

# Lifestyle Intervention

## Nutrition Therapy and Physical Activity



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### KEYWORDS

- Medical nutrition therapy • Weight loss • Carbohydrate • Lifestyle intervention
- Physical activity • Exercise

### KEY POINTS

- An individualized nutrition plan should be discussed with patients in a series of encounters with a registered dietitian starting at the time of diabetes diagnosis.
- Diabetes meal planning approaches should include instruction on a variety of topics including carbohydrate counting, healthy food choices, glycemic index, Mediterranean-style diet, low and high sodium foods, low-fat and low-carbohydrate diets.
- Early engagement in physical activity halts or slows the progression of type 2 diabetes development. Activities should include aerobic activities (at least 150 minutes per week) and resistance training 2-3 days per week.
- Accommodation to permit physical activity engagement for all patients with obesity and or diabetes should be performed.
- For patients attempting to lose weight, a mild to moderate daily energy deficit is needed (10-25% relative caloric restriction).

### INTRODUCTION

Diabetes and obesity are major health concerns in the United States.<sup>1-5</sup> It is estimated that more than 3 out of every 4 adults with diabetes are overweight.<sup>6</sup> In a nationally representative sample of US adults, the prevalence of diabetes was found to increase with increasing weight classes.<sup>7</sup> The survey revealed that nearly one-fourth of adults with diabetes in this sample had poor glycemic control (defined as hemoglobin A1c [HbA1c] level >8.0%) and nearly half were considered obese.<sup>7</sup> Being obese with diabetes increases insulin resistance and negatively affects glucose tolerance, thereby making glycemic targets more difficult to achieve pharmacologically.

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Public health authorities and medical professionals have recommended weight loss as a therapeutic strategy for patients who are obese or who are overweight with comorbid conditions such as diabetes for several years.<sup>8</sup> The 1998 Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults state that, “the initial goal of weight loss therapy should be to reduce body weight by approximately 10% from baseline.”<sup>9</sup> Recommended weight-loss strategies included a low-calorie diet to create a deficit of 500 to 1000 kcal/d, behavior therapy, and increased physical activity. More recently, lifestyle intervention strategies have been incorporated into clinically effective diabetes prevention trials around the world.<sup>5,10,11</sup> These strategies have also been found to be integral components of the treatment and management of type 2 diabetes, with documented improvements in weight, depression scores, quality of life, and various biochemical markers of health status.<sup>12,13</sup> Lifestyle intervention seems to be particularly beneficial early in the natural history of type 2 diabetes, before loss of beta cell function and mass becomes so extensive that multidrug pharmacotherapy is required to achieve optimal glycemic control.<sup>14,15</sup>

As type 2 diabetes progresses over the years with the continued loss of beta cell function and enduring insulin resistance, medications are often added to the treatment plan to achieve optimal glycemic control. From a lifestyle perspective, a reduced energy intake with an emphasis on nutrient-dense, fiber-rich foods (**Box 1**) along with regular physical activity should be priorities for all individuals living with type 2 diabetes.<sup>2</sup> However, people with diabetes, as well as their health care providers, are reluctant to initiate the use of medication for fear of weight gain. Referral to a registered dietitian (RD) for nutrition therapy has been shown to help mitigate this unwanted side effect of treatment.<sup>16–20</sup> In addition, successful lifestyle intervention typically reduces the reliance on pharmacologic agents to achieve glycemic targets.<sup>12</sup> Therefore, regardless of duration of diabetes in years, nutrition therapy remains a key treatment strategy.

Because of the importance of physical activity in enhancing weight loss and supporting weight maintenance, and the increasingly strong evidence that increased physical activity and fitness level can affect health independently of body mass index,<sup>21</sup> it is important to have interventions available that can lead to sustained changes in physical activity. The role of physical activity in treatment of type 2 diabetes is elaborated later in this article.

**Box 1****Nutrient-dense foods**

Nutrient density is a measure of the amount of nutrients a food contains compared with the number of calories. A food is more nutrient dense when the level of nutrients is high in relation to the number of calories the food contains.

Nutrient-dense food choices include the following:

- Grains, especially whole grains
- Fruits and vegetables: fresh, frozen, or canned with so-called lite sodium
- Fat-free or low-fat milk or dairylike products
- Lean protein sources or meat alternatives such as beans, lentils, and unsalted nuts
- Substitute unsaturated (liquid fats such as olive, canola, corn, safflower oil) for foods higher in saturated (solid fats) or *trans* fats as much as possible.

## **NONPHARMACOLOGIC TREATMENT OPTIONS: LIFESTYLE INTERVENTION: NUTRITION THERAPY**

In a recent position statement for the management of hyperglycemia in type 2 diabetes the American Diabetes Association (ADA) and European Association for the Study of Diabetes endorse a patient-centered approach.<sup>22</sup> At diagnosis, before initiating pharmacotherapy, highly motivated patients with HbA1c already near target levels (eg, 7.5%) should be given the opportunity to participate in lifestyle change for a period of 3 to 6 months. Individuals with moderate hyperglycemia or in whom lifestyle changes are anticipated to be unsuccessful could be started on an antihyperglycemic agent (usually metformin) at diagnosis, which can later be modified or possibly discontinued if lifestyle changes are successful. Pharmacologic treatment options for type 2 diabetes are discussed in detail elsewhere in this issue.

### ***Diabetes Nutrition Therapy: How Is It Provided?***

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People with diabetes should ideally be referred to an RD, and preferably one who is knowledgeable and skilled in providing diabetes medical nutrition therapy (MNT) soon after diagnosis.<sup>23</sup> Another option is participation in a comprehensive diabetes self-management education (DSME) program that includes instruction on nutrition.<sup>23</sup> Many insurance plans and Medicare cover MNT and DSME. These services require a referral or prescription from the health care provider and it is important to confirm coverage in advance of receiving service. Some insurance plans require preauthorization before diabetes self-management or nutrition consultation services are covered. Medicare typically covers up to 10 hours of initial DSME and 3 hours of MNT, and up to 2 hours of each type of service in subsequent years. However, national data in the United States indicate that only about a half of all persons with diabetes receive diabetes education and even fewer see an RD.<sup>6</sup> One study of more than 18,000 people with diabetes revealed that only 9.1% had at least 1 nutrition visit within a 9-year period.<sup>24</sup>

### ***Diabetes Medical Nutrition Therapy: The Process***

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MNT is based on an assessment of lifestyle changes that would assist the person with diabetes in achieving and maintaining clinical goals<sup>3</sup> and has been shown to be effective in diabetes management.<sup>2</sup> The Academy of Nutrition and Dietetics Evidence-Based Nutrition Practice Guidelines recommend the following structure for the implementation of MNT for adults with diabetes<sup>25</sup>:

- A series of 3 to 4 encounters with RDs lasting from 45 to 90 minutes
  - The series of encounters should begin at diagnosis of diabetes or at first referral to an RD for MNT for diabetes and should be completed within 3 to 6 months.
- The RD should determine whether additional MNT encounters are needed.
- At least 1 follow-up encounter is recommended annually to reinforce lifestyle changes and to evaluate and monitor outcomes that indicate the need for changes in MNT or medications.
  - An RD should determine whether additional MNT encounters are needed.

The RD prioritizes nutrition therapy based on a thorough nutrition assessment of the individual. Once an assessment has been completed, the RD determines the nutrition diagnosis, which includes the presence of, risk of, or potential for developing a nutritional deficit that can be addressed by nutrition therapy. Nutrition interventions are specific actions to remedy the nutrition diagnosis and can include clinical and behavioral goals collaboratively agreed on with the person with diabetes, as well as specific

nutrition intervention strategies. These strategies might include selecting a meal-planning strategy such as carbohydrate counting or the plate method, or education on topics such as how to read food labels, portion control, or tips for eating out. In addition, monitoring outcomes and providing ongoing support are also key components of MNT.

### ***Individualization of the Eating Plan***

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The ADA 2013 position statement, *Nutrition Therapy: Recommendations for the Management of Adults with Diabetes* recommends the development of an individualized eating plan as needed to achieve treatment goals with ongoing support and encouragement to assist with health behavior change.<sup>2</sup> The eating plan should be based on the individual's personal and cultural preferences, literacy and numeracy, and readiness to change, because there is no single eating plan that meets the needs of all adults with diabetes. Food choices should not be limited unnecessarily but should be guided by scientific evidence and the need to delay or prevent complications of diabetes.

In the past a nutrition prescription included a specified calorie level and macronutrient percentage. However, despite efforts since 1994 to promote the individualization of the meal plan, the ADA diet continues to be prescribed. A recent systematic review found that there continues to be no ideal macronutrient distribution for the nutritional management of diabetes.<sup>26</sup> Research has also shown that a wide variety of diabetes meal-planning approaches and eating patterns can be clinically effective, with many including a reduced energy component.<sup>2</sup> Examples include carbohydrate counting, healthy food choices, glycemic index, as well as eating patterns such as the Mediterranean-style diet, Dietary Approach to Stop Hypertension, vegan or vegetarian, and low-fat and low-carbohydrate diets.

### **NONPHARMACOLOGIC TREATMENT OPTIONS: LIFESTYLE INTERVENTION: PHYSICAL ACTIVITY**

Regular physical activity can help people with type 2 diabetes achieve a variety of goals,<sup>27,28</sup> including:

- Increased cardiorespiratory fitness and vigor
- Improved glycemic control
- Decreased insulin resistance
- An improved lipid profile
- Reduced blood pressure
- Maintenance of a healthy body mass after weight loss
- Less depression and anxiety
- Less sleep apnea
- Less medication use
- An overall improved quality of life

However, it is doubtful whether increased physical activity provides significant protection against premature mortality from heart disease and stroke in patients already diagnosed with type 2 diabetes.<sup>12</sup> Nonetheless, a healthful eating plan and regular exercise when implemented soon after diagnosis in a real-world health care setting improves markers of inflammation and the cardiovascular risk profile in patients with type 2 diabetes.<sup>29</sup> In adolescents with type 2 diabetes, regular physical activity is associated with lower HbA1c levels, lower body mass index, and higher HDL-cholesterol levels but not lower medication use.<sup>30</sup>

### Definitions and Types of Activity

Physical activity is defined as any body movement caused by the contraction of skeletal muscle that substantially increases energy expenditure.<sup>31</sup> Physical activity comes in a variety of forms and may be performed during a person's occupation or as a leisure activity. It can also be performed at a range of intensities and this is typically expressed either in absolute terms (eg, metabolic equivalents, mL/kg/min, kcal/min), or in relative terms (eg, percent heart rate reserve, percent maximal oxygen consumption [ $V_{O_{2max}}$ ], ratings of perceived exertion scale).

Exercise is a structured form of physical activity that can be prescribed as a therapeutic dose with a recommended type, intensity, and volume (ie, duration and frequency). Aerobic exercise, such as walking, bicycling, or jogging, is physical activity that involves continuous, rhythmic movements of large muscle groups lasting for at least 10 minutes at a time. Resistance exercise is physical activity involving brief repetitive exercises with weights, weight machines, resistance bands, or the person's own body weight to increase muscle strength (eg, pushups, sit-ups, and pull-ups). Flexibility exercise, such as lower back or hamstring stretching, is a form of activity that enhances the ability of joints to move through their full ranges of motion.

### Recommendations on Type, Intensity, and Volume of Exercise

The American College of Sports Medicine and the ADA joint Position Stands recommendations suggest both aerobic and resistance-type exercise for people with prediabetes or type 2 diabetes.<sup>32</sup> A summary of recommendations is shown in [Table 1](#). A goal of 150 minutes per week of accumulated moderate-intensity aerobic exercise is recommended for all patients with diabetes as long as this volume of exercise can be tolerated by the individual.<sup>32</sup> In general, aerobic exercise in the form of brisk walking on level ground, cycling, or recumbent cycling for those with joint pain with walking, are preferred activities for overweight/obese elderly patients with diabetes.<sup>33</sup>

Definitions, Examples and Frequency	Intensity	Examples
Aerobic exercise: rhythmic, repeated, and continuous movements of large muscle groups for at least 10 min at a time	Moderate: 50%–70% of person's maximum heart rate, or 40%–60% of heart rate reserve, or about 4–6 metabolic equivalents	Brisk walking (9–12 min per km [15–20 min per mile]), dancing, continuous swimming, biking, raking leaves, water aerobics
Performed daily or every other day Total amount = 150–175 min/wk (moderate to vigorous intensity)	Vigorous: >70% of a person's maximum heart rate, or 60%–85% of heart rate reserve, or about 6–8 metabolic equivalents	Jogging, walking up an incline, aerobics, team sports (soccer, hockey, basketball), fast swimming, fast dancing
Resistance exercise: activities that use muscular strength to move against a weight or against a load <sup>a</sup>	Start with 1 set of 10–15 repetitions at moderate weight	Exercise with weight machines Weight lifting
Performed 2–3 times per week	Progress to 2 sets of 10–15 repetitions Progress to 3 sets of 8 repetitions at heavier weight	Sit-ups, pull-ups (assisted), and pushups (modified if necessary)

<sup>a</sup> Initial instruction and periodic supervision by a qualified exercise professional are recommended.

More vigorous activities, such as walking up hills or jogging, can be encouraged for middle-aged and younger patients. In addition, resistance exercise performed 2 or 3 times per week provides additional benefits that complement those of aerobic training (eg, increased lean mass and strength, reduced body fat, increased resting metabolic rate).<sup>34,35</sup>

## TREATMENT RESISTANCE AND COMPLICATIONS: NUTRITION THERAPY AND PHYSICAL ACTIVITY

It is essential that people with diabetes are actively involved with health professionals to collaboratively develop appropriate nutrition interventions and an individualized eating pattern that they can implement. Multiple encounters to provide education and counseling initially and on a continued basis are also essential.<sup>36</sup> Because of the progressive nature of type 2 diabetes, nutrition therapy recommendations often need to be adjusted over time based on changes in life circumstance, preferences, and disease course. Progression of diabetes complications may be modified by improving glycemic control, reducing blood pressure, and reducing fat intake.<sup>2</sup>

Because cardiovascular disease (CVD) is a common cause of death among individuals with and without diabetes, nutrition recommendations similar to those for the general population to manage CVD risk factors should be followed. The Dietary Guidelines for Americans 2010 recommendations include reducing saturated fats to less than 10% of calories, aiming for 300 mg of dietary cholesterol per day, and limiting *trans* fat as much as possible.<sup>37</sup> In people with type 2 diabetes, a Mediterranean-style, monounsaturated fatty acid-rich eating pattern may also benefit glycemic control and CVD risk factors and can, therefore, be recommended as an effective alternative to a lower-fat, higher-carbohydrate eating pattern.<sup>2,14,38–40</sup>

Evidence from 2 meta-analyses shows no clear benefits for individuals with diabetic neuropathy on renal parameters from protein-restricted diets.<sup>41,42</sup> Therefore reducing protein intake to less than the usual intake for people with diabetes and diabetic kidney disease (either microalbuminuria or macroalbuminuria) is not recommended because it does not alter glycemic measures, cardiovascular risk measures, or the course of glomerular filtration rate decline.<sup>2</sup>

Although regular physical activity is clearly beneficial for patients with diabetes, compliance with recommendations is often poor. Compared with physical activity advice only, supervised programs involving both aerobic and resistance exercise are associated with better improvements in glycemic control in people with type 2 diabetes.<sup>43</sup> Supervision helps with instruction, safety, motivation, and the capacity to overcome any physical barriers. Unsupervised exercise programs usually fail to improve glycemic control on their own, but can be associated with improved HbA1c levels if they are done with dietary intervention.<sup>43</sup> Exercise dropout remains a major limitation, with ~ 60% of patients failing to maintain both aerobic and resistance-type exercises after a lifestyle intervention.<sup>44</sup> However, motivational interviewing following a lifestyle intervention improves the maintenance of physical activity in people with type 2 diabetes.<sup>45</sup>

Although having diabetes increases the risk of having underlying CVD and other comorbidities, there is little evidence to suggest that moderate-intensity exercise triggers adverse cardiovascular events or worsens disease complications in people with diabetes.<sup>46</sup> Nonetheless, before beginning a program of vigorous physical activity, people with diabetes should be assessed for conditions that might increase risks associated with certain types of exercise or predispose them to injury.<sup>33</sup> Before

establishing an exercise prescription, health care providers should pay attention to and talk to patients about the following relative contraindications for vigorous exercise<sup>46</sup>:

- Severe autonomic neuropathy (symptoms during exertion may include dizziness)
- Severe peripheral neuropathy (feet should be inspected regularly and proper footwear is required)
- Proliferative retinopathy (should be treated before starting resistance exercise or vigorous aerobic exercise)
- CVD (symptoms may or may not include dyspnea, or chest discomfort)
- Musculoskeletal issues (back, hip, and/or knee problems)

Initial physical assessment before initiating a new program of vigorous exercise should include a resting electrocardiogram and possibly a stress test for individuals with possible CVD.<sup>27</sup> Patients with severe autonomic neuropathy, severe peripheral neuropathy, preproliferative or proliferative retinopathy, and unstable angina should be stabilized and exercise only at a low intensity for brief periods (eg, 10–15 minutes of walking) under appropriate supervision. This type of activity may be best done in a cardiac rehabilitation setting.<sup>47,48</sup> Patients with severe peripheral neuropathy should be instructed to inspect their feet daily, especially on days in which they are physically active, and to wear appropriate footwear.<sup>33</sup> Patients with movement disorders, pain, or any physical limitations should be supervised by a qualified exercise professional.

The risk of hypoglycemia during exercise is of concern for all patients with diabetes who are taking insulin or insulin secretagogues (sulfonylureas and meglitinides). Reductions in insulin administration or oral secretagogues may be needed once the new exercise pattern is established. Patients should be encouraged to monitor their blood glucose levels regularly and to treat hypoglycemia accordingly. As a general rule, patients should indicate in their log books the level of blood glucose just before initiating an exercise session (eg, walking, physically demanding chores) and following every 30 to 45 minutes of sustained activity. Hypoglycemia can be prevented and/or treated by the consumption of 15 to 30 g of fast-acting carbohydrate before exercise or when hypoglycemia develops. If hypoglycemia develops regularly with increased activity levels, perhaps because of a change in routine, then a reduction in exogenous insulin (or oral hypoglycemic agent) should be considered. Patients taking insulin can reduce mealtime insulin by 25% to 50% at the meal before exercise if the activity follows after a meal.<sup>49</sup> Reductions in basal insulin should also be made if the activity is particularly prolonged or regular (every day).

Education on the treatment of mild hypoglycemia includes the assessment of the individual's ability to recognize foods that contain carbohydrate and how these foods affect blood glucose. Based on the 2013 ADA/Endocrine Society Scientific Statement, as a starting point the treatment of hypoglycemia should include carrying carbohydrate foods such as glucose tablets, as well as education on how to use them<sup>50</sup>:

- Take 15 g of glucose or half a cup of fruit juice
- Wait 15 minutes
- Remeasure blood glucose level
- Repeat if hypoglycemia persists

People with diabetes may be more susceptible to adverse events associated with hot environments, perhaps because of reduced capacity to dissipate heat.<sup>51</sup> Thus, elderly patients in particular and those with autonomic neuropathy, cardiac disease,

or pulmonary disease should take care to avoid heat-related illness. Precautions may include exercising indoors in cool environments or outdoors in the early or later hours of the day during hot or sunny days.

### EVALUATION OF OUTCOME: NUTRITION THERAPY AND PHYSICAL ACTIVITY

Diabetes nutrition therapy has been found to be an effective component of a comprehensive group education program or an individualized session.<sup>23</sup> Evidence from meta-analyses, randomized controlled trials, and observational studies shows that nutrition therapy improves metabolic outcomes such as HbA1c, lipids, and blood pressure in people with diabetes.<sup>13,14,16,36,52</sup> Individualized education sessions or group education programs including nutrition therapy have shown HbA1c reductions of 0.5% to 2% for type 2 diabetes.<sup>2-4,16,17,53,54</sup>

The evaluation of exercise interventions can be performed by conducting an initial assessment of exercise fitness and body composition. Maximal exercise testing on a motorized treadmill or cycle ergometer can be useful for exercise prescription and postintervention assessment. This is best done before an intervention, because the appropriate exercise intensity can be prescribed and assessed more accurately when the maximum heart rate or  $VO_{2max}$  is determined from exercise testing by a qualified clinical exercise physiologist or equivalent health care expert. Estimating target heart rate or work rate from age-predicted calculations is simpler but is prone to measurement error and medication interactions with the cardiovascular system. Exercise testing can also be useful for risk stratification, given that lower aerobic capacity and the presence of ischemic changes on electrocardiogram are each associated with higher risks of cardiovascular and overall morbidity and mortality in diabetes<sup>55,56</sup> and in prediabetes.<sup>57</sup> Exercise testing may also help detect coronary disease and allow the aerobic exercise prescription to be below the ischemic threshold. Several other assessments should be considered both as a baseline and as outcome follow-up<sup>58</sup>:

- An assessment of fall risk (eg, the Timed Up and Go Test, Functional Reach Test, Berg Balance Scale, Dynamic Gait Index)
- Baseline physical activity level (pedometer/accelerometer)
- Body composition (bioelectrical impedance, waist circumference)
- Muscle strength (manual muscle testing, handgrip dynamometer, or repetition maximal testing of certain muscle groups)

### LONG-TERM RECOMMENDATIONS: CLINICAL PRIORITIES: NUTRITION THERAPY AND PHYSICAL ACTIVITY

The ADA 2013 nutrition therapy recommendations provide a summary of priority topics for persons with diabetes<sup>2</sup>:

- Portion control with emphasis on choosing nutrient-dense, high-fiber foods, whenever possible, instead of processed foods with added sodium, fat, and sugars.
- Carbohydrate-containing foods and beverages are the greatest determinant of the postmeal blood glucose excursions in people with diabetes, along with the capacity to secrete endogenous insulin. Therefore it is important for individuals with diabetes to know what foods contain carbohydrates (starchy vegetables, whole grains, fruit, milk and milk products, vegetables, and sugar) and how the various forms of carbohydrate influence their glycemia.



- For individuals trying to lose weight, a mild to moderate daily energy deficit is needed (10%–25% relative caloric restriction). Modest weight loss (of >6 kg or ~7.0%–8.5% loss of initial body weight) may provide clinical benefits such as improved glycemia, blood pressure, and/or lipid levels in some individuals with diabetes, especially those early in the disease process. Intensive lifestyle interventions (counseling about nutrition therapy, physical activity, and behavior change) with ongoing support are recommended to achieve and sustain a modest energy deficit until a goal weight is achieved.
- Limitation of any caloric sweetener, including high-fructose corn syrup and sucrose, reduces risk of worsening the cardiometabolic risk profile and weight gain.<sup>2</sup> The term free fructose refers to the consumption of fructose that is naturally occurring in foods such as fruit, and does not include the fructose that is found in the form of the disaccharide sucrose or the fructose in high-fructose corn syrup.<sup>2</sup> It seems that free fructose is not more harmful than other forms of sugar unless it is consumed in excessive amounts (>12% of the total caloric intake).<sup>59,60</sup>
- The selection of lean protein sources and meat alternatives and the substitution of foods high in unsaturated fat (liquid oils) should be preferred rather than those high in *trans* or saturated fats. Fat quality seems to be more important than quantity.
- Micronutrients, vitamins, herbal products, and supplements are not recommended for management of diabetes because of a lack of evidence at this time. However, without well-designed clinical trials to prove efficacy, the benefit of pharmacologic doses of micronutrients and supplements is unknown, and findings from small clinical and animal studies is frequently extrapolated to clinical practice.<sup>61</sup>
- Use of nonnutritive sweeteners (NNS), also commonly referred to as artificial sweeteners, continues to be an area of much debate and misinformation. The US Food and Drug Administration has reviewed several types of hypocaloric sweeteners (eg, aspartame, sucralose, saccharin, and sugar alcohols) for safety and has approved them for consumption by the general public, including people with diabetes.<sup>62</sup> **Table 2** shows the acceptable daily intake of popular nonnutritive sweeteners (based on a 70-kg [150-lb] adult). Research supports that nonnutritive sweeteners do not produce a glycemic effect; however, foods containing

Type of Sweetener	Acceptable Daily Intake <sup>a</sup> (mg/kg Body Weight)	Amount of Diet Soda/Day (355-mL [12-ounce] can)	Amount of Artificial Sweetener (Packets)
Aspartame	50	17	97
Saccharin	5	2	9
Sucralose	5	5	68
Acesulfame K	15	26	20
Stevia	0–4	<sup>b</sup>	30

<sup>a</sup> The US Food and Drug Administration sets an acceptable daily intake (ADI) for each sweetener, which is the maximum amount considered safe to consume each day during a person's lifetime. The ADI is set at about 100 times less than the smallest amount that might cause health concerns, based on studies done in laboratory animals.

<sup>b</sup> Product information not available; sodas containing Stevia are not widely available.

NNSs may affect glycemia based on other ingredients in the product.<sup>63</sup> In a recently published meta-analysis that included 15 randomized controlled trials, the use of NNSs and other low-calorie sweeteners (LCSs) such as sugar alcohols was associated with lower body weight, BMI, and waist circumference when substituted for calorically dense alternatives. The meta-analysis also included 9 cohort studies that reported that the use of NNSs and LCSs were associated with less weight gain but a slightly greater BMI.<sup>64</sup>

- The recommendation for the general population to limit sodium intake to less than 2300 mg/d is also appropriate for individuals with diabetes. Lower levels should only be considered on an individual basis for people with diabetes and hypertension.
- Moderate alcohol consumption (1 drink/d or less for adult women and 2 drinks/d or less for adult men) has minimal acute or long-term effects on blood glucose and may have beneficial effects on cardiovascular risk. To reduce the risk of hypoglycemia for individuals using insulin or insulin secretagogues, alcohol should be consumed with food.

Key strategies for individuals requiring medications or insulin include:

- Eating moderate amounts of carbohydrate at meals (and snacks, if desired)
- Not skipping meals
- If on a multiple-daily injection plan or an insulin pump, take mealtime insulin before eating
- If on a premixed or fixed insulin plan, meals need to be eaten at similar times every day and contain similar amounts of carbohydrate that match set doses of insulin

According to the ADA/American College of Sports Medicine position statement<sup>32</sup> and the guide to prescribing physical activity for patients with diabetes by Colberg<sup>65</sup>:

- At least 2.5 h/wk of moderate to vigorous physical activity should be undertaken as part of lifestyle changes to prevent type 2 diabetes onset in high-risk adults.
- Persons with type 2 diabetes should undertake at least 150 min/wk of moderate to vigorous aerobic exercise spread over at least 3 days during the week, with no more than 2 consecutive days between bouts of aerobic activity.
- In addition to aerobic training, persons with type 2 diabetes should undertake moderate to vigorous resistance training at least 2 to 3 d/wk.
- Supervised and combined aerobic and resistance training may confer additional health benefits, although milder forms of physical activity (such as yoga) have shown mixed results.
- Persons with type 2 diabetes are encouraged to increase their total daily unstructured physical activity.
- Flexibility training may be included but should not be undertaken in place of other recommended types of physical activity.
- Although hyperglycemia can be worsened by exercise in type 1 diabetic individuals who are insulin deficient and ketotic (caused by missed or insufficient insulin), few persons with type 2 diabetes develop such a profound degree of insulin deficiency. As such, individuals with type 2 diabetes may engage in physical activity, using caution when exercising with blood glucose levels exceeding 300 mg/dL (16.7 mmol/L) without ketosis, provided they are feeling well and are adequately hydrated.
- Known CVD is not an absolute contraindication to exercise. Individuals with angina classified as moderate or high risk should likely begin exercise in a supervised cardiac rehabilitation program.

- Patients with intermittent claudication are advised to walk at a speed that induces claudication pain within 3 to 5 minutes. Walking should be stopped when claudication pain is rated as moderate and the patient should rest until the claudication pain has resolved. At that point, the patient should resume walking until moderate claudication pain is induced again. The walking exercise program should begin with exercise and rest cycles of at least 30 minutes and should progress to 60 minutes.<sup>66</sup>
- Individuals with peripheral neuropathy and without acute ulceration may participate in moderate weight-bearing exercise. Comprehensive foot care including daily inspection of feet and use of proper footwear (correct sizing and with custom-made foot beds with some cushioning, if feasible) is recommended for prevention and early detection of sores or ulcers. In general, shoes should:
  - Fit well
  - Be made out of breathable material
  - Have a firm heel
  - Have hook and loop type fasteners or shoelaces
  - Have good shock absorption
  - Not be bent or twisted
  - Have no seams in the toe box
  - Stabilize overpronation or oversupination
- Moderate walking likely does not increase risk of foot ulcers or reulceration in patients with peripheral neuropathy.
- Individuals with cardiac autonomic neuropathy should be screened and receive physician approval and possibly an exercise stress test before exercise initiation. Exercise intensity is best prescribed using the heart rate reserve method with direct measurement of maximal heart rate.
- In individuals with proliferative or preproliferative retinopathy or macular degeneration, careful screening and physician approval are recommended before initiating an exercise program. Activities that greatly increase intraocular pressure, such as high-intensity aerobic or resistance training (with large increases in systolic blood pressure) and head-down activities, are not advised with uncontrolled proliferative disease, nor are jumping or jarring activities, all of which increase hemorrhage risk.
- Individuals with nephropathy often have exercise intolerance. However, exercise training improves cardiovascular risk profile, muscle mass, physical function, and quality of life in individuals with kidney disease<sup>67</sup> and may even be undertaken during dialysis sessions. Animal models suggest that regular exercise delays the progression of diabetic nephropathy<sup>68,69</sup> although good evidence for this in humans is currently lacking. The presence of microalbuminuria per se does not necessitate exercise restrictions.
- Patients with knee pain from osteoarthritis and obesity should be encouraged to participate in modified exercise programs to help with weight loss and improvements in pain, physical function, mental health, and quality of life.<sup>70</sup> Walking, if tolerated, should be encouraged, as should resistance exercise as long as the affected joints are not overly stressed. Other exercise modes, such as recumbent cycling and aquatic exercises, may also help limit knee pain.
- Efforts to promote physical activity should focus on developing self-efficacy and fostering social support from family, friends, and health care providers. Encouraging mild or moderate physical activity may be most beneficial to adoption and maintenance of regular physical activity participation. Lifestyle interventions may have some efficacy in promoting physical activity behavior.

### Box 2 The 5 As

**Assess:** establish current physical activity level and readiness for change (consider the frequency, intensity, duration, and type of activity)

- Not active, not thinking about physical activity
- Not active, ready for physical activity
- Active and ready to maintain or progress

**Advise:** strongly encourage all patients to get more active by reviewing the health risks of inactivity and the benefits of physical activity. Advise on the appropriate amount and type of physical activity.

**Agree:** collaboratively develop goals and a personalized action plan. Provide individually relevant exercise prescriptions, time frames, and monitoring of strategies to meet the goals.

**Assist:** identify personal barriers and strategies to overcome barriers. Identify connections and resources for exercise and physical activity in the community.

**Arrange:** specify plan for follow-up at diabetes-focused visits with telephone calls or email reminders. Review physical activity level at subsequent visits and provide advice to achieve the next level of activity.

*Adapted from Glynn TJ, Manley MW. How to help your patients stop smoking: a National Cancer Institute manual for physicians. Bethesda (MD): National Cancer Institute; 1989. NIH publication no. 89-3064.*

To help facilitate changes in physical activity and eating habits, diabetes health care professionals can incorporate the use of the so-called 5 As (assess, advise, agree, assist, and arrange). This approach does not require a lot of training and offers a simple framework that can be integrated with other education and counseling resources. The 5 As concept was introduced by the National Cancer Institute as a guide to help physicians counsel their patients about smoking cessation.<sup>71</sup> This framework has since been expanded to address broader issues of health behavior change and to give care providers the flexibility of addressing important lifestyle topics in a manner ranging from simple to in-depth (depending on time, training, and resources). **Box 2** provides an example of how to use the 5 As for development of a physical activity prescription<sup>71,72</sup>:

### FUTURE CONSIDERATIONS/SUMMARY

Lifestyle intervention for the treatment of type 2 diabetes should focus on a reduced energy intake with modification of food choices (increased whole grains, fiber, vegetables, and fruit; reduced total and saturated fat, sugar, and refined grains) and increased physical activity (150 min/wk of aerobic exercise plus strength training 2–3 times per week). In order to be successful another critical component of lifestyle intervention is the use of behavior modification, such as motivational interviewing, self-monitoring, and individualized goal setting, to support long-term results.

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