

The Obesity/Diabetes Connection

Childhood Obesity

The causes of obesity are multi-faceted and include genetic, behavioral, biological, cultural and nutritional factors. Obesity occurs when an individual consumes more calories than the body can physically burn. Children do need extra nutrients and calories to fuel their growth and development, but some children may be eating too much or exercising too little. The root cause of obesity is the excess consumption of food, calories and a lack of physical activity. Genetic and environmental factors contribute to the number of calories people consume and burn resulting in varied weight loss and gain for different people.

Overweight in children ages 6-11 and adolescents 12-19 can be defined as at or above the 85th percentile of body mass index (BMI). Obesity, in children is defined as at or above the 95th percentile of BMI. The Center for Disease Control and Prevention (CDC) avoids using the word "obesity" and identifies every child and adolescent above the 85th percentile as "overweight." If one parent is obese, there is a 50 percent chance that their child will be obese. When both parents are obese their children have an 80 percent chance of obesity.

Body Mass Index

This index uses height, weight, gender and age to assess a child's weight. The formula used to calculate body mass index



(BMI) is: $BMI = \text{weight in kilograms} / (\text{height in meters})^2$

For children and adolescents, the number is then plotted on a pediatric growth chart to determine the child's percentile, meaning how the child compares to others of the same sex and age. For example, a child with a BMI in the 80th percentile means that compared with other children in the same sex and age, 80 percent have a lower BMI. A child with a BMI greater than 95th percentile is overweight/obese, and a child that falls between the 85th and 95th percentile is considered at risk for becoming overweight. This is a higher cutoff than for adults. Growth charts are not used in adult BMI – An adult with a BMI between 25 and 30 is overweight, and an adult with a BMI over 30 is considered obese. The prevalence of overweight children ages 6-11 has more than

Figure 1 Overweight* Prevalence Among Children and Adolescents

United States, 2003–2004

Children ages...		Black (non-hispanic)	Hispanic (Mexican American)	White (non-hispanic)
6 - 11 years	Male	17.5%	25.3%	18.5%
	Female	26.5%	19.4%	16.9%
12 - 19 years	Male	18.5%	18.3%	19.1%
	Female	25.4%	14.1%	15.4%

*BMI at the 95th percentile or higher

Childhood Obesity increases the risk of many serious illnesses including:

- Asthma
- Diabetes
- Gallstones
- Heart Disease & High Cholesterol
- High Blood Pressure
- Lipid Problems
- Liver Problems
- Eating & Sleep Disorders
- Skin Disorders
- Osteoporosis
- Menstrual / Reproductive Problems

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Family Commitment Reasonable Goals for Weight Loss

Children need structure and support to make changes in their eating habits and exercise. To increase the chances for successful weight loss, they need family support and encouragement. Here are some helpful hints:

- ✓ To avoid your child feeling singled out or deprived, commit to new behaviors and healthy habits as a family.
- ✓ Make small, gradual changes which will be easy to incorporate in your daily lives.
- ✓ Focus on long-term diet and exercise changes rather than diets or quick fixes. Healthy living often involves lifestyle changes in eating, and exercise should focus on health rather than pounds lost.
- ✓ Set achievable goals for your child and family. Goals may be eating meals together at the table, not in front of the television, or drinking low-fat milk or water with meals versus sugar-sweetened beverages.

doubled in the past 20 years and adolescents ages 12-19 has more than tripled. In addition, the emotional and social effects of being overweight can cause serious issues, such as:

- **Low self-esteem and bullying:** Children will often tease overweight peers resulting in low self-esteem for the targeted child.
- **Behavior and learning problems:** Socially, overweight children tend to have more anxiety affecting their social skills. They may act out or withdraw, either of which may interfere with learning.
- **Depression:** Social isolation and low self-esteem create overwhelming feelings of hopelessness in some overweight children, which is as serious in children as in adults.

Risk Factors for Obesity

- **Family history of obesity:** Children from minority or low-income backgrounds are at a greater risk of becoming obese, as their parents may lack time and resources to make healthy eating and regular exercise a family priority.
- **Family history of obesity-related health risks:** Cardiovascular disease, high cholesterol, high blood pressure and type 2 diabetes.
- **Family history of cigarette smoking and sedentary behaviors.**
- **Signs of child obesity-related health risks by doctor's assessment...**
 - Cardiac risk factors – high blood pressure, heart rate and cardiac output.

Surgery and Medications

These strategies for weight loss are rarely used for children and should always be implemented under the direction of a physician.

Weight Loss Surgery

Bariatric surgery is always a risky option and the effects on adolescents are largely unknown. Even overweight adolescents have nutrient needs for normal growth and development, which some surgeries such as gastric bypass may compromise in digestion and absorption. Surgery does not address the psychological issues that may be causing the overeating and inactivity. It is never an easy answer to weight loss and should never replace the need for healthy diet and regular exercise.

Medications

New prescription weight loss drugs are now approved for adolescents, but some may alter brain chemistry to curb hunger. These drugs may alter the digestion process and the absorption of nutrients in the intestines. Risks in long-term use are unknown, and weight maintenance after medications have been discontinued is still in question.

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- Type 2 diabetes risk factors – glucose intolerance and higher than average insulin levels.
- Orthopedic problems – symptoms include weight stress in the joints of the lower limbs, tibial torsion and bowed legs and slipped capital femoral epiphysis.
- Skin disorders
- Psychological/Psychiatric Issues – poor self esteem, negative self- image, depression and withdrawal from peers.
- Patterns of sedentary behavior

Obesity and Type 2 Diabetes

A consequence of the increase in childhood and adolescent obesity has been a rise in the incidence of type 2 diabetes and prediabetes. If left untreated, prediabetes can progress to type 2 diabetes. Formerly referred to as adult-onset diabetes, type 2 is fueled largely by the obesity epidemic. This increasingly common condition presents special challenges for both parents and children.

Type 2 diabetes is a chronic condition that affects the way the body metabolizes sugar (glucose). In children it develops when the body becomes resistant to the effects of insulin, a hormone that regulates the absorption of sugar into body cells. It also

occurs when a child's pancreas produces some but not enough insulin to maintain a normal blood sugar level.

Causes

To understand type 2 diabetes, first you must understand how glucose is normally processed in the body. Glucose is a main source of energy for the cells that make up muscles and other tissues. It comes from two major sources: food and the liver. During digestion, sugar is absorbed into the bloodstream. Normally, sugar then enters cells with the help of insulin. The hormone insulin comes from the pancreas, a gland located just behind the stomach. When a child eats, the pancreas secretes insulin into the bloodstream. As insulin circulates, it acts like a key by unlocking microscopic doors that allow sugar to enter cells. Insulin lowers the amount of sugar in the bloodstream, and as blood sugar level drops, so does the secretion of insulin from the pancreas. The liver acts as a glucose storage and manufacturing center. When insulin levels are low – for example, when a child hasn't eaten for a while — the liver releases the stored glucose to keep the glucose level within a normal range. In type 2 diabetes, this process works improperly. Instead of moving into the cells, sugar builds up in the bloodstream. This



Screening and Diagnosis

If diabetes is suspected, a blood screening test will be administered.

Random blood sugar test

A blood sample is taken at a random time. Regardless of when your child last ate, a blood sugar level of 200 milligrams per deciliter (mg/dL) or higher suggests diabetes.

Fasting blood sugar test

A blood sample is taken after an overnight fast. A fasting blood sugar level less than 100 mg/dL is normal. A fasting blood sugar level from 100 -125 mg/dL is considered prediabetes (high risk of developing diabetes.) If the results are 126 mg/dL or higher on two separate tests, your child will be diagnosed with diabetes.

If diabetes is diagnosed, other tests will be performed to distinguish between type 1 and type 2 diabetes. This may require different treatment strategies. Type 1 is characterized by the need for insulin treatment and often develops at a younger age than type 2, which is more common in children who are obese and sometimes can be managed without insulin.

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occurs when the pancreas doesn't make enough insulin or the cells become resistant to the action of insulin. Exactly why this happens is uncertain, although excess weight and inactivity seem to be important factors.

Risk Factors

Researchers don't fully understand why some children develop type 2 diabetes and others don't. It's clear that certain factors increase the risk:

- **Weight:** Being overweight is a primary risk factor for type 2 diabetes in children. The more fatty tissue, the more resistant the cells become to insulin. The good news is that many children with type 2 diabetes can improve their blood sugar levels simply by losing excess weight.
- **Inactivity:** The less active the child, the greater the diabetes risk. Activity helps control weight, uses glucose as energy and makes

cells more sensitive to insulin.

- **Family history:** The risk of type 2 diabetes increases if a parent or sibling has it, but it's difficult to tell if this is related to lifestyle, genetics or both.
- **Race:** Although it's unclear why, children of certain races – especially African-Americans, Hispanics, Native Americans and Asians – are more likely to develop type 2 diabetes.

Complications

Type 2 diabetes can be easy to ignore, especially in the early stages when the child is feeling fine. But type 2 diabetes must be taken seriously. The condition can affect nearly every major organ in the body, including the heart, blood vessels, nerves, eyes and kidneys. Keeping the child's blood sugar level consistently close to normal can dramatically reduce the risk of complications. To diagnose type 2 diabetes before it does serious damage,

screening is recommended for all children and adolescents at high risk, even if they have no signs or symptoms. Consult your child's health care provider if you are concerned or if you notice any signs or symptoms (see figure 2).

Figure 2

Signs and Symptoms of Type 2 Diabetes

Type 2 diabetes in children often develops gradually. Some children have no signs or symptoms while others may experience one or more of the following:

Increased thirst and frequent urination: As excess sugar builds up in the child's bloodstream, fluid is pulled from the cells. This may leave the child thirsty. As a result, the child may drink – and urinate – more than usual.

Extreme hunger: Without enough insulin to move sugar into the cells, a child's muscles and organs become depleted of energy triggering intense hunger.

Weight loss: Despite eating more than usual to relieve hunger, the child may lose weight. Without the energy sugar supplies, muscle tissues and fat stores simply shrink.

Fatigue: If the child's cells are deprived of sugar, he or she may become tired and irritable.

Blurred vision: If blood sugar is too high, fluid may be pulled from the lenses of the eyes. This may affect the ability to focus clearly.

Slow-healing sores or frequent infections: Type 2 diabetes affects the child's ability to heal and resist infections.

Patches of dark, velvety skin: Some children who have type 2 diabetes have patches of dark, velvety skin in the folds and creases of their bodies—usually in the armpits and neck. This condition, called acanthosis nigricans, may be a sign of insulin resistance.

Short-term Complications

Short-term complications of type 2 diabetes require immediate care. Left untreated, these conditions can cause seizures and loss of consciousness (coma).

- **Low blood sugar (hypoglycemia):** If the blood sugar level drops below the target range, it's known as low blood sugar. Blood sugar level can drop for many reasons including skipping a meal, getting more physical activity than normal or injecting too much insulin. Watch for early signs and symptoms of low blood sugar such as sweating, shakiness, weakness, hunger, dizziness and nausea. Later signs and symptoms include slurred speech, drowsiness and confusion. If hypoglycemia develops during the night, a child might wake with sweat-soaked pajamas or a headache. Thanks to a natural rebound effect, nighttime hypoglycemia might cause an unusually high blood sugar reading first thing in the morning.

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If signs or symptoms of low blood sugar develop, give the child fruit juice, glucose tablets, hard candy, regular (not diet) soda or another source of sugar. If the child loses consciousness, an emergency injection of glucagon may be needed. (Glucagon is a hormone that stimulates the release of sugar into the blood.)

• **High blood sugar (hyperglycemia):** Likewise, blood sugars can rise for many reasons including overeating, insufficient insulin amounts or illness. Watch for frequent urination, increased thirst, dry mouth, blurred vision, fatigue and nausea. If you suspect hyperglycemia, check the child's blood sugar. You might need to adjust the child's meal plan or medications. If the child's blood sugar is dangerously high, call the child's health care provider right away or seek emergency care.

• **Increased ketones in your child's urine (diabetic ketoacidosis):** If the cells are starved for energy, the body may begin to break down fat, producing toxic acids known as ketones. Watch for loss of appetite, nausea, vomiting, fever, stomach pain and a sweet, fruity smell on the child's breath. If you suspect ketoacidosis, check the child's urine for excess ketones with an over-the-counter ketones test kit. If the child has excess ketones in his or her urine, call the child's health care provider right away or seek emergency care.

Long-term Complications

Long-term complications of type 2 diabetes develop gradually. The earlier the child develops diabetes and the less controlled the blood sugar has been, the higher the risk of complications. Eventually, diabetes complications may be disabling or even life threatening.

- **Heart and blood vessel disease:** Diabetes dramatically increases the risk of various cardiovascular problems, including coronary artery disease with chest pain (angina), heart attack, stroke, narrowing of the arteries (atherosclerosis) and high blood pressure.
- **Nerve damage (neuropathy):** Excess sugar can injure the walls of the tiny blood vessels (capillaries) that nourish the nerves,

Keep A Healthy Weight



- Don't force your children to eat when they are not hungry, and teach them it is OK not to finish every meal or beverage.
- Don't use food to punish or reward.
- Don't offer desserts as a reward for finishing a meal. This may teach your child to value desserts and sweets more than other foods.
- Don't eat out at fast-food restaurants more than once per week.
- After the age of 2, skim milk can safely replace whole milk.
- Make sure all foods are eaten at the table and not in front of the television.
- Limit how much television your family watches. Instead, try to get your child to do something active, like riding their bike or playing active games.
- Spend time being active with your child and family – include family walks or activities together when you can.

especially in the legs. This can cause tingling, numbness, burning or pain that usually begins at the tips of the toes or fingers and over a period of months or years gradually spreads upward. Left untreated, the child could lose all sense of feeling in the affected limbs.

- **Kidney damage (nephropathy):** The kidneys contain millions of tiny blood vessel clusters that filter waste from the blood. Diabetes can damage this delicate filtering system. The earlier diabetes develops, the greater the concern. Severe damage can lead to kidney failure or irreversible end-stage kidney disease, requiring dialysis or a kidney transplant.
- **Eye damage:** Diabetes can damage the blood vessels of the retina (diabetic retinopathy); can also lead to cataracts and a greater risk of glaucoma. By adulthood, diabetes is a leading cause of blindness.

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- **Foot damage:** Nerve damage in the feet or poor blood flow to the feet increases the risk of various foot complications. Left untreated, cuts and blisters can become serious infections.
- **Skin conditions:** Diabetes may increase susceptibility to skin problems including bacterial infections, fungal infections and itching.
- **Osteoporosis:** Diabetes may lead to lower than normal bone mineral density, increasing the risk of adult osteoporosis.

Managing Type 2 Diabetes

There's no cure for type 2 diabetes, but there's plenty that can be done to help a child cope with the disease. Managing type 2 diabetes is a lifelong commitment of monitoring blood sugar, eating healthy foods and exercising regularly. Parents must take an active role to help children make good decisions about their diet.

Healthy Eating

Although there is no diabetes diet, a child with type 2 diabetes won't be restricted to a lifetime of boring, bland foods. Instead, he will need plenty of fruits, vegetables and whole grains—foods high in nutrition and low in fat and calories—and fewer sweets. In fact, it's the best plan for any child in order to maintain a healthy weight and decrease the risk of developing diabetes.

Understanding what and how much to feed a diabetic child can be a challenge. A registered dietitian can help you create a meal plan that fits the child's health goals, food preferences and lifestyle. Once you've covered the basics, remember the importance of consistency to keep the child's blood sugar on an even keel. Encourage the same amount of food with the same proportion of carbohydrates, proteins and fats at the same time every day. Sugary foods are OK once in a while, as long as they're included in the meal plan.

Physical Activity

All children need exercise to stay healthy, and children who are obese or have type 2 diabetes are no exception. Make physical activity part of the daily routine. Not only does it burn calories, but it also builds strong, healthy bones and muscles that can help children sleep well at night and stay focused during the day. Active children are more likely to become fit adults. It will also help adolescents maintain healthy weights in spite of fluctuating hormone changes.

Consider signing your child up for a sports team or dance lessons. Better yet, get in the act together. Play catch in the backyard. Take a walk, or race through your neighborhood. Visit an indoor climbing wall or local pool. Remember that physical



activity lowers blood sugar. Check blood sugar level before any activity. A snack might be needed before exercising to help prevent low blood sugar.

Insulin and Other Medications

Some children who have type 2 diabetes can control their blood sugar with diet and exercise alone, but many also need oral medication or insulin treatment.

Metformin is the only oral medication approved for children and adolescents (age 10+) who have type 2 diabetes. Metformin reduces the amount of sugar the liver releases into the bloodstream between meals. Although the drug is effective, some brands are only for adult use. Side effects may include nausea, upset stomach, diarrhea and, in rare occasions, a harmful buildup of lactic acid (lactic acidosis). Metformin isn't safe for anyone who has liver, kidney or heart failure.

Because stomach enzymes interfere with insulin taken by mouth, oral insulin isn't an option for lowering blood sugar. Often, insulin is injected using a fine needle and syringe or an insulin pen (a device that resembles an ink pen with an insulin-filled cartridge.)

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An insulin pump also may be an option. It is a device about the size of a cell phone worn on the outside of the body. A tube connects the reservoir of insulin to a catheter inserted under the skin of the abdomen. The pump is programmed to automatically dispense specific amounts of insulin and can be adjusted to deliver more or less depending on meals, activity and blood sugar level.

Many types of insulin are available, including rapid-acting insulin, long-acting insulin and intermediate options. Examples include regular insulin (Humulin R and Novolin R), NPH insulin (Humulin N, Novolin N), insulin lispro (Humalog), insulin aspart (NovoLog) and insulin glargine (Lantus). Depending on need, a mixture of insulin types may be prescribed to use throughout the day and night. Inhaled insulin (Exubera) hasn't been approved for children.

Conclusion

Healthy living choices are necessary to maintain normal weight and decrease the risk of developing type 2 diabetes in children and adolescents. Similar strategies can be used to control weight and blood sugar. Healthy lifestyle choices that can help prevent type 2 diabetes in children include:

- Eating healthy foods: Offer foods low in fat and calories. Focus on fruits, vegetables and whole grains. Strive for variety to prevent boredom.
- Getting more physical activity: Encourage the child to get active. Sign up for a sports team or dance lessons, or look for active things to do as a family.
- Losing excess pounds: Make permanent changes in eating and exercise habits. Better yet, make it a family affair.

The same lifestyle choices that can help prevent type 2 diabetes in children can do the same for adults. ❖

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