



3. Prevention or Delay of Type 2 Diabetes: *Standards of Medical Care in Diabetes—2019*

American Diabetes Association

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The American Diabetes Association (ADA) “Standards of Medical Care in Diabetes” includes ADA’s current clinical practice recommendations and is intended to provide the components of diabetes care, general treatment goals and guidelines, and tools to evaluate quality of care. Members of the ADA Professional Practice Committee, a multidisciplinary expert committee, are responsible for updating the Standards of Care annually, or more frequently as warranted. For a detailed description of ADA standards, statements, and reports, as well as the evidence-grading system for ADA’s clinical practice recommendations, please refer to the Standards of Care Introduction. Readers who wish to comment on the Standards of Care are invited to do so at professional.diabetes.org/SOC.

For guidelines related to screening for increased risk for type 2 diabetes (prediabetes), please refer to Section 2 “Classification and Diagnosis of Diabetes.”

Recommendation

3.1 At least annual monitoring for the development of type 2 diabetes in those with prediabetes is suggested. **E**

Screening for prediabetes and type 2 diabetes risk through an informal assessment of risk factors (**Table 2.3**) or with an assessment tool, such as the American Diabetes Association risk test (**Fig. 2.1**), is recommended to guide providers on whether performing a diagnostic test for prediabetes (**Table 2.5**) and previously undiagnosed type 2 diabetes (**Table 2.2**) is appropriate (see Section 2 “Classification and Diagnosis of Diabetes”). Those determined to be at high risk for type 2 diabetes, including people with A1C 5.7–6.4% (39–47 mmol/mol), impaired glucose tolerance, or impaired fasting glucose, are ideal candidates for diabetes prevention efforts. Using A1C to screen for prediabetes may be problematic in the presence of certain hemoglobinopathies or conditions that affect red blood cell turnover. See Section 2 “Classification and Diagnosis of Diabetes” and Section 6 “Glycemic Targets” for additional details on the appropriate use of the A1C test.

At least annual monitoring for the development of diabetes in those with prediabetes is suggested.

LIFESTYLE INTERVENTIONS

Recommendations

3.2 Refer patients with prediabetes to an intensive behavioral lifestyle intervention program modeled on the Diabetes Prevention Program (DPP) to achieve

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and maintain 7% loss of initial body weight and increase moderate-intensity physical activity (such as brisk walking) to at least 150 min/week. **A**

3.3 Based on patient preference, technology-assisted diabetes prevention interventions may be effective in preventing type 2 diabetes and should be considered. **B**

3.4 Given the cost-effectiveness of diabetes prevention, such intervention programs should be covered by third-party payers. **B**

The Diabetes Prevention Program

Several major randomized controlled trials, including the Diabetes Prevention Program (DPP) (1), the Finnish Diabetes Prevention Study (DPS) (2), and the Da Qing Diabetes Prevention Study (Da Qing study) (3), demonstrate that lifestyle/behavioral therapy featuring an individualized reduced calorie meal plan is highly effective in preventing type 2 diabetes and improving other cardiometabolic markers (such as blood pressure, lipids, and inflammation). The strongest evidence for diabetes prevention comes from the DPP trial (1). The DPP demonstrated that an intensive lifestyle intervention could reduce the incidence of type 2 diabetes by 58% over 3 years. Follow-up of three large studies of lifestyle intervention for diabetes prevention has shown sustained reduction in the rate of conversion to type 2 diabetes: 45% reduction at 23 years in the Da Qing study (3), 43% reduction at 7 years in the DPS (2), and 34% reduction at 10 years (4) and 27% reduction at 15 years (5) in the U.S. Diabetes Prevention Program Outcomes Study (DPPOS). Notably, in the 23-year follow-up for the Da Qing study, reductions in all-cause mortality and cardiovascular disease-related mortality were observed for the lifestyle intervention groups compared with the control group (3).

The two major goals of the DPP intensive, behavioral, lifestyle intervention were to achieve and maintain a minimum of 7% weight loss and 150 min of physical activity similar in intensity to brisk walking per week. The DPP lifestyle intervention was a goal-based intervention: all participants were given the same weight loss and physical activity goals, but individualization was permitted in the

specific methods used to achieve the goals (6).

The 7% weight loss goal was selected because it was feasible to achieve and maintain and likely to lessen the risk of developing diabetes. Participants were encouraged to achieve the 7% weight loss during the first 6 months of the intervention. However, longer-term (4-year) data reveal maximal prevention of diabetes observed at about 7–10% weight loss (7). The recommended pace of weight loss was 1–2 lb/week. Calorie goals were calculated by estimating the daily calories needed to maintain the participant's initial weight and subtracting 500–1,000 calories/day (depending on initial body weight). The initial focus was on reducing total dietary fat. After several weeks, the concept of calorie balance and the need to restrict calories as well as fat was introduced (6).

The goal for physical activity was selected to approximate at least 700 kcal/week expenditure from physical activity. For ease of translation, this goal was described as at least 150 min of moderate-intensity physical activity per week similar in intensity to brisk walking. Participants were encouraged to distribute their activity throughout the week with a minimum frequency of three times per week with at least 10 min per session. A maximum of 75 min of strength training could be applied toward the total 150 min/week physical activity goal (6).

To implement the weight loss and physical activity goals, the DPP used an individual model of treatment rather than a group-based approach. This choice was based on a desire to intervene before participants had the possibility of developing diabetes or losing interest in the program. The individual approach also allowed for tailoring of interventions to reflect the diversity of the population (6).

The DPP intervention was administered as a structured core curriculum followed by a more flexible maintenance program of individual sessions, group classes, motivational campaigns, and restart opportunities. The 16-session core curriculum was completed within the first 24 weeks of the program and included sections on lowering calories, increasing physical activity, self-monitoring, maintaining healthy lifestyle behaviors, and psychological, social, and motivational challenges. For further details on the core curriculum sessions, refer to ref. 6.

Nutrition

Structured behavioral weight loss therapy, including a reduced calorie meal plan and physical activity, is of paramount importance for those at high risk for developing type 2 diabetes who have overweight or obesity (1,7). Because weight loss through lifestyle changes alone can be difficult to maintain long term (4), people being treated with weight loss therapy should have access to ongoing support and additional therapeutic options (such as pharmacotherapy) if needed. Based on intervention trials, the eating patterns that may be helpful for those with prediabetes include a Mediterranean eating plan (8–11) and a low-calorie, low-fat eating plan (5). Additional research is needed regarding whether a low-carbohydrate eating plan is beneficial for persons with prediabetes (12). In addition, evidence suggests that the overall quality of food consumed (as measured by the Alternative Healthy Eating Index), with an emphasis on whole grains, legumes, nuts, fruits and vegetables, and minimal refined and processed foods, is also important (13–15).

Whereas overall healthy low-calorie eating patterns should be encouraged, there is also some evidence that particular dietary components impact diabetes risk in observational studies. Higher intakes of nuts (16), berries (17), yogurt (18,19), coffee, and tea (20) are associated with reduced diabetes risk. Conversely, red meats and sugar-sweetened beverages are associated with an increased risk of type 2 diabetes (13).

As is the case for those with diabetes, individualized medical nutrition therapy (see Section 5 “Lifestyle Management” for more detailed information) is effective in lowering A1C in individuals diagnosed with prediabetes (21).

Physical Activity

Just as 150 min/week of moderate-intensity physical activity, such as brisk walking, showed beneficial effects in those with prediabetes (1), moderate-intensity physical activity has been shown to improve insulin sensitivity and reduce abdominal fat in children and young adults (22,23). On the basis of these findings, providers are encouraged to promote a DPP-style program, including its focus on physical activity, to all individuals who have been identified

to be at an increased risk of type 2 diabetes. In addition to aerobic activity, an exercise regimen designed to prevent diabetes may include resistance training (6,24). Breaking up prolonged sedentary time may also be encouraged, as it is associated with moderately lower postprandial glucose levels (25,26). The preventive effects of exercise appear to extend to the prevention of gestational diabetes mellitus (GDM) (27).

Technology-Assisted Interventions to Deliver Lifestyle Interventions

Technology-assisted interventions may effectively deliver the DPP lifestyle intervention, reducing weight and, therefore, diabetes risk (28–31). Such technology-assisted interventions may deliver content through smartphone and web-based applications and telehealth (28). The Centers for Disease Control and Prevention (CDC) Diabetes Prevention Recognition Program (DPRP) (www.cdc.gov/diabetes/prevention/lifestyle-program) does certify technology-assisted modalities as effective vehicles for DPP-based interventions; such programs must use an approved curriculum, include interaction with a coach (which may be virtual), and attain the DPRP outcomes of participation, physical activity reporting, and weight loss. The selection of an in-person or virtual program should be based on patient preference.

Cost-effectiveness

A cost-effectiveness model suggested that the lifestyle intervention used in the DPP was cost-effective (32,33). Actual cost data from the DPP and DPPOS confirmed this (34). Group delivery of DPP content in community or primary care settings has the potential to reduce overall program costs while still producing weight loss and diabetes risk reduction (35–37). The use of community health workers to support DPP efforts has been shown to be effective with cost savings (38) (see Section 1 “Improving Care and Promoting Health in Populations” for more information). The CDC coordinates the National Diabetes Prevention Program (National DPP), a resource designed to bring evidence-based lifestyle change programs for preventing type 2 diabetes to communities (www.cdc.gov/diabetes/prevention/index.htm). Early results from the CDC’s National DPP during the first 4 years of implementation

are promising (39). In an effort to expand preventive services using a cost-effective model that began in April 2018, the Centers for Medicare & Medicaid Services has expanded Medicare reimbursement coverage for the National DPP lifestyle intervention to organizations recognized by the CDC that become Medicare suppliers for this service (<https://innovation.cms.gov/initiatives/medicare-diabetes-prevention-program/>).

Tobacco Use

Smoking may increase the risk of type 2 diabetes (40); therefore, evaluation for tobacco use and referral for tobacco cessation, if indicated, should be part of routine care for those at risk for diabetes. Of note, the years immediately following smoking cessation may represent a time of increased risk for diabetes (40–42) and patients should be monitored for diabetes development and receive evidence-based interventions for diabetes prevention as described in this section. See Section 5 “Lifestyle Management” for more detailed information.

PHARMACOLOGIC INTERVENTIONS

Recommendations

- 3.5** Metformin therapy for prevention of type 2 diabetes should be considered in those with prediabetes, especially for those with BMI ≥ 35 kg/m², those aged <60 years, and women with prior gestational diabetes mellitus. **A**
- 3.6** Long-term use of metformin may be associated with biochemical vitamin B12 deficiency, and periodic measurement of vitamin B12 levels should be considered in metformin-treated patients, especially in those with anemia or peripheral neuropathy. **B**

Pharmacologic agents including metformin, α -glucosidase inhibitors, glucagon-like peptide 1 receptor agonists, thiazolidinediones, and several agents approved for weight loss have been shown in research studies to decrease the incidence of diabetes to various degrees in those with prediabetes (1,43–49), though none are approved by the U.S. Food and Drug

Administration specifically for diabetes prevention. One has to balance the risk/benefit of each medication. Metformin has the strongest evidence base (50) and demonstrated long-term safety as pharmacologic therapy for diabetes prevention (48). For other drugs, cost, side effects, and durable efficacy require consideration.

Metformin was overall less effective than lifestyle modification in the DPP and DPPOS, though group differences declined over time (5) and metformin may be cost-saving over a 10-year period (34). It was as effective as lifestyle modification in participants with BMI ≥ 35 kg/m² but not significantly better than placebo in those over 60 years of age (1). In the DPP, for women with history of GDM, metformin and intensive lifestyle modification led to an equivalent 50% reduction in diabetes risk (51), and both interventions remained highly effective during a 10-year follow-up period (52). In the Indian Diabetes Prevention Programme (IDPP-1), metformin and the lifestyle intervention reduced diabetes risk similarly at 30 months; of note, the lifestyle intervention in IDPP-1 was less intensive than that in the DPP (53). Based on findings from the DPP, metformin should be recommended as an option for high-risk individuals (e.g., those with a history of GDM or those with BMI ≥ 35 kg/m²). Consider monitoring vitamin B12 levels in those taking metformin chronically to check for possible deficiency (54) (see Section 9 “Pharmacologic Approaches to Glycemic Treatment” for more details).

PREVENTION OF CARDIOVASCULAR DISEASE

Recommendation

- 3.7** Prediabetes is associated with heightened cardiovascular risk; therefore, screening for and treatment of modifiable risk factors for cardiovascular disease is suggested. **B**

People with prediabetes often have other cardiovascular risk factors, including hypertension and dyslipidemia (55), and are at increased risk for cardiovascular disease (56). Although treatment goals for people with prediabetes are the same as for the general population (57), increased vigilance is warranted to identify

and treat these and other cardiovascular risk factors (e.g., smoking).

DIABETES SELF-MANAGEMENT EDUCATION AND SUPPORT

Recommendation

3.8 Diabetes self-management education and support programs may be appropriate venues for people with prediabetes to receive education and support to develop and maintain behaviors that can prevent or delay the development of type 2 diabetes. **B**

As for those with established diabetes, the standards for diabetes self-management education and support (see Section 5 “Lifestyle Management”) can also apply to people with prediabetes. Currently, there are significant barriers to the provision of education and support to those with prediabetes. However, the strategies for supporting successful behavior change and the healthy behaviors recommended for people with prediabetes are comparable to those for diabetes. Although reimbursement remains a barrier, studies show that providers of diabetes self-management education and support are particularly well equipped to assist people with prediabetes in developing and maintaining behaviors that can prevent or delay the development of diabetes (21,58).

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