Screening for Prediabetes and Type 2 Diabetes in Children and Adolescents
US Preventive Services Task Force Recommendation Statement

US Preventive Services Task Force

**IMPORTANCE** The Centers for Disease Control and Prevention estimates that 210 000 children and adolescents younger than 20 years had diabetes as of 2018; of these, approximately 23 000 had type 2 diabetes. Youth with type 2 diabetes have an increased prevalence of associated chronic comorbid conditions, including hypertension, dyslipidemia, and nonalcoholic fatty liver disease. Data indicate that the incidence of type 2 diabetes is rising; from 2002-2003 to 2014-2015, incidence increased from 9.0 cases per 100 000 children and adolescents to 13.8 cases per 100 000 children and adolescents.

**OBJECTIVE** The US Preventive Services Task Force (USPSTF) commissioned a review of the evidence on screening for prediabetes and type 2 diabetes in asymptomatic, nonpregnant persons younger than 18 years. This is a new recommendation.

**POPULATION** Children and adolescents younger than 18 years without known diabetes or prediabetes or symptoms of diabetes or prediabetes.

**EVIDENCE ASSESSMENT** The USPSTF concludes that the evidence is insufficient to assess the balance of benefits and harms of screening for type 2 diabetes in children and adolescents. There is a lack of evidence on the effect of screening for, and early detection and treatment of, type 2 diabetes on health outcomes in youth, and the balance of benefits and harms cannot be determined.

**RECOMMENDATION** The USPSTF concludes that the current evidence is insufficient to assess the balance of benefits and harms of screening for type 2 diabetes in children and adolescents. (I statement)


**Summary of Recommendation**

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See the Practice Considerations section for additional information regarding the I statement. USPSTF indicates US Preventive Services Task Force.

**Importance**

The Centers for Disease Control and Prevention estimates that 210 000 children and adolescents younger than 20 years had diabetes as of 2018; of these, approximately 23 000 had type 2 diabetes. Youth with type 2 diabetes have an increased prevalence of associated chronic comorbid conditions, including hypertension, dyslipidemia, and nonalcoholic fatty liver disease. Data indicate that the incidence of type 2 diabetes is rising; from 2002-2003 to 2014-2015, incidence increased from 9.0 cases per 100 000 children and adolescents to 13.8 cases per 100 000 children and adolescents. Most of the increase in the incidence rate is in American Indian/Alaska Native, Black, and Hispanic/Latino children and adolescents. Approximately 18% of adolescents aged 12 to 18 years had prediabetes during 2005 to 2016.
Definitions of Prediabetes and Type 2 Diabetes

Diabetes refers to a range of metabolic disorders characterized by hyperglycemia. Type 2 diabetes is characterized by insulin resistance and progressive loss of β-cell insulin secretion. In contrast, type 1 diabetes is the result of autoimmune β-cell destruction, usually leading to absolute insulin deficiency. Prediabetes is the term used for individuals whose blood glucose levels (measured by plasma glucose level or hemoglobin A1c [HbA1c] level) are considered higher than normal but do not meet criteria for diabetes. The definitions of prediabetes and diabetes in children and adolescents are the same as in adults. A fasting plasma glucose level of 100 to 125 mg/dL (5.6-6.9 mmol/L), an HbA1c level of 5.7% to 6.4%, or a 2-hour postload glucose level of 140 to 199 mg/dL (7.8-11.0 mmol/L) are consistent with prediabetes. A fasting plasma glucose level of 126 mg/dL (7.0 mmol/L) or greater, an HbA1c level of 6.5% or greater, or a 2-hour postload glucose level of 200 mg/dL (11.1 mmol/L) or greater are consistent with the diagnosis of type 2 diabetes. The diagnosis of prediabetes or type 2 diabetes should be confirmed with repeat testing before starting interventions.

Screening Tests

Although there is insufficient evidence to recommend for or against screening in patients without signs or symptoms, prediabetes and type 2 diabetes can be detected by measuring fasting plasma glucose or HbA1c level, or with an oral glucose tolerance test. HbA1c level is a measure of long-term blood glucose concentration and is not affected by acute changes in glucose levels. The oral glucose tolerance test is performed in the morning in a fasting state, with blood glucose concentration measured 2 hours after ingestion of a 75-g oral glucose load.

Treatment and Preventive Interventions

Lifestyle interventions to achieve weight loss, improve diet, and increase physical activity are often recommended for youth diagnosed with prediabetes and diabetes. The Centers for Disease Control and Prevention recommends programs that increase exercise and improve nutrition; these programs include extensive education on promoting self-management skills and establishing individualized plans for self-monitoring of glycemic targets. Formal programs to improve diet and increase exercise are often paired with pharmacotherapy. The US Food and Drug Administration has approved 3 drugs for treatment of type 2 diabetes in children: metformin, insulin, and liraglutide. While metformin has demonstrated improvements in body mass index (BMI), fasting glucose level, and insulin resistance, it is not approved by the US Food and Drug Administration to prevent the progression of prediabetes to diabetes.

Suggestions for Practice Regarding the I Statement

Potential Preventable Burden

Diabetes (both type 1 and type 2) is the third most common chronic disease in childhood. Many of the diabetes complications experienced by adults (such as kidney failure, non-injury-related lower-limb amputations, and blindness) can begin in childhood. Compared with non-Hispanic White youth, the type 2 diabetes rate in American Indian/Alaska Native, Black, and Hispanic/Latino youth has been shown to be 5, 4, and 8 times higher, respectively. Causes of these differences are not well understood, but structural factors that disproportionately affect non-White populations, as well as cultural and environmental influences and quality of and access to health care, may contribute significantly to differences by race and ethnicity.

Obesity and excess adipose tissue, especially when centrally distributed, are the most important risk factors for type 2 diabetes in younger persons. Family history of diabetes (including gestational diabetes) is also a strong risk factor. Risk assessment tools are also available to help identify children and adolescents at
increased risk for prediabetes and type 2 diabetes; however, there is limited evidence on their accuracy.14,15

Type 2 diabetes is much more common in older than in younger children, often presenting at the onset of puberty.16 This timing is likely related to physiologic, but transient, pubertal insulin resistance that can be exacerbated by metabolic challenges related to obesity.17,18 Twenty-two percent to 52% of children and adolescents with prediabetes return to normal glycemia or normal glucose tolerance without intervention over 6 months to 2 years.2,7

Potential Harms
Because some youth with prediabetes may revert to normal glycemia without intervention, potential harms of screening include labeling, overdiagnosis, and overtreatment. Potential harms caused by treatment of type 2 diabetes include hypoglycemia and gastrointestinal issues (eg, nausea or vomiting) related to medication use.2,7

Other Related USPSTF Recommendations
The USPSTF has other recommendations on screening for obesity in children and adolescents (B recommendation) and screening for prediabetes and type 2 diabetes in adults (B recommendation).19,20 The USPSTF also has a recommendation on screening for gestational diabetes in pregnant persons (B recommendation).21

**Supporting Evidence**

**Scope of Review**
The USPSTF commissioned a systematic review of the evidence on screening for prediabetes and type 2 diabetes in asymptomatic, nonpregnant persons younger than 18 years.3 This review focused on evidence of the benefits and harms of screening for prediabetes and type 2 diabetes and the benefits and harms of interventions for screen-detected prediabetes and type 2 diabetes or recently diagnosed type 2 diabetes. The USPSTF focused on effects of screening and interventions on health outcomes, including mortality, cardiovascular morbidity, chronic kidney disease, amputation, skin ulcers, visual impairment, neuropathy, and quality of life. The review also looked at the evidence on the effectiveness of interventions for prediabetes to delay or prevent progression to type 2 diabetes.
Benefits of Early Detection and Treatment

The USPSTF found no studies addressing the direct benefits of screening for type 2 diabetes and prediabetes on health outcomes in asymptomatic children and adolescents.

Two randomized clinical trials examined the benefits of interventions for screen-detected or recently diagnosed type 2 diabetes and prediabetes on health outcomes. The first and larger study was the Treatment Options for Type 2 Diabetes in Adolescents and Youth (TODAY) study (n = 699), which randomly assigned adolescents with obesity (defined as a BMI ≥85th percentile for age and sex) and recently diagnosed type 2 diabetes to metformin monotherapy, metformin plus rosiglitazone, or metformin plus a lifestyle intervention. No statistically significant differences were found in rates of diabetic ketoacidosis or renal impairment. However, studies were underpowered to detect differences in these health outcomes. The second study was a 16-week trial that compared metformin and placebo in 82 treatment-naïve adolescents aged 10 to 16 years with previous or newly diagnosed type 2 diabetes. It reported that zero participants developed diabetes during the 6-month trial; however, the overall attrition rate was high (23%), and some participants were withdrawn from the study because they started taking metformin.

Harms of Screening and Treatment

The USPSTF found no studies addressing the harms of screening for type 2 diabetes and prediabetes in asymptomatic children and adolescents.

Two previously mentioned intervention trials (n = 781) reported on harms associated with treatment of youth recently diagnosed with type 2 diabetes. The TODAY study reported that 4 youths had severe hypoglycemia. It also reported that more youths had repeated mild hypoglycemia in the group that received metformin plus rosiglitazone than in the metformin monotherapy or metformin plus lifestyle intervention groups (n = 19 [8.2%] for metformin plus rosiglitazone vs n = 10 [4.3%] for metformin monotherapy vs n = 8 [3.4%] for metformin plus lifestyle intervention; P = .05 across the 3 groups). The 16-week trial comparing metformin monotherapy with placebo reported zero hypoglycemic events requiring medical attention in either study group.

Gastrointestinal events were common in both studies. In the TODAY study, lower rates of gastrointestinal symptoms were reported in the metformin plus rosiglitazone group than in the metformin monotherapy or metformin plus lifestyle intervention groups. The 16-week trial reported that more youths treated with metformin than with placebo had abdominal pain (25% vs 12%) and nausea or vomiting (17% vs 10%). Other adverse events were reported in both studies; however, events were varied, and most found no difference between groups or reported that events were not attributed to study interventions.

Response to Public Comment

A draft version of this recommendation statement was posted for public comment on the USPSTF website from December 14, 2021, to January 18, 2022. Several comments noted the connection between excess body weight and impaired glucose tolerance as well as the recent rise in childhood obesity. These comments suggested that a risk-based approach (ie, screening youth with overweight and obesity) may better identify children and adolescents with prediabetes and type 2 diabetes. The USPSTF found no evidence on screening for type 2 diabetes or prediabetes in children and adolescents, including in those with risk factors. The USPSTF is calling for more studies on the benefits and harms of screening in children and adolescents, including those that may be at higher risk. Comments also proposed that the scope of the recommendation should include screening for type 1 diabetes. Given the distinct clinical course of type 1 diabetes, the USPSTF chose to focus on type 2 diabetes and prediabetes.

Additionally, the USPSTF wishes to clarify that the I statement is neither a recommendation for nor against screening. Clinicians should continue to use their clinical judgment to determine if screening is appropriate for individual patients.

Research Needs and Gaps

More studies are needed that address the following areas.

• The effects of screening on health outcomes in children and adolescent populations reflective of the prevalence of diabetes in the US, particularly American Indian/Alaska Native, Black, Hispanic/Latino, and Native Hawaiian/Pacific Islander youth, who have a higher prevalence of diabetes than White youth.

• The effects of screening on health outcomes in children and adolescents considered to be at higher risk such as those who are overweight, have obesity, or have a family history of diabetes.

• The effects of lifestyle interventions, pharmacotherapy, or both for treatment of screen-detected prediabetes and diabetes on health outcomes in children and adolescents, particularly in racial and ethnic groups who have a higher prevalence of diabetes than White youth.

• Trials (both screening and intervention) focusing on health outcomes such as mortality, cardiovascular morbidity, chronic kidney disease, amputation, visual impairment, neuropathy, and quality of life that are of sufficient duration and sample size.

• The natural history of prediabetes in children and adolescents, including the identification of factors associated with risk of progression to diabetes or reversion to normoglycemia.

Recommendations of Others

The American Diabetes Association recommends risk-based screening for type 2 diabetes after onset of puberty or age 10 years in children who have overweight (defined as a BMI ≥85th percentile) or obesity (defined as a BMI ≥95th percentile) and 1 or more additional risk factors for diabetes. In children who are deemed at high risk, it recommends screening every 3 years if tests are normal or more frequently if BMI increases.
Additional Information: We thank Justin Mills, MD, MPH (AHRQ), who contributed to the writing of the manuscript, and Lisa Nicollella, MA (AHRQ), who assisted with coordination and editing.

Additional Information: The US Preventive Services Task Force (USPSTF) makes recommendations about the effectiveness of specific preventive care services for patients without obvious related signs or symptoms. It bases its recommendations on the evidence of both the benefits and harms of the service and an assessment of the balance. The USPSTF does not consider the costs of providing a service in this assessment. The USPSTF recognizes that clinical decisions involve more considerations than evidence alone. Clinicians should understand the evidence but individualize decision-making to the specific patient or situation. Similarly, the USPSTF notes that policy and coverage decisions involve considerations in addition to the evidence of clinical benefits and harms. Published by JAMA—Journal of the American Medical Association under arrangement with the Agency for Healthcare Research and Quality (AHRQ). ©2022 AAMA and United States Government, as represented by the Secretary of the Department of Health and Human Services (HHS), by assignment from the members of the United States Preventive Services Task Force (USPSTF). All rights reserved.

REFERENCES


