calculation is another aspect of advanced CHO counting. The insulin-to-CHO ratio helps the person with diabetes understand how much rapid or short-acting insulin is needed to metabolize the CHO that is consumed at a meal or snack. It allows greater flexibility in lifestyle and can improve glucose control. The insulin to carbohydrate ratio (ICR) is the number of grams of carbohydrate that one unit of insulin will “cover”. To calculate the ICR (insulin to carbohydrate ratio), of 1:15, divide the number of grams of CHO for the meal by 15 to determine the number of units of prandial insulin needed to cover the amount of carbohydrate to be consumed. For example, if a person with diabetes plans to eat 75 gms of CHO, they would divide 75 by 15 which equals 5. Five units of prandial insulin are needed to cover 75 grams of carbohydrate for that individual. The ratio should be individualized for each PWD based on individual responses to carbohydrate and considering possible differences in meals and timeframe. (98) It may be helpful to provide worksheets when a PWD begins to use this formula. These are available through numerous diabetes education and research organizations.

An "average" ICR can be 1 unit of insulin for every 10 to 15 grams of CHO for an adult or 1 unit for every 20 to 30 grams of carbohydrate for a school-age child, however careful monitoring of blood glucose and individual response should be evaluated to individualize the ratio.

A correction factor is used to correct a high or low blood glucose level before a meal. The correction factor is added or subtracted to the prandial bolus insulin dose. For example, a factor of 1800 is used for rapid-acting insulin, and 1500 for regular insulin. Thus, if a person uses 60 units of total daily insulin and rapid insulin before meals, the correction factor would be 30 (1800 divided by 60). This means that 1 additional unit of insulin will lower blood glucose by approximately 30 mg/dL. Thus, if the pre-meal blood glucose is 169, and the target glucose is 130 or less, 1 extra unit of insulin should be given with the meal ($169 - 130 = 39$). (98) The diabetes management team can help establish personal ICRs and help educate on specific amount of CHO in grams that are consumed, and appropriate correction factors.

Calorie Counting and Fat Counting

These are meal planning methods that can be useful for people with type 2 diabetes who want to lose weight. Knowledge regarding the number of total calories and fat grams in a given food (including pre-prepared and fast foods) and becoming adept at label reading, can help promote weight loss when incorporated into other lifestyle changes. One of the first studies designed to determine empirically if people can learn a calorie counting system and if estimated food intake improves with training demonstrated that use of the Health Management Resources Calorie System tool (HMRc, Boston, MA, USA) helped to teach people how to estimate food intake more accurately. (99)

Table 2.

RESOURCES FOR DIABETES NUTRITION EDUCATION

➤ Choose My Plate (2019)

www.choosemyplate.gov

➤ Eat Out, Eat Well

Hope S. Warshaw, MMSc, RD, CDE

Your go-to resource for assembling healthy meals in just about any type of restaurant, from fast food to upscale dining and ethnic cuisines.

Order from: The American Diabetes Assn., www.shopdiabetes.org, 1-800-232-6455

➤ The CalorieKing Calorie, Fat & Carbohydrate Counter 2018

Find nutrition facts from your favorite brands and chain restaurants

Order from: www.CalorieKing.com or Amazon.com

➤ What Can I Eat? The Diabetes Guide to Healthy Food Choices 2nd Edition

A 28-page guide for planning meals and making the best food choices. Includes carb counting, glycemic index, plate method, eating out, meals/snack ideas, best food choices and more

Order from: The American Diabetes Assn., Inc. www.shopdiabetes.org, 1-800-232-6455

➤ Eating Healthy with Diabetes, 5th Edition

Picture cues for portion sizes and color codes for food types teach how to put together a healthy diet plan to manage diabetes

Order from: The Academy of Nutrition and Dietetics. www.eatright.org or the American Diabetes Assn., Inc. www.shopdiabetes.org.

➤ Diabetes Meal Planning Made Easy & Healthy Portions Meal Measure

Meet your health and nutrition goals with healthy diabetes meal plans, shopping strategies and our handy portion control guide.

Order from: The American Diabetes Association, www.shopdiabetes.org, 800-232-6455

➤ Diabetes Place Mat Kit for People with Diabetes

Order from: NCES Health & Nutrition Information Catalog- Available in Spanish https://www.ncescatalog.com/NCES-MyPlacemat-for-Diabetes_p_1103.html OR

School Health Corporation <https://www.schoolhealth.com/nutrition-place-mat-for-diabetes>

➤ The Complete Month of Meals Collection, 2017

Available from: Amazon.com or American Diabetes Association, 1-800-232-6455; www.shopdiabetes.org

➤ Choose Your Foods: Food Lists for Diabetes

Order from: Academy of Nutrition and Dietetics OR American Diabetes Associations;
www.eatright.org OR <http://shopdiabetes.org> or Amazon.com

Available in Spanish

➤ Diabetes Food Hub www.diabetesfoodhub.org

A website available on the American Diabetes Association site that has meal planning, grocery lists, recipes, menus and healthy substitutions. Section in Spanish available.

➤ The Complete Guide to Carb Counting

American Diabetes Association 4th edition

Has all the expert information you need to practice carb counting, whether you're learning the basics or trying to master more advanced techniques.

Order from American Diabetes Association, <http://shopdiabetes.org> or Amazon.com

➤ Diabetes and Carb Counting for Dummies 1st Edition

Sherri Shafer, RD, CDE

Provides essential information on how to strike a balance between carb intake, exercise, and diabetes medications while making healthy food choices. — Covering the latest information on why carb counting is important for Type 1 diabetes, Type 2 diabetes, and gestational diabetes.

Available at Amazon.com

The resources listed above are a sampling of the many available, primarily from the American Academy of Nutrition and Dietetics and the American Diabetes Association. There are several other organizations and websites which have educational materials available for persons with diabetes. A few which should be mentioned with their websites include:

-----Diabetes Care and Education (www.dce.org/public-resources/diabetes) sponsored by the Academy of Nutrition and Dietetics, has a good list of diabetes resource websites

-----Joslin Diabetes Center (www.joslin.org)

-----National Diabetes Education Program (www.ndep.nih.gov; www.diabetes.niddk.nih.gov)

-----Many pharmaceutical companies also have free nutrition education materials which can be obtained for persons with diabetes.

SUMMARY

Knowledge and individual application to improve adherence to the core foundational nutrition principles is one of the most important aspects of diabetes lifestyle management. There is no longer such a thing as a 1200 or 1800 calorie ADA diet! The dietary goals covered here, along with other lifestyle changes, if consistently applied, can help to improve metabolic profiles and ultimately help prevent long-term complications associated with diabetes. Motivating the PWD to make changes by working with a diabetes management team to implement an individualized program may help to elicit positive outcomes.

The authors are employees of Eli Lilly & Company, and the content of this chapter reflects their own views and training as Registered Dietitian Nutritionists not that of the company.

REFERENCES

1. Ali M.K, et al. Achievement of Goals in US Diabetes Care: 1999-2010. *N Engl J Med*. 2013;368:1613–24. [PubMed: 23614587]
2. American Diabetes Association. Diabetes Care. 2019 Jan;42 Supplement 1:S46–S60. <https://doi.org>. [PubMed: 30559231] [CrossRef]
3. Clinical Practice Guidelines for Healthy Eating for the Prevention and Treatment of Metabolic and Endocrine Diseases in Adults. Cosponsored by American Association of Clinical Endocrinologists/American College of Endocrinology and The Obesity Society© 2013. *ENDOCRINE PRACTICE*. 2013 September/October;19 Suppl 3 Vol.
4. The Diabetes Control and Complications Trial Research Group, The Effect of Intensive Treatment of Diabetes on the Development and Progression of Long-Term Complications in Insulin-Dependent Diabetes Mellitus. *New England Journal of Medicine*. 1993;329(14):977–86. [PubMed: 8366922]
5. Franz J, et al. Evidence-based diabetes nutrition therapy recommendations are effective: the key is individualization. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*. 2014;7:65–72. [PMC free article: PMC3938438] [PubMed: 24591844]
6. Fineman R.D., et al. Dietary carbohydrate restriction as the first approach in diabetes management: Critical review and evidence base. *Nutrition*. 2015;31:1–13. [PubMed: 25287761]
7. Evert A.B., Boucher J.L., et al. Nutrition Therapy Recommendations For the Management of Adults with Diabetes: Position Statement by the ADA. *Diabetes Care*. 2013;36:3821–42. [PMC free article: PMC3816916] [PubMed: 24107659]
8. Cozma AI, Sievenpiper JL, de Souza R.J., et al. Effect of fructose on glycemic control in diabetes: a systematic review and meta-analysis of controlled feeding trials. *Diabetes Care*. 2012;35:1611–1620. [PMC free article: PMC3379616] [PubMed: 22723585]
9. Position of the Academy of Nutrition and Dietetics. Use of Nutritive and Nonnutritive Sweeteners *Acad Nutr Diet*. 2012;112:739–758.
10. Alexander D. Nichol, Maxwell J. Holle & Ruopeng An Glycemic Impact of Non-nutritive sweeteners: A systemic review and meta-analysis of randomized controlled trials. *European Journal of Clinical Nutrition*. 2018;72:796–804. volume. pages. [PubMed: 29760482]
11. Wendy J. Dahl PhD, RD Maria L. Stewart PhD Position of the Academy of Nutrition and Dietetics: Health Implications of Dietary Fiber *Journal of the Academy of Nutrition and Dietetics*. 2015 November;115(Issue 11):1861–1870. Volume. Pages.
12. Burger KNJ, Beulens JWJ, van der Schouw YT, Sluijs I, Spijkerman AMW, Sluik D, et al. Dietary Fiber, Carbohydrate Quality and Quantity, and Mortality Risk of Individuals with Diabetes Mellitus. *PLoS ONE*. 2012;7(8):e43127. [PMC free article: PMC3426551] [PubMed: 22927948]
13. www.accessdata.fda.gov/scripts/interactivenutritionfactslabel/dietary-fiber.html. Accessed January, 2019.
14. https://www.ars.usda.gov/ARUserFiles/80400530/pdf/dbrief/12_fiber_intake_0910.pdf. Accessed January, 2019.
15. Wheeler ML, Dunbar SA, Jaacks LM, et al. Macronutrients, food groups, and eating patterns in the management of diabetes: a systematic review of the literature,2010. *Diabetes Care*. 2012;35:435–445. [PMC free article: PMC3263899] [PubMed: 22275443]
16. <https://www.diabetesfoodhub.org/search-results.html?keywords=fiber+content>, accessed January, 2019.
17. WebMD website <http://www.webmd.com/diet/healthtool-fiber-meter> accessed January, 2019.
18. Liu F., et al. *European Journal of Clinical Nutrition*. 2017;71:pages9–20. volume.

19. www.diabetes.org/food-and-fitness/food/planning-meals/gluten-free/diets accessed February 2019.
20. Svenson, J., et al; Potential beneficial effects of a gluten-free diet in newly diagnosed children with type 1 diabetes: a pilot study, 2016 Jul 7;5(1):994.
21. Millen B.E., et al. 2013 American Heart Association/American College of Cardiology Guideline on Lifestyle Management to Reduce Cardiovascular Risk: Practice Opportunities for Registered Dietitian Nutritionists. *J Acad Nutr Diet.* 2014;114(11):1723–1729. [PubMed: 25439080]
22. Institute of Medicine. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. Washington, DC, National Academies Press, (Internet) 2005. http://nationalacademies.org/hmd/~media/Files/Activity%20Files/Nutrition/DRI-Tables/8_Macronutrient%20Summary.pdf?la=en.
23. Position of the Academy of Nutrition and Dietetics. Dietary Fatty Acids for Healthy Adults. *J Acad Nutr Diet.* 2014;114:136–153. [PubMed: 24342605]
24. https://www.heart.org/idc/groups/heart-public/@wcm/@global/documents/downloadable/ucm_321858.pdf accessed March 2019.
25. Dietary Fats and Cardiovascular Disease A Presidential Advisory From the American Heart Association *Circulation.* 2017;136: e1–e23.
26. Quin F., et al. Metabolic Effects of Monounsaturated Fatty Acid-Enriched Diets Compared With Carbohydrate or Polyunsaturated Fatty Acid-Enriched Diets in Patients With Type 2 Diabetes: A Systematic Review and Meta-analysis of Randomized Controlled Trials. *Diabetes Care.* 2016 Aug;39(8):1448–57. [PMC free article: PMC4955926] [PubMed: 27457635]
27. Imamura F, Micha R, Wu JHY, de Oliveira Otto MC, Otite FO, Abioye AI, et al. Effects of Saturated Fat, Polyunsaturated Fat, Monounsaturated Fat, and Carbohydrate on Glucose-Insulin Homeostasis: A Systematic Review and Metanalysis of Randomized Controlled Feeding Trials. *PLoS Med.* 2016;13(7):e1002087. [PMC free article: PMC4951141] [PubMed: 27434027]
28. <https://my.clevelandclinic.org/health/articles/17290-omega-3-fatty-acids>. Accessed March 2019.
29. <https://www.healthline.com/nutrition/12-omega-3-rich-foods>. Accessed March 2019.
30. https://health.gov/dietaryguidelines/2015/resources/2015-2020_Dietary_Guidelines.pdf .
31. Van Horn L, et al. The evidence for dietary prevention and treatment of cardiovascular disease. *Journal of the American Dietetic Association.* 2008;108:287. [PubMed: 18237578]
32. <https://www.fda.gov/food/ucm292278.htm>. Accessed March 2019.
33. Gupta A.K., et al. Role of phytosterols in lipid lowering: current perspectives. *QJM.* 2011 Apr;104(4):301–8. [PubMed: 21325285]
34. Bard J.M., et al. Effect of phytosterols/stanols on LDL concentration and other surrogate markers of cardiovascular risk. *Diabetes Metab.* 2015 Feb;41(1):69–75. [PubMed: 25497967]
35. <https://www.kidney.org/news/monthly/protein-in-our-diet> .
36. National Kidney Foundation. KDOQI clinical practice guidelines for diabetes and chronic kidney disease. *Am J Kidney Dis.* 2012;49 Suppl 2:S1–S179. pp. [PubMed: 17276798]
37. https://www.joslin.org/info/diet_and_diabetes_a_personalized_approach.html accessed March 20, 2019.
38. Campbell A.P., Rains T.M. Dietary Protein Is Important in the Practical Management of Prediabetes and Type 2 Diabetes. *J Nutr.* 2015 Jan;145(1):164S–169S. [PubMed: 25527675]
- 39.

- Valdés-Ramos R., et al. Vitamins and Type 2 Diabetes Mellitus. *Endocrine, Metabolic & Immune Disorders - Drug Targets*. 2015;15:54–63. [PMC free article: PMC4435229] [PubMed: 25388747]
40. Seida J.C., et al. Clinical review: Effect of vitamin D3 supplementation on improving glucose homeostasis and preventing diabetes: a systematic review and meta-analysis. *J Clin Endocrinol Metab*. 2014 Oct;99(10):3551–60. [PMC free article: PMC4483466] [PubMed: 25062463]
 41. Saneei, P. et al.; Influence of Dietary Approaches to Stop Hypertension (DASH) diet on blood pressure: A systematic review and meta-analysis on randomized controlled trials *Nutrition, Metabolism and Cardiovascular Diseases* 2014 (24):12, 1253–1261.
 42. <https://health.usnews.com/best-diet/best-diabetes-diets> accessed March 2019.
 43. Hruby A., et al. Higher Magnesium Intake Reduces Risk of Impaired Glucose and Insulin Metabolism and Progression From Prediabetes to Diabetes in Middle-Aged Americans. *Diabetes Care*. 2014;37(2):419–427. [PMC free article: PMC3898748] [PubMed: 24089547]
 44. fnic.nal.usda.gov/fnic/dri-calculator/index.php accessed April 2019.
 45. <http://www.diabetes.org/food-and-fitness/food/what-can-i-eat/making-healthy-food-choices/alcohol.html> accessed April 2019.
 46. Diabetes Care and Education, Ready, Set Start Counting! Carbohydrate Counting – a Tool to Help Manage Your Blood Glucose. Diabetes Care and Education, a dietetic practice group of the Academy of Nutrition and Dietetics 2016.
 47. Diabetes Care and Education, Advanced Insulin Management: Using Insulin to Carb Ratios and Correction Factors) Diabetes Care and Education, a dietetic practice group of the Academy of Nutrition and Dietetics 2013, reviewed 2016.
 48. Warshaw, H.S. and Kulkarni K. Complete Guide to Carb Counting, 3rd Edition.
 49. <https://drc.ucsf.edu/living-with-diabetes/diet-and-nutrition/understanding-carbohydrates/counting-carbohydrates/> accessed April 2019.
 50. www.glycemicindex.com;
University of Sydney accessed April 2019.
 51. <https://lpi.oregonstate.edu/mic/food-beverages/glycemic-index-glycemic-load#glycemic-load> accessed April 2019.
 52. Marsh K., et al. Glycemic index and glycemic load of carbohydrates in the diabetic diet. *Curr Diab Rep*. 2011;11:120–127. [PubMed: 21222056]
 53. Wolpert, H.; American Diabetes Association, Intensive Diabetes Management, 6th edition; 2016.
 54. Virtanen, Suvi; Medical Nutrition Therapy of Children and Adolescents with Diabetes; Diabetes in Childhood and Adolescence, *Pediatr Adolesc Med*. Basel, Karger, 2005, vol 10, pp139-149.
 55. Smart CE, et al. ISPAD Clinical Practice Consensus Guidelines 2018: Nutrition Management in Children and Adolescents with Diabetes. *Pediatric Diabetes*. 2018 October;19 Suppl.27:136–154. [PubMed: 30062718]
 56. <https://www.choosemyplate.gov> accessed April 2019.
 57. <https://www.mayoclinic.org/diseases-conditions/diabetic-hypoglycemia/symptoms-causes/syc-20371525> accessed April 2019.
 58. <http://www.diabetes.org/living-with-diabetes/treatment-and-care/whos-on-your-health-care-team/when-youre-sick.html> accessed April 2019.
 59. Shugart C, Jackson J, Fields KB. Diabetes in sports. *Sports Health*. 2010;2(1):29–38. [PMC free article: PMC3438860] [PubMed: 23015921]

60. Powers, M.A., Handbook of Diabetes Medical Nutrition Therapy.
61. Kaufman FR, ed. Medical Management of Type 1 Diabetes. 6th ed. Alexandria, VA: American Diabetes Association; 2012.
62. <http://www.diabetes.org/living-with-diabetes/treatment-and-care/blood-glucose-control/hypoglycemia-low-blood.html> accessed April 2019.
63. Centers for Disease Control and Prevention. National Diabetes Statistics Report, 2017. Atlanta, GA: Centers for Disease Control and Prevention, U.S. Dept of Health and Human Services; 2017.
64. Diabetes Care. 2007 May;30(5):1219–1225. <https://doi.org>. [PubMed: 17259468] [CrossRef]
65. D’Adamo E, Caprio S. Type 2 diabetes in youth: epidemiology and pathophysiology. Diabetes care. 2011;34:s161–5. [PMC free article: PMC3632155] [PubMed: 21525449]
66. Van Dam RM, et al. Dietary patterns and risk for type 2 diabetes mellitus in U.S. men. Ann Int Med. 2002;136:201–208. [PubMed: 11827496]
67. Lindstrom J., et al. The Finnish Diabetes Prevention Study (DPS): Lifestyle intervention and 3-year results on diet and physical activity. Diabetes Care. 2003;26(12):3230–3236. [PubMed: 14633807]
68. Saristo T, et al. Lifestyle intervention for prevention of type 2 diabetes in primary care: one year follow-up of the Finnish national diabetes prevention program (FIN-D2D). Diabetes Care. 2010;33(10):2146–2151. [PMC free article: PMC2945150] [PubMed: 20664020]
69. Diabetes Prevention Program Research Group. Reduction in the incidence of Type 2 diabetes with lifestyle intervention or Metformin. N Engl Jour Med. 2002;346(6):393–403. [PMC free article: PMC1370926] [PubMed: 11832527]
70. Katula J, et al. One year results of a community-based translation of the diabetes prevention program. Diabetes Care. 2011;34:1451–1457. [PMC free article: PMC3120203] [PubMed: 21593290]
71. Katula, J. et al; The Healthy Living Partnerships to Prevent Diabetes Study 2-Year Outcomes of a Randomized Controlled Trial, Am J Prev Med. 2013 Apr; 44(4 0 4): S324–S332.
72. Lim, E.L.,et al; Reversal of type 2 diabetes: normalization of beta cell function in association with decreased pancreas and liver triacylglycerol, Diabetologia, 2011, published online.
73. Taylor R. Banting Lecture 2012, Reversing the twin cycles of Type 2 diabetes. Diabet Med. 2013 Mar;30(3):267–275. [PMC free article: PMC3593165] [PubMed: 23075228]
74. Sacks FM, Bray GA, Carey VJ, et al. Comparison of Weight-Loss Diets with Different Compositions of Fat, Protein, and Carbohydrates. N Engl J Med. 2009;360:859–873. [PMC free article: PMC2763382] [PubMed: 19246357]
75. Elhayany A, et al. A low carbohydrate Mediterranean diet improves cardiovascular risk factors and diabetes control among overweight patients with type 2 diabetes mellitus: a 1-year prospective randomized intervention study. Diabetes Obes Metab. 2010 Mar;12(3):204–9. [PubMed: 20151996]
76. Tay J., et al. Comparison of low- and high-carbohydrate diets for type 2 diabetes management: a randomized trial. The American Journal of Clinical Nutrition. 2015 October;102(Issue 4):780–790. Volume. Pages. [PubMed: 26224300]
77. www.nwronline.com accessed March 2019.
78. Bloomgarden Zachary. Type 2 Diabetes in the Young. Diabetes Care. 2004;27(4):998–1010. [PubMed: 15047665]
- 79.

- Mayer-Davis E., et al. Incidence Trends of Type 1 and Type 2 Diabetes among Youths, 2002–2012. *N Engl J Med.* 2017;376:1419–1429. [PMC free article: PMC5592722] [PubMed: 28402773]
80. <https://www.joslin.org/info/diabetes-and-nutrition.html> accessed March 2019.
 81. <https://oldwayspt.org/resources/oldways-mediterranean-diet-pyramid> accessed March 2019.
 82. <https://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/> accessed March 2019.
 83. Geil, P and Ross, T.A.; What Do I Eat Now? A Step-by-Step Guide to Eating Right with Type 2 Diabetes, 2015.
 84. <https://www.schoolhealth.com/nutrition-place-mat-for-diabetes.com> accessed April 2019.
 85. <http://www.diabetes.org/food-and-fitness/food/planning-meals/create-your-plate/> Accessed April 2019.
 86. <https://www.nhlbi.nih.gov/health-topics/dash-eating-plan> accessed April 2019.
 87. <https://health.usnews.com/best-diet/flexitarian-diet> accessed April 2019.
 88. <https://health.usnews.com/best-diet/volumetrics-diet> accessed April 2019.
 89. <https://diet.mayoclinic.org/diet/how-it-works> accessed April 2019.
 90. <https://www.jennycraig.com/> accessed April 2019.
 91. <https://www.ornish.com/proven-program/nutrition> accessed April 2019.
 92. <https://health.usnews.com/best-diet/vegan-diet> accessed April 2019.
 93. <https://health.usnews.com/best-diet/weight-watchers-diet> accessed April 2019.
 94. The American Diabetes Association Month of Meals Diabetes Meal Planner Paperback–October 8, 2010 American Diabetes Association.
 95. Choose Your Foods: Food Lists for Diabetes; 2014 Academy of Nutrition and Dietetics, American Diabetes Association.
 96. Laurenzi A, et al. Effect of carbohydrate counting and glucose control on quality of life over 24 weeks in adult patients with type 1 diabetes on continuous subcutaneous insulin infusion. *Diabetes Care.* 2011;34:823–827. [PMC free article: PMC3064035] [PubMed: 21378215]
 97. Schmidt S., et al. Effects of advanced carbohydrate counting in patients with Type 1 diabetes: a systematic review. *Diabet. Med.* 2014;31:886–896. [PubMed: 24654856]
 98. Kulkarni, KH; Carbohydrate Counting: A practical meal planning option for people with diabetes; *Clin Diab* 2005 23, (3) 120-22.
 99. Martin C, et al. Empirical evaluation of the ability to learn a calorie counting system and estimate portion size and food intake. *British Jour of Nutrition.* 2007;94:439–444. [PubMed: 17397559]
 100. Workinger J, et al. Challenges in the Diagnosis of Magnesium Status. *Nutrients.* 2018;10(9):1202. [PMC free article: PMC6163803] [PubMed: 30200431]
 101. American Heart Association Infographic, Four Ways to Get Good Fats, 2018, <https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/healthy-cooking-oils> accessed online 03. May 2019.
 102. Shah SR, et al. Use of dark chocolate for diabetic patients: a review of the literature and current evidence. *Journal of Community Hospital Internal Medicine Perspectives.* 2017;7(No. 4):218–221. Vol. [PMC free article: PMC5699188] [PubMed: 29181133]
 103. Malinowski B, et al. Intermittent Fasting in Cardiovascular Disorders-An Overview. *Nutrients.* 2019 Mar 20;11(3):E673. pii. [PMC free article: PMC6471315] [PubMed: 30897855]
 104. Drummen M, et al. Dietary protein and energy balance in relation to obesity and co-morbidities. *Frontiers in Endocrinology.* 2018;9:443. Volume. Article. [PMC free article: PMC6087750] [PubMed: 30127768]
 - 105.

<https://www.health.harvard.edu/vitamins-and-supplements/health-benefits-of-taking-probiotics>
accessed August 20, 2019.

106. Shah, et al. EMJ Diabet. 2017;5(1):104–110.
107. Barengolts E., et al. The Effect of Probiotic Yogurt on Glycemic Control in Type 2 Diabetes or Obesity: A Meta-Analysis of Nine Randomized Controlled Trials. *Nutrients*. 2019;11(3):671. [PMC free article: [PMC6471569](#)] [PubMed: 30897796]
108. Everett Alison B., et al. Nutritional Recommendations for Adults with Prediabetes and Diabetes: A Consensus Report. *Diabetes Care*. 2019;42:731–754. [PMC free article: [PMC7011201](#)] [PubMed: 31000505]
109. www.efsa.europa.eu/en/corporate/pub/factsheetaspartame accessed August 17, 2019.
110. www.cancer.org/cancer/cancer-causes/aspartame accessed August 17, 2019.

Copyright © 2000-2023, MDText.com, Inc.

This electronic version has been made freely available under a Creative Commons (CC-BY-NC-ND) license. A copy of the license can be viewed at <http://creativecommons.org/licenses/by-nc-nd/2.0/>.

Bookshelf ID: NBK279012 PMID: 25905243