
Type 2 diabetes in children and adolescents

Screening, diagnosis, and management

Once thought to primarily affect adults, type 2 diabetes is on the rise among the young. The increased prevalence is largely associated with increased obesity rates among children and adolescents.

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Type 2 diabetes is a growing health concern in the United States, with 20.8 million people suffering from the disease, or 7% of the population.¹ It is estimated that more than 6 million of these people have not received a diagnosis of diabetes.¹ Even more alarming, type 2 diabetes, often referred to as *adult-onset diabetes* and thought primarily to affect adults, is on the rise among children and adolescents. Early recognition of risk factors for and signs of type 2 diabetes, and screening for it in this population, can prevent the disease from developing in those with prediabetes and can slow or even reverse progression in those with the disease. This article reviews the criteria for diagnosis and provides an overview of the recommended protocol for management in patients aged 20 years and younger.

Increasing prevalence and incidence

In 2005, the CDC estimated that 176,500 people aged 20 years or younger have been given a diagnosis of diabetes.¹ The American Diabetes Association (ADA) reports in a consensus statement that 8% to 45% of children with new diagnoses of diabetes have a nonimmune-mediated form; in the majority of these patients, this is type 2 diabetes.² The disease disproportionately affects children of American Indian, African-American, Mexican American, and Pacific Islander ethnic backgrounds. Prior to 1994, type 2 diabetes had been diag-

nosed in less than 5% of patients with the disease. Since then, that percentage has risen to 30% to 50%.³

Information on the long-term effects and management of type 2 diabetes in the pediatric population is limited. Some studies, however, have focused on determining the prevalence of diabetes among specific ethnic groups. For example, in a study of the Pima Indians of Arizona, less than 1% of children aged 10 to 14 years and 2% to 3% of children aged 15 to 19 years received a diagnosis of type 2 diabetes between 1967 and 1976.⁴ Follow-up estimates showed that the prevalence of the disease increased; from 1987 to 1996, 2% to 3% and 4% to 5% of Pima Indian children in those age groups, respectively, received a diagnosis of type 2 diabetes.⁴ In

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Learning objectives

- Discuss the prevalence and the relevance of type 2 diabetes in the pediatric population
- Describe the screening criteria to identify children who are at risk of type 2 diabetes
- Outline the pathogenesis and clinical presentation of type 2 diabetes in children and adolescents
- Review the first- and second-line treatment choices

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FIGURE 1

Acanthosis nigricans



Grade 1



Grade 2



Grade 3



Grade 4

Photos courtesy of Driscoll Children's Hospital

a broader context, the Indian Health Service reports a 54% increase in cases of type 2 diabetes among all American Indian groups within a similar time period and in similar age groups.² Clinic-based studies in Cincinnati indicate that the incidence of type 2 diabetes among all children increased 10 times from 1982 to 1994, and similar studies in Florida show that the prevalence increased from 9.4% to 20% between 1994 and 1998.⁴

In 2002, data collection began for SEARCH for Diabetes in Youth, a 5-year multicenter study funded by the CDC and the National Institutes of Health.⁵ The primary goals of this study include estimating the incidence and prevalence of diabetes among US children and adolescents by age, gender, and racial or ethnic group. Researchers aim to develop a uniform classification of

types of childhood diabetes based on clinical characteristics and complications.⁵ Data on prevalence is currently available, but the final report is expected in 2010.

Along with the rise in prevalence of type 2 diabetes, there is an increase in obesity as well. Researchers postulate that these increases are correlated. A report from the second National Health and Nutrition Examination Survey states that 16% of children aged 6 to 19 years are considered overweight.⁶ The report also points out that this percentage has tripled since 1980. An estimated 85% of children with type 2 diabetes are overweight or obese when the disease is diagnosed.² A high body mass index (BMI) is the first criteria for screening children and adolescents for type 2 diabetes.³

Clinical presentation

The pathophysiology of type 2 diabetes in children, although not completely understood, is similar to that in adults. It is characterized by insulin resistance in muscle, fat, and liver cells with an increase in insulin production by pancreatic beta cells. This leads to hyperinsulinemia and eventually to insulin secretion dysfunction. Impaired insulin secretion is the clinical marker for the development of type 2 diabetes.²

The clinical presentation of diabetes in children also is comparable to that of adults. Polydipsia, polyuria, and weight loss are the most frequently reported symptoms. Most patients, however, are asymptomatic.⁷ A definitive sign of insulin resistance is acanthosis nigricans, a velvety, hyperpigmented skin thickening found in the intertriginous areas such as the nape, axillae, and folds of the inner thigh (see Figure 1). Insulin resistance is frequently seen in patients with polycystic ovary syndrome. These patients may demonstrate hirsutism, amenorrhea or menstrual irregularities, and obesity.⁷

The ADA's criteria for determining which children are at risk of developing type 2 diabetes are listed in Table 1. Those patients at high risk should be screened initially at age 10 years and then every 2 years thereafter.²

Hyperglycemia develops gradually; symptoms may be subtle, and many patients are unaware that diabetes is developing. An incidental finding of glucosuria or hyperglycemia leads to the diagnosis in up to 50% of cases.⁷ A fasting plasma glucose test is preferred over an oral glucose tolerance test because the former is more convenient and less expensive. A diagnosis of type 2 diabetes is made when a random glucose level is higher than 200 mg/dL, the fasting glucose level is higher than 126 mg/dL, or the 2-hour postprandial glucose level is higher than 200 mg/dL.² Elevated insulin and C-peptide levels with no autoantibodies to islet cells or insulin indicates type 2 disease.

Treating younger patients

As in adults, the first line of treatment in younger patients is a proper diet and regular exercise. But less than 10% of children and adolescents with the disease will achieve effective glycemic control with these measures alone. Pharmacologic agents are often needed.³ Knowledge of efficacy and long-term effects of pharmacologic agents in patients who are younger than 20 years is minimal. Insulin and metformin are the only two drugs currently approved by the FDA for use in children.⁸ About half of children and adolescents with diabetes are treated with insulin; the other half are treated with oral agents, mostly metformin.⁴ The ADA recommends metformin monotherapy as a first-choice oral regimen.² If monotherapy is inadequate, an oral sulfonylurea or insulin may be added.² Other classes of oral agents can be com-

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Key Points

- In 2005, the CDC estimated that 176,500 people aged 20 years or younger were given a diagnosis of diabetes.
- An estimated 85% of children with type 2 diabetes are overweight or obese when the disease is diagnosed.
- The first-line treatment for type 2 diabetes in children is the same as for adults: proper diet and regular exercise.

Competencies

Medical knowledge	◆◆◆◆◆
Interpersonal & communication skills	◆
Patient care	◆◆
Professionalism	◆
Practice-based learning and improvement	◆
Systems-based practice	◆

For an explanation of competencies ratings, see the table of contents.

TABLE 1

Indicators to screen for type 2 diabetes in pediatric patients

BMI greater than 85th percentile for age and sex or weight >120% of ideal body weight, plus two of the following criteria:

- First- or second-degree relative with a diagnosis of type 2 diabetes
- Ethnic background includes American Indian, African-American, Hispanic American, Asian, or South Pacific Islander
- Signs of insulin resistance or a condition related to insulin resistance (ie, acanthosis nigricans, hypertension, hyperlipidemia, or polycystic ovary syndrome)

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bined with metformin but are used less frequently in children² (see Table 2, page 54). When ketoacidosis is present or the type of diabetes is in question, the ADA recommends treatment with insulin instead of oral agents.

The ADA recommendations for disease management and evaluation of treatment effectiveness among these patients include an annual ophthalmologic examination,

TABLE 2

Oral agents used to treat type 2 diabetes

Drug	Mechanism of action	Benefits	Side effects	Comments
Alpha-glucosidase inhibitors	Slow carbohydrate absorption	Can deter patient from eating foods high in carbohydrates	Nausea, dyspepsia, diarrhea	
Meglitinides	Increase insulin secretion	Work well in children with an irregular eating schedule	Hypoglycemia	Not to be used with sulfonylureas
Metformin	Decreases hepatic glucose production and improves insulin sensitivity	<ul style="list-style-type: none"> • Approved by the FDA for use in pediatric patients • Recommended by ADA as first-line oral therapy • Rarely induces hypoglycemia 	<ul style="list-style-type: none"> • Diarrhea, nausea, vomiting, flatulence • Lactic acidosis 	<ul style="list-style-type: none"> • Contraindicated in patients with renal or hepatic impairment • Liver enzymes, creatinine, and lactate dehydrogenase should be monitored
Sulfonylureas	Increase insulin secretion	<ul style="list-style-type: none"> • Well-documented in adults • Inexpensive 	<ul style="list-style-type: none"> • Hypoglycemia • Weight gain 	
Thiazolidinediones	Improve peripheral insulin sensitivity	Decrease visceral fat	Weight gain	

Key: ADA, American Diabetes Association.
 Data from American Diabetes Association,² Bloomgarden ZT,⁴ and Aye T, et al.⁸

annual urinalysis for microalbuminuria, regular BP measurements, and lipid profiles every 2 years once glycemic control is achieved.^{2,3} Other recommendations are glucose monitoring once or twice daily, especially after any adjustments in treatment regimen, and hemoglobin A1C measurements every 3 months with periodic foot examinations.⁸

Conclusion

The multifaceted approach to management of type 2 diabetes in children and adolescents is similar to that used in adults with the disease. First, patients and their families must acknowledge that lifestyle modifications such as eating a balanced diet, maintaining a healthy weight, and exercising regularly are essential. Health care providers should encourage all patients to adhere to these principles, but this is especially important for those patients at higher risk for developing this disease. Screening those children who are at increased risk for developing type 2 diabetes can lead to earlier recognition of its onset and intervention, which can slow down or even halt progression to a clinical diagnosis.

Type 2 diabetes in the pediatric population is a growing problem. The subtle differences in risk factors, screening and diagnosis protocols, and management of younger patients with this disease present a challenge for clinicians. As further studies provide a better understanding of the effects of type 2 diabetes and its long-term treatment in pediatric patients, it is important for PAs to keep up to date with the evolving protocols for diagnosis and treatment. □

REFERENCES

1. National Diabetes Fact Sheet. United States, 2005. [CDC Web site]. Available at: http://www.cdc.gov/diabetes/pubs/pdf/ndfs_2005.pdf. Accessed February 5, 2007.
2. American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care*. 2000;23(3):381-389.
3. Bobo N, Evert A, Gallivan J, et al; Diabetes in Children Adolescents Work Group of the National Diabetes Education Program. An update on type 2 diabetes in youth from the National Diabetes Education Program. *Pediatrics*. 2004;114(1):259-263.
4. Bloomgarden ZT. Type 2 diabetes in the young: the evolving epidemic. *Diabetes Care*. 2004;27(4):998-1010.
5. Fact Sheet. SEARCH for diabetes in youth. [CDC Web site]. Available at: <http://www.cdc.gov/diabetes/pubs/factsheets/search.htm>. Accessed February 5, 2007.
6. National Center for Health Statistics—2004 Fact Sheet. Obesity still a major problem, new data show. [CDC Web site]. Available at: <http://www.cdc.gov/nchs/pressroom/04facts/obesity.htm>. Accessed February 5, 2007.
7. Callahan ST, Mansfield MJ. Type 2 diabetes mellitus in adolescents. *Curr Opin Pediatr*. 2000;12(4):310-315.
8. Aye T, Levitsky LL. Type 2 diabetes: an epidemic disease in childhood. *Curr Opin Pediatr*. 2003;15(4):411-415.