Obesity is clearly recognized as a major risk factor for diabetes mellitus and cardiovascular disease. Body weight has been inversely correlated with morbidity and mortality: the larger we grow, the shorter our lifespan. Prevalence rates of diabetes in the United States continue to exceed predicted levels and are closely related to the rise in obesity we have seen over the past 30 to 40 years. Obesity rates in adults in particular have doubled in the past generation.
It is well documented that childhood obesity increases the risk of adult obesity. One study found that 80% of obese adults had become obese by the time they reached age 25. Even obese children as young as age 6 have a 50% chance of being an obese adult. It appears that if obesity starts before the age of 8, it is more likely to be severe in adults. In a study of adult coronary heart disease risk factors, 30% of obese adults reported that their obesity began in childhood. Childhood obesity also increases the risk of adult mortality. It is not surprising in light of these statistics that the prevalence of diabetes and its complications are rapidly expanding in our population.

In the past 30 years alone, pediatric obesity rates have tripled in the United States. Currently, 1 in 3 children are overweight, and 1 in 6 adolescents are obese. This epidemic has affected even our youngest children: 1 in 7 low-income preschool children are obese. Previously, treatment of childhood obesity was focused on preventing adult obesity and the complications commonly seen in adults. Recent studies, however, report an increase in morbidity and mortality associated with childhood obesity.

Childhood complications of obesity are significant and can include type 2 diabetes and hepatic steatosis or steatohepatitis. It has been estimated that 40% of obese children have evidence of fatty liver changes at ultrasound imaging, which may be a more sensitive marker for the diagnosis of steatohepatitis than elevated levels of transaminases. Hepatic steatohepatitis is now recognized as the leading cause of cryptogenic cirrhosis in the United States. We have not yet determined how many children will be at risk for fatty liver hepatitis or non-alcoholic steatohepatitis (NASH), but the incidence of hepatic diseases may closely follow the rise in obesity.

Type 2 diabetes was once considered a disease of adults only, but the rates of childhood type 2 diabetes are now rapidly increasing. Typically, a person can have NASH or type 2 diabetes for up to a decade before complications arise. Diagnosis of diabetes and its complications in childhood, however, may profoundly affect life expectancy.

Childhood body mass index (BMI) is calculated using weight-to-height charts by the percentage of weight divided by height. The Centers for Disease Control and Prevention has a simple calculator for assessing BMI in children and adolescents (see http://apps.nccd.cdc.gov/dnpabmi/) and also provides standardized BMI tables that can be used in the office setting (see Tables 1 and 2). The former ratings for excess weight in children were changed from “at risk for overweight” and “overweight” to “overweight” and “obese,” more accurately reflecting the adverse outcomes of excess weight in childhood. Overweight is defined as a BMI of >85% and obesity as a BMI of 95%.

Data from the National Health and Nutrition Examination Survey (NHANES) show that children of all ages are at risk, but the greatest burden falls on those from minority groups. Nearly 10% of children under the age of 2 are overweight, and this number increases to 12.5% in Hispanic children. Among children 3 to 17 years of age, 32% are overweight or obese. In Hispanic adolescents, 43% of boys and 40% of girls are overweight, and within that population, the rates for Mexican-American adolescents are 46% for boys and 42% for girls. Further, the rates for non-Hispanic black Americans are 33% for adolescent boys and 46% for girls.

Why is obesity so prevalent?

Many issues contribute to childhood obesity, but essentially they can be boiled down to increased caloric intake and reduced calorie expenditure. Food intake has changed substantially over the past 20 years. Children now eat as much as one-third of their calories from “fast foods,” which typically are calorie and fat dense. Furthermore, soda consumption has increased 65% and has been estimated to be as much as 25% of all calories consumed.

Even small changes in calorie consumption can equate to significant weight gain. An additional 50 calories per day (one-third can of cola) can result in 5 extra pounds of weight in 1 year and 50 pounds in a decade. Further, access to fresh whole foods is limited due to
expense and geographical location. In our rural Appalachian town we have over 50 fast food restaurants, and they are easier to access for many people than the grocery store. Many families have become too busy to sit down for the family dinner and will now grab something on the run.

Children also spend less time in physical activity. Fewer schools offer daily gym classes, and many athletic programs have been cut. There are fewer safe outdoor places for play, and many children are geographically isolated from public play spaces. Families may also live at greater distances from health-related resources and have inadequate access to public transportation. During harder financial times, fewer children participate in school gym programs, clubs, and team sports.

Further, American youth are affected by increased television viewing and screen time. Television watching and other “screen-time” activities (video games, video phones, smart phones, and texting) contribute to obesity by displacing time for physical activity, adding unplanned calorie consumption during screen time, and leading to a loss of recognition of normal satiety cues when distracted by passive entertainment. These risk factors provide unique challenges for the management of childhood obesity.

### Link between childhood obesity and diabetes

The direct link between type 2 diabetes and obesity in children has become increasingly evident. This was confirmed when a recent study showed that 89.8% of children diagnosed with type 2 diabetes were overweight or obese. Children born in the year 2000 in the United States have a 1 in 3 chance of developing diabetes. This rate increases for people of color and is as high as 50% among Hispanic children. Obesity and its related complications are largely responsible for the increased prevalence of this disease and have contributed to the fact that this is the first generation of Americans expected to have a shorter life expectancy than their parents.

### Diabetes in minority populations

Studies report that 20% of pediatric patients with newly diagnosed diabetes have type 2 diabetes. There appears to be a disproportionately higher incidence of type 2 diabetes in minority children, as shown by ranges from 3.7/100,000 in non-Hispanic whites to 38.42/100,000 in Navajo Indian females. Gender also influences incidence: females in the pediatric population have a 60% higher incidence of type 2 diabetes than of their male counterparts.

Our understanding of diabetes in American youth has been greatly improved with the publication of results from the SEARCH trial, a large population-based study examining physician-diagnosed diabetes in people under age 20 in the United States. This large epidemiologic trial set out...
to gain a better understanding of the prevalence of type 1 and type 2 diabetes in children, the level of control, and their experience with this disease.\textsuperscript{21}

The SEARCH trial found that many children who have developed type 2 diabetes have poor glucose control. Black and Hispanic children, however, were more likely to develop diabetes and to have worse control.\textsuperscript{23}

In a trial of glucose tolerance status in obese youth, good control was observed in 71\% of non-Hispanic white children, 59\% of African American children, 50\% of Hispanic children, 47\% of Asian/Pacific Island children, and only 34\% of American Indian children.\textsuperscript{23} Among Hispanic children, those of Mexican heritage had the greatest risk. Lower income status among this group was seen to further increase risk, with the peak incidence of diabetes seen in girls aged 10-14 years old.\textsuperscript{24,25}

It is clearly recognized that type 2 diabetes is a progressive, incurable, but treatable disease, and the duration of the disease predicts complications and mortality. As such, it is reasonable to conclude that children with type 2 diabetes may be facing a grim future unless they seek comprehensive treatment for diabetes and obesity. Preventing our youth from getting diabetes and treating it aggressively once diagnosed should be a public health priority.

**Screening children for diabetes**

The American Diabetes Association has developed screening guidelines for children who are at high risk of developing diabetes.\textsuperscript{26} The recommendations endorse screening children who are overweight (BMI > 85th percentile for age and gender), those who have a body weight greater than 120\% of the ideal for height, and anyone who meets at least 2 of the following criteria:

- family history of type 2 diabetes.
- high-risk race/ethnicity, including American Indian, African-American, Hispanic, or Asian/Pacific Islander.
- physical signs of insulin resistance such as acanthosis nigricans.
- conditions related to insulin resistance such as hypertension, dyslipidemia, or polycystic ovarian syndrome.\textsuperscript{24}

Testing should begin at age 10 or at the onset of puberty, whichever comes first. Screening should occur every other year, and the test of choice is a fasting blood glucose test. One study found that obese children who had impaired fasting glucose developed type 2 diabetes within 2 years.\textsuperscript{25}

**Final notes**

As a clinician, I often think the burden of obesity is too great to manage from the perspective of a single practice. I have learned, however, that physicians can be trusted resources, and many lifestyle changes are more likely to occur if addressed by a physician. We need to remember that changing even one child’s life may affect many more indirectly. The first phase of this treatment occurs in our office. For those who need additional help, there are comprehensive programs.

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### Table 2

**2 to 20 years: Girls**

**Body mass index-for-age percentiles**

<table>
<thead>
<tr>
<th>Date</th>
<th>Age</th>
<th>Weight</th>
<th>Stature</th>
<th>BMI</th>
<th>Comments</th>
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<td></td>
<td></td>
<td></td>
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</tr>
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<td>35 cm</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>2</td>
<td>11 kg</td>
<td>36 cm</td>
<td>19</td>
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<td>2012</td>
<td>3</td>
<td>12 kg</td>
<td>37 cm</td>
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</tr>
</tbody>
</table>

*To Calculate BMI: Weight (kg) ÷ Stature (cm) ÷ 10,000 or Weight (lbs) ÷ Stature (m) ÷ 703*
that can supplement our efforts. Previous studies have shown that family-based programs that include both nutritional and physical activity interventions are the most successful.27-30

The health and economy of our country are directly affected by the obesity epidemic. It is estimated that nearly 40% of children in the United States are from minority backgrounds and many of these children may develop diabetes at a young age, which may substantially shorten their lives. As we acknowledge the increased risk, we need to address this issue swiftly and universally.

Important links

- CDC: The Economic Consequences of Obesity http://www.cdc.gov/obesity/causes/economics.html

References


